

Part 1 General

1.1 GENERAL

- .1 This section covers items common to Divisions 26. This section supplements requirements of Division 1.
- .2 The contractor must obtain and pay for all relevant permits.

1.2 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CSA C22.1-21, Canadian Electrical Code, Part 1 (25th Edition), Safety Standard for Electrical Installations.
 - .2 Ontario Electrical Safety Code, 28th Edition, 2021
- .2 Electrical and Electronic Manufacturer's Association of Canada (EEMAC)
 - .1 EEMAC 2Y-1-1958, Light Gray Colour for Indoor Switch Gear.
- .3 Institute of Electrical and Electronics (IEEE)/National Electrical Safety Code Product Line (NESC)
 - .1 IEEE SP1122-2000, The Authoritative Dictionary of IEEE Standards Terms, 7th Edition.

1.3 DEFINITIONS

- .1 Electrical and electronic terms: unless otherwise specified or indicated, terms used in these specifications, and on drawings, are those defined by IEEE SP1122.

1.4 DESIGN REQUIREMENTS

- .1 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 and labels for control items in English.

1.5 SUBMITTALS

- .1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Shop drawings:
 - .1 Submit drawings to be stamped and signed by professional engineer registered or licensed in Ontario, Canada.
 - .2 Submit wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, ductwork, and other items that must be shown to ensure coordinated installation.
 - .3 Identify on wiring diagrams circuit terminals and indicate internal wiring for each item of equipment and interconnection between each item of equipment.
 - .4 Indicate of drawings clearances for operation, maintenance, and replacement of

operating equipment devices.
.5 If changes are required, notify Consultant of these changes before they are made.

- .3 Quality Control: in accordance with Section 01 45 00 - Quality Control.
- .1 Provide CSA certified equipment and material.
 - .2 Where CSA certified equipment and material is not available, submit such equipment and material to inspection authorities for special inspection before delivery to site.
 - .3 Submit test results of installed electrical systems and instrumentation.
 - .4 Permits and fees: in accordance with General Conditions of contract.
 - .5 Submit, upon completion of Work, load balance report as described in PART 3 - LOAD BALANCE.
 - .6 Submit certificate of acceptance from authority having jurisdiction upon completion of Work to Consultant.
- .4 Manufacturer's Field Reports: submit to Consultant manufacturer's written report, within 3 days of review, verifying compliance of Work and electrical system and instrumentation testing, as described in PART 3 - FIELD QUALITY CONTROL. Provide the commissioning documentation and final report.

1.6 QUALITY ASSURANCE

- .1 Quality Assurance: in accordance with Section 01 45 00 - Quality Control.
- .2 Qualifications: Electrical work to be carried out by qualified, licensed electricians or apprentices in accordance with authorities having jurisdiction.
- .1 Employees registered in provincial apprentices' program: permitted, under direct supervision of qualified licensed electrician, to perform specific tasks.

1.7 DELIVERY, STORAGE AND HANDLING

- .1 Material Delivery Schedule: provide Contractor with schedule within 2 weeks after award of Contract.
- .2 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling.
- .3 Develop Construction Waste Management Plan and Waste Reduction Workplan related to work of this section.
- .4 Packaging Waste Management: remove for reuse and return of pallets, crates, padding, and packaging materials as specified in Construction Waste Management Plan and Waste Reduction Workplan.

1.8 SYSTEM STARTUP

- .1 Instruct Consultant 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 Consultant to supervise start-up of installation, check, adjust, balance and calibrate components and instruct operating personnel. Coordinate functional testing and testing sequences. Provide commissioning documentation and final report.
- .3 Provide these services for such period, and for as many visits as necessary to put

equipment in operation and ensure that operating personnel are conversant with aspects of its care and operation.

1.9 OPERATING INSTRUCTIONS

- .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.

1.10 VOLTAGE RATINGS

- .1 Operating voltages: to CAN3-C235-83 (R2006).
- .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.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

- .1 Provide material and equipment in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Material and equipment to be CSA certified. Where CSA certified is not available, obtain special approval from ESA before delivery to site and submit such approval as described in PART 1 - SUBMITTALS.
- .3 Factory assemble control panels and component assemblies.

2.2 ELECTRIC MOTORS, EQUIPMENT AND CONTROLS

- .1 Verify installation and co-ordination responsibilities related to motors, equipment and controls, as indicated.
- .2 Control wiring and conduit: in accordance with Section 26 29 03 - Control Devices except

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

2.3 WARNING SIGNS

- .1 Warning Signs: in accordance with requirements of authority having jurisdiction.

2.4 WIRING TERMINATIONS

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

2.5 EQUIPMENT IDENTIFICATION

- .1 Identify electrical equipment with nameplates and labels as follows:
 - .1 Nameplates: plastic laminate lamicooid 3 mm thick plastic engraving sheet, black face, white core, mechanically attached with self tapping screws.
 - .2 Sizes as follows:

NAMEPLATE SIZES

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

- .2 Labels: embossed plastic labels with 6 mm high letters unless specified otherwise.
- .3 Wording on nameplates to be approved by Owner prior to manufacture.
- .4 Allow for minimum of twenty-five (25) letters per nameplate.
- .5 Nameplates for terminal cabinets and junction boxes to indicate system and/or voltage characteristics.
- .6 Disconnects, starters and contactors: indicate equipment being controlled and voltage.
- .7 Terminal cabinets and pull boxes: indicate system and voltage.
- .8 Identification to be English.
- .9 Panelboards branch circuit type: indicate panel number as designed on detail sheets. Voltage and source panel, i.e., Panel "B" 120/208V-3Ø-4W fed from Panel DP-A.
- .10 Transformers: indicate capacity, primary and secondary voltages and transformer designation number indicating transformer number.

- .11 Distribution panels to have lamicaid labels indicating the equipment which the circuit breaker is feeding and location of the equipment.

2.7 WIRING IDENTIFICATION

- .1 Identify wiring with permanent indelible identifying markings, 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 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 15m intervals.
- .3 Colours: 25mm wide prime colour. Pre-paint all system boxes and covers, power boxes and covers and conduit couplings to match the following:

<u>Prime</u>	
up to 250 V	Black
251V to 600V	Brown
Fire Alarm	Red
Data	Blue
Telephone/PA System	White
Intrusion Detection	Yellow
Access Control	Purple
Surveillance	Green
<u>Mechanical Controls</u>	<u>Orange</u>

2.9 INSPECTION CERTIFICATES

- .1 Contractor to pay for and arrange permits and fees.
- .2 Notify Consultant of changes required by Electrical Safety Authority prior to making changes.
- .3 Furnish certificates of acceptance from authorities having jurisdiction on completion of work to Consultant.
- .4 Electrical and fire alarm certificates are required for occupancy permits. Provide letter or certificate for each phase to Consultant.

2.10 FINISHES

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

- .2 Paint indoor switchgear and distribution enclosures light gray to EEMAC 2Y-1.
- .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.

2.11 ACCESS DOORS

- .1 Supply access doors to concealed electrical equipment and/or devices for operating, inspecting, adjusting and servicing.
- .2 Flush mounted 600x600mm 24" x 24" for body entry and 300x300mm 12" x 12" for hand entry unless otherwise noted. Doors to open 180°, have rounded safety corners, concealed hinges, screwdriver latches and anchor straps.
- .3 Access doors, hinges, screws, etc. to be tamper proof in areas where tamper proof equipment is called for and/or as specified in drawings.
- .4 Material:
 - .1 Special areas such as tiled or marble surfaces: use stainless steel with brushed satin or polished finish as directed by Consultant.
 - .2 Remaining areas: use prime coated steel.
- .5 Installation:
 - .1 Locate so that concealed items are accessible.
 - .2 Locate so that hand or body entry is achieved.
 - .3 Installation by Division 09.
- .6 Standard of Acceptance: Mifab CAD-DW or approved alternate.
- .7 Fire rated access panels: 16 ga. mounting frame, 20 gauge sandwich type insulated self-closing door with concealed hinge, 50mm 2" thickness of fire rated insulation in door, self latching ring pull latch, primer coated, 1½ hour rating.
 - .1 Standard of Acceptance: Mifab MPFR.
 - .2 Alternate: Acudor FW-5050.
- .8 Access doors must maintain fire rating if installed in a fire rated assembly. Refer to Architectural Drawings for locations of fire rated walls and ceilings.

2.12 DEMOLITION

- .1 The full extent of the demolition is not shown on the drawings. All equipment located on the existing walls and ceilings affected in the demolition are to be disconnected and removed. All services which have become redundant under the contract shall be removed. All items that are removed during the demolition that are not to be re-used are to be removed from site. The contractor is to make a site visit to familiarize themselves with the site conditions and the extent of the scope of work.
- .2 The contractor is to relocate any electrical items that do not appear on the drawings that are to remain in service, but which interfere with the new construction.
- .3 The contractor is to reconnect any services which are to remain that have been temporarily disconnected during the demolition or construction.

- .4 Any equipment that is to be re-used must be cleaned of paint, plastic or other marks or debris to the satisfaction of the Engineer.
- .5 It is the contractor's responsibility to reconnect any existing loads which do not appear on panel details which are to be re-used. These loads are to be identified and recorded for as-built records.
- .6 The contractor for this Division is responsible for the removal, storage, cleaning and reinstallation of any existing materials to be re-used.
- .7 Any redundant existing material or any equipment so designated by the Owner or specified on the drawings is to be turned over to the Owner.
- .8 It is the responsibility of the Division 26 contractor to identify and protect any materials or equipment prior to the commencement of demolition that is to be retained in place or reconnected.
- .9 During the demolition process, maintain adequate structural support for equipment and material.
- .10 This contractor shall maintain existing electrical services and systems at all times to areas beyond the construction area.
- .11 Any existing services disrupted during the demolition that are not intended to be removed as part of the contract are to be reinstated immediately.
- .12 Continuity of service of the fire alarm system is to be maintained to all occupied areas of the building throughout the demolition process.
- .13 The electrical contractor will carry twenty (20) licensed electricians manhours in his tender for the removal or relocation of equipment, devices or conduits which are not specifically identified on the tender documents. The licensed electrician shall have a minimum of 10 years' experience. The contractor shall review all such removals/relocations with the Engineer prior to undertaking the work. For the purpose of bidding hours indicated above, cost of hours shall be inclusive of required supervision percentage time for the project/work.

2.13 SINGLE LINE DIAGRAM

- .1 Provide copy of the single line in 18 x 24 format in frame protected by glass and posted in the main electrical room.

Part 3 Execution

3.1 INSTALLATION

- .1 Do complete installation in accordance with CSA C22.1 except where specified otherwise.
- .2 Do overhead and underground systems in accordance with CSA C22.3 No.1 except where specified otherwise.

3.2 NAMEPLATES AND LABELS

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

3.3 CONDUIT AND CABLE INSTALLATION

- .1 Install conduit and sleeves prior to pouring of concrete.
 - .1 Sleeves through concrete: schedule 40 steel pipe sized for free passage of conduit, and protruding 50mm.
- .2 If plastic sleeves are used in fire rated walls or floors, remove before conduit installation.
- .3 Install cables, conduits and fittings embedded or plastered over, close to building structure so furring can be kept to minimum.
- .4 Core drill penetrations for conduit through concrete block walls.

3.4 LOCATION OF OUTLETS

- .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.
- .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.

3.5 MOUNTING HEIGHTS

- .1 Mounting height of equipment is from finished floor to centerline 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: 1100mm.
 - .2 Wall receptacles:
 - .1 General: 610mm.
 - .2 Above top of continuous baseboard heater: 200mm.
 - .3 Above top of counters or counter splash backs: 175 mm.
 - .4 In mechanical rooms: 1100mm.
 - .3 Panelboards: as required by Code or as indicated.
 - .4 Data, Telephone and interphone outlets: 610mm.
 - .5 Wall mounted telephone and interphone outlets: 1100mm.
 - .6 Fire alarm stations: 1100mm.
 - .7 Fire alarm horn/strobes: 2000mm.
 - .8 Wall mounted speakers: As indicated on drawings.
 - .9 Clocks: unless noted otherwise on drawing.
 - .10 Doorbell pushbuttons: 1100mm.
 - .11 Emergency lights: Not less than 2m above finished floor where practical.

3.6 CO-ORDINATION OF PROTECTIVE DEVICES

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

3.7 FIELD QUALITY CONTROL

- .1 Load Balance:
 - .1 Measure phase current to panelboards with normal loads (lighting) operating at time of acceptance; adjust branch circuit connections as required to obtain best balance of current between phases and record changes.
 - .2 Measure phase voltages at loads and adjust transformer taps to within 2% of rated voltage of equipment.
 - .3 Provide upon completion of work, load balance report as directed in PART 1 – SUBMITTALS: phase and neutral currents on panelboards, dry-core transformers and motor control centers, operating under normal load, as well as hour and date on which each load was measured, and voltage at time of test.
- .2 Conduct following tests in accordance with Section 01 45 00 – Quality Control
 - .1 Power distribution system including phasing, voltage, grounding and load balancing.
 - .2 Circuits originating from branch distribution panels.
 - .3 Lighting and its control.
 - .4 Motors, heaters and associated control equipment including sequenced operation of systems where applicable.
 - .5 Systems: fire alarm system communications.
 - .6 Insulation resistance testing:
 - .1 Megger circuits, feeders and equipment up to 350 V with a 500 V instrument.
 - .2 Megger 350-600 V circuits, feeders and equipment with a 1000 V instrument.
 - .3 Check resistance to ground before energizing.
- .3 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.
- .4 Submit test results for Consultants review.
- .5 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.

3.8 CLEANING

- .1 Clean and touch up surfaces of shop-painted equipment scratched or marred during shipment or installation, to match original paint.
- .2 Clean and prime exposed non-galvanized hangers, racks and fastenings to prevent rusting.

END OF SECTION

PART 1 – GENERAL

1.1 General

- .1 The requirements of Division 01 – Quality Control apply to work performed under this Section, with the exception that the cost for this work is to be paid for by this section and not the testing allowance.

1.2 Reference Standards

- .1 Reference Standard CSA Z462-18 Workplace Electrical Safety.

PART 2 – TESTS

2.1 Co-ordination Study and Arc Flash Study

- .1 Immediately on award of Contract, prepare a co-ordination and arc fault study and submit for approval. Co-ordination and arc flash study to be completed prior to distribution shop drawing submittals. All distribution change costs associated with not following this sequence to be born by this trade.
- .2 The co-ordination study data shall be presented in tables and on composite charts and shall include and not be limited to the following:
 - .1 Maximum available short circuit current 12.47KV, 600V, and 120/208V systems based on 500MVA available at the utility. This shall be calculated for every bus down to the lighting panel level.
 - .2 Maximum available ground fault current of 12470/7200, 600V, and 120/208V systems.
 - .3 Power supply authority system protective devices with which Owners equipment must co-ordinate.
 - .4 Power Supply Authority feeder cables thermal short circuit damage curve.
 - .5 Power transformer thermal short circuit damage curve, 3 phase, phase to ground.
 - .6 Main and feeder circuit breakers.
 - .7 Distribution transformer and generator thermal short circuit damage curves.
 - .8 Largest distribution breaker characteristics in each panel.
 - .9 Largest branch breaker in each panel.
 - .10 Establish the required setting for all ground fault protective devices.
 - .11 General damage and decrement curves.
 - .12 Cable damage curves.
 - .13 Co-ordination charts shall be drawn in ink on log paper. Each chart shall include single line diagram of the appropriate devices with description and numbering matching that shown on the contract documents. Transformers shall be shown complete with KVA rating, primary and secondary voltages, winding connections, grounding method and impedance.
A copy of the single-line in Autocad 2010 .DWG format on magnetic media will be made available if requested. (This is offered for those firms utilizing software which has a graphical interface to CAD drawings.)
 - .14 The co-ordination study shall include a list of recommendations to improve co-ordination or protection where possible.
 - .15 Selective co-ordination is required to the last branch breaker on the essential system.

2.3 Pre-Service Testing

- .1 The following tests shall be made prior to putting the electrical equipment into service to ensure that the distribution equipment has been installed in a satisfactory manner and suitable for placing into service, without endangering personnel or the system.
- .2 Include in Tender amount, all costs and fees incurred for this testing. No additional costs will be accepted by the Owner.
- .3 Equipment which fails to meet the specified requirements and performance test shall be corrected and retested until operation is satisfactory without additional cost to the Owner.
- .4 The Consultant shall be advised in advance of all tests and shall be given the opportunity to witness any or all tests.
- .5 Provide infrared thermographic inspection of the major pieces of electrical equipment including switchboards, unit substations, splitter boxes, distribution transformers and all motor control centers, panels after entire system is operation. Provide test report with pictures of all equipments.
- .6 Typed report of test results shall be prepared and submitted for review in accordance with requirements of Division 01.
- .7 Check all fuse sizes, and all solid state gripping devices to the values as established by the co-ordination study.

2.4 Testing Acceptable Firms

- .1 The following testing firms are acceptable:
 - .1 Rondar (905) 561-2808.
 - .2 Haronitis & Assoc. (905) 474-0800.
 - .3 Brosz & Assoc. (905) 472-6660.
 - .4 Schneider (613) 247-7171
 - .5 Siemens (613) 737-6072

PART 3 – EXECUTION

- .1 Perform tests as specified and submit to consultant a typed written report and typed table of test results including a column to indicated a pass or fail result. Person in charge of testing on site shall be experienced in this type of testing. It is expected that this person would not be the same person performing other tests.
- .2 Perform conductor insulation integrity tests on all wiring installed in the course of the work of this division.
- .3 Perform co-ordination and arc flash study and Pre-service testing as specified.
- .4 Ensure that test reports are submitted as soon as tests are completed. These reports should be included in the O & M manual only once it is reviewed and approved.

- .5 Copies of test reports shall be used to prepare typed test reports and be submitted within 10 working days completion of testing for review.
- .6 Test reports are to be included in O & M in manuals after review.

Part 1 General

1.1 REFERENCES

- .1 CSA C22.2No.65-03 Wire Connectors.
- .2 CSA International
 - .1 CAN/CSA-C22.2 No.18-[98(R2003)], Outlet Boxes, Conduit Boxes and Fittings.
 - .2 CAN/CSA-C22.2 No.65-[03(R2008)], Wire Connectors (Tri-National Standard with UL 486A-486B and NMX-J-543-ANCE-03).
- .3 Electrical and Electronic Manufacturers' Association of Canada (EEMAC)
 - .1 EEMAC 1Y-2-[1961], Bushing Stud Connectors and Aluminum Adapters (1200 Ampere Maximum Rating).
- .4 National Electrical Manufacturers Association (NEMA).

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittals 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.

1.3 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 77 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for wire and box connectors for incorporation into manual.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground, indoors or in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect wire and box connectors from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
- .4 Develop Construction Waste Management Plan and Waste Reduction Workplan related to Work of this Section.
- .5 Packaging Waste Management: remove for reuse and return of pallets, crates, padding, and packaging materials as specified in Construction Waste Management Plan and Waste Reduction Workplan.

Part 2 Products

2.1 MATERIALS

- .1 All Fixture and Branch Circuit wiring joints, in junction and outlet boxes shall be made with CSA Certified Pressure Type connectors rated at 600 volts minimum (1,000 volts when enclosed in fixture or sign). Connector body shall consist of a cone-shaped coil spring insert, insulated with a colour-coded, flame-retardant shell which shall be knurled for easy grip and capable of use with an Electrician's Pliers.

Part 3 Execution

3.1 INSTALLATION

- .1 Remove insulation carefully from ends of conductors and:
 - .1 Install wire-nut connectors. Installation shall meet secureness tests in accordance with CSA C22.2 No.65.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

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

1.2 REFERENCES

- .1 CSA C22.2 No .0.3-01 (R2005), Test Methods for Electrical Wires and Cables.

1.3 PRODUCT DATA

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

1.4 GENERAL

- .1 Size wires for 3% maximum voltage drop to farthest outlet based a 15A-120V loaded circuit. Maximum suggested home runs to branch panels at 120V for #12 AWG is 13.2m in length, #10 AWG is 22.9m in length, and #8 AWG is 33.5m in length.
- .2 Colour coding shall be as follows for 120/208V:
 - .1 Phase conductors: red, black, blue.
 - .2 Neutral conductors: white.
 - .3 Bonding to ground: green.
- .3 In 120/208V branch circuits supplying power receptacles, the common neutral conductor of each 3 circuits or 2 circuit group shall be 1 size larger than the ungrounded conductors until the first 2 of 3 or 1 of 2 circuits have been dropped off. The grounding conductor within each group shall be of the same ampacity and size as the ungrounded conductors throughout.
- .4 Every 3 circuit group or 2 circuit group of 120/208V, branch circuits must carry a dedicated grounding conductor throughout.

Part 2 Products

2.1 BUILDING WIRES

- .1 Conductors: stranded for 10 AWG and larger. Minimum size: 12 AWG.
- .2 Copper conductors: size as indicated, with 600 V insulation of chemically cross-linked thermosetting polyethylene material rated RW90.

2.2 ARMoured CABLES

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

2.3 CONTROL CABLES

- .1 Type LVT: 2 soft annealed copper conductors, sized as indicated, with thermoplastic insulation, outer covering of thermoplastic jacket, and armour of closely wound aluminum wire. Jacket colour to be orange.
- .2 Low energy 300 V control cable: stranded annealed copper conductors sized as indicated, with PVC insulation type TW -40°C with shielding of braid over each group, over all conductors and overall covering of PVC jackets. Jacket colour to be orange.
- .3 600 V type: 14 AWG stranded annealed copper conductors, sizes as indicated with cross-linked polyethylene type RW90 (x-link) and overall covering of thermoplastic jacket with sheath of aluminum interlocked armour and jacket over sheath of PVC. Armor not required when in cable tray. Jacket colour to be orange.

2.4 FIRE ALARM CABLES

- .1 Type FAS105-300V Soft Annealed copper conductors 3C#18 or 2C#18 FAS with separate bond wire is acceptable. Flame retardant PVC insulation, outer covering of flame PVC (Red) for initiating circuits. Run in EMT conduit (refer to 26 05 00, 2.8).
- .2 Type FAS105-300V Soft Annealed copper conductors 3C#14 or 2C#14 FAS with separate bond wire is acceptable. Flame retardant insulation, outer covering of flame retardant PVC (red) for signaling circuits. Run in EMT conduit (refer to 26 05 00, 2.8).

Part 3 Execution

3.1 INSTALLATION OF BUILDING WIRES

- .1 Install wiring as follows:
 - .1 In conduit systems in accordance with Section 26 05 34.

3.2 INSTALLATION OF ARMOURED CABLES

- .1 Group cables wherever possible.
- .2 Terminate cables in accordance with Section 26 05 20 - Wire and Box Connectors - 0 - 1000 V.

3.3 INSTALLATION OF CONTROL CABLES

- .1 Install control cables in conduit, and cable troughs.
- .2 Ground control cable shield.
- .3 Provide control cable with 300V insulation to units without 575, or 600V power.

END OF SECTION

Part 1 General N/A

Part 2 Products

2.1 SUPPORT CHANNELS

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

Part 3 Execution

3.1 INSTALLATION

- .1 Secure equipment to poured concrete with Hilti HIT adhesive system used elsewhere. Hilti HIT system unnecessary for conduit.
- .2 Secure electrical equipment (transformers, disconnect switches, panels, starters, etc.) to concrete masonry walls with minimum 13mm dia. Hilti HY-70 (hollow block location) with 51mm embedment or Hilti HY-200 (grouted block location) with 114mm embedment up to a maximum loading of 150# per anchor. For lightweight electrical components supported off concrete masonry walls use 3/16 Tapcons with 50mm embedment up to a maximum loading of 25# per anchor. For all other equipment supports, for equipment anchors in excess of the above limits, or for alternate fastening systems, approval must be obtained from structural engineer and owner's representative.
- .3 Support equipment, conduit or cables using clips, spring loaded bolts, cable clamps designed as accessories to basic channel members.
- .4 Fasten exposed conduit or cables to building construction or support system using straps.
 - .1 One-hole steel straps to secure surface conduits and cables 50mm and smaller.
 - .2 Two-hole steel straps for conduits and cables larger than 50mm.
 - .3 Beam clamps to secure conduit to exposed steel work.
 - .4 Do not secure directly to roof deck.
- .5 Suspended support systems.
 - .1 Support individual cable or conduit runs with 6mm dia threaded rods and spring clips.
 - .2 Support 2 or more cables or conduits on channels supported by 6mm dia threaded rod hangers where direct fastening to building construction is impractical.
- .6 For surface mounting of two or more conduits use channels at 1.5m oc spacing.
- .7 Provide metal brackets, frames, hangers, clamps and related types of support structures where indicated or as required to support conduit and cable runs.
- .8 Ensure adequate support for raceways and cables dropped vertically to equipment where there is no wall support.
- .9 Do not use wire lashing or perforated strap to support or secure raceways or cables.
- .10 Do not use supports or equipment installed for other trades for conduit or cable support except with permission of other trade and approval of Engineer.

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- .11 Install fastenings and supports as required for each type of equipment cables and conduits, and in accordance with manufacturer's installation recommendations.
- .12 Do not suspend from metal deck.
- .13 Any wall penetrations of conduit to be done neatly through core holes.

END OF SECTION

Part 1 General

1.1 SHOP DRAWINGS AND PRODUCT DATA

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

Part 2 Products

2.1 SPLITTERS

- .1 Sheet metal enclosure, welded corners and formed hinged cover suitable for locking in closed position.
- .2 Main and branch lugs to match required size and number of incoming and outgoing conductors as indicated.
- .3 At least three spare terminals on each set of lugs in splitters less than 400 A.

2.2 JUNCTION AND PULL BOXES

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

2.3 CABINETS

- .1 Type E: sheet steel, hinged door and return flange overlapping sides, handle, lock and catch, for surface mounting.
- .2 Type T: sheet steel cabinet, with hinged door, latch, lock, 2 keys, containing 19 mm sheet steel backboard for surface mounting.
- .3 Type T cabinets for bell telephone, LAN, public address and intercom systems shall be minimum 1000H x 600W x 150D.

Part 3 Execution

3.1 Splitter Installation

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

3.2 JUNCTION, PULL BOXES AND CABINETS INSTALLATION

- .1 Install pull boxes in inconspicuous but accessible locations.
- .2 Mount cabinets with top not higher than 2 m above finished floor.
- .3 Install terminal block as indicated in Type T cabinets.
- .4 Only main terminal & junction boxes are indicated. Install pull boxes so as not to exceed 30 m of conduit run between pull boxes.

3.3 IDENTIFICATION

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

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 CSA C22.1-21, 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 100mm 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. Identify future use of outlet on back of cover.
- .5 Combination boxes with barriers where outlets for more than one system are grouped.

2.2 SHEET STEEL OUTLET BOXES

- .1 Electro-galvanized steel single and multi-gang flush device boxes for flush installation, minimum size 76 x 50 x 38mm or as indicated. 100mm square outlet boxes when more than one conduit enters one side with extension and plaster rings as required.
- .2 Electro-galvanized steel utility boxes for outlets connected to surface mounted EMT conduit, minimum size 100 x 54 x 48mm.
- .3 100mm square or octagonal outlet boxes for lighting fixture outlets.
- .4 100mm square outlet boxes with extension and plaster rings for flush mounting devices in finished plaster walls.

2.3 MASONRY BOXES

- .1 Electro-galvanized steel masonry single and multi-gang boxes for devices flush mounted in exposed block walls.

2.4 CONCRETE BOXES

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

2.5 CONDUIT BOXES

- .1 Cast FS or FD aluminum/feraloy boxes with factory-threaded hubs and mounting feet for surface wiring of switches and receptacle in mechanical and electrical rooms and unfinished areas.

2.6 FITTINGS - GENERAL

- .1 Bushing and connectors with nylon insulated throats.
 - .2 Knock-out fillers to prevent entry of debris.
-

- .3 Conduit outlet bodies for conduit up to 32 mm and pull boxes for larger conduits.
- .4 Double locknuts and insulated bushings on sheet metal boxes.

Part 3 Execution

3.1 INSTALLATION

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

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 26 05 00 - Common Work Results - For Electrical.

1.2 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CAN/CSA C22.2 No. 18-98(R2003), Outlet Boxes, Conduit Boxes, Fittings and Associated Hardware, A National Standard of Canada.
 - .2 CSA C22.2 No. 56-04, Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit.
 - .3 CSA C22.2 No. 83-M1985(R2003), Electrical Metallic Tubing.
 - .4 CSA C22.2 No. 211.2-M1984(R2003), Rigid PVC (Unplasticized) Conduit.

Part 2 Products

2.1 LOCATION OF CONDUIT

- .1 Drawings do not indicate all conduit runs. Those indicated are in diagrammatic form only. Provide all conduits from end point to source point as necessary to form complete system. Use armored cable where indicated. Coordinate exact routing with General Contractor.
- .2 All conduit runs within the building are to be above grade. Do not run conduits under the slab unless explicitly indicated on drawings.

2.2 CONDUITS

- .1 Electrical metallic tubing (EMT): to CSA C22.2 No. 83, with couplings.
- .2 Flexible metal conduit: to CSA C22.2 No. 56, aluminum liquid-tight flexible metal.

2.3 CONDUIT FASTENINGS

- .1 One-hole steel straps to secure surface conduits 50mm and smaller.
- .2 Two-hole steel straps for conduits larger than 50mm.
- .3 Beam clamps to secure conduits to exposed steel work.
- .4 Channel type supports for two or more conduits at 1.5m on center.
- .5 Threaded rods, 6mm diameter, to support suspended channels.
- .6 Do not fasten conduit to roof deck (Siporex or metal pan).

2.4 CONDUIT FITTINGS

- .1 Fittings: to CAN/CSA C22.2 No. 18, manufactured for use with conduit specified. Coating: same as conduit.
- .2 Ensure factory "ells" where 90 degrees bends for 25mm and larger conduits.

- .3 Set-screws connectors and couplings for EMT.

2.5 EXPANSION FITTINGS FOR RIGID CONDUIT

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

2.6 FISH CORD

- .1 Polypropylene.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

- .1 Install 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 in unfinished areas.
- .3 Use electrical metallic tubing (EMT), except in cast concrete, to each corridor, classroom and office for main branch circuit conductor runs. Use from main branch circuit runs for drops to wiring devices in concrete block walls.
- .4 Use flexible metal conduit for connection to motors in dry areas, connection to recessed incandescent fixtures without prewired outlet box, connection to surface or recessed fluorescent fixtures & work in movable metal partitions.
- .5 Use liquid tight flexible metal conduit for connection to motors or vibrating equipment in damp, wet or corrosive locations.
- .6 Minimum conduit size for lighting and power circuits: 21mm.
- .7 Bend conduit cold:
 - .1 Replace conduit if kinked or flattened more than 1/10th of its original diameter.
- .8 Mechanically bend steel conduit over 21mm diameter.
- .8 Field threads on rigid conduit must be of sufficient length to draw conduits up tight.
- .10 Install fish cord in empty conduits.
- .11 Run 2 - 25mm spare conduits up to accessible t-bar ceiling space from each flush panel.

- .1 Terminate these conduits in 150 x 150 x 100mm junction boxes in ceiling space or in case of an exposed concrete slab, terminate each conduit in surface type box.
- .12 Remove and replace blocked conduit sections.
 - .1 Do not use liquids to clean out conduits.
- .13 Dry conduits out before installing wire.
- .14 Conduit wall penetrations to be performed neatly by core holes.
- .15 Do not install conduit in building wall, floor or ceiling control joints.

3.3 SURFACE CONDUITS

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

3.4 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.

3.5 CLEANING

- .1 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

Part 1 General

1.1 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit descriptive data and shop drawings in accordance with Division 01 requirements and Section 26 05 00.
- .2 Descriptive Data
 - .1 Catalog cuts or data sheets on vibration isolators and specific restraints detailing compliance with the specification.
 - .2 Detailed schedules of flexibly and rigidly mounted equipment, showing vibration isolators and seismic restraints by referencing numbered descriptive drawings.
- .3 Shop Drawings
 - .1 Submit fabrication details for equipment bases, including dimensions, structural member sizes, and support point locations.
 - .2 Provide all details of suspension and support for equipment hung from the ceiling.
 - .3 Where walls, floors, slabs, or supplementary steel work are used for seismic restraint locations, details of acceptable attachment methods for cable tray, conduit, and equipment must be included and approved before the condition is accepted for installation. Restraint manufacturers' submittals must include spacing, static loads, and seismic loads at all attachment and support points.
 - .4 Provide specific details of seismic restraints and anchors; include number, size, and locations for each piece of equipment.

1.2 DESIGN REQUIREMENTS

- .1 The contractor shall retain a specialty consultant or equipment manufacturer to develop a seismic restraint system and perform seismic calculations in accordance with the Ontario Building Code and local codes and additional requirements specific in this section. Calculations, restraint selections, and installation details shall be done by a professional engineer experienced in seismic restraint design and installation and licensed in the Province of Ontario.
- .2 The seismic restraint design, consisting of calculations, restraint selection, installation details, and other documentation, shall be submitted. This submittal shall be signed and sealed by a professional engineer, as stated above.
- .3 The seismic restraint design shall clearly indicate the attachment points to the building structure and all design forces (in X, Y, and Z direction) at the attachment points. The seismic restraint engineer shall coordinate all attachments with the building's structural engineer of record, who shall verify the attachment methods and the ability of the building structure to accept the loads imposed. The seismic restraint design shall be based on actual equipment data (dimensions, weight, center of gravity, etc.) obtained from submittals or the manufacturers. The equipment manufacturer shall verify that the attachment points on the equipment can accept the combination of seismic, weight, and other loads imposed.
- .4 Analysis should include calculated dead loads, static seismic loads, and capacity of materials utilized for the connection of the equipment or system to the structure. Analysis should detail anchoring methods, bolt diameter, embedment, and/or welded length. All seismic restraint devices should be designed to accept, without failure, the forces through the equipment or system's center of gravity.

- .5 All seismic restraints and combination isolator/restraints should have verification of their seismic capabilities. Manufacturers may verify their capabilities by testing that is witnessed by an independent professional engineer.
- .6 Engineering Design Criteria
 - .1 Design system in accordance with Ontario Building Code Part 4.
 - .2 Seismic design must be considered for equipment, conduit and cable tray.
 - .3 The building is of a [low][normal][high][post-disaster] importance category as defined in Table 4.1.2.1.B of the Ontario Building Code, Division B-Part 4.

Part 2 Products

2.1 SPRING MOUNTINGS

- .1 As in the ASHRAE Handbook, Chapter 46, type 3, should be built into a ductile casting or welded steel housing to provide all-directional seismic snubbing. The snubber should be adjustable vertically and allow a maximum of 1/4 in. (6mm) travel in all directions before contacting the resilient snubbing collars.

2.2 SEISMIC CABLE RESTRAINTS

- .1 Should consist of steel cables sized to resist seismic loads with a minimum safety factor of 2 and arranged to provide all-directional restraint. Cables should be pre-stretched to achieve a certified minimum modulus of elasticity. Cable end connections should be steel assemblies that swivel to the final installation angle and utilize two clamping bolts to provide proper cable engagement. Alternatively, 45 degree bent steel plates, with holes for attachment to the structure and for steel cable loops with thimbles and wire rope clamps, are acceptable. A minimum of two wire rope clamps is required at each end of the cable assembly.

2.3 SEISMIC SOLID BRACES

- .1 Should consist of steel angles, channels, or strut channels to resist seismic loads with a minimum safety factor of 2 and arranged to provide all-directional restraint. Seismic solid brace end connectors should be steel assemblies that swivel to final installation angle and utilize two through-bolts to provide proper attachment.

2.4 STEEL ANGLES OR STRUT CHANNELS

- .1 Sized to prevent buckling should be clamped to vertical support rods utilizing a minimum of two clamps at each restraint location when required. Clamp assemblies may be ductile casting or strut channels assemblies.

Part 3 Execution

3.1 GENERAL NOTES

- .1 All seismic restraint systems should be installed in strict accordance with the manufacturer's written instructions and all certified submittal data.
- .2 Installation of seismic restraints should not cause any change of position of equipment,

- conduit, or cable tray, resulting in stresses or misalignment.
- .3 No rigid connections between equipment and the building structure should be made that degrade the noise and vibration-isolation system specified.
 - .4 The contractor shall not install any equipment, cable tray or conduit that makes rigid connections with the building unless isolation is not specified. "Building" includes, but is not limited to, slabs, beams, columns, studs, and walls.
 - .5 Coordinate work with other trades to avoid rigid contact with the building.
 - .6 Any conflicts with other trades that will result in rigid contact with equipment, conduit or cable tray due to inadequate space or other unforeseen conditions should be brought to the engineer's attention prior to installation.
 - .7 Prior to installation, bring to the engineer's attention any discrepancies between the specifications and the field conditions or changes required due to specific equipment selection.
 - .8 Overstressing of the building structure should not occur because of overhead support of equipment. Contractor should submit loads to the structural engineer of record for approval. Generally, bracing may occur from:
 - .1 flanges of structural beams,
 - .2 upper truss cords in bar joist construction, and
 - .3 concrete anchors.
 - .9 Type 6 cable restraints should be installed slightly slack to avoid short-circuiting the isolated suspended equipment, cable tray or conduit. When cables are installed slack a safety factor of 5 shall be used.
 - .10 Type 6 cable assemblies should be installed taut on non-isolated systems. Type 7 seismic solid braces may be used in place of cables on rigidly attached systems only.
 - .11 Cables should not be installed over sharp corners.
 - .12 At all locations where type 6 or 7 restraints are located, the support rods should be braced when necessary to accept compressive loads with type 8 braces. Welding of compression braces to the vertical support rods is not acceptable.
 - .13 The vibration-isolation manufacturer shall furnish integral structural steel bases as required. Independent steel rails should not be permitted.
 - .14 Post-installed concrete anchors should be approved for seismic restraint systems and suitable for building construction.
 - .15 Seismic restraints should be mechanically attached to the system. It is not sufficient to loop restraints around the system.
 - .16 Conduit or cable tray crossing building seismic joints, passing from building to building, or supported from different portions of the building shall be installed to allow differential support displacements without damaging the conduit, cable tray, equipment connections, or support connections.
 - .17 Do not brace a system to two different structures, such as a wall and a ceiling.
-

3.2 CERTIFICATION

- .1 At the completion of the installation the seismic specialist shall visit the site and review that the installation of restraint for systems is in accordance with their design. The specialist shall provide written certification that the systems have been correctly restrained. The certification shall be sealed by the engineer responsible for the seismic design. Provide copy of certification to local municipality when required. Include copy of certification in O & M manuals.

END OF SECTION

Part 1 General

1.1 PRODUCT DATA

- .1 Submit product data in accordance with Division 01 requirements.
- .2 Submit information indicating:
 - .1 Dimensions.
 - .2 Installation recommendations.
 - .3 Technical specification including impedance, X/R ratio. X and R as well as items indicated under "Design" below.

Part 2 Products

2.1 TRANSFORMERS

- .1 Use transformers of one manufacturer throughout project.
- .2 Design.
 - .1 Type: ANN.
 - .2 3-phase, kVA as indicated, 600V input, 120/208V output, 60 Hz.
 - .3 Voltage taps: standard.
 - .4 Insulation: Class H, 150°C temperature rise.
 - .5 Basic Impulse Level (BIL): standard
 - .6 Hipot: standard
 - .7 Average sound level: standard
 - .8 Impedance at 170°C: standard
 - .9 Enclosure: EEMAC 1, removable metal front panel.
 - .10 Mounting: Wall.
 - .11 Finish: in accordance with Section 26 05 00 - Common Work Results - Electrical.
 - .12 Phase connection: Delta-Wye.
 - .13 CSA-3R enclosure.
 - .14 Transformers to meet or exceed transformer energy efficiency regulations as defined by CAN/CSA-C802.2-06.
 - .15 Copper windings.

2.2 EQUIPMENT IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results - Electrical.
- .2 Label size: 7.

2.3 VIBRATION ISOLATION

- .1 Provide spring vibration isolators to technical requirements of Section 23 05 49 for all transformers larger than 15KVA. Note that transformers suspended from the ceiling require different isolators than those floor or wall mounted.

Part 3 Execution

3.1 INSTALLATION

- .1 Mount dry type transformers as indicated.
- .2 Mount dry type transformers above 75 kVA on floor unless indicated otherwise.

- .3 Ensure adequate clearance around transformer for ventilation.
- .4 Install transformers in level upright position.
- .5 Remove shipping supports only after transformer is installed and just before putting into service.
- .6 Loosen isolation pad bolts until no compression is visible.
- .7 Make primary and secondary connections in accordance with wiring diagram.
- .8 Energize transformers after installation is complete.

END OF SECTION

Part 1 General

1.1 REFERENCES SECTIONS

- .1 This Section is to be read in conjunction with Section 26 28 21 "Moulded Case Circuit Breakers".

1.2 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings and product data in accordance with Division 01 requirements.
- .2 Indicate on shop drawings.
 - .1 Floor anchoring method and foundation template.
 - .2 Dimensioned cable entry and exit locations.
 - .3 Dimensioned position and size of bus.
 - .4 Overall length, height and depth.
 - .5 Dimensioned layout of internal and front panel mounted components.

1.3 MAINTENANCE DATA

- .1 Provide maintenance data for service entrance board for incorporation into manual specified in Division 01.
- .2 Submit copies of maintenance data for complete assembly including components.

1.4 SOURCE QUALITY CONTROL

- .1 Submit 4 copies of certified test results.

1.5 ACCEPTABLE MANUFACTURERS

- .1 Eaton Cutler Hammer.
- .2 Schneider Electric (FPE, Square D).
- .3 Siemens.
- .4 GE.

Part 2 Products

2.1 SERVICE ENTRANCE BOARD

- .1 Rating: 600V, 3 phase, 4 wire, 400A, short circuit current 35kA (rms symmetrical).
- .2 Cubicles: free standing, dead front, size as indicated.
- .3 Barrier metering section from adjoining sections.
- .4 Provision for installation of power supply authority metering CTs and PTs after main breaker.
- .5 Owner's metering and meter enclosure by Contractor.
- .6 Distribution sections rated for 600V, 3 phase, 4 wire, 400A .
- .7 Hinged access panels with captive knurled thumb screws.

- .8 Bus bars and main connections: 99.3% copper.
- .9 Bus from load terminals of main disconnect switch via metering section to main lugs of distribution section.
- .10 Identify phases with colour coding.
- .11 Drip hood for protection from building sprinkler system.
- .12 Main breaker c/w single phasing, under voltage and under voltage trip protection.

2.2 MOLDED CASE CIRCUIT BREAKERS

- .1 Provide breakers to technical requirements of Section 26 28 21 - Moulded Case Circuit Breakers.
- .2 Main breakers to have solid state trip.

2.3 GROUNDING

- .1 Copper ground bus extending full width of cubicles and located at bottom.
- .2 Lugs at each end for size 3/0 grounding cable.

2.4 FINISHES

- .1 Apply finishes in accordance with Section 26 05 00 - Common Work Results - Electrical.
 - .1 Service entrance board exterior gray.
 - .2 Supply 2 spray cans touch-up enamel.

2.5 EQUIPMENT IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results - Electrical.
- .2 Nameplates:
 - .1 White plate, black letters, size 7.
 - .2 Complete board labelled: "600V."
 - .3 Main disconnect labelled: "Main Switch".
 - .4 Branch disconnects labelled: to indicate feeder designation.
 - .5 Metering, transfer and distribution compartments appropriately labelled.

2.6 OWNER & METERING

- .1 Provide Digital Owners metering c/w KVA, KW, Amps, Volts, KVAR, KVAHR, KWHR and KVARHR for all line to line to neutral and phase combinations as applicable.

Part 3 Execution

3.1 INSTALLATION

- .1 Locate service entrance board.
 - .2 Connect main secondary service to line terminals of main breaker.
 - .3 Connect load terminals of distribution breakers to feeders.
-

- .4 Check factory made connections for mechanical security and electrical continuity.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Materials and installation for standard and custom breaker type panelboards.

1.2 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 06 10 00.01 - Rough Carpentry - Short Form: Plywood Backboard.
- .4 Section 26 05 00 - Common Work Results - Electrical.
- .5 Section 26 28 21 - Moulded Case Circuit Breakers.

1.3 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CSA C22.2 No.29-11, Panelboards and enclosed Panelboards.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for grounding equipment and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.
 - .2 Include on drawings:
 - .1 Electrical detail of panel, branch breaker type, quantity, ampacity and enclosure dimension.

1.5 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Division 01 Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance and maintenance data for panelboards for incorporation into manual.

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground, indoors or in dry location and in accordance with

- manufacturer's recommendations in clean, dry, well-ventilated area.
- .2 Store and protect panelboards from nicks, scratches, and blemishes.
- .3 Replace defective or damaged materials with new.

- .4 Develop Construction Waste Management Plan Waste Reduction Workplan related to Work of this Section.
- .5 Packaging Waste Management: remove for reuse and return of pallets, crates, padding, and packaging materials as specified in Construction Waste Management Plan Waste Reduction Workplan.

1.7 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Drawings to include electrical detail of panel, branch breaker type, quantity, ampacity and enclosure dimension.

Part 2 Products

2.1 PANELBOARDS

- .1 Panelboards: to CSA C22.2 No.29 and acceptable manufacturer's include Square D, Eaton and Siemens.
 - .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. (Maximum fault current).
- .2 120/208V-3Ø, 120/240V-1Ø or 347/600V-3Ø panelboards: bus and breakers rated for interrupting capacity or as indicated. Designed as lighting panels, power panels, and power conditioned panels.
- .3 Sequence phase bussing with odd numbered breakers on left and even on right, with each breaker identified by permanent number identification as to circuit number and phase.
- .4 Panelboards: mains, number of circuits, and number and size of branch circuit breakers as indicated.
- .5 Two keys for each panelboard and key panelboards alike.
- .6 Copper bus with copper neutral of same ampere rating as mains.
- .7 Mains: suitable for bolt-on breakers.
- .8 Trim with concealed front bolts and hinges.
- .9 Trim and door finish: baked grey enamel.
- .10 Surface mount as indicated on drawings.
- .11 Drip hood on surface panels.

2.2 BREAKERS

- .1 Breakers: to Section 26 28 16.02 - Moulded Case Circuit Breakers.
- .2 Breakers with thermal and magnetic tripping in panelboards except as indicated otherwise. All breakers to be bolt-on type.
- .3 Main breaker: separately mounted on top or bottom of panel to suit cable entry. When mounted vertically, down position should open breaker.
- .4 Lock-on devices for receptacles, fire alarm clock outlet, emergency, door supervisory, intercom, stairway, exit & night light, public address, telephone and LAN circuits.

2.3 EQUIPMENT IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results - Electrical.
- .2 Nameplate for each panelboard size 4 engraved as indicated.
- .3 Nameplate for each circuit in distribution panelboards size 2 engraved as indicated.
- .4 Complete circuit directory with typewritten legend showing location and load of each circuit. (Lighting, power and power conditioned panels).

Part 3 Execution

3.1 INSTALLATION

- .1 Locate panelboards as indicated and mount securely, plumb, true and square, to adjoining surfaces.
- .2 Install surface mounted panelboards on u-channel. Where practical, group panelboards on common u-channel support system.
- .3 Mount panelboards to height specified in Section 26 05 00 - Common Work Results - Electrical or as indicated.
- .4 Connect loads to circuits.
- .5 Connect neutral conductors to common neutral bus with respective neutral identified.
- .6 Do not enter top of surface mounted panels (drip proof construction for sprinklered buildings).
- .7 Where bottom or side entry into surface panels is not possible, provide liquid tight connectors.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

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

1.2 RELATED SECTIONS

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

1.3 REFERENCES

- .1 CSA International
 - .1 CSA C22.2 No.42-10, General Use Receptacles, Attachment Plugs and Similar Devices.
 - .2 CAN/CSA C22.2 No.42.1-00(R2009), Cover Plates for Flush-Mounted Wiring Devices (Bi-national standard, with UL 514D).
 - .3 CSA C22.2 No.55-M1986 (R2008), Special Use Switches.
 - .4 CSA C22.2 No.111-10, General-Use Snap Switches (Bi-national standard, with UL 20).

1.4 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 wiring devices and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Ontario.

1.5 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Division 01 Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for wiring devices for incorporation into manual.

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground, indoors or in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect wiring devices from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

- .4 Develop Construction Waste Management Plan & Waste Reduction Workplan related to Work of this Section.
- .5 Packaging Waste Management: remove for reuse and return of pallets, crates, padding, and packaging materials as specified in Construction Waste Management Plan and Waste Reduction Workplan.

1.7 SHOP DRAWINGS AND PRODUCT DATA

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

Part 2 Products

2.1 SWITCHES

- .1 20A, 120 V, single pole, double pole, three-way, four-way to: CSA-C22.2 No.55 and CSA-C22.2 No.111.
- .2 Manually-operated general-purpose ac switches with following features:
 - .1 Terminal holes approved for No. 10 AWG wire.
 - .2 Silver alloy contacts.
 - .3 Urea or melamine moulding for parts subject to carbon tracking.
 - .4 Suitable for back and side wiring.
 - .5 White toggle.
- .3 Toggle operated locking fully rated for tungsten filament and fluorescent lamps, and up to 80% of rated capacity of motor loads.
- .4 Switches of one manufacturer throughout project. (except as noted).
Standard of Acceptance: Hubbell or Leviton Commercial grade.

2.2 RECEPTACLES

- .1 Duplex receptacles, CSA type 5-15 R, 125 V, 15 A, U ground, to: CSA-C22.2 No.42 with following features:
 - .1 White urea moulded 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 rivetted grounding contacts.
- .2 Other receptacles with ampacity and voltage as indicated.
- .3 Receptacles of one manufacturer throughout project.
- .4 Receptacles to be tamper resistant.
- .5 Manufacturer: Hubbell or Leviton, white only.

2.3 SPECIAL WIRING DEVICES

- .1 Class A GFCI specification grade 15A-125V, U ground.
- .2 CSA Type 5-20RA, 125V, 20A, U ground for the housekeeping receptacles and any receptacle noted as 20A-120V. White molded housing.

2.4 COVER PLATES

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

Part 3 Execution

3.1 INSTALLATION

- .1 Switches:
 - .1 Install single throw switches with handle in "UP" position when switch closed.
 - .2 Install switches in gang type outlet box when more than one switch is required in one location.
 - .3 Mount toggle switches at height in accordance with Section 26 05 00 - Common Work Results - Electrical and 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 in accordance with Section 26 05 00 - Common Work Results - Electrical and as indicated.
 - .3 Where split receptacle has one portion switched, mount vertically and switch upper portion.
- .3 Cover plates:
 - .1 Protect stainless steel cover plate finish with paper or plastic film until painting and other work is finished.
 - .2 Install suitable common cover plates where wiring devices are grouped.
 - .3 Do not use cover plates meant for flush outlet boxes on surface-mounted boxes.
 - .4 Install stainless steel cover plates for all flush mounted devices.
 - .5 Install cast aluminum cover plates on all exterior devices.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

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

1.2 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures.

1.3 REFERENCES

- .1 Canadian Standards Association (CSA International).
 - .1 CSA-C22.2 No. 5-09, Moulded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures (Tri-national standard with UL 489, tenth edition, and the second edition of NMX-J-266-ANCE).

1.4 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 circuit breakers and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Include time-current characteristic curves for breakers with ampacity of 100A and over or with interrupting capacity of 22,000 A symmetrical (rms) and over at system voltage.
- .4 Certificates:
 - .1 Prior to installation of circuit breakers in either new or existing installation, Contractor must submit PDF copies of a production certificate of origin from the manufacturer. Production certificate of origin must be duly signed by factory and local manufacturer's representative certifying that circuit breakers come from this manufacturer and are new and meet standards and regulations.
 - .1 Production certificate of origin must be submitted to Consultant for approval.
 - .2 Delay in submitting production of certificate of origin will not justify any extension of contract and additional compensation.
 - .3 Any work of manufacturing, assembly or begin only after acceptance of production certificate of origin by Consultant reserves the right to mandate manufacturer listed on circuit breakers to authenticate new circuit breakers under the contract, and to Contractor's expense.
 - .4 Production certificate of origin must contain:
 - .1 Manufacturer's name and address and person responsible for authentication. Person responsible must sign and date certificate.
 - .2 Licensed dealer's name and address and distributor responsible for Contractor's account.
 - .3 Contractor's name and address and person responsible for project.
 - .4 Local manufacturer's representative name address. Local manufacturer's representative must sign and date certificate.
 - .5 Name and address of building where circuit breakers will be installed.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: Deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store circuit breakers off ground, indoors or in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect circuit breakers from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

1.6 SUBMITTALS

- .1 Submit product data in accordance with Section 01 33 00 - Submittal Procedures
- .2 Include time-current characteristic curves for breakers with ampacity of 100A and over.

Part 2 Products

2.1 ACCEPTABLE MANUFACTURER

- .1 Square D, Eaton or Siemens

2.2 BREAKERS GENERAL

- .1 Moulded-case circuit breakers, Circuit breakers, and Ground-fault circuit-interrupters: to CSA C22.2 No. 5
- .2 Bolt-on moulded case circuit breaker: quick- make, quick-break type, for manual and automatic operation with temperature compensation for 40 degrees 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.
 - .1 Trip settings on breakers with adjustable trips to range from 3-8 times current rating.
- .5 Circuit breakers to have minimum symmetrical rms interrupting capacity rating as the panelboard/device they are installed in, as indicated on drawings.

2.3 MAGNETIC BREAKERS DESIGN B

- .1 Moulded case circuit breaker to operate automatically by means of magnetic tripping devices to provide instantaneous tripping for short circuit protection. (isolation purpose).

Part 3 Execution

3.1 INSTALLATION

- .1 Install circuit breakers as indicated.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

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

1.2 RELATED SECTIONS

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

1.3 REFERENCES

- .1 CSA Group
 - .1 CAN/CSA-C22.2 No.4-04(R2009), Enclosed and Dead-Front Switches (Tri-National Standard, with ANCE NMX-J-162-2004 and UL 98).
 - .2 CSA C22.2 No.39=13, Fuseholder Assemblies.

1.4 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 disconnect switches - fused and non-fused and include product characteristics, performance criteria, physical size, finish and limitations.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground, indoors or in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect disconnect switches - fused and non-fused from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

Part 2 Products

2.1 ACCEPTABLE MANUFACTURER

- .1 Square D, Eaton and Siemens.

2.2 DISCONNECT SWITCHES

- .1 Fusible and non-fusible, disconnect switch in CSA Enclosure Type 3, size as indicated on drawing.
- .2 Provision for 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: to CSA C22.2 No.39 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 Ensure switch for service entrance is approved for use as service entrance and kA ratings are as indicated on drawings.

2.3 EQUIPMENT IDENTIFICATION

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

2.4 ISOLATION SWITCHES

- .1 Toggle type.
- .2 Hp rated.
- .3 120, 240, 208 or 600V rated or 3 phase to suit motor.
- .4 Padlock provision in off position.
- .5 Surface mount enclosure, CSA type 3.

Part 3 Execution

3.1 INSTALLATION

- .1 Install disconnect switches complete with fuses if applicable.
- .2 Install isolation switches at motors as indicated.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

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

1.2 RELATED SECTIONS

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

1.3 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CSA C22.2 No.14-10, Industrial Control Equipment.
- .2 National Electrical Manufacturers Association (NEMA)
 - .1 NEMA ICS 1-2000 (R2008), Industrial Control and Systems: General Requirements.
- .3 National Electrical Manufacturers Association (NEMA)
 - .1 NEMA ICS 1-2000(R2008), Industrial Control and Systems: General Requirements.

1.4 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 control devices and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.
 - .2 Include schematic, wiring, interconnection diagrams.

1.5 QUALITY ASSURANCE

- .1 CONDUCT TESTS IN ACCORDANCE WITH SECTION 26 05 00 - COMMON WORK RESULTS FOR ELECTRICAL.

1.6 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Division 01 Closeout Submittals.
 - .2 Operation and Maintenance Data: submit operation and maintenance data for control devices for incorporation into manual.
-

1.7 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground, indoors, or in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect control devices from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
- .4 Develop Construction Waste Management Plan and Waste Reduction Workplan related to Work of this Section.
- .5 Packaging Waste Management: remove for reuse and return of pallets, crates, padding, and packaging materials as specified in Construction Waste Management Plan and Waste Reduction Workplan.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURER

- .1 Square 'D'.

2.2 AC CONTROL RELAYS

- .1 Fixed contact type: general purpose low coil current heavy duty with 2 N.O. 2 N.C. poles. Coil rating: 120V, 15VA. Contact rating: 120V, 10A.

2.3 RELAY ACCESSORIES

- .1 Standard contact cartridges: normally-open - convertible to normally-closed in field.
- .2 Overlap contact cartridges: normally-open convertible to normally closed in field.
- .3 Mounting strips: indexed strips easily cut to required length and bolted in place. Relays are installed in rows on strip with captive mounting screws. Rows of relays on mounting strip from their own wiring trough.

2.4 PUSHBUTTONS

- .1 Heavy duty Oil tight. Operator flush type. Black Green, with 1-NO and 1-NC contacts rated at 10A, AC, labels as indicated. Stop pushbuttons coloured red, provision for padlocking in depressed position labelled stop.

2.5 SELECTOR SWITCHES

- .1 3 position labelled HOA as indicated heavy duty oil tight, operators wing lever contact arrangement as indicated, rated 120V, 10A, AC.
-

2.6 INDICATING LIGHTS

- .1 Heavy duty Oil tight, full voltage, lens colour: red or as indicated, supply voltage: 120V, lamp voltage: 120V, labels as indicated.

2.7 CONTROL AND RELAY PANELS

- .1 CSA Type 12 sheet steel enclosure with hinged padlockable access door, accommodating relays timers, labels, as indicated, factory installed and wired to identified terminals.

2.8 CONTROL CIRCUIT TRANSFORMERS

- .1 Single phase, dry type.
- .2 Primary: 208 V as indicated, 60 Hz ac.
- .3 Secondary: 120 V and/or 24V AC as indicated.
- .4 Rating: 50 VA or as indicated.
- .5 Secondary fuse: 1 A.
- .6 Close voltage regulation as required by magnet coils and solenoid valves.

2.9 THERMOSTAT (LINE VOLTAGE)

- .1 Wall mounted, for exhaust fan or heater control.
- .2 Full load rating: 8 A at 120 V, or 20A at 208V-1Ø. Voltage to match equipment voltage requirements.
- .3 Temperature setting range: as indicated on control diagrams or to suit description of operation.
- .4 Thermometer Range: selected to allow for required temperature range.
- .5 Markings in 5 degrees increments.
- .6 Any thermostats indicated on drawings in corridors, gym, cafetorium, shops, washrooms or change rooms are to have guards Safety Technology International model STI 9620.
- .7 Line voltage thermostats are to be standard or reverse acting as indicated on drawings.

Part 3 Execution

3.1 INSTALLATION

- .1 Install pushbutton stations, control and relay panels, control devices and interconnect as indicated or to suit description of operation.

3.2 FIELD QUALITY CONTROL

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

- .2 Depending upon magnitude and complexity, divide control system into convenient sections, energize one section at time and check out operation of section.
- .3 Upon completion of sectional test, undertake group testing.
- .4 Check out complete system for operational sequencing.
- .5 Submit to Consultant one copy of test results.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 American National Standards Institute (ANSI)
 - .1 ANSI C82.11-1993, lamp current crest factor.
 - .2 ANSI C82.2 Input wattage.

1.2 RELATED SECTIONS

- .1 Information for Tenderers.
- .2 Refer to Section 26 05 00 Common Work Results - Electrical for related Sections applicable to this Project.

1.3 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings and product data in accordance with Section 26 05 00 Common Work Results - Electrical.
- .2 Submit list of replacement lamp data for each luminaire. Include lamp type, voltage, wattage, base type and order code. Include list in Maintenance Manual.
- .3 Submit a luminaire and lamp shop drawing for each luminaire type.

1.4 CODE REQUIREMENTS

- .1 Installation of lighting equipment to conform to Section 30, Ontario Electrical Safety Code and as amended or supplemented by Provincial, municipal, or other regulatory agencies having jurisdiction.

1.5 OPERATION AND MAINTENANCE DATA

- .1 Provide operation and maintenance data for incorporation into manual specified in Section 26 05 00 Common Work Results – Electrical.

1.6 GUARANTEE

- .1 Replace:
 - .1 Luminaires which show evidence of corrosion, rough handling, scratching of finishes, etc., are to be replaced with new luminaires at no additional cost.

1.7 OPERATIONAL TESTING

- .1 Check wiring for agreement with design circuits.
 - .2 Test for short circuits and improper grounds.
 - .3 Test operation of luminaire.
 - .4 Allow for 3rd party testing of lighting controls.
-

Part 2 Products

2.1 GENERAL

- .1 Verify the Catalogue Number of all fixtures with the description prior to ordering and check for final ceiling finish in all areas where recessed fixtures are called for to purchase ceiling trim, flanges and mounting brackets to suit the particular construction used where the fixtures are installed.
- .2 Provide jack chains and 's' hooks for all luminaires in area of work.
- .3 Luminaires shall carry the CSA label.
- .4 Provide supporting devices, plaster frames, junction boxes and outlet boxes where required.
- .5 Provide lenses or diffusers of glass or acrylic material as indicated. Acrylic lenses shall be minimum 3mm thick.
- .6 Include finishes to Section 26 05 00 Common Work Results - Electrical and as indicated.
- .7 Where soffits or ceilings have thermal insulation, provide luminaires which are CSA approved for such use.

2.2 FINISHES

- .1 Baked enamel finish:
 - .1 Conditioning of metal before painting:
 - .1 For corrosion resistance conversion coating to ASTM F 1137.
 - .2 For paint base, conversion coating to ASTM F 1137.
 - .2 Metal surfaces of luminaire housing and reflectors finished with high gloss baked enamel aluminum to give smooth, uniform appearance, free from pinholes or defects.
 - .3 Reflector and other inside surfaces finished as follows:
 - .1 White, minimum reflection factor 85%.
 - .2 Colour fastness: yellowness factor not above 0.02 and after 250 hours exposure in Atlas fade-ometer not to exceed 0.05.
 - .3 Film thickness, not less than 0.03 mm average and in no areas less than 0.025 mm.
 - .4 Gloss not less than 80 units as measured with Gardner 60° gloss meter.
 - .5 Flexibility: withstand bending over 12 mm mandrel without showing signs of cracking or flaking under 10 times magnification.
 - .6 Adhesion: 24 mm square lattice made of 3 mm squares cut through film to metal with sharp razor blade. Adhesive cellulose tape applied over lattice and pulled. Adhesion satisfactory if no coating removed.
- .2 Alzak finish:
 - .1 Aluminium sheet fabricated from special aluminum alloys and chemically brightened, subsequently anodically treated to specifications established by Alcoa, to produce:
 - .1 Finish for mild commercial service, minimum density of coating 7.8 g/m², minimum reflectivity 83% for specular, 80.5% for semi-specular and 75% for diffuse.
 - .2 Finish for regular industrial service, minimum density of coating 14.8

- .3 g/m², minimum reflectivity 82% for specular and 73% for diffuse.
Finish for heavy duty service, minimum density of coating 21.8 g/m²,
minimum reflectivity 85% for specular, 65% for diffuse.

2.3 LENSES

- .1 Design K-12
.1 100% virgin acrylic, UV stabilized, clear.
.2 .113 overall thickness.
.3 Square base male conical per 625mm² 64 prisms.
.4 Suitable for 1 x 4', nominal fixture dimensions.
.5 Meets or exceeds flame and smoke density rating.
- .2 Design K-19
.1 100% virgin acrylic, UV stabilized, clear.
.2 .187 overall thickness.
.3 Square base male conical per 625mm² 64 prisms.
.4 Suitable for 2 x 4', nominal fixture dimensions.
.5 Meets or exceeds flame and smoke density rating.

2.4 LIGHTING FIXTURES

- .1 Type letters for each lighting fixture shown on the drawings are indicated on lighting fixture schedule and/or legend.
- .2 Manufacturer's names and products listed in the luminaires schedule indicate the standard of acceptance for each lighting fixtures.
- .3 Acceptable manufacturers:
.1 LED fixtures: Lithonia, Cooper, Philips DayBrite or approved equal
.2 Other acceptable manufacturers may be indicated on the schedule for specified fixtures.

2.6 LUMINAIRE SCHEDULE

<u>Type</u>	<u>Description</u>	<u>Catalog Number</u>
A	4' Surface sealed LED fixture	Lithonia #FEML484000LMLPPFLMD120 GZ1035K80 or approved equal
B	LED potlight	Lithonia #WF6LL LED 40KBN CSA or approved equal
C	Exterior LED wallpack	Bega # 24 035 19 537 K4 CSA cert., black finish or approved equal
D	4' LED strip with lens	Lithonia # CLX-L48-4000LM- SEF-RDL-120-GZ10-35K-80CRI or approved equal
E	Emergency wall pack	Aimlite# EBST120362MD7WLA or approved equal
E1	Emergency battery unit	Aimlite# EBST120720 or approved equal

R	Single emergency remote head	Aimlite# RMMD01127WWHTVDR or approved equal
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Part 3 Execution

3.1 INSTALLATION

- .1 Locate and install luminaires as indicated, complete with all wiring, connections, fittings, hangers, aligners, box covers and accessories, as required.
- .2 Review all ceiling types, construction details and mounting arrangements before placing luminaire orders and ensure that all mounting assemblies, framing rings and similar features are included and match the required installation.
- .3 Install luminaires and lens materials in architectural details.
- .4 Install luminaires parallel with building lines. Wall-mounted luminaires shall be installed plumb.
- .5 All luminaires and assemblies shall be properly secured and supported. Support luminaires independent of the ceiling construction, complete with all fasteners such as 'S' hooks, framing and hangars, as may be required. Do not secure luminaires to mechanical ductwork or other vibration producing apparatus, unless specifically detailed on the drawings.
- .6 Where a luminaire is suspended from the ceiling using a self-aligning box cover, an additional ground wire from the outlet box to the luminaire shall be provided.
- .7 Coordinate the installation of luminaires with the work of other trades, ensuring that the necessary depths and mounting spaces are provided. Luminaires which cannot be installed due to a conflict with structural members, pipes or ductwork shall be relocated to a more suitable location, as directed by Engineer.
- .8 Provide unistrut supports as required for new Gym light fixtures.
- .9 Provide unistrut support as required to mount new light fixtures on exposed steel structures.
- .10 Coordinate location of new light fixtures in the boiler room with Mechanical Contractor. Allow for final relocation of lights when all the work is completed in the boiler room.
- .11 Provide jack chain and 's' hook support to the building structure for all light fixtures.

3.2 WIRING

- .1 In corridors:
 - .1 Connect luminaires to lighting circuits through conduit system with drops of armoured cable not exceeding 3' in length.
- .2 In rooms:
 - .1 Connect luminaries to main conduit run junction box in same room with armoured cable.
 - .2 Interconnect luminaires in the same room using armoured cable.

3.3 LUMINAIRE ALIGNMENT

- .1 Align luminaires mounted in continuous rows to form straight uninterrupted line.
- .2 Support luminaire independently of ceiling. Using "S" hooks and chains to structural steel or suspended "U" channels and in accordance with Ontario Electrical Safety Code.
- .3 Support continuous row mounted fluorescent fixtures every 1M.

3.4 CO-ORDINATION OTHER DIVISIONS

- .1 Fully co-ordinate with other divisions to avoid interference with ductwork and piping and other services.

3.5 TEST

- .1 Perform tests in accordance with Section 26 05 00 - Electrical Testing Requirements.
- .2 Check luminaires and replace defective lamps, ballasts, lenses, drivers, modules, and accessories.
- .3 Electrical Contractor to arrange & pay for 3rd party testing/calibration of all lighting controls.

3.6 CLEANING

- .1 Prior to take-over of the project, clean the lenses and reflectors of all luminaires with damp cloth to remove dust, smudges and fingerprints.

END OF SECTION
