

**Part 1            General**

**1.1                General**

- .1        This Section covers items common to Sections of Division 16. This section supplements requirements of Division 1.

**1.2                Codes and Standards**

- .1        Do complete installation in accordance with CSA C22.1-2006 except where specified otherwise.
- .2        Do overhead and underground systems in accordance with CSA C22.3 No.1-M1979 except where specified otherwise.
- .3        Abbreviations for electrical terms: to CSA Z85-1983.

**1.3                Care, Operation and Start-up**

- .1        Instruct operating personnel in the operation, care and maintenance of equipment.
- .2        Arrange and pay for services of manufacturer's factory service engineer to supervise start-up of installation, check, adjust, balance and calibrate components.
- .3        Provide these services for such period, and for as many visits as necessary to put equipment in operation, and ensure that operating personnel are conversant with all aspects of its care and operation.

**1.4                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.

**1.5                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 Consultant will provide drawings and specifications required by Electrical Inspection Department and Supply Authority at no cost.
- .4 Notify Consultant of changes required by Electrical Inspection Department prior to making changes.
- .5 Furnish Certificates of Acceptance from authorities having jurisdiction on completion of work to Consultant.

#### **1.6 Materials and Equipment**

- .1 Provide materials and equipment in accordance with Section 01610 - Basic Product Requirements.
- .2 Equipment and material to be CSA certified. Where there is no alternative to supplying equipment which is not CSA certified, obtain special approval from Electrical Inspection Department.
- .3 Factory assemble control panels and component assemblies.

#### **1.7 Electric Motors, Equipment and Controls**

- .1 Control wiring and conduit is specified in Division 16 except for conduit, wiring and connections below 50 V which are related to control systems specified in Division 15 and shown on mechanical drawings.

#### **1.8 Finishes**

- .1 Shop finish metal enclosure surfaces by application of rust resistant primer inside and outside, and at least two coats of finish enamel.
  - .1 Paint outdoor electrical equipment "equipment green" finish to EEMAC Y1-1-1955.
  - .2 Paint indoor switchgear 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.

#### **1.9 Equipment Identification**

- .1 Identify electrical equipment with nameplates as follows:

- .2 Nameplates:
- .1 Lamicoid 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 Wording on nameplates to be approved by Consultant prior to manufacture.
- .4 Allow for average of twenty-five (25) letters per nameplate.
- .5 Identification to be English.
- .6 Nameplates for terminal cabinets and junction boxes to indicate system and/or voltage characteristics.
- .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.

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

#### **1.11 Conduit, Junction Box and Cable Identification**

- .1 Code conduits, boxes and metallic sheathed cables with vinyl label.
- .2 Code with label identifying system at points where conduit or cable enters wall, ceiling, or floor, and at 15 m intervals for the following systems:

System & Label
120/208V
600 V
Telephone/Data
Fire Alarm
Emergency Lighting

- .3 Lettering minimum 20 mm high.
- .4 Standard of acceptance: Thomas & Betts.
- .5 Submit sample for approval.

### **1.12 Wiring Terminations**

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

### **1.13 Manufacturers and CSA Labels**

- .1 Visible and legible after equipment is installed.

### **1.14 Warning Signs**

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

### **1.15 Location of Outlets**

- .1 Locate outlets in accordance with Section 01720 - Preparation.
- .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 elevator machine rooms on latch side of floor.

### **1.16 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 at following heights unless indicated otherwise.
  - .1 Local switches: 1200 mm.
  - .2 Wall receptacles:
    - .1 General: 400 mm.
    - .2 Above top of continuous baseboard heater: 300 mm.
    - .3 Above top of counters or counter splash backs: 175 mm.
    - .4 In mechanical rooms: 1200 mm.
  - .3 Panelboards: as required by Code or as indicated.
  - .4 Telephone and interphone outlets: 300 mm.
  - .5 Wall mounted telephone and interphone outlets (non-accessible): 1500 mm.
  - .6 Fire alarm stations: 1200 mm.
  - .7 Fire alarm horns: 2100 mm.
  - .8 Wall mounted pushbuttons: 1200 mm.

### **1.17 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, dry-core transformers and motor control centres, operating under normal load. State hour and date on which each load was measured, and voltage at time of test.

### **1.18 Conduit and Cable Installation**

- .1 Install conduit and sleeves prior to pouring of concrete. Sleeves through concrete: schedule 40 steel pipe plastic sheet metal, 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.

**1.19 Field Quality Control**

- .1 Conduct and pay for following tests:
  - .1 Motors, heaters and associated control equipment including sequenced operation of systems where applicable.
  - .2 Furnish manufacturer's certificate or letter confirming that entire installation as it pertains to each system has been installed to manufacturer's instructions.
  - .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.
  - .4 Carry out tests in presence of Contract Administrator.
  - .5 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.
  - .6 Submit test results for Contract Administrator's review.

**1.20 Coordination of Protective Devices**

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

**1.21 Weatherproof/Moisture Proof Devices**

- .1 All devices in the following area are to be weatherproof:
  - .1 Building exterior
  - .2 Parking lot
  - .3 Roof
  - .4 Areas exposed to weather

**1.22 Existing Facilities**

- .1 The Contractor is advised that there are electrical conduits within the area of excavation, including a major electrical cable carrying power from the existing garages to the existing salt-sand building and NMW 10 direct buried cable connecting existing floodlights along the fence line to the main cable. The approximate (only) locations of cables are shown on the drawings. Cables are specified to be 1 metre below the surface. Contractor shall take care to detect all electrical lines with a metal detector or similar device and shall hand excavate over all electrical trenches. Place pressure-treated 2' x 6' boards over

NMW 10 direct buried cable to the floodlights. Place concrete block over any exposed major cable.

### **1.23 Scope of Work**

- .1 Supply and install north parking automotive receptacles including new locally mounted panelboard, conduit, energy saving duplex receptacles on guardrail supplied and installed by this contract. System to include new distribution circuit breaker from existing distribution panel and required feeder cable. Power to come from the existing distribution switchboard.
- .2 Supply and install new 120 volt duplex receptacles, data outlets and upgraded existing fluorescent lighting for the renovated main floor office area.
- .3 Supply and install new distribution system for the garage addition including all required lighting for workshop, storage room, mezzanine storage, power requirements for workshop, exhaust fan power and air handling unit power system. Relocate existing lighting and electrical equipment to accommodate new garage addition. System to include new distribution circuit breaker from existing distribution panel and required feed cable. Power to come from the existing distribution switchboard.
- .4 Supply and install new distribution system for proposed storage building, system to include panelboard, photocell controlled exterior lighting, interior incandescent lighting, convenience receptacles and parking stall receptacles. System to include new distribution circuit breaker from existing distribution panel and required feeder cable. Power to come from the existing distribution switchboard.
- .5 Verify the proper operation of existing south parking lot automotive receptacles and energy control system.

**END OF SECTION**

**Part 1            General**

**Part 2            General**

**2.1                Equipment**

- .1            Clamps for grounding of conductor, size as required to rod electrodes.
- .2            System and circuit, equipment, grounding conductors, bare stranded copper, soft annealed, un-armoured, size as indicated.
- .3            Insulated grounding conductors: green, type RW90.
- .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            Thermit welded type conductor connectors.
  - .4            Bonding jumpers, straps.
  - .5            Pressure wire connectors.

**Part 3            PART 3 - EXECUTION**

**3.1                Installation General**

- .1            Install complete permanent, continuous, system and circuit, equipment, grounding systems including, conductors, connectors and accessories to conform to requirements of Contract Administrator, the City, and local authority having jurisdiction over installation. Provide a ground wire in all conduit.
- .2            Install connectors in accordance with manufacturer's instructions.
- .3            Protect exposed grounding conductors from mechanical injury.
- .4            Use mechanical connectors for grounding connections to equipment provided with lugs.
- .5            Soldered joints not permitted.
- .6            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.



- .7 Make grounding connections in radial configuration only, with connections terminating at single grounding point. Avoid loop connections.
- .8 Bond single conductor, metallic armoured cables to cabinet at supply end, and provide non-metallic entry plate at load end.

### **3.2 Equipment Grounding**

- .1 Install grounding connections to typical equipment included in, but not necessarily limited to following list: Generator, service equipment, duct systems, frames of motors, starters, control panels, distribution panels, and propane storage tanks.
- .2 Reconnect existing ground conductors to new equipment where possible.

### **3.3 Field Quality Control**

- .1 Perform tests in accordance with Section 16010 - Electrical General Requirements.
- .2 Perform ground continuity and resistance tests using method appropriate to site conditions and to approval of Contract Administrator and local authority having jurisdiction over installation.
- .3 Perform tests before energizing electrical system.
- .4 Disconnect ground fault indicator during tests.

**END OF SECTION**

**Part 1            General**

**1.1                Related Work**

- .1            Fastenings and supports: Section 01610 - Basic Product Requirements.

**Part 2            Products**

**2.1                Support Channels**

- .1            U shape, size 41 x 41 mm, 2.5 mm thick, surface mounted.

**Part 3            Execution**

**3.1                Installation**

- .1            Secure equipment to solid masonry, tile and plaster surfaces with lead anchors.
- .2            Secure equipment to poured concrete with expandable inserts.
- .3            Secure equipment to hollow masonry walls or suspended ceilings with toggle bolts.
- .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 malleable iron 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 dia threaded rods and spring clips.
  - .2            Support 2 or more cables or conduits on channels supported by 6 mm dia threaded rod hangers where direct fastening to building construction is impractical.

- .7 For surface mounting of two or more conduits use channels at 1.5 m oc spacing.
- .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 Contract Administrator.
- .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**

**Part 1            General**

**1.1                References**

- .1            CSA C22.2 No. 0.3-M1985, Test Methods for Electrical Wires and Cables.

**1.2                Product Data**

- .1            Submit product data in accordance with Division 1.

**Part 2            Products**

**2.1                Building Wires**

- .1            Copper conductors: size as indicated, with 600 V insulation of chemically cross-linked thermosetting polyethylene material rated RW90 and 600V power circuit min. #12 AWG).
- .2            RWU90 rated for cables installed underground.

**2.2                Armoured Cables**

- .1            Conductors: insulated, copper size as indicated.
- .2            Type: AC90.
- .3            Armour: interlocking type fabrication from aluminum strip.
- .4            For use in partition drywall walls or fixture drops in T-bar ceilings.

**2.3                Fire Alarm Cable**

- .1            Non-metallic sheathed cable 300 V rated 4/c #18 AWG for smoke/heat detectors.
- .2            Non-metallic sheathed cable neoprene jacketed 300V rated 2/c minimum #12 AWG for signal devices.

**2.4                TECK Cable**

- .1            Conductors:
  - .1            Grounding conductor: copper
  - .2            Circuit conductors: copper, size as indicated.

- .2 Insulation:
  - .1 Type: ethylene propylene rubber
  - .2 Chemically cross-linked thermosetting polyethylene rated Type RW90.
- .3 Inner jacket: polyvinyl chloride material.
- .4 Armour: interlocking aluminum.
- .5 Overall covering: thermoplastic polyvinyl chloride material.
- .6 Fastenings:
  - .1 One hole malleable iron straps to secure surface cables 2 in. and smaller. Two hole steel straps for cables larger than 2 in.
  - .2 Channel type supports for two or more cables at 30 in. centres.
  - .3 One-quarter in. diameter threaded rods to support suspended channels.
- .7 Connectors:
  - .1 Watertight, approved for TECK cable.

**Part 3 Execution**

**3.1 Installation of Building Wires**

- .1 Install wiring as follows:
  - .1 In conduit systems in accordance with Section 16133.

**3.2 Installation of 0-1000V TECK Cable**

- .1 Install cables.
- .2 Group cables wherever possible on channel with cable clamps.
- .3 Terminate cables in accordance with Section 16151 – Wire and Box Connectors 0-1000V.

**END OF SECTION**

**Part 1            General**

**1.1                RELATED SECTIONS**

- .1            Section 16010 – Electrical General Requirements

**1.2                REFERENCES**

- .1            Canadian Standards Association, (CSA International)
  - .1            CSA-T529-95(R2000), Telecommunications Cabling Systems in Commercial Buildings (Adopted ANSI/EIA TIA 568a with modifications).
  - .2            CSA-C22.2 No. 214-02, Communications Cables (Bi-national Standard, with UL 444).
  - .3            CAN/CSA-C22.2 No. 182.4-M90(R2001), Plugs, Receptacles, and Connectors for Communication Systems.
- .2            Telecommunications Industry Association (TIA)
  - .1            TIA/EIA-568-2001, Commercial Building Telecommunications Cabling Standards Set.

**1.3                SYSTEM DESCRIPTION**

- .1            Structured system of telecommunications cables (copper) installed within buildings for distributing voice and data signals.
- .2            Installed in physical star configuration with separate horizontal and backbone sub-systems. Horizontal cables link work areas to telecommunications closet located on same floor. Telecommunications closets linked to central equipment room by backbone cables.

**Part 2            Products**

**2.1                STATION WIRE (ZSW)**

- .1            4-pair, 24 AWG, 100 ohm cable with insulated copper conductor in separate outer jacket: to C22.2 No. 214. FT-4, FT-6 fire-rated jacket.
- .2            Voice-grade electrical transmission requirements: to CSA T529 and TIA-EIA-568.
- .3            Data-grade electrical transmission requirements to: CSA T529 and TIA-EIA-568.

**2.2                HORIZONTAL CABLING SPECIFICATIONS: CATEGORY 6**

- .1            Contractor Qualifications
  - .1            The Contractor performing the data cabling installation shall have a structured cabling industry affiliation such as BICSI (Building Industry Consultants

International) membership, RCDD (Registered Communications Distributor Designer) and/or a structured cabling vendor certification. All data cabling installers shall be licensed and insured.

.2 The data cabling Contractor shall provide references of similar projects.

.2 Horizontal Cabling

.1 Category 6 100 ohm 22-24 AWG four-pair unshielded twisted pair cabling certified to a minimum of 250 MHz shall be used for the data horizontal cabling. The Category 6 horizontal cabling shall meet the minimum technical specifications defined in the document ANSI/TIA/EIA-568-B.2-1 ("Transmission Performance Specifications for 4-pair 100ohm Category 6 Cabling").

.2 All data telecommunications jacks shall be of type RJ45 and shall be TIA/EIA certified Category 6. The RJ45 jack is an 8-position modular jack of the ISO 8877 type and wired as a T568A type.

.3 One hundred percent of the installed cabling links must be tested and must pass the requirements of the standards mentioned in 1.1 above. Any failing link must be diagnosed and corrected. The corrective action shall be followed with a new test to prove that the corrected link meets the performance requirements. The final and passing result of the tests for all links shall be provided in the test results documentation in accordance with Section 3.5 below.

.4 No installed cabling may be exposed to view outside of the telecommunications closet. It shall be within a raceway, behind a suspended ceiling or concealed with wire molding.

.5 All horizontal cabling runs shall run from each work area in a star topology to a telecommunications closet. There shall be no connector in the cable run between the outlet in the work area and the closet.

.6 No cabling run may exceed a length of 90 meters.

.7 All category 6 cabling shall be terminated in the telecommunications closet on 19 inch rack mount modular RJ45 patch panels.

.8 The category 6 cabling in the racks shall be installed with sufficient and appropriate mounting clips, brackets, and cable management to provide a secure and maintainable system. Care shall be taken to not cause the cables to be overly crimped.

.9 The UTP Category 6 cable tail shall be terminated with a minimum of 14" of slack but not to exceed 18".

.1 After dressing cable to the final location, the sheath shall be removed to a point that allows the conductors to be splayed and terminated in a neat and uniform fashion. Every effort must be made to maintain sheath integrity by removing only as much as is practical to accomplish termination. Cable pair twist shall be maintained up to the point of termination. As stated in 568-B.2-1, the pairs in a cable should never be untwisted more than 0.5 inches from the point of termination. Under no circumstances shall cable pairs be untwisted or otherwise altered prior to termination.

.2 Any unused horizontal cabling shall be labelled and loosely coiled.

- .3 Bidder shall specify cables proposed for use and submit documentation proving that the proposed cables meet these specifications.

- .3 Labelling

- .1 All cables shall be labelled with tag wraps or some other permanent marker capable of withstanding multiple pulling of cable through raceways. Labels shall be located 0.5 meters from the work area end.
- .2 All terminations shall be clearly identified on patch panel in telecommunications closet. All jacks in the patch panel must be in sequential order.
- .3 At each work area, faceplate outlet shall be professionally printed with jack numbers clearly visible without removing outlet faceplate. The labelling shall be metal or vinyl adhesive tape with embossed or indelible printing for each outlet.
- .4 An example of the alpha-numbering scheme is as shown.  
**xx-yy-zzz**, where
  - xx = Level/Floor designator
  - yy = Zone number on floor
  - zzz = Workstation jack numberConsecutive numbering is acceptable if a floor plan identifying the location of the jacks is provided.

- .4 Field Test Quality

- .1 The Contractor shall visually inspect all cables, cable reels, and shipping cartons to detect cable damage incurred during shipping and transport. Visibly damaged items shall not be installed.
- .2 Cable testing is to be performed only after installation is complete.
- .3 The test parameters for Cat 6 are defined in TIA Cat 6 standard, which refers to the ANSI/TIA/EIA-568-B.2 standard. In order to pass the test all measurements (at each frequency in the range from 1 MHz through 250 MHz) must meet or exceed the limit value determined in the above-mentioned standard.
- .4 The test equipment (tester) shall comply with the accuracy requirements for Level III field testers as defined in the TIA Cat 6 Document. The tester including the appropriate interface adapter must meet the specified accuracy requirements. The accuracy requirements for the permanent link test configuration (baseline accuracy plus adapter contribution) are specified in Table B.2 of Annex B of the TIA Cat 6 Standard. (Table B.3 in this TIA document specifies the accuracy requirements for the Channel configuration.)
- .5 Test results shall be presented in electronic form as a comma separated values formatted file (CSV). If preferred the results may also be presented in the Microsoft Excel format.



**Part 3 Execution**

**3.1 INSTALLATION OF HORIZONTAL DISTRIBUTION CABLES**

- .1 Install ZSW horizontal cables, as indicated in conduits from termination in telecommunications closet to outlets.
- .2 Terminate 1 ZSW cables per work station terminated in accordance with CAN/CSA C22.2 No. 182.4 and CSA-T529.

**3.2 FIELD QUALITY CONTROL**

- .1 Perform tests in accordance with Section 16010 – Electrical General Requirements..
- .2 Test UTP cable installations for:
  - .1 Continuity: including open/short, polarity, and pair transpositions.
  - .2 DC loop resistance.
  - .3 Length using TDR.

**END OF SECTION**

**Part 1            General**

**1.1                References**

- .1            CSA C22.1-2006 Canadian Electrical Code, Part 1.

**Part 2            Products**

**2.1                Outlet and Conduit Boxes General**

- .1            Size boxes in accordance with CSA C22.1.
- .2            4 inch square or larger outlet boxes as required for special devices.
- .3            Gang boxes where wiring devices are grouped.
- .4            Blank cover plates for boxes without wiring devices.
- .5            Combination boxes with barriers where outlets for more than one system are grouped.

**2.2                Sheet Steel Outlet Boxes**

- .1            Electro-galvanized steel utility boxes for outlets connected to surface-mounted EMT conduit, minimum size 4 x 2 1/8 x 2 inch.

**2.3                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 1 ¼ inch and pull boxes for larger conduits.
- .4            Double lock nuts and insulated bushings on sheet metal boxes.

**Part 3            Execution**

**3.1                Installation**

- .1            Support boxes independently of connecting conduits.

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

**END OF SECTION**

**Part 1            General**

**1.1                References**

- .1                    .1            Canadian Standards Association (CSA)
  - .1            CAN/CSA C22.2 No.18-92, Outlet Boxes, Conduit Boxes, and Fittings.
  - .2            CSA C22.2 No.45-M1981(R1992), Rigid Metal Conduit.
  - .3            CSA C22.2 No.56-1977(R1977), Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit.
  - .4            CSA C22.2 No.83-M1985(R1992), Electrical Metallic Tubing.
  - .5            CSA C22.2 No.211.2-M1984(R1992), Rigid PVC (Unplasticized) Conduit.
  - .6            CAN/CSA C22.2 No.227.3-M91, Flexible Nonmetallic Tubing.

**Part 2            Products**

**2.1                2.1 Conduits**

- .1            Rigid metal conduit: to CSA C22.2 No.45, hot dipped galvanized steel threaded.
- .2            Electrical metallic tubing (EMT): to CSA C22.2 No.83, with couplings.
- .3            Rigid pvc conduit: to CSA C22.2 No.211.2.
- .4            Flexible metal conduit: to CSA C22.2 No.56, liquid-tight flexible metal or flexible metal conduit as specified.

**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 dia., to support suspended channels.

**2.3                Conduit Fittings**

- .1            Fittings: manufactured for use with conduit specified. Coating: same as conduit.

- .2 Factory "ells" where 90bends are required for 25 mm and larger conduits.
- .3 Watertight connectors and couplings for EMT. Set-screws are not acceptable.

#### **2.4 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 Conceal conduits except in mechanical and electrical service rooms.
- .3 Use hot dipped galvanized steel threaded conduit except where specified otherwise.
- .4 Use electrical metallic tubing (EMT) except in cast concrete.
- .5 Use flexible metal conduit for connection to motors in dry areas.
- .6 Use liquid tight flexible metal conduit for connection to motors or vibrating equipment in damp, wet or corrosive locations.
- .7 Minimum conduit size for lighting and power circuits: 19 mm.
- .8 Bend conduit cold. Replace conduit if kinked or flattened more than 1/10th of its original diameter.
- .9 Mechanically bend steel conduit over 19 mm dia.
- .10 Field threads on rigid conduit must be of sufficient length to draw conduits up tight.
- .11 Install fish cord in empty conduits.
- .12 Remove and replace blocked conduit sections. Do not use liquids to clean out conduits.
- .13 Dry conduits out before installing wire.

#### **3.2 Raceways in Existing Building**

- .1 Surface mounted metallic wiremold on block/concrete walls in finished areas:
  - .1 Standard of acceptance: Wiremold V500, V700, 2000 and 4000 series
  - .2 Maximum 40% fill.

- .3 Paint to match wall finish.
- .2 Recessed in drywall walls. Patch and paint wall.

### 3.3 Rigid PVC conduit.

- .1 Use in:
  - .1 Pool area
  - .2 Showers
  - .3 Pool locker rooms
  - .4 Washrooms
  - .5 Areas cleaned by hose down.

### 3.4 Surface Conduits

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

### 3.5 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.

### 3.6 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 25 mm concrete cover.
- .7 Organize conduits in slab to minimize cross-overs.

**END OF SECTION**

**Part 1            General**

**1.1                Shop Drawings and Product Data**

- .1            Submit shop drawings and product data in accordance with Division 1.

**Part 2            Products**

**2.1                Manufacturers**

- .1            Acceptable manufacturers:
  - .1            Leviton
  - .2            Pass & Seymour
  - .3            Hubble

**2.2                Switches**

- .1            15 A, 347 V, single pole, double pole, three-way, four-way switches, commercial grade.
- .2            20 A, 120 V single pole for 120 V lighting source.
- .3            Manually operated general purpose ac switches with following features:
  - .1            Terminal holes approved for No. 10 AWG wire.
  - .2            Silver alloy contacts.
  - .3            Nylon molding for parts subject to carbon tracking.
  - .4            Suitable for back and side wiring.
  - .5            Ivory toggle.
- .4            Toggle operated, fully rated for tungsten filament and fluorescent lamps, and up to 80% of rated capacity of motor loads.
- .5            Switches of one manufacturer throughout project.
- .6            Standard of acceptance: Pass & Seymour 2601 347-I and 2601-I.

**2.3                Receptacles**

- .1            Decorative duplex receptacles, CSA type 5-15 R, 125 V, 15 A, U ground, commercial grade, with following features:
  - .1            Ivory nylon molded housing.
  - .2            Suitable for No. 10 AWG for back and side wiring.
  - .3            Break-off links for use as split receptacles.



- .4 Eight back wired entrances, four side wiring screws.
- .5 Triple wipe contacts and riveted grounding contacts.
- .6 Standard of acceptance: Pass & Seymour 885I Series.
- .2 Other receptacles with ampacity and voltage as indicated. Orange isolated ground receptacles Pass & Seymour IG26262 as indicated.
- .3 GFCI Leviton receptacles standard of acceptance: 8598-Ivory, Smart GFCI with LGD indicator light.
- .4 Parking lot automotive block heater receptacles to be IPLC (Intelligent Parking Lot Controller).
- .5 Receptacles of one manufacturer throughout project.
- .6 Mount weatherproof receptacles horizontal.

**2.4 Manual Motor Disconnects'**

- .1 Double pole, 120V, 30A rated starting switch.
- .2 Standard of acceptance: Pass & Seymour PS30AC2-HP.

**2.5 Cover Plates**

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

**2.6 Weatherproof Device Coverplates**

- .1 Grey thermoplastic with independent covers (non GFI)
- .2 Standard of acceptance: Leviton 4976-GY.
- .3 GFI receptacles cover standard of acceptance: Leviton 4978-GY.

**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 16010 - Electrical General Requirements, 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 in Section 16010 - Electrical General Requirements, or as indicated.
  - .3 Where split receptacles has one portion switched, mount vertically and switch upper portion.
- .3 Cover Plates:
- .1 Install suitable common cover plates where wiring devices are grouped.
  - .2 Do not use cover plates meant for flush outlet boxes on surface-mounted boxes.

**END OF SECTION**

**Part 1            General**

**1.1                References**

- .1            CSA C22.2No.65-1956(R1965) Wire Connectors.
- .2            EEMAC 1Y-2, 1961 Bushing Stud Connectors and Aluminum Adapters (1200 Ampere Maximum Rating).

**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 conductors 10 AWG or less.
- .3            Bushing stud connectors: to EEMAC 1Y-2 to consist of:
  - .1            Connector body and stud clamp for stranded round copper conductors.
  - .2            Clamp for stranded round copper conductors.
  - .3            Bolts for copper conductors bar.
- .4            Clamps or connectors for armoured cable, aluminum sheathed cable, flexible conduit, 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.
  - .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                REFERENCES**

- .1            The Munsell System of Colour Notation.

**Part 2            Products**

**2.1                MATERIALS**

- .1            Enclosure constructed with 2.7 mm thick minimum steel, with weather and corrosion resistant finish, Munsell Notation 7.5GY3.5/1.5, size as indicated.
- .2            Entire enclosure capable of withstanding maximum impact force of 86 MN/m<sup>2</sup> area without rupture of material.
- .3            Removable enclosure panels with formed edges, galvanized steel external fasteners removable only from inside enclosure.
- .4            Enclosure equipped with hot dipped galvanized mounting rails 1 m adjustable horizontally and vertically to enable mounting of equipment at any location within housing.
  - .1            Rails: 14 mm holes and 50 x 14 mm slots on 100 mm centres for horizontal adjustment.
  - .2            Holes in side panel flanges in 60 mm increments for vertical adjustment.
- .5            Cover: tamperproof, bolt-on, domed to shed water.
- .6            Door: minimum 1 m wide, hinged, 3 point latching, with padlocking means.
- .7            Ventilation panel constructed to allow air circulation yet preventing entry of foreign objects, wild life, vermin.
- .8            Enclosure construction such as to allow any configuration of single or ganged enclosures.
- .9            Enclosure capable of being shipped in knocked-down condition.

**Part 3            Execution**

**3.1                INSTALLATION**

- .1            Assemble enclosure in accordance with manufacturer's instructions and mount on concrete pad.
- .2            Mount equipment in enclosure.

**END OF SECTION**

**Part 1            General**

**1.1                Related Work Specified Elsewhere**

- .1        Basic Electrical - Section 16010 Materials and Methods
- .2        Conduit, Conduit Fastenings and Conduit Fittings - Section 16133
- .3        Wires and Cables 0-1000V - Section 16122

**1.2                Shop Drawings and Product Data**

- .1        Submit shop drawings in accordance with Division 1.
- .2        Indicate:
  - .1        Mounting method and dimensions
  - .2        Starter size and type
  - .3        Layout of identified internal and front panel components
  - .4        Enclosure types
  - .5        Wiring diagram for each type of starter
  - .6        Interconnection diagrams

**1.3                Operation and Maintenance Data**

- .1        Provide operation and maintenance data for motor starters for incorporation into manual specified in Division 1.
- .2        Include operation and maintenance data for each type and style of starter.

**1.4                Maintenance Materials**

- .1        Provide maintenance materials in accordance with Section 16010.
- .2        Provide listed spare parts for each different size and type of starter:
  - .1        4 contacts, stationary.
  - .2        4 contacts, movable.
  - .3        2 contacts, auxiliary.
  - .4        2 control transformers.
  - .5        2 operating coils.
  - .6        2 fuses.
  - .7        10 indicating lamps.
  - .8        1 HOA kit.

**Part 2 Products**

**2.1 Materials**

- .1 Starters: NEMA rated.
  - .1 Half size starters not acceptable.

**2.2 Manual Motor Starters**

- .1 Single and Three phase manual motor starters of size, type, rating, and enclosure type as indicated, with components as follows:
  - .1 Switching mechanism, quick make and break.
  - .2 Overload heaters, manual reset, trip indicating handle.
- .2 Accessories:
  - .1 Toggle switch labeled as indicated.
  - .2 Indicating light: type and color as indicated.
  - .3 Locking tab to permit padlocking in "ON" or "OFF" position.
  - .4 Flush mounted type in public areas or as indicated.

**2.3 Full Voltage Magnetic Starters**

- .1 Magnetic and combination magnetic starters of size, type, rating and enclosure type as indicated with components as follows:
  - .1 Contractor solenoid operated, rapid action type.
  - .2 Motor overload protective device in each phase, manually reset from outside enclosure.
  - .3 Wiring and schematic diagram inside starter enclosure in visible location.
  - .4 Identify each wire and terminal for external connections, within starter, with permanent number marking identical to diagram.
- .2 Combination type starters to include motor circuit interrupter with operating lever on outside of enclosure to control motor circuit interrupter, and provision for:
  - .1 Locking in "OFF" position with up to 3 padlocks.
  - .2 Independent locking of enclosure door.
  - .3 Provision for preventing switching to "ON" position while enclosure door open.
- .3 Accessories
  - .1 Selector switches standard labeled as indicated.
  - .2 Indicating lights standard type and color as indicated.

- .3 2-N/O and 1-N/C spare auxiliary contacts unless otherwise indicated.
- .4 Red run light, green stop light, amber fault light.
- .5 Door mounted H/O/A selector switch.

**2.4 Control Transformer**

- .1 Single phase, dry type, control transformer with primary voltage as indicated and 120V secondary, complete with secondary fuse, installed in with starter as indicated.
- .2 Size control transformer for conduit circuit load plus 20% spare capacity.

**2.5 Finishes**

- .1 Apply finishes to enclosure in accordance with Section 16010 - Electrical General Requirements.

**2.6 Equipment Identification**

- .1 Provide equipment identification in accordance with Section 16010 - Electrical General Requirements.
- .2 Manual starter designation label, white plate, black letters, size 1, engraved as indicated.
- .3 Magnetic starter designation label, white plate, black letters, size 4 engraved as indicated.

**2.7 Acceptable Manufacturers**

- .1 Cutler Hammer, Square D, Siemens.

**Part 3 Execution**

**3.1 Installation**

- .1 Install starters, connect power and control as indicated.
- .2 Ensure correct fuses and overload devices elements installed.

**3.2 Tests**

- .1 Perform tests in accordance with Section 16010 - Electrical General Requirements and manufacturer's instructions.
- .2 Operate switches, contactors to verify correct functioning.

- .3 Perform starting and stopping sequences of contactors and relays.
- .4 Check that sequence controls, interlocking with other separate related starters, equipment, control devices, operate as indicated.
- .5 Ensure motor rotation corresponds with the direction required by the driven equipment.

**END OF SECTION**



**Part 1            General**

**1.1                Related Work Specified Elsewhere**

- .1            Electrical General Requirements - Section 16010

**1.2                Product Data**

- .1            Submit product data in accordance with Section 01300 – Submittals.
- .2            Include time current characteristic curves for breakers with ampacity of 100A and over.

**Part 2            Products**

**2.1                Breakers General**

- .1            Moulded case circuit breakers: to CSA C22.2 No. 5.
- .2            Bolt-on moulded case circuit breaker: quick-make, quick-break type, for manual and automatic operation with temperature compensation for 40 deg. C ambient.
- .3            Common-trip breakers: with single handle for multi-pole applications.
- .4            Magnetic instantaneous trip elements in circuit breakers to operate only when value of current reaches setting. Trip settings on breakers with adjustable trips to range from 3 – 10 times current rating.
- .5            RMS symmetrical current interrupting capacity to match panel.

**2.2                Thermal Magnetic Breakers**

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

**2.3                Solid State Trip Breakers**

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

**2.4 Manufacturers**

- .1 Acceptable manufacturer: Square D, Cutler Hammer, Siemens.

**Part 3 Execution**

**3.1 Installation**

- .1 Install circuit breakers as indicated.

**END OF SECTION**

**Part 1            General**

**1.1                Product Data**

- .1        Submit product data in accordance with Section 01330 – Submittal Procedures.

**Part 2            Products**

**2.1                Disconnect Switches**

- .1        Fusible, horsepower rated disconnect switch in CSA Enclosure 1 or 3 as shown, size as indicated.
- .2        Provision of padlocking in on-off switch position by three locks.
- .3        Mechanically interlocked door to prevent opening when handle in ON position.
- .4        Fuses: size as indicated.
- .5        Fuseholders: relocatable and suitable without adaptors, for type and size of fuse indicated.
- .6        Quick-make, quick-break action.
- .7        ON-OFF switch position indication on switch enclosure cover.
- .8        Solid neutral block as required.
- .9        Acceptable Manufacturer: Square D Series CH.

**2.2                Equipment Identification**

- .1        Provide equipment identification in accordance with Section 16010 – Electrical General Requirements.
- .2        Indicate name of load controlled on size 4 nameplate.

**Part 3            Execution**

**3.1                Installation**

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

**END OF SECTION**

**Part 1            General**

**1.1                Related Work Specified Elsewhere**

- .1            Electrical General Requirements - Section 16010
- .2            Conduit, Conduit Fastenings and Conduit Fittings - Section 16133
- .3            Moulded Case Circuit Breakers - Section 16412

**1.2                Shop Drawings**

- .1            Submit shop drawings in accordance with Section 01340 – Shop Drawings, Product Data, Samples and Mock-Ups.
- .2            Drawings to include electrical detail of panel, branch breaker type, quantity, ampacity and enclosure dimension.

**1.3                Plant Assembly**

- .1            Install circuit breakers in panelboards before shipment.
- .2            In addition to CSA requirements manufacturer's nameplate must show fault current that panel including breakers has been built to withstand.

**Part 2            Products**

**2.1                Manufacturers**

- .1            Acceptable Manufacturer:
  - .1            Square D, Cutler Hammer, Siemens

**2.2                Panelboards**

- .1            Panelboards: to CSA C-22.2 No. 29.
- .2            Panelboards: product of one manufacturer.
- .3            250V branch circuit panelboards: bus and breakers rated for 10kA (symmetrical) interrupting capacity minimum or as indicated.
- .4            Sequence phase bussing such that circuit breakers will be numbered in consecutive order, with each breaker identified by permanent number identification as to circuit number and phase.

- .5 Panelboards: mains, number of circuits, and number and size of branch circuit breakers as indicated.
- .6 Two keys for each panelboard and key panelboards alike.
- .7 Copper bus with neutral of same ampere rating as mains.
- .8 Main: suitable for bolt-on 1" wide breakers.
- .9 Isolated ground bus on panels.
- .10 Trim and door finish: baked grey enamel.
- .11 Panelboards shall have sprinkler hoods.
- .12 Panels shall have piano hinge front door covers. Panel NMD600-1-1 shall also have hinged front trim cover.

### **2.3 Breaker**

- .1 Breakers: to Section 16412 – Moulded Case Circuit Breakers.
- .2 Breakers with thermal and magnetic tripping in panelboards except as indicated otherwise.
- .3 Branch circuit breakers to be 15A single pole unless otherwise indicated on drawings.

### **2.4 Equipment Identification**

- .1 Provide equipment identification in accordance with section 16010 – Electrical General Requirements.
- .2 Nameplate for each panelboard size 5 engraved as indicated.
- .3 Complete circuit directory with typewritten legend showing location and load of each circuit.

## **Part 3 Execution**

### **3.1 Installation**

- .1 Locate panelboards as indicated and mount securely, plumb, true and square, to adjoining surfaces.
- .2 Mount panelboards to height specified in Section 16010 – Electrical General Requirements or as indicated.

- .3 Connect loads to circuits.
- .4 Connect branch circuit neutral conductors to common neutral bus.
- .5 Trims of recessed panelboards shall be flush with wall. Coordinate installation with wall installer to ensure that walls with recessed equipment will be deep enough to accept same.
- .6 Locate all panelboards as shown on the drawings.
- .7 Wiring in panelboards shall be neat and organized. All neutral conductors shall be identified in the panel with their associated circuit numbers by means of Brady Markers.
- .8 All panelboards throughout the building shall be phased together such that the left-hand, centre and right-hand panelboard busses represent phases A, B and C respectively. All indicating meters shall be identified to this sequence.
- .9 All existing panelboards modified by this contract shall be supplied with new updated, typewritten panel schedules.

**END OF SECTION**