

PART 1 - GENERAL

- 1.1 RELATED REQUIREMENTS** .1 Section 26 05 32 - Outlet Boxes, Conduit Boxes and Fittings.
- 1.2 REFERENCES** .1 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.
.2 Reference Standards:
.1 CSA Group
.1 CSA C22.1-12, Canadian Electrical Code, Part 1 (22nd Edition), Safety Standard for Electrical Installations.
.2 CAN3-C235-83 (R2006), Preferred Voltage Levels for AC Systems, 0 to 50 000 V.
- 1.3 ACTION AND INFORMATIONAL SUBMITTALS** .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
.2 Product Data:
.1 Submit manufacturer's instructions, printed product literature and data sheets for light fixtures, fire alarm devices and distribution 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 Submit wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, ductwork, and other items that must be shown to ensure co-ordinated installation.
.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 on drawings clearances for operation, maintenance, and replacement of operating equipment devices.
.5 Submit copy of drawings and product data to authority having jurisdiction.
.6 If changes are required, notify Departmental Representative of these changes before they are made.
.4 Certificates:
.1 Provide CSA certified equipment and material.
.2 Where CSA certified equipment and material is not available, submit such equipment and material to authority having jurisdiction for special approval 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 Departmental Representative.

**1.4 CLOSEOUT
SUBMITTALS**

- .1 Operation and Maintenance Data: submit operation and maintenance data for incorporation into manual.
 - .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.

**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 indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect materials from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, and packaging materials as specified in Construction Waste Management Plan.

PART 2 - PRODUCTS**2.1 DESIGN
REQUIREMENTS**

- .1 Operating voltages: to CAN3-C235.
- .2 Motors, electric heating, control and distribution devices and equipment to operate satisfactorily at 60 Hz within normal operating limits established by above standard.
 - .1 Equipment to operate in extreme operating conditions established in above standard without damage to equipment.
- .3 Language operating requirements: provide identification nameplates and labels for control items in English and French.
- .4 Use one nameplate or label for each language.

**2.2 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 material and equipment are not available, obtain special approval from authority having jurisdiction before delivery to site and submit such approval as described in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS.

2.2 MATERIALS AND EQUIPMENT (Cont'd)

- .3 Factory assemble control panels and component assemblies.

2.3 WIRING TERMINATIONS

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

2.4 EQUIPMENT IDENTIFICATION

- .1 Identify electrical equipment with nameplates and labels as follows:
- .1 Nameplates: lamicaid 3 mm thick plastic engraving sheet, black face, white core, lettering accurately aligned and engraved into core.
 - .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: electronically printed, self-adhesive plastic labels with 6 mm high letters unless specified otherwise.
- .3 Wording on nameplates and labels to be approved by Departmental Representative prior to manufacture.
- .4 Allow for minimum of twenty-five (25) letters per nameplate and label.
- .5 Nameplates for terminal cabinets and junction boxes to indicate system and/or voltage characteristics.
- .6 Identify equipment with Size 3 labels engraved "ASSET INVENTORY NO. " as directed by Departmental Representative.
- .7 Disconnects, starters and contactors: indicate equipment being controlled and voltage.
- .8 Terminal cabinets and pull boxes: indicate system and voltage.

2.5 WIRING IDENTIFICATION

- .1 Identify wiring with permanent indelible identifying markings, 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.

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

	Prime	Auxiliary
up to 250 V	Yellow	
up to 600 V	Yellow	Green

- 2.7 FINISHES
- .1 Shop finish metal enclosure surfaces by application of rust resistant primer inside and outside, and at least two coats of finish enamel.
 - .1 Paint indoor switchgear and distribution enclosures light gray .

PART 3 - EXECUTION

- 3.1 EXAMINATION
- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

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

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

- 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.

3.5 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 In mechanical rooms: 1200 mm.

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 - ACTION AND INFORMATIONAL SUBMITTALS, phase and neutral currents on panelboards, dry-core transformers and motor control centres, operating under normal load, as well as hour and date on which each load was measured, and voltage at time of test.
- .2 Conduct following tests in accordance with Section 01 45 00 - Quality Control.
 - .1 Power distribution system including phasing, voltage, grounding and load balancing.
 - .2 Circuits originating from branch distribution panels.
 - .3 Lighting and its control.
 - .4 Motors, heaters and associated control equipment including sequenced operation of systems where applicable.
 - .5 Systems: fire alarm.
 - .6 Insulation resistance testing:
 - .1 Megger circuits, feeders and equipment up to 350 V with a 500 V instrument.
 - .2 Megger 350-600 V circuits, feeders and equipment with a 1000 V instrument.
 - .3 Check resistance to ground before energizing.
- .3 Carry out tests in presence of Departmental Representative.
- .4 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.

3.8 SYSTEM STARTUP

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

3.8 SYSTEM STARTUP (Cont'd) .2 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.

3.9 CLEANING .1 Progress Cleaning:
.1 Leave Work area clean at end of each day.
.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.
.3 Waste Management: separate waste materials for reuse and recycling.
.1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

PART 1 - GENERAL

- 1.1 REFERENCES .1 CSA International
- .1 CAN/CSA-C22.2 No. 18-98(R2003), Outlet Boxes, Conduit Boxes and Fittings.
 - .2 CAN/CSA-C22.2 No. 65-13, Wire Connectors.
- .2 National Electrical Manufacturers Association (NEMA)

PART 2 - PRODUCTS

- 2.1 MATERIALS .1 Pressure type wire connectors to: CAN/CSA-C22.2 No. 65, with current carrying parts of copper sized to fit copper conductors as required.
- .2 Fixture type splicing connectors to: CAN/CSA-C22.2 No.65, with current carrying parts of copper sized to fit copper conductors 10 AWG or less.
- .3 Bushing stud connectors: to NEMA to consist of:
- .1 Connector body and stud clamp for copper conductors.
 - .2 Clamp for copper conductors.
 - .3 Stud clamp bolts.
 - .4 Bolts for copper conductors.
 - .5 Bolts for aluminum conductors bar.
 - .6 Sized for conductors as required.
- .4 Clamps or connectors for armoured cable as required to: CAN/CSA-C22.2 No. 18.

PART 3 - EXECUTION

- 3.1 INSTALLATION .1 Remove insulation carefully from ends of conductors and cables and:
- .1 Install mechanical pressure type connectors and tighten screws with appropriate compression tool recommended by manufacturer. Installation shall meet secureness tests in accordance with CAN/CSA-C22.2 No. 65.
 - .2 Install fixture type connectors and tighten to CAN/CSA-C22.2 No. 65. Replace insulating cap.
 - .3 Install bushing stud connectors in accordance with NEMA.

PART 1 - GENERAL

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| <u>1.1 RELATED REQUIREMENTS</u> | .1 | Section 26 05 00 - Common Work Results for Electrical. |
| | .2 | Section 26 05 20 - Wire and Box Connectors - (0-1000 V). |
| | .3 | Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings. |

PART 2 - PRODUCTS

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|----------------------------|----|---|
| <u>2.1 BUILDING WIRES</u> | .1 | Conductors: stranded for 10 AWG and larger. Minimum size: 12 AWG. |
| | .2 | Copper conductors: size as indicated, with 1000 V insulation of cross-linked thermosetting polyethylene material rated RW90 XLPE. |
| <u>2.2 ARMoured CABLES</u> | .1 | Conductors: insulated, copper, size as indicated. |
| | .2 | Type: AC90. |
| | .3 | Armour: interlocking type fabricated from aluminum strip. |

PART 3 - EXECUTION

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| <u>3.1 FIELD QUALITY CONTROL</u> | .1 | Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical. |
| | .2 | Perform tests using method appropriate to site conditions and to approval of Departmental Representative and local authority having jurisdiction over installation. |
| | .3 | Perform tests before energizing electrical system. |
| <u>3.2 GENERAL CABLE INSTALLATION</u> | .1 | Terminate cables in accordance with Section 26 05 20 - Wire and Box Connectors - (0-1000 V). |
| | .2 | Cable Colour Coding: to Section 26 05 00 - Common Work Results for Electrical. |
| | .3 | Conductor length for parallel feeders to be identical. |
| | .4 | Lace or clip groups of feeder cables at distribution centres, pull boxes, and termination points. |
| | .5 | Wiring in walls: typically drop or loop vertically from above to better facilitate future renovations. Generally wiring from below and horizontal wiring in walls to be avoided unless indicated. |
| | .6 | Branch circuit wiring for receptacles to be 2-wire circuits only, i.e. common neutrals not permitted. |

3.3 INSTALLATION OF .1
BUILDING WIRES

Install wiring as follows:

- .1 In conduit systems in accordance with Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.

3.4 INSTALLATION OF .1
ARMOURED CABLES

Group cables wherever possible on channels.

PART 1 - GENERAL

- 1.1 RELATED REQUIREMENTS .1 Section 26 05 00 - Common Work Results for Electrical.

PART 2 - PRODUCTS

- 2.1 EQUIPMENT .1 Grounding conductors: bare stranded copper, tinned, soft annealed, size as required.
- .2 Insulated grounding conductors: green, copper conductors, size as required.
- .3 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 Pressure wire connectors.

PART 3 - EXECUTION

- 3.1 INSTALLATION GENERAL .1 Install complete permanent, continuous grounding system including, conductors, connectors, accessories. Where EMT is used, run ground wire in 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 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.
- .6 Make grounding connections in radial configuration only, with connections terminating at single grounding point. Avoid loop connections.
- 3.2 EQUIPMENT GROUNDING .1 Install grounding connections to typical equipment included in, but not necessarily limited to following list. Service equipment, transformers, switchgear, duct systems, frames of motors, motor control centres, starters, control panels, building steel work, generators, elevators and escalators, distribution panels, outdoor lighting, cable trays.
- 3.3 FIELD QUALITY CONTROL .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Perform ground continuity and resistance tests using method appropriate to site conditions and to approval of Departmental Representative and local authority having jurisdiction over installation.

3.3 FIELD QUALITY	.3	Perform tests before energizing electrical system.
CONTROL		
<u>(Cont'd)</u>	.4	Disconnect ground fault indicator during tests.

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS .1 Section 26 05 00 - Common Work Results for Electrical.

1.2 REFERENCES .1 Canadian Standards Association (CSA International)
.1 CSA C22.1-12, Canadian Electrical Code, Part 1, 22nd Edition.

PART 2 - PRODUCTS

2.1 JUNCTION AND PULL BOXES .1 Construction:welded steel enclosure.
.2 Covers Flush Mounted: 25 mm minimum extension all around.
.3 Covers Surface Mounted: screw-on flat covers.

PART 3 - EXECUTION

3.1 JUNCTION, PULL BOXES AND CABINETS INSTALLATION .1 Install pull boxes in inconspicuous but accessible locations.
.2 Only main junction and pull boxes are indicated. Install additional pull boxes as required by CSA C22.1.

3.2 IDENTIFICATION .1 Equipment Identification: to Section 26 05 00 - Common Work Results for Electrical.
.2 Identification Labels: size 2 indicating system name voltage and phase or as indicated.

PART 1 - GENERAL

- 1.1 REFERENCES .1 Canadian Standards Association (CSA International)
.1 CSA C22.1-12, Canadian Electrical Code, Part 1, 22nd Edition.

PART 2 - PRODUCTS

- 2.1 OUTLET AND CONDUIT BOXES GENERAL .1 Size boxes in accordance with CSA C22.1.
.2 102 mm square or larger outlet boxes as required.
.3 Gang boxes where wiring devices are grouped.
.4 Blank cover plates for boxes without wiring devices.
.5 347 V outlet boxes for 347 V switching devices.
.6 Combination boxes with barriers where outlets for more than one system are grouped.
- 2.2 GALVANIZED STEEL OUTLET BOXES .1 One-piece electro-galvanized construction.
.2 102 mm square or octagonal outlet boxes for lighting fixture outlets.
- 2.3 CONDUIT BOXES .1 Cast FS boxes with factory-threaded hubs and mounting feet for surface wiring of devices.
- 2.4 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 35 mm and pull boxes for larger conduits.
.4 Double locknuts and insulated bushings on sheet metal boxes.
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PART 3 - EXECUTION

- 3.1 INSTALLATION
- .1 Support boxes independently of connecting conduits.
 - .2 Fill boxes with paper, sponges or foam or similar approved material to prevent entry of debris during construction. Remove upon completion of work.
 - .3 For flush installations mount outlets flush with finished wall using plaster rings to permit wall finish to come within 6 mm of opening.
 - .4 Provide correct size of openings in boxes for conduit, mineral insulated and armoured cable connections. Do not install reducing washers.
 - .5 Vacuum clean interior of outlet boxes before installation of wiring devices.
 - .6 Identify systems for outlet boxes as required.

PART 1 - GENERAL

- 1.1 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 (R2009), Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit.
 - .3 CSA C22.2 No. 83-M1985(R2013), Electrical Metallic Tubing.
 - .4 CSA C22.2 No. 211.2-06(R2011), Rigid PVC (Unplasticized) Conduit.

PART 2 - PRODUCTS

- 2.1 CONDUITS .1 Electrical metallic tubing (EMT): to CSA C22.2 No. 83, with couplings.
- .2 Rigid pvc conduit: to CSA C22.2 No. 211.2.
 - .3 Flexible metal conduit: to CSA C22.2 No. 56, aluminum liquid-tight flexible metal.

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

- 2.3 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 25 mm and larger conduits.
 - .3 Steel set-screw couplings and connectors for EMT.

- 2.4 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.
- .4 Use rigid pvc conduit underground.
- .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: 21 mm.
- .8 Bend conduit cold:
.1 Replace conduit if kinked or flattened more than 1/10th of its original diameter.
- .9 Mechanically bend steel conduit over 21 mm diameter.
- .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.
.1 Do not use liquids to clean out conduits.
- .13 Dry conduits out before installing wire.
- 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 channels.
- .5 Do not pass conduits through structural members except as indicated.
- .6 Do not locate conduits less than 75 mm parallel to steam or hot water lines with minimum of 25 mm at crossovers.

3.4 CONCEALED
CONDUITS

.1 Run parallel or perpendicular to building lines.

3.5 CONDUITS
UNDERGROUND

.1 Slope conduits to provide drainage.

PART 1 - GENERAL

- 1.1 REFERENCES** .1 National Research Council Canada (NRCC)
.1 NRCC NBCC-2010, National Building Code of Canada 2010.
- 1.2 DEFINITIONS** .1 Priority Two (P2) Buildings: buildings in which life safety is of paramount concern. It is not necessary that P2 buildings remain operative during or after earthquake activity.
.2 SRS: acronym for Seismic Restraint System.
- 1.3 DESCRIPTION** .1 SRS fully integrated into, and compatible with:
.1 Noise and vibration controls specified elsewhere.
.2 Structural, mechanical, electrical design of project.
.2 Systems, equipment not required to be operational during and after seismic event.
.3 During seismic event, SRS to prevent systems and equipment from causing personal injury and from moving from normal position.
.4 Designed by Professional Engineer specializing in design of SRS and registered in Province of Ontario.
- 1.4 ACTION AND INFORMATIONAL SUBMITTALS** .1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
.2 Shop drawings: submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.
.3 Submit design data including:
.1 Full details of design criteria.
.2 Design calculations (including restraint loads resulting from seismic forces in accordance with National Building Code, detailed work sheets, tables).
.3 Separate shop drawings for each SRS and devices for each system, equipment.
.4 Identification of location of devices.
.5 Schedules of types of SRS equipment and devices.
.6 Details of fasteners and attachments to structure, anchorage loadings, attachment methods.
.7 Installation procedures and instructions.
- 1.5 QUALITY ASSURANCE** .1 Health and Safety:
.1 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

PART 2 - PRODUCTS

2.1 SRS <u>MANUFACTURER</u>	.1	SRS from one manufacturer regularly engaged in SRS production.
2.2 <u>GENERAL</u>	.1	SRS to provide gentle and steady cushioning action and avoid high impact loads.
	.2	SRS to restrain seismic forces in every direction.
	.3	Fasteners and attachment points to resist same load as seismic restraints.
	.4	SRS of Conduit systems compatible with: .1 Expansion, anchoring and guiding requirements. .2 Equipment vibration isolation and equipment SRS.
	.5	SRS utilizing cast iron, threaded pipe, other brittle materials not permitted.
	.6	Attachments to RC structure: .1 Use high strength mechanical expansion anchors. .2 Drilled or power driven anchors not permitted.
	.7	Seismic control measures not to interfere with integrity of firestopping.
2.3 SRS FOR STATIC <u>EQUIPMENT, SYSTEMS</u>	.1	Floor-mounted equipment, systems: .1 Anchor equipment to equipment supports. .2 Anchor equipment supports to structure. .3 Use size of bolts scheduled in approved shop drawings.
	.2	Suspended equipment, systems: .1 Use one or combination of following methods: .1 Install tight to structure. .2 Cross-brace in every direction. .3 Brace back to structure. .4 Slack cable restraint system. .2 SCS to prevent sway in horizontal plane, "rocking" in vertical plane, sliding and buckling in axial direction. .3 Hanger rods to withstand compressive loading and buckling.
2.4 SRS FOR <u>VIBRATION ISOLATED EQUIPMENT</u>	.1	Floor mounted equipment, systems: .1 Use one or combination of following methods: .1 Vibration isolators with built-in snubbers. .2 Vibration isolators and separate snubbers. .3 Built-up snubber system approved by Departmental Representative consisting of structural elements and elastomeric layer. .2 SRS to resist complete isolator unloading. .3 SRS not to jeopardize noise and vibration isolation systems. Provide 4-8 mm clearance between seismic restraint snubbers and equipment during normal operation of equipment and systems. .4 Cushioning action: gentle and steady by utilizing elastomeric material or other means in order to avoid high impact loads.

**2.4 SRS FOR
VIBRATION ISOLATED
EQUIPMENT
(Cont'd)**

- .2 Suspended equipment, systems:
 - .1 Use one or combination of following methods:
 - .1 Slack cable restraint system.
 - .2 Brace back to structure via vibration isolators and snubbers.

**2.5 SLACK CABLE
RESTRAINT SYSTEM
(SCS)**

- .1 Use elastomer materials or similar to avoid high impact loads and provide gentle and steady cushioning action.
- .2 SCS to prevent sway in horizontal plane, "rocking" in vertical plane, sliding and buckling in axial direction.
- .3 Hanger rods to withstand compressive loading and buckling.

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 datasheet.

3.2 INSTALLATION

- .1 Attachment points and fasteners:
 - .1 To withstand same maximum load that seismic restraint is to resist and in every direction.
- .2 Slack Cable Systems (SCS):
 - .1 Connect to suspended equipment so that axial projection of wire passes through centre of gravity of equipment.
 - .2 Use appropriate grommets, shackles, other hardware to ensure alignment of restraints and to avoid bending of cables at connection points.
 - .3 Conduit systems: provide transverse SCS at 10 m spacing maximum, longitudinal SCS at 20 m maximum or as limited by anchor/slack cable performance.
 - .4 Small conduits may be rigidly secured to larger pipes for restraint purposes, but not reverse.
 - .5 Orient restraint wires on ceiling hung equipment at approximately 90 degrees to each other (in plan), tie back to structure at maximum of 45 degrees to structure.
 - .6 Adjust restraint cables so that they are not visibly slack but permit vibration isolation system to function normally.
 - .7 Tighten cable to reduce slack to 40 mm under thumb pressure. Cable not to support weight during normal operation.
- .3 Install SRS at least 25 mm from equipment, systems, services.
- .4 Miscellaneous equipment not vibration-isolated:
 - .1 Bolt through house-keeping pad to structure.
- .5 Co-ordinate connections with other disciplines.

**3.3 FIELD QUALITY
CONTROL**

- .1 Inspection and Certification:
 - .1 SRS: inspected and certified by Seismic Engineer upon completion of installation.
 - .2 Provide written report to Departmental Representative with certificate of compliance.
- .2 Commissioning Documentation:
 - .1 Upon completion and acceptance of certification, hand over to Departmental Representative complete set of construction documents, revised to show "as-built" conditions.

PART 1 - GENERAL

- 1.1 RELATED REQUIREMENTS .1 Section 26 05 00 - Common Work Results for Electrical.
- 1.2 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. 42.1-13, Cover Plates for Flush-Mounted Wiring Devices (Bi-national standard, with UL 514D).

PART 2 - PRODUCTS

- 2.1 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 Receptacles of one manufacturer throughout project.
- 2.2 COVER PLATES .1 Cover plates for wiring devices to: CSA C22.2 No. 42.1.
- .2 Stainless steel, vertically brushed, 1 mm thick cover plates for wiring devices mounted in flush-mounted outlet box.
 - .3 Cast cover plates for wiring devices mounted in surface-mounted FS type conduit boxes.
- 2.3 SOURCE QUALITY CONTROL .1 Cover plates from one manufacturer throughout project.

PART 3 - EXECUTION

- 3.1 INSTALLATION .1 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 for Electrical as indicated.
- .2 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.
- 3.2 PROTECTION .1 Protect installed products and components from damage during construction.
- .2 Protect stainless steel cover plate finish with paper or plastic film until painting and other work is finished.
- .3 Repair damage to adjacent materials caused by wiring device installation.

PART 1 - GENERAL

- 1.1 REFERENCES** .1 CSA International
- .1 CSA C22.2 No. 5-13, Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures.
- 1.2 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 Certificates:
- .1 Prior to installation of circuit breakers in either new or existing installation, Contractor must submit 3 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 Departmental Representative 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 installation to begin only after acceptance of production certificate of origin by Departmental Representative. Unless complying with this requirement, Departmental Representative 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 person of distributor responsible for Contractor's account.
- .3 Contractor's name and address and person responsible for project.
- .4 Local manufacturer's representative name and address. Local manufacturer's representative must sign and date certificate.
- .5 Name and address of building where circuit breakers will be installed:
- .1 Project title.
- .2 End user's reference number.
- .3 List of circuit breakers.

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 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 with interchangeable trips as indicated.
- .6 Circuit breakers to have minimum symmetrical rms interrupting capacity rating in accordance with panelboard where they are being installed.

PART 3 - EXECUTION**3.1 INSTALLATION**

- .1 Install circuit breakers as indicated.

PART 1 - GENERAL

- 1.1 RELATED REQUIREMENTS .1 Section 26 05 00 - Common Work Results for Electrical.
- 1.2 REFERENCES .1 Canadian Standards Association (CSA International).
.1 CAN/CSA C22.2 No. 4-04 (R2009), Enclosed Switches.
.2 CSA C22.2 No. 39-13), Fuseholder Assemblies.
- 1.3 HEALTH AND SAFETY .1 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

PART 2 - PRODUCTS

- 2.1 DISCONNECT SWITCHES .1 Non fusible, disconnect switch in CSA Enclosure 2, to CAN/CSA C22.2 No. 4 size as indicated. Provide weatherproof enclosures for all disconnects installed in damp or wet applications.
.2 Provision for padlocking in ON-OFF switch position.
.3 Mechanically interlocked door to prevent opening when handle in ON position.
.4 Quick-make, quick-break action.
.5 ON-OFF switch position indication on switch enclosure cover.
- 2.2 EQUIPMENT IDENTIFICATION .1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results for Electrical.
.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.

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS .1 Section 26 05 00 - Common Work Results for Electrical.

1.2 REFERENCES .1 International Electrotechnical Commission (IEC)
.1 IEC 947-4-1-2002, Part 4: Electromechanical contactors and motor-starters.

PART 2 - PRODUCTS

2.1 MATERIALS .1 Starters: to IEC 947-4 with AC4 utilization category.

2.2 FULL VOLTAGE MAGNETIC STARTERS .1 Combination magnetic starters of size, type, rating and enclosure type as indicated with components as follows:
.1 Contactor 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 circuit breaker with operating lever on outside of enclosure to control circuit breaker, and provision for:
.1 Locking in "OFF" position with.
.2 Independent locking of enclosure door.
.3 Provision for preventing switching to "ON" position while enclosure door open.
.3 Accessories:
.1 Pushbuttons & selector switches: heavy duty oil tight labelled as indicated.
.2 Indicating lights: heavy duty oil tight type and color as indicated.
.3 1-N/O and 1-N/C spare auxiliary contacts unless otherwise indicated.

2.3 EQUIPMENT IDENTIFICATION .1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results for Electrical.
.2 Magnetic starter designation label, white plate, black letters, size 4 engraved as indicated.

PART 3 - EXECUTION

- 3.1 INSTALLATION
- .1 Install starters and control devices in accordance with manufacturer's instructions.
 - .2 Install and wire starters and controls as indicated.
 - .3 Ensure correct fuses installed.
 - .4 Confirm motor nameplate and adjust overload device to suit.
- 3.2 FIELD QUALITY CONTROL
- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical and manufacturer's instructions.
 - .2 Operate switches and 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.