## Part 1 General

### 1.1 RELATED REQUIREMENTS

.1 Section 01 33 00 – Submittal Procedures

.2 Section 01 61 00 – Basic Product Requirements

.3 Section 01 77 00 – Closeout Procedures

.4 Section 01 78 00 – Closeout Submittals

.5 Section 01 79 00 – Demonstration and Training

### 1.2 REFERENCE STANDARDS

.1 Canadian Standards Association (CSA International)

Part 1 CSA C22.1-15 Canadian Electrical Code, Part 1

Part 2 CAN3-C235-83(R2015) Preferred Voltage Levels for AC Systems, 0 to 50,000 V

Part 3 National Building Code of Canada 2010

Part 4 National Fire Code of Canada 2010

Part 5 CSA Z85-83 Abbreviations for electrical terms

Part 6 CSA C22.2 No. 42-10 – General Use Receptacles, Attachment Plugs and Similar Wiring Devices

.2 Electrical and Electronic Manufacturer's Association of Canada (EEMAC)

.1 EEMAC 2Y-1-1958 Light Gray Colour for Indoor Switch Gear

.2 EEMAC Y1-1-1985 Equipment Green for outdoor electrical equipment

.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.

### 1.3 GENERAL

.1 This section supplements requirements of Division 00 and 01.

.2 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.

.3 Pre-tender site inspection is not mandatory.

### 1.4 RESPONSIBILITY FOR NEW AND EXISTING PROPERTY

.1 Electrical contractor shall assume responsibility for the care, custody and control of existing work completed by others which is assigned to him for performance of the Work.

.2 Electrical contractor shall assume responsibility for and shall make good, damage to existing work completed by others attributable to performance of Work of this Contract.

.3 Protect existing property with polyethylene covers, crates or other suitable method to insure protection of the existing equipment.

.4 Ensure that existing equipment to be turned over to the owner or reused is carefully dismantled and not damaged or lost. Do not reuse existing materials and equipment unless specifically indicated.

.5 Protect equipment and materials in storage on site during and after installation until final acceptance. Leave factory covers in place. Take special precautions to prevent entry of foreign material into working parts of electrical equipment and systems.

## 1.5 DRAWINGS AND SPECIFICATIONS

.1 The Drawings and Specifications shall be held to determine the general character and general arrangement of the Work.

.2 Drawings and specifications are complementary each to the other and what is called for by one to be binding as if called for by both.

.3 Drawings and Specifications indicate the general scope of the Project in terms of the dimensions of the Work, the type of structural, mechanical, electrical utility systems and the architectural elements of construction. The drawings and specifications do not necessarily indicate or describe all Work required for the full performance and completion of the requirements of the Contract Documents. On the basis of the general scope indicated, described or implied, the Contractor shall furnish all items required for the proper execution and completion of the Work.

.4 The Contract Documents are issued to facilitate construction by expressing the design intent. The Drawings and Specifications do not necessarily contain all of the details required to construct the project, and contractor supplied detail in the form of detailed construction documents (referred to in the Contract Documents as the Electrical Contractors supplied shop drawings, submittals, and field coordination drawings) is required for construction of the Work; all of which set out the specific and final details required for placing and constructing the finished Work. By contrast, the Drawings and specifications are not intended to be used as a set of detailed instructions on how to construct the Work. Construction means, methods, techniques, sequences, procedures and site safety precautions are the responsibility of the Electrical Contractor.

.5 Shop Drawings, product data, samples and similar submittals provided by the Electrical contractor are not Contract Documents. The purpose of these submittals is to demonstrate the way by which the Electrical Contactor proposes to conform to the design intent expressed in the Contract Documents.

.6 The Electrical Contractor must examine the Drawings and Specifications to satisfy himself regarding the design intent and the extent of the proposed Work by personal examination of the existing building, site and surroundings. He shall make his own estimate there from the facilities and difficulties to attain the performance and completion of the Work.

.7 Follow architectural, structural, mechanical drawings for details of this work and install electrical equipment, conduit, boxes and fittings to coordinate with architectural, structural and mechanical work and details. Refer to architectural and structural drawings for accurate building dimensions.

## 1.6 INTENT

.1 Electrical Contractor to provide all labour and materials necessary for a complete and operating electrical system as indicated on the drawings and specified herein. Any work even if not shown or specified, which is obviously necessary or reasonable implied to complete the work to be done as if it was both shown and specified

.2 Responsibility as to which trade provides required articles or materials rests solely with the General Contractor. Extras will not be considered based on the grounds of difference in interpretation of specifications as to which trade involved is to provide certain specialties or materials.

## 1.7 WORK INCLUDED

.1 The work under this section includes, but is not necessarily limited to, the categories of work itemized below. Examine all plans and read thoroughly the entire specification:

.1 Demolition of existing electrical device(s).
.2 New electrical services to mechanical equipment.
.3 Modifications to existing branch circuit panels.

## 1.8 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.

## 1.9 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submittals: In accordance with Section 01 33 00 - Submittal Procedures and this section.

.2 Submit to the Departmental Representative at the time of Award of Contract cost breakdown of the Contract amount for the following items. Each item price shall be complete including wiring, control, testing, labour, overhead, mark-up, etc. where applicable to each item. Labour and material costs shall be shown separate for each item. Items are as follows:

.1 Administration and Training
.2 Testing and Commissioning
.3 Maintenance Manual and Record Drawings
.4 Low voltage wiring and equipment
.5 Job mobilization and demobilization
.6 Labour rate

.3 Submit approved electrical permit prior to start of electrical work.

.4 Shop drawings:

.1 Submit drawings as a pdf document electronically.
.2 Clearly mark each sheet of submittal material (using arrows, underlining or circling) to show differences from what is specified, particularly sizes, types, model numbers, rating, capacities, and options actually being proposed. Cross out non-applicable material.
.3 All shop drawings submitted for review shall be certified by the manufacture and carefully checked by this contractor, noting all changes required, and shall bear the contractor's approval stamp signature; drawings will not be considered if not previously checked by this contractor. Incomplete submissions will be rejected.
.4 Catalogue numbers used in the specifications are for reference purposes only. Confirm exact component requirements with technical descriptions provided. Should any discrepancy exist, which leaves doubt as to the true intent and meaning, obtain a ruling from the Departmental Representative prior to ordering.

.5 Shop Drawings. Product Data, Samples and similar submittals provided by the Electrical Contractor are not Contract Documents. The purpose of these submittals is to demonstrate the way by which the Electrical Contractor purposes to conform to the design intent expressed in the Contract Documents.

.6 Submit wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, controls, panels, accessories, piping, and other items that must be shown to ensure co-ordinated installation.

.7 Indicate on drawings clearances for operation, maintenance, and replacement of operating equipment devices.

.5 Submit to Electrical Inspection Authority and Supply Authority necessary number of working drawings and specifications for examination and approval prior to commencement of work and pay all associated fees.

.6 Submit shop drawings for the following items:

.1 All items of distribution equipment.
.2 Motor control equipment.
.3 Other manufactured items as directed or noted elsewhere in this specification.

.7 Submit samples of labels including; arc flash, wiring, lamacoid, piping etc.

.8 Submit list and wording for identification of labels, signs etc for review.

.9 Submit qualifications for electrical workers when required.

.10 Submit such equipment and material to authority having jurisdiction inspection authorities for approval before delivery to site.

.11 Submit test results of installed electrical systems and instrumentation.

.12 Submit certificate of clearance from authority having jurisdiction upon completion of Work to Departmental Representative.

.13 Manufacturer's Field Reports: submit to Departmental Representative the manufacturer's written report, within 3 days for review, verifying compliance of Work and electrical system and instrumentation testing, as described in PART 3 - FIELD QUALITY CONTROL.

## 1.10 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 01 78 00 - Closeout Submittals.

.2 Operation and Maintenance Data: submit operation and maintenance data

.1 Provide for each system and principal item of equipment as specified in technical sections for use by operation and maintenance personnel.

.2 Operating instructions to include following:

.1 Wiring diagrams, control diagrams, and control sequence for each principal system and item of equipment.

.2 Start up, proper adjustment, operating, lubrication, and shutdown procedures.

.3 Safety precautions.

.4 Procedures to be followed in event of equipment failure.

.5 Other items of instruction as recommended by manufacturer of each system or item of equipment.

.3 Print or engrave operating instructions and frame under glass or in approved laminated plastic.

.4 Post instructions where directed.

.5 For operating instructions exposed to weather, provide weather-resistant materials or weatherproof enclosures.

.6 Ensure operating instructions will not fade when exposed to sunlight and are secured to prevent easy removal or peeling.

## 1.11 STANDARDS

.1 Carry out all work in accordance with these drawings and specifications, meet the Canadian Electrical Code (CSA C22.1) and latest applicable Municipal and Provincial codes and standards and regulations. In each and every instance of application, the Code, Regulation, Statute, By-law or this Specification having most stringent requirement applies.

.2 Where reference is made to standards such as EEMAC, NEMA, CSA, IPCEA, ULC, etc., the latest editions and revisions of such standard specifications to apply.

.3 Perform all work safely incompliance with CSA Z462 – Workplace Electrical Safety Standard, Manufactures Instructions, Occupational Health and Safety Act and Regulations, and authority having jurisdiction requirements.

## 1.12 WARRANTY

.1 The Electrical Contractor shall furnish a written guarantee stating that all work executed and all apparatus installed in the contract will be free from defective workmanship and materials for a period of one (1) year from the date of final acceptance of work. Electrical Contractor shall repair and replace any work, which fails of becomes defective during the term of the guarantee/warranty, providing the operating and maintenance instructions have been complied with. The period of guarantee specified shall not, in any way, supplement any other guarantees of a longer period provided by Manufacturers or as called for in the project documents.

.2 Owner Requirements during Warrantee

.1 Unless specified otherwise the Owner shall be responsible for all routine maintenance requirements as required in the manufacturer's instructions.

## 1.13 TEMPORARY USAGE

.1 New equipment used for construction purposes shall have the manufacturer's warranty extended for a period of one year from the date of accepted Substantial Performance.

.2 Temporary or trial usage requested by the Owner of Electrical equipment supplied under contract shall not represent acceptance. The Electrical Contractor is responsible operate and maintain all equipment during trial usage.

## 1.14 CERTIFICATE OF SUBSTANTIAL PERFORMANCE

.1 Refer to Divisions 0 and 1.

.2 Prior to a Substantial Performance review being done, Electrical Contractor shall certify the following in writing to the Departmental Representative:

.1 All systems are installed and suitable for operation for the purpose intended.

.2 All Identification of Equipment has been completed including:

.1 Conduit and junction boxes

.2 Wire and circuit numbers

.3 Submission to the Departmental Representative the following:

.1 A complete list of outstanding work as assessed by Electrical Contractor on site. List to be detailed, accurate and shall list room by room, all work not yet complete.

.2 A completed substantial completion check list.

.3 A complete list of any materials not on site to complete project.

.4 A statement of value of the remaining work to complete the project.

.5 Completed project as-built drawings for review.

.6 All Test results.

.7 Final certificates from the authorities having jurisdiction.

.8 All Electrical operation and maintenance data as specified.

.9 Copies of extended warrantees, with cards completed and mailed to manufacturers.

.10 Final draft of O&M manuals for review.

.11 Transmittal letter signed by the Owners' authorized representative indicating all spare parts, tools, etc turned over to the Owner, as required by the contract.

.3 A Substantial Completion will not be done until all of this information is received.

.4 Within ten (10) working days after receipt of written application for a "Certificate of Substantial Performance", the Departmental Representative will visit the site.

.5 If in the opinion of the Departmental Representative that the Electrical Contractor, after initial review of the site on the request for a substantial completion by the General Contractor, has not completed a reasonable and accurate deficiency list, the Departmental Representative will complete a deficiency list at the expense of the Electrical Contractor.

.6 The Consultant will provide one (1) site visit for the purpose of reviewing the application for a Substantial Performance. Subsequent visit if required shall be at the expense of the Electrical contractor.

.7 If, after the Consultant's site visit the application for a "Certificate of Substantial Performance" is not approved, the Electrical Contractor shall reapply in accordance with the Consultant's site visit report and pay for costs of addition reviews.

## 1.15 CERTIFICATE OF TOTAL PERFORMANCE

.1 Refer to General Conditions and Supplementary Conditions.

.2 Prior to the application for a statement of "Total Performance", the Contractor shall certify the following in writing to the Departmental Representative:

.1 All items noted in previous site visit reports including that performed for Substantial Performance have been completed.

.2 Warranty forms are mailed to the manufacture. (Provide a copy of original warranty for equipment which has a warranty period of longer than one year within the O&M manual).

.3 Completed and Accepted Operating and Maintenance (O&M) Manuals have been submitted to the owner.

.4 The Owner has received instructions in the operation and maintenance of the system.

.5 Completed and Accepted As-built drawings.

.3 Within ten (10) working days after receipt of written application for a "Certificate of Total Performance", the Departmental Representative will visit the site.

.4 The Departmental Representative will provide one (1) site visit for the purpose of reviewing the application for a Total Performance.

**1.16 DESIGN REQUIREMENTS**

.1 Operating voltages: to CAN3-C235.

.2 Motors, electric heating, control and distribution devices and equipment to operate satisfactorily at 60 Hz within normal operating limits established by the above standard.

.1 Equipment to operate in extreme operating conditions established in the above standard without damage to equipment.

.3 Language operating requirements: provide identification nameplates and labels for control items in English

**1.17 QUALITY ASSURANCE**

.1 Electrical Contractor to be completely responsible of ascertaining that every item included in Contract complies in all respects with specifications and drawings. Any item of equipment found by the Departmental Representative, not to comply with specifications and drawings, to be replaced at no additional cost with an item or unit of the Departmental Representative's choice.

.2 Qualifications: electrical Work to be carried out by qualified, licensed journeyman electricians who hold a valid Electrical Contractor license or apprentices in accordance with authorities having jurisdiction as per the conditions of Provincial Act respecting manpower vocational training and qualification.

.1 Employees registered in provincial electrical apprentices program: permitted, under direct supervision of qualified licensed electrician, to perform specific tasks determined based on training level attained and demonstration of ability to perform specific duties. Electrical Apprentice to Journeyman Electrician ratio to be in compliance with provincial standards.

.3 Fire Stop contractors and installers are required to be accredited by the manufacture of the product being installed.

.4 Site Meetings:

.1 Site Meetings: as part of Manufacturer's Field Services described in Part 3 - FIELD QUALITY CONTROL, schedule site visits, to review Work, at stages listed.

.1 After delivery and storage of products, and when preparatory Work is complete but before installation begins.

.2 Twice during progress of Work at 25% and 60% complete.

.3 Upon completion of Work, after cleaning is carried out.

.5 Health and Safety Requirements: do construction occupational health and safety in accordance with the Provincial OH&S act.

**1.18 DELIVERY, STORAGE AND HANDLING**

.1 Material Delivery Schedule: provide to the Departmental Representative with a schedule within 2 weeks after award of Contract.

.2 Assume complete responsibility for maintaining all materials and equipment delivered to the site in new condition. Repair or replace damaged articles. Make arrangements as necessary for proper storage and security of materials delivered to the site

**1.19 SYSTEM STARTUP AND TRAINING**

.1 Instruct Owner and operating personnel in operation, care and maintenance of systems, system equipment and components.

.2 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.

.1 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 will aspects of its care and operation.

.3 Document start up and training records including names and signatures of participants, instructional material covered, instruction on maintenance manual information and details, time required for training, location of training session, etc. Submit documentation of training with maintenance manuals.

.4 Coordinate with the owner for training schedule a minimum of 5 working days in advance.

.5 Provide a minimum of one instructional training session for each major item of equipment or each system for the benefit of the owner’s staff. The purpose of the training sessions is to instruct the staff on operating procedures for equipment installed on this project.

**Part 2 Products**

**2.1 DESIGN REQUIREMENTS**

.1 Operating voltages: to CAN3-C235.

.2 Motors, electric heating, control and distribution devices and equipment to operate satisfactorily at 60 Hz within normal operating limits established by above standard.

.1 Equipment to operate in extreme operating conditions established in above standard without damage to equipment.

.3 Language operating requirements: provide identification nameplates or labels for control items in English.

**2.2 MATERIALS AND EQUIPMENT**

.1 Provide CSA certified equipment and material.

.2 Where CSA certified equipment and material is not available, Equipment and material is to bear a certification mark or field inspection label acceptable to the provincial inspection authority having jurisdiction.

.3 All materials and equipment provided shall be new. Provide materials and equipment in accordance with applicable sections.

.4 Materials and equipment shall be manufactured to NEMA specifications.

.5 Factory assemble control panels and component assemblies

## 2.3 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 05 34, except for conduit, wiring and connections below 50 V which are related to control systems as shown on mechanical drawings specified in mechanical sections.

## 2.4 WARNING SIGNS

.1 Warning Signs: in accordance with requirements of authority having jurisdiction or as noted in the specifications or drawings.

.2 Use lamacoid decal signs, minimum size 175 x 250 mm. Signs to be mounted with mechanical anchors. Black face with white lettering.

.3 Arc Flash Hazard Labels to meet CSA Z462 “Workplace electrical safety”.

## 2.5 WIRING TERMINATIONS

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

.2 Terminate all device terminations around screws or compression terminals. Push in termination will be rejected.

## 2.6 EQUIPMENT IDENTIFICATION

.1 Identify electrical equipment with labels or nameplates as follows:

.1 Nameplates: plastic laminate lamicoid 3 mm thick plastic engraving sheet melamine, black matt white finish face, black white core, lettering accurately aligned and engraved into core mechanically attached with self tapping screws.

.2 Sizes as follows:

| | | | |
|---|---|---|---|
| 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 6 mm high letters unless specified otherwise.

.3 Wording on labels nameplates to be approved by Departmental Representative prior to manufacture.

.4 Allow for minimum of twenty-five (25) letters per label nameplate.

.5 Nameplates for terminal cabinets and junction boxes to indicate system and/or voltage characteristics.

.6 Identify equipment with Size 3 labels engraved "ASSET INVENTORY NO. _____. Departmental Representative.

.7 Disconnects, starters and contactors: indicate equipment being controlled and voltage.

.8 Terminal cabinets and pull boxes: indicate system and voltage.

.9 Transformers: indicate capacity, primary and secondary voltages.

## 2.7 WIRING IDENTIFICATION

.1 Identify wiring with permanent indelible identifying markings, coloured plastic tapes 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.

## 2.8 CONDUIT AND CABLE IDENTIFICATION

.1 Colour code conduits, boxes and metallic sheathed cables.

.2 Code with plastic tape or paint at points where conduit or cable enters wall, ceiling, or floor, and at 15 m intervals.

.3 Colours: 25 mm wide prime colour and 20 mm wide auxiliary colour.

| | Prime | Auxiliary |
|---|---|---|
| up to 250 V | Yellow | |
| up to 600 V | Yellow | Green |
| up to 5 kV | Yellow | Blue |
| up to 15 kV | Yellow | Red |
| Telephone | Green | |
| Other Communication Systems | Green | Blue |
| Fire Alarm | Red | |
| Emergency Voice | Red | Blue |
| Other Security Systems | Red | Yellow |

## 2.9 FINISHES

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

.1 Paint outdoor electrical equipment to color chosen by owner

.2 Paint indoor switchgear and distribution enclosures to color chosen by owner

# Part 3 Execution

## 3.1 INSTALLATION

.1 Do complete installation in accordance with CSA C22.1 except where specified otherwise.

.2 Obtain and pay for all electrical inspection fees.

.3 Notify Departmental Representative of changes required by Electrical Inspection Department prior to making changes.

## 3.2 NAMEPLATES AND LABELS

.1 Ensure manufacturer's nameplates, CSA labels and identification nameplates are visible and legible after equipment is installed.

.2 Lettering accurately aligned and engraved into core mechanically attached with machine screws or rivets. Two-sided tape is not acceptable.

.3 Nameplates and labels to match existing.

.4 Miscellaneous Equipment and Devices

.1 Provide engraved nameplates to all push button stations, control devices, panels, local starters, and any other equipment that requires identification on installation. Install nameplates directly on equipment or adjacent to it, as mounting space permits

.5 Mount all labels and nameplates level and square and on top center of the equipment or electrical cover plates.

## 3.3 WIRING IDENTIFICATION

.1 Identify wiring with permanent indelible identifying labels on both ends of phase conductors of feeders and branch circuit wiring. Identify panel identification number and circuit number on branch circuit wiring.

.2 Maintain phase sequence and colour coding throughout.

.3 Colour coding: to CSA C22.1.

.4 Use color coded wires in computer, communication, and specific purpose cables, matched throughout system. Label both ends of cables as approved by the owner and Departmental Representative.

## 3.4 CONDUIT AND CABLE IDENTIFICATION

.1 Color code conduits, boxes and metallic sheathed cables.

.2 Use labels with black letters on an orange background for conduits and cables in exposed areas.

.3 Code with plastic tape or paint at points where conduit or cable enters wall, ceiling, or floor, and at 15 m intervals in concealed locations.

.4 Colours: 25 mm wide prime colour and 20 mm wide auxiliary colour.

| | Prime | Auxiliary |
|---|---|---|
| up to 250 V | Yellow | |
| up to 600 V | Yellow | Green |
| Fire Alarm | Red | Yellow |

## 3.5 CUTTING AND PATCHING

.1 Refer to Divisions 0 and 1.

.2 Obtain written approval from the Departmental Representative before drilling, coring, cutting or burning structural members. Ensure post tensioned or pre-stressed strands are located accurately and avoid with and adequate margin of safety.

.3 All coring through walls and slabs requires scanning/x-ray to prove clear before proceeding.

.4 Provide inserts, holes, and sleeves, cutting and fitting required for electrical work. Relocate improperly located holes and sleeves.

.5 Patch and make good building where damaged from equipment installation, improperly located holes, etc. Work to be performed by the trade or contractor responsible for that type of work.

.6 Consider requirements in advance for Fire Stopping and coordinate with the appropriate contractor. Install fire stopping devices prior to installation of wiring or piping as required.

## 3.6 CONDUIT AND CABLE INSTALLATION

.1 If plastic sleeves are used in fire rated walls or floors, remove before conduit or cable installation.

.2 Install cables, conduits and fittings embedded or plastered over, close to building structure so furring can be kept too minimum.

.3 Lay out conduit to avoid interference with other trades, and to maintain maximum headroom. Arrange conduit to conserve space, allow maintenance, and avoid crossovers where possible. Coordinate with other trades in order not to restrict ceiling access to ceiling voids about the installed electrical and mechanical services.

.4 Flash openings through exterior walls and roof and make completely weatherproof.

## 3.7 PAINTING

.1 Paint all iron or steel structures fabricated and installed for supporting equipment after wire brushing clean and applying one prime coat of paint. After all equipment is installed and all piping complete provide a touch-up coat of enamel to match the equipment being supported

.2 Paint all conduit, boxes, fittings, and equipment installed exposed in finished area. Co-ordinate this work with the painting trade.

.3 Shop finish metal enclosure by removal of rust and scale, cleaning, application of rust resistant primer inside and outside, and at least two coats of finished enamel.

.4 Clean and touch up surfaces, to shop-painted equipment scratched or marred during shipment or installation, to match original finish.

.5 Clean, prime, and paint exposed hangers, racks, fastenings to prevent rusting.

.6 All electrical fittings, supports, hanger rods, pull boxes, channel fittings, conduit racks, outlet boxes, brackets, clamps, etc. shall either have a galvanized finish, or have a painted silver/ galvanized finish over corrosion resistant primer.

.7 Clean and prime exposed non-galvanized hangers, racks, and fastenings to prevent rusting.

## 3.8 ACCESS

.1 Provide access doors for installation in walls and ceiling to service electrical equipment requiring access or servicing.

.2 Supply to appropriate trade for installation. Doors to be ULC labelled when installed in fire separations. Wherever finish and construction allow, install flush with the finished surface. Provide 16 gauge frames, 14 gauge door panels, piano hinge, screw drive latch, and mounting channels as required for installation. Minimum size, 300 mm x 300 mm for hand access or 600 x 900 for persons to pass through.

.3 Coordinate with spaces in order to best locate the access door to best accommodate service personal, without interference of other installations and have safe, reasonable reach to the equipment.

.4 Install electrical equipment, junction boxes in a location readily accessible for service and reasonable access to meet work safety requirements.

.5 Minimum access space required in concealed locations:

450 mm horizontal radius from device or cover plate to adjacent surfaces or equipment.

Clear access of 600 mm x 600 mm vertically and horizontally between access panel and equipment.

Maximum horizontal reach from access panel 600 mm.

Maximum vertical distance from access panel 1000 mm.

## 3.9 WORK PROVIDED FOR OTHER DIVISION

.1 Sleeve all conduit openings through floor, walls, and ceilings 27 mm larger all around the duct or pipe.

.2 Verify installation and co-ordination responsibilities related to motors, equipment, and controls, as required.

.3 All control wiring and conduit is included in Division 25 including conduit, wiring, and connections for wiring below 50V.

## 3.10 LOCATION OF OUTLETS, FIXTURES AND EQUIPMENT

.1 Locate outlets in accordance with Section 26 05 32 - Outlet Boxes, Conduit Boxes, and Fittings.

.2 Do not install outlets back-to-back in wall; allow minimum 150 mm horizontal clearance between boxes. Mount boxes in rated walls with adequate spacing to maintain the required rating.

.3 Change location of outlets, fixtures and equipment at no extra cost or credit, providing distance does not exceed 3000 mm, and information is given before installation.

.4 Co-ordinate the rough-in location of all outlets with architectural, structural, and mechanical drawings. Ensure compatibility with finishes, accessories, and devices by others. Locate light switches on latch side of doors.

## 3.11 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.

.3 Install electrical equipment in accordance with latest edition of CSA B651.

## 3.12 CO-ORDINATION OF PROTECTIVE DEVICES

.1 Ensure circuit protective devices such as over current trips, relays and fuses are installed to required values and settings. Submit coordination and commissioning report from manufacturer’s representative

## 3.13 SPRINKLERED ROOMS

.1 In rooms where electrical equipment is installed surface mounted, electrical equipment contained in these rooms to be protected by non-combustible drip hoods, shields, and gasketted doors as applicable to inhibit water ingression into electrical equipment. Paint to match the equipment finish.

## 3.14 FIELD QUALITY CONTROL

.1 Conduct following documentation and commissioning tests:

- .1 Circuits originating from branch distribution panels: Verify wire size, identification.
- .2 Motors, heaters, and associated control equipment: Verify sequenced operation of systems, motor rotation, overload ratings.
- .3 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.

.2 Provide instruments, meters, equipment, and personnel required to conduct tests during and at conclusion of project.

.3 Manufacturer's Field Services:

- .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - SUBMITTALS.
- .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
- .3 Schedule site visits, to review Work, as directed in PART 1 - QUALITY ASSURANCE.

## 3.15 INSPECTION

.1 Obtain a Certificate of Acceptance from Inspection Authority on completion of work and include in project manuals.

.2 Take immediate and direct action to respond to items on review report lists during and on completion of project.

## 3.16 COMMISIONING

**.1** Make all arrangements to include full participation of manufacturer’s technical representatives for the Project Commissioning.

**.2** Prior to Substantial Performance of the Work, the Contractor shall provide Project Commissioning work and documentation as generally listed herein and as more specifically described in appropriate section of these specifications. Procedures shall include submittals, proper start-up of equipment or systems, adjustments, documentation, reports, confirmation and verification, testing and operator instructions.

- .1 Shop Drawings

.2 A complete list of outstanding work as assessed by the Electrical Contractor on site. List to be detailed, accurate and shall list a room by room, all work not yet complete.

.3 A complete substantial completion check list.

.4 A complete list of material not on site to complete project

.5 All test results and reports.

.6 Transmittal letter signed by the Owner's authorized representative indicating all spare parts, tools, etc., turned over to the Owner, as required by contract.

.7 Project record drawings as built.

.8 Operation and Maintenance Manuals

.9 Equipment Identification Index

.10 Panel Directories

.11 Guarantees and Warrantees

.12 Permits

.3 Contractor to complete deficiency inspections on a regular and ongoing basis. Deficiencies to be completed prior to substantial inspection. A detailed deficiency report is to be given to the Departmental Representative prior to substantial inspection.

.4 If in the opinion of the Departmental Representative that the contractor did not complete deficiencies or do a thorough inspection of the project prior to requesting substantial completion the Departmental Representative will complete a deficiency inspection at the Electrical Contractor's expense.

## 3.17 OPERATION AND MAINTENANCE DATA

.1 Provide Operating and Maintenance Manuals in accordance with Division 01 Contract Close Out and this Section.

.2 Provide services of qualified and experienced personnel to prepare proper documentation and to instruct Owner in the operation and preventative maintenance of each piece of equipment and system supplied and installed. Install and index sub tabs as required. Complete and turn over documentation prior to Substantial Performance inspection.

.3 In addition to the number of copies of Operating and Maintenance Manuals specified in Division 1, provide one (1) additional copy for Consultant.

.4 Each binder shall be fully indexed with table of contents (with clear plastic cover) at beginning and contain material according to the following indexing system:

.1 Tab 1.0 Electrical Systems: Title page with clear plastic protection cover. Include project name, year, name of Owner and Contractor

.2 Tab 1.1 Description and Operation of Systems: Provide complete description of each system. Include detailed system description and components comprising that system, explanation of how each component interfaces with others to complete the system, location of each panel or operating parameters. Include complete and detailed operation of each major component. Include complete troubleshooting sequence and safeguards to check if equipment goes off line. With each system description, include list of major equipment with make, model and serial numbers. Details of design elements, construction features, component function and maintenance requirements, to permit effective start-up operation, maintenance, repair, modification, extension and expansion of any portion or feature of installation.

.4 Tab 1.2 Maintenance and Service Division: Provide detailed preventative maintenance and service schedule for each of the major components to include daily, weekly, monthly, semi-annual and yearly checks and tasks.
Explain how to proceed with each task required for each piece of typical equipment such as motors, fire alarm equipment, lighting equipment, service equipment, etc. Compile this information for each typical piece of equipment separate from the shop drawings section. Provide instructions for All Systems, including wiring diagrams, installation and operation and maintenance instructions.

.5 List of Equipment Suppliers and Contractors: Provide complete list of equipment Suppliers and Contractors, including address, telephone number, facsimile number, and E-mail address. Outline procedures for purchasing parts and equipment. Include steps to take in order to purchase new parts.

.6 Guarantees: Include in this section all written guarantees and performance certificates for work under Division 26 including extended manufacturer warranties.

.7 Certification: Include copy of test data: load balance reports, insulation resistance reports, arc flash analysis, ground resistance test, data certification, etc. Start-up reports, verification, and commissioning reports, for each major equipment and system. Include with major equipment makes, models and serial numbers.
Systems Demonstration Certificate and Record of training including topic, location, length of time, dates, and participants. Documentation of turnover of spare parts and equipment as required by other sections or notes on the drawings

.8 Shop Drawings and Maintenance Bulletins: A complete set of manufacturer's shop drawings duly approved by Consultant, a complete set of manufacturer's operating and maintenance instructions and parts list for all equipment. Include technical data, product data, supplemented by bulletins, component illustrations, exploded views, technical descriptions of items and parts lists. Advertising or sales literature is not acceptable.

.9 Saftey: include MSDS, Arc Flash Hazard information and reports, Electrical Safety instructions.

.10 The divider tabs shall be laminated mylar plastic, with reinforced holes and coloured according to section. The colouring is as follows:
Electrical Systems - 1.0 to 1.2 - Orange.
Certification - 2.0 to … - Green.
Shop Drawings and Maintenance - 3.0 to … - Yellow.
Safety – Red.
Plastic tabs with type insertions will not be accepted.

.5 Bind in a 76 mm thick, black, hard cloth expandable three ring binder. Label directly on the front cover as well as the spine ("ELECTRICAL MAINTENANCE MANUAL - PROJECT NAME - YEAR") with gold embossed lettering. Plastic sleeves for identification will not be accepted. Where binder type is identified in Division 01 that section shall take precedence.

.6 Turn over one manual to Electrical Consultant and the balance to the Owner after Departmental Representative review and all documentation included.

## 3.18 PROJECT RECORD DOCUMENTS (AS-BUILT)

.1 Submit project record documents as noted below and specified elsewhere.

.2 Contractor to provide 1 set of marked up electrical as-built drawings along with addendums, SI, and CCN. Provide sets of white prints of the construction drawings.

Mark thereon all changes as work progresses and as changes occur. This shall include changes to all electrical systems as shown in the tender documents. Ensure that items marked correspond to the drawing title.

.1 Use different colour waterproof ink for each service on a per drawing basis.

.2 Make mark-ups available for reference purposes and inspection at all times.

.3 The owner or Departmental Representative may review these drawings to ascertain the appropriate level of detail is incorporated. Where this review reveals that in the Departmental Representative opinion progress of the record drawings, the Electrical Contractor shall update the drawings to the appropriate level prior to the next scheduled review.

.4 Record all circuit numbers and all conduits, feeders, junction boxes, lighting, outlets, systems, etc., installed during the course of the project, whether or not such items were shown on the original contract documents.

.5 Identify on wiring diagrams circuit terminals and indicate internal wiring for each item of equipment and interconnection between each item of equipment.

.6 Include one line diagrams of distribution equipment.

.7 Include items deleted or relocated do to site conditions during the course of the project.

.8 Indicate on record drawings the location of all concealed services, including in or under slab systems, and underground installations. Show dimensions from reference points to accurately locate these systems.

.9 Include on drawings addendum, SI and CCN changes.

.10 Update, delete, modify or add to the drawing, notes, schedules and as required, to accurately reflect site conditions.

.3 Present finalized as-built markup drawings to Departmental Representative at the time of Substantial Performance.

## 3.19 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.

.3 Turn over the electrical installation left in a clean and finished condition, to the satisfaction of the engineer.

## 3.20 COST BREAKDOWN

.1 Submit to the Departmental Representative at the time of Award of Contract cost breakdown of the Contract amount for the following items.

Each item price shall be complete including wiring, control, testing, labour, overhead, mark-up, etc., where applicable to each item. Labour and material costs shall be shown separate for each item. Items are as follows:

.1 Administration and Training

.2 Testing and Commissioning

.3 Maintenance Manual and Record Drawings

.4 Low voltage wiring and equipment

.5 Job mobilization and demobilization

.6 Labour rate

.2 Each progress claim submitted by the Contractor for approval by the Departmental Representative shall indicate the work completed to date and the total cost for each item indicated above and, a signed copy of all review report items to date completed.

Contractor shall also provide a description of the work and the material and equipment delivered to the site for each progress claim period.

**3.21 POWER SHUT DOWN**

.1 The contractor shall request a system shut down to the general contractor and owner as required for completing the installation.

.2 System shut downs shall include a work plan including suspected impact to other existing operating systems, schedule and back up contingency submitted to the owner a minimum of 5 working days prior to the proposed shut down.

.3 Shut down shall not commence until the owner, general contractor and electrical contractor have accepted the plan.

**OWNER INSTRUCTION REPORT**

**Section:** _____ **System Description:** _____

**Duration:** _____ **Hrs.** **Date:** _____ **Time:** _____

**Instructor:** _____ **From: (Company)** _____

**Name of Owner's Personnel Present:**

**1.** _____ **3.** _____

**2.** _____ **4.** _____

**Name of Contractor Instructors:**

**1.** _____ **3.** _____

**2.** _____ **4.** _____

_____

**To be filled in by Owner Personnel** **Name/Signature:** _____

| | | | |
|---|---|---|---|
| **1.** | **Manuals presented for use.** | **Yes** _____ | **No** _____ |
| **2.** | **The Instructor(s) for the training session were knowledgeable in the topic area.** | **Yes** _____ | **No** _____ |
| **3.** | **The instructions were presented in an organized and effective manner.** | **Yes** _____ | **No** _____ |
| **4.** | **The training session adequately prepared you to operate or maintain the system.** | **Yes** _____ | **No** _____ |

_____

_____

**Owner Signature:** _____

**Contractor Signature:** _____

**END OF SECTION**

## Part 1 General

### 1.1 RELATED REQUIREMENTS

.1 Materials and installation for wire and box connectors.

### 1.2 REFERENCE STANDARDS

.1 Canadian Standards Association (CSA International)

.1 CAN/CSA-C22.2 No.18.1-13, Outlet Boxes, Conduit Boxes, Fittings and Associated Hardware.

.2 CSA C22.2 No.65-13, 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)

### 1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for wire and box connectors and include product characteristics, performance criteria, physical size, finish and limitations.

### 1.4 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 01 78 00 - Closeout Submittals.

.2 Operation and Maintenance Data: submit operation and maintenance data for wire and box connectors for incorporation into manual.

## Part 2 Products

### 2.1 MATERIALS

.1 Pressure type wire connectors to: CSA C22.2No.65, with current carrying parts of copper sized to fit copper conductors as required.

.2 Fixture type splicing connectors to: CSA C22.2No.65, with current carrying parts of copper sized to fit copper conductors 10 AWG or less.

.3 Bushing stud connectors: to EEMAC 1Y-2 to consist of:

.1 Connector body and stud clamp for stranded copper conductors.

.2 Clamp for stranded copper conductors.

.3 Stud clamp bolts.

.4 Bolts for copper conductors.

.5 Sized for conductors as indicated.

.4 Clamps or connectors for armoured cable as required to CAN/CSA-C22.2No.18.

## Part 3 Execution

### 3.1 EXAMINATION

.1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for wire and box connectors installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate in presence of Departmental Representative.

.2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.

.3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

### 3.2 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 REQUIREMENTS

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

### 1.2 REFERENCE STANDARDS

.1 CSA C22.2 No. 0.3-09(R2014), Test Methods for Electrical Wires and Cables.

.2 CAN/CSA-C22.2 No. 131-14, Type TECK 90 Cable.

### 1.3 PRODUCT DATA

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

## Part 2 Products

### 2.1 GENERAL

.1 Aluminum conductors are not permitted for any wiring.

.2 Non-metallic sheathed cable is not permitted.

.3 Conductors: minimum #12 AWG for branch circuit wiring.

.4 Low voltage control wiring as required by the manufacturer.

### 2.2 BUILDING WIRES

.1 Copper conductors with insulation of chemically cross-linked thermosetting polyethylene material type RW90 rated 600V for 300V circuits or less.

.2 Copper conductors with insulation of chemically cross-linked thermosetting polyethylene material type RW90 rated 1000V for circuits greater than 300V.

.3 Grounding conductors: bare copper, or where installed within conduit raceways, grounding conductor shall be insulated.

### 2.3 TECK CABLES

.1 Cable copper conductors with insulation of chemically cross-linked thermosetting polyethylene (XLPE), type RW90, rated 1000V for circuits greater than 300V.

.2 Cable copper conductors with insulation of chemically cross-linked thermosetting polyethylene (XLPE), type RW90, rated 600V for circuits less than 300V.

.3 PVC inner jacket.

.4 Interlocking aluminium armour.

.5 PVC outer jacket.

.6 Fastenings (specific only to TECK cables):

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

.2 Channel type supports for two or more cables at 1500 mm centers.

.7 Connectors:

.1 Watertight, approved for TECK cable.

**2.4 ARMOURED CABLES**

.1 Conductors: insulated, copper.

.2 Type: AC90

.3 Armour: interlocking type fabricated from aluminum strip.

.4 Outer Jacket: ACWU90 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 GENERAL**

.1 Conductor length for parallel feeders to be identical.

.2 All feeders and branch circuits must contain a green bonding conductor, sized to code requirements.

.3 When changing the rotation for three phase devices, the change shall be made at the motor splice box.

.4 Circuits sharing a neutral shall be consecutive breakers in the panel (i.e. 1-3-5 or 12-14-16).

.5 All wiring shall be installed in raceway or as TECK, refer to drawings. Wiring shall not be permitted to be installed in the free air.

.6 Neutral conductors shall be the same ampacity as phase conductors.

.7 Conductors shall be tag identified where passing through junction boxes and at terminations or joints.

.8 Conductor runs shall be continuous from source device to load device where practicable.

.9 Record updated information on As-built drawings. Include actual wiring routes throughout the site.

.10 Install all wiring as per manufacturer’s instructions.

**3.2 INSTALLATION OF BUILDING WIRES**

.1 Install wiring in conduit systems, cable tray, or neatly strapped to structure as indicated and required by code.

## 3.3 INSTALLATION OF TECK90 CABLE (0 -1000 V)

.1 Install cables as indicated.

.2 Group cables wherever possible on channels.

## 3.4 INSTALLATION OF ARMOURED CABLES

.1 Final connection to vibrating equipment, motors and transformers: Provide 1 m watertight flexible cable as the final connection to all vibrating equipment. TECK is acceptable.

**END OF SECTION**

## Part 1 General

### 1.1 REFERENCE STANDARDS

.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 or set in poured concrete walls and ceilings as indicated.

.2 Threaded rod hangers must be galvanized.

.3 Plastic anchors are **NOT** permitted.

.4 Tie wraps used for supporting are not acceptable.

.5 Acceptable channel manufacturers: Tuffstrut-Pilgrim or equivalent.

### 2.2 FASTENERS

.1 Acceptable fasteners:

- .1 Alex-Drill Plug - size #12, code - 15/00/1238.
- .2 Hilti-HKD.
- .3 Hilti-Kwik-Bolts.
- .4 Beam clamps.

.2 Inserts for conduit and raceway hangers for single, double, and multiple runs shall be galvanized. Approved products: Burndy, Flexibar.

.3 Hangers shall be provided for all electrical conduit and shall be galvanized after fabrication. Approved products: Burndy, Canadian Strut, Steel City, Electrovert, Myatt.

## Part 3 Execution

### 3.1 INSTALLATION

.1 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.

.2 Hangers, in general, shall be supported from inserts in concrete construction or from building structural steel beams using beam clamps. Additional angle or channel steel members required between beams for supporting conduits and cables shall be provided.

.3 Any additional supports required from existing concrete construction for any piping or equipment shall be provided by drilling same and installing cinch anchors.

.4 Support equipment, conduit or cables using clips, spring loaded bolts, cable clamps designed as accessories to basic channel members.

.5 Conduit or other electrical equipment shall not be supported from mechanical ducts, pipes, etc.

.6 Fasten exposed conduit or cables to building construction or support system using straps.

.1 One-hole galvanized steel straps to secure surface conduits and cables 50 mm and smaller.

.2 Two-hole galvanized steel straps for conduits and cables larger than 50 mm.

.3 Beam clamps to secure conduit to exposed steel work.

.7 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 and cable tray on channels supported by 12.5 mm diameter threaded rod hangers where direct fastening to building construction is impractical. Install trapeze hangers minimum 3 metres on centre and at elbows.

.8 For surface mounting of two or more conduits use channels at spacing as required by C22.1.

.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 Do not use wire lashing or perforated strap to support or secure raceways or cables.

.12 Do not use supports or equipment installed for other trades for conduit or cable support except with permission of other trade and approval of Departmental Representative.

.13 Install fastenings and supports as required for each type of equipment cables and conduits, and in accordance with manufacturer's installation recommendations.

.14 Perforated strapping shall not be used to hang conduit.

.15 All wireways or conduit openings through floors, walls and ceilings shall be sleeved 25 mm larger all around the duct or pipe. All openings through fire barriers shall be properly sealed.

.16 Holes in concrete slabs larger than 110 mm in diameter shall be sleeved. Smaller holes may be diamond core drilled upon approval of location. Structural members shall not be cut or drilled.

.17 All patching of finished construction shall be performed under the sections of the specification covering these materials.

.18 All exposed equipment and supporting devices in finished areas shall be painted white or to match finish.

**END OF SECTION**

## Part 1 General

### 1.1 REFERENCE STANDARDS

.1 Canadian Standards Association (CSA International)

.1 CSA C22.1-15, Canadian Electrical Code, Part 1, 23rd Edition.

## Part 2 Products

### 2.1 OUTLET AND CONDUIT BOXES GENERAL

.1 Gang boxes where wiring devices of the same system are grouped.

.2 Install blank cover plates for boxes without wiring devices.

.3 Separate boxes where devices for more than one system are grouped.

.4 Sectional or handy boxes not permitted. Use FS boxes for surface wiring in storage and mechanical rooms

.5 Use square corner rings in wall board applications. Use plaster rings in masonry and plaster finishes only.

.6 Extension rings are generally not acceptable. When agreed by the Departmental Representative to use an extension ring a maximum of one ring may be permitted.

.7 347V outlet boxes for 347V switching devices.

.8 Outdoors or damp locations, boxes shall be cast Feraloy or aluminum type ‘FS’ with threaded hubs and vapor proof covers.

### 2.2 GALVANIZED STEEL OUTLET BOXES

.1 One-piece electro-galvanized construction.

.2 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.

.3 Utility boxes for outlets connected too surface-mounted EMT conduit, minimum size 102 x 54 x 48 mm.

.4 102 mm square or octagonal outlet boxes for lighting fixture outlets.

.5 Extension and plaster rings for flush mounting devices in finished plaster tile walls.

### 2.3 CONCRETE BOXES

.1 Electro-galvanized sheet steel concrete type boxes for flush mount in concrete.

### 2.4 FLOOR BOXES

.1 Concrete tight electro-galvanized sheet steel floor boxes with adjustable finishing rings to suit floor finish with brass brushed aluminum faceplate. Device mounting plate to

accommodate short or long ear single duplex receptacles. Minimum depth: 73 mm for receptacles and communication outlets.

.2 Adjustable, watertight, concrete tight, cast floor boxes with openings drilled and tapped for 16, 21 and 27 mm conduit. Minimum size: 73 mm deep.

**2.5 CONDUIT BOXES**

.1 Cast FS aluminum boxes with factory-threaded hubs and mounting feet for surface wiring of switches and receptacles.

**2.6 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.

**2.7 FITTINGS - GENERAL**

.1 Bushing and connectors with nylon insulated throats.

.2 Knock-out fillers or threaded plugs to be used in openings or unused box openings.

.3 Conduit outlet bodies for conduit up to 1-1/4 (32 mm) trade size and pull boxes for larger conduits.

.4 Double locknuts and insulated bushings to be installed on sheet metal boxes when ridged conduit and fittings are used.

## 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 REFERENCE STANDARDS

.1 Canadian Standards Association (CSA International)

.1 CAN/CSA C22.2 No. 18.1-13, Outlet Boxes, Conduit Boxes, Fittings and Associated Hardware, A National Standard of Canada.

.2 CSA C22.2 No. 45.1-07(R2012), Rigid Metal Conduit.

.3 CSA C22.2 No. 56-13, Flexible Metal Conduit, and Liquid-Tight Flexible Metal Conduit.

.4 CSA C22.2 No. 83-M1985(R2013), Electrical Metallic Tubing.

## Part 2 Products

### 2.1 CABLES AND REELS

.1 Provide cables on reels or coils.

.1 Mark or tag each cable and outside of each reel or coil, to indicate cable length, voltage rating, conductor size, and manufacturer's lot number and reel number.

.2 Each coil or reel of cable to contain only one continuous cable without splices.

### 2.2 CONDUITS

.1 Minimum 21 mm (3/4”) trade size.

.2 Electrical metallic tubing EMT.

.3 Liquid-tight flexible metal conduit.

.4 Rigid galvanized steel threaded conduit.

### 2.3 CONDUIT FASTENINGS

.1 One-hole steel straps to secure surface conduits 50 mm and smaller.

.1 Two-hole steel straps for conduits larger than 50 mm.

.2 Beam clamps to secure conduits to exposed steel work.

.3 Channel type supports for two or more conduits at 3 m on centre.

.4 Threaded rods, 6 mm diameter, to support suspended channels.

### 2.4 CONDUIT FITTINGS

.1 Set-screws and watertight fittings for EMT.

.2 Steel, double bevel sealing ring for liquid-tight flexible metal conduit. T&B 5200 series or equivalent.

.3 All others as manufactured for use with conduit specified. Coating: same as conduit.

.4 Factory “ells” where 90 degree bends are required and exposed.

**2.5 EXPANSION FITTINGS FOR RIGID CONDUIT**

.1 Weatherproof expansion fittings with internal bonding assembly suitable for 200 100 mm linear expansion.

.2 Watertight expansion fittings with integral bonding jumper suitable for linear expansion and 19 mm deflection.

.3 Weatherproof expansion fittings for linear expansion at entry to panel.

**2.6 FISH CORD**

.1 5 mm Polypropylene. All empty conduits to contain fish cord or as noted on drawings.

**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 Conceal conduits except in mechanical and electrical service rooms and in unfinished areas.

.2 Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass.

.3 Install separate conduit(s) for power and each equipment circuit.

.4 Install separate conduits from each receptacle to ceiling space. Receptacles shall not be loop fed horizontally in walls.

.5 Install conduits parallel with building lines.

.6 Group conduits wherever possible on channels.

.7 Conduits for receptacles shall be filled with the maximum number of conductors as follows:

| Size of Conduit | R90, RW90 Without a Jacket |
|---|---|
| 21 mm (3/4”) | 8 |
| 27 mm (1”) | 12 |
| 35mm (1-1/4”) | 20 |

.8 Use electrical metallic tubing (EMT) except where specified otherwise.

.9 Use liquid tight flexible metal conduit for connection to motors, instruments, and sensors and for fishing into block walls and existing walls.

.10 Use rigid galvanized steel threaded conduit in hazardous areas and where specified otherwise.

.11 Bend conduit cold. Replace conduit if chinked or flattened more than $1/10^{th}$ of its original diameter.

.12 Mechanically bend steel conduit over 25 mm (1") trade size. Use factory 90 degree fittings on piping over 25 mm (1") trade size

.13 Where elbows 45 degrees and larger are required to pass through a wall provide a pull box.

.14 Field threads on rigid conduit must be of sufficient length to draw conduits up tight.

.15 Install fish cord in empty conduits.

.16 Where conduits become blocked, remove, and replace blocked section. Do not use liquids to clean out conduits.

.17 Dry conduits out before installing wire.

.18 Record updated information on As-built drawings. Include actual wiring routes throughout the site

.19 Coordinate piping installation locations with other trades

.20 Provide identification labels and paint.

.21 All conduits are to be bonded to ground as required by other sections.

.22 Conduit terminations are to be in min 100 x 100 x 38mm box.

## 3.3 SURFACE CONDUITS

.1 Locate conduits behind infrared or gas fired heaters with 1.5 m clearance.

.2 Run conduits in flanged portion of structural steel.

.3 Do not pass conduits through structural members except as indicated.

.4 Do not locate conduits less than 75 mm parallel to stream or hot water lies with a minimum of 25 mm as crossovers.

## 3.4 CONCEALED CONDUITS

.1 Run parallel or perpendicular to building lines.

.2 Do not install horizontal runs in walls.

.3 Do not install conduits in terrazzo or concrete toppings.

**END OF SECTION**