

Part 1 General

**1.1 RELATED
REQUIREMENTS**

.1 Division 01 – General Requirements.

1.2 REFERENCES

.1 Canadian Standards Association (CSA International)

.1 CSA C22.1-12, Canadian Electrical Code, Part 1 (22nd Edition), Safety Standard for Electrical Installations.

.2 CAN3-C235-83(R2010), Preferred Voltage Levels for AC Systems, 0 to 50,000 V.

.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.

.4 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS).

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.

**1.6 QUALITY
ASSURANCE**

.1 Qualifications: electrical Work to be carried out by qualified, licensed electricians who hold valid Master Electrical Contractor

license or apprentices as per the conditions of Provincial Act respecting manpower vocational training and qualification.

- .1 Employees registered in provincial apprentices program: permitted, under direct supervision of qualified licensed electrician, to perform specific tasks.
- .2 Permitted activities: determined based on training level attained and demonstration of ability to perform specific duties.

**1.7 WASTE
MANAGEMENT AND
DISPOSAL**

- .1 Waste management and disposal to be in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

**1.8 SYSTEM
STARTUP**

- .1 Instruct Departmental Representative and operating personnel in operation, care and maintenance of systems, system equipment and components.
- .2 Arrange and pay for services of manufacturer's factory service engineer to supervise start-up of installation, check, adjust, balance and calibrate components and instruct operating personnel.
- .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.

Part 2 Products

**2.1 MATERIALS AND
EQUIPMENT**

- .1 Material and equipment to be CSA certified. Where CSA certified material and equipment is not available, obtain special approval from authority having jurisdiction before delivery to site and submit such approval as described in PART 1 - SUBMITTALS.
- .2 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.

2.3 WARNING SIGNS

- .1 Warning Signs: in accordance with requirements of Departmental Representative.
- .2 Ensure that all electrical equipment is field marked to warn of potential electric shock and arc flash hazards as per CSA C22.1, Rule 2-306.

2.4 WIRING

- .1 Ensure lugs, terminals, screws used for termination of wiring are

TERMINATIONS

suitable for either copper or aluminum conductors.

2.5 EQUIPMENT IDENTIFICATION

- .1 Identify electrical equipment with nameplates and labels as follows:
- .1 Nameplates: lamicoïd 3 mm thick plastic engraving sheet, matt white finish face, black core, lettering accurately aligned and engraved into core mechanically attached with self-tapping screws.
- .2 Sizes as follows:
- | NAMEPLATE SIZES | | | |
|-----------------|-------------|---------|------------------|
| Size 1 | 10 x 50 mm | 1 line | 3 mm high lette |
| Size 2 | 12 x 70 mm | 1 line | 5 mm high lette |
| Size 3 | 12 x 70 mm | 2 lines | 3 mm high lette |
| Size 4 | 20 x 90 mm | 1 line | 8 mm high lette |
| Size 5 | 20 x 90 mm | 2 lines | 5 mm high lette |
| Size 6 | 25 x 100 mm | 1 line | 12 mm high lette |
| Size 7 | 25 x 100 mm | 2 lines | 6 mm high lette |
- .2 Labels: embossed 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 Disconnects, starters and contactors: indicate equipment being controlled and voltage.
- .7 Terminal cabinets and pull boxes: indicate system and voltage.
- .8 Transformers: indicate capacity, primary and secondary voltages.

2.6 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 Colour code conduits, boxes and metallic sheathed cables.
- .5 Code with plastic tape or paint at points where conduit or cable enters wall, ceiling, or floor, and at 15 m intervals.

.6	Colours: 25 mm wide prime colour and 20 mm wide auxiliary colour.		
		Prime	Auxilia
	up to 250 V	Yellow	
	up to 600 V	Yellow	Gre
	up to 5 kV	Yellow	Bl
	up to 15 kV	Yellow	R
	Telephone	Blue	
	Other Communication Systems		Bl
	Fire Alarm	Red	
	Emergency Voice	Red	Bl
	Other Security Systems	Red	Yellc

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 outdoor electrical equipment "equipment green", Munsell 9GY 1.5/2.6. Finish to IEEE C57.12.28.
 - .2 Paint indoor switchgear and distribution enclosures light gray to EEMAC 2Y-1.

Part 3 Execution

3.1 INSTALLATION

- .1 Do complete installation in accordance with CSA C22.1 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: plastic, sized for free passage of conduit, and protruding 50 mm.
- .2 If plastic sleeves are used in fire rated walls or floors, remove before conduit installation.
- .3 Install cables, conduits and fittings embedded or plastered over, close to building structure so furring can be kept to minimum.

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: 1400 mm.
	.2	Wall receptacles:
	.1	General: 300 mm.
	.2	Above top of continuous baseboard heater: 200 mm.
	.3	Above top of counters or counter splash backs: 175 mm.
	.4	In mechanical rooms: 1400 mm.
	.3	Panelboards: as required by Code or as indicated.
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	Conduct following tests:
	.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	Insulation resistance testing:
	.1	Megger circuits, feeders and equipment up to 350 V with a 500 V instrument.
	.2	Megger 350-600 V circuits, feeders and equipment with a 1000 V instrument.
	.3	Check resistance to ground before energizing.
	.2	Carry out tests in presence of Departmental Representative.
	.3	Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.

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- .4 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.
 - .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.

3.8 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.

3.9 CUTTING AND PATCHING

- .1 Cutting and patching and associated costs for Div. 26 shall be the responsibility of Div. 26; confirm the location of all holes with the General Contractor prior to starting Work.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Division 01 – General Requirements.

1.2 REFERENCES

- .1 Canadian Standards Association (CSA International):
- .1 CAN/CSA-C22.2 No.18.3-12, Conduit, Tubing and Cable Fittings.
 - .2 CAN/CSA-C22.2 No.65-13, Standard for Wire Connectors (5th Edition) (National Standard with UL 486A-486B).
- .2 National Electrical Manufacturers Association (NEMA)

1.3 SUBMITTALS

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

1.4 CLOSEOUT SUBMITTALS

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

Part 2 Products

2.1 MATERIALS

- .1 Pressure type wire connectors to: CAN/CSA-C22.2 No.65, with current carrying parts of copper or copper alloy aluminum alloy 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 or copper alloy sized to fit copper conductors 10 AWG or less.

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.

END OF SECTION

Part 1 General

- 1.1 RELATED REQUIREMENTS** .1 Division 01 – General Requirements.
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- 1.2 REFERENCES** .1 Canadian Standards Association (CSA International).
- .1 CSA C22.2 No. 0.3-09 Test Methods for Electrical Wires and Cables, Includes update No. 1 (2010).
- 1.3 PRODUCT DATA** .1 Submit product data in accordance with Section 01 33 00 - Submittal Procedures.
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- 1.4 WASTE MANAGEMENT AND DISPOSAL** .1 Waste management and disposal to be in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

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 cross-linked thermosetting polyethylene material rated RW90 XLPE or RWU90.
- 2.2 CONTROL CABLES** .1 Type: LVT: soft annealed copper conductors, sized as indicated, with PVC insulation, and outer PVC jacket.
- .2 Type: low energy 300 V control cable: stranded annealed copper conductors sized as indicated with polyethylene insulation and outer PVC jacket, rated FT-6.
- .3 Type: 600 V stranded annealed copper conductors, sizes as indicated, with XLPE insulation and outer PVC jacket.

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 - Conduits, Conduit Fastenings and Conduit Fittings.
- 3.2 INSTALLATION OF CONTROL CABLES** .1 Install control cables in conduit.

.2 Ground control cable shield.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Division 01 – General Requirements.

1.2 WASTE MANAGEMENT AND DISPOSAL

.1 Waste management and disposal to be in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

Part 2 Products

2.1 SUPPORT CHANNELS

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

Part 3 Execution

3.1 INSTALLATION

- .1 Secure equipment to finished masonry, drywall, and tile surfaces with nylon shields.
- .2 Secure equipment to poured concrete with expandable inserts.
- .3 Secure equipment to hollow masonry walls or suspended ceilings with toggle bolts.
- .4 Support equipment, conduit or cables using clips, spring loaded bolts, cable clamps designed as accessories to basic channel members.
- .5 Fasten exposed conduit or cables to building construction or support system using straps.
- .1 One-hole steel straps to secure surface conduits and cables 50 mm and smaller.
- .2 Two-hole steel straps for conduits and cables larger than 50 mm.
- .3 Beam clamps to secure conduit to exposed steel work.
- .6 For surface mounting of two or more conduits use channels at 1.5 m on centre 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.
- .11 Install fastenings and supports as required for each type of equipment cables and conduits, and in accordance with manufacturer's installation recommendations.

END OF SECTION

Part 1 General

**1.1 RELATED
REQUIREMENTS**

- .1 Division 01 – General Requirements.
- .2 Section 26 05 00 – Common Work Results for Electrical.

1.2 SUBMITTALS

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

**1.3 WASTE
MANAGEMENT AND
DISPOSAL**

- .1 Waste management and disposal to be in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

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 turned edge covers.

Part 3 Execution

**3.1 JUNCTION AND
PULL BOXES
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.

END OF SECTION

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.

END OF SECTION

Part 1 General

<u>1.1 RELATED SECTIONS</u>	.1	Division 01 – General Requirements.
<u>1.2 REFERENCES</u>	.1	Canadian Standards Association (CSA International)
	.1	CAN/CSA C22.2 No. 18.1-13 Metallic Outlet Boxes.
	.2	CSA C22.2 No. 45.1-07 (R2012), Electrical Rigid Metal Conduit-Steel.
	.3	CSA C22.2 No. 56-(R2009), Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit.
	.4	CSA C22.2 No. 83-M1985 (R2008), Electrical Metallic Tubing.
	.5	CAN/CSA C22.2 No. 227.3-05 (R2010), Nonmetallic Mechanical Protection Tubing (NMPT).
<u>1.3 SUBMITTALS</u>	.1	Provide product data and shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
<u>1.4 WASTE MANAGEMENT AND DISPOSAL</u>	.1	Waste management and disposal to be in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
 Part 2 Products		
<u>2.1 CONDUITS</u>	.1	Rigid metal conduit: to CSA C22.2 No. 45, hot dipped galvanized steel threaded.
	.2	Epoxy coated conduit: to CSA C22.2 No. 45, with zinc coating and corrosion resistant epoxy finish inside and outside.
	.3	Electrical metallic tubing (EMT): to CSA C22.2 No. 83, with couplings.
	.4	Flexible metal conduit: to CSA C22.2 No. 56, liquid-tight flexible metal.
	.5	Flexible PVC conduit: to CAN/CSA-C22.2 No. 227.3.
<u>2.2 CONDUIT FASTENINGS</u>	.1	One hole steel straps to secure surface conduits 50 mm and smaller. Two hole steel straps for conduits larger than 50 mm.
	.2	Beam clamps to secure conduits to exposed steel work.

	.3	Channel type supports for two or more conduits at 1.5 m on centre.
	.4	Threaded rods, 6 mm diameter, to support suspended channels.
2.3 CONDUIT FITTINGS	.1	Fittings: manufactured for use with conduit specified. Coating: same as conduit.
2.4 EXPANSION FITTINGS FOR RIGID CONDUIT	.1	Weatherproof expansion fittings for linear expansion at entry to panel.
2.5 FISH CORD	.1	Polypropylene.

Part 3 Execution

3.1 INSTALLATION	.1	Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass.
	.2	Use rigid hot dipped galvanized steel threaded conduit where specified.
	.3	Use epoxy coated conduit in corrosive areas.
	.4	Use electrical metallic tubing (EMT) where conduit is cast in concrete or where conduit will be exposed to mechanical injury. Use rigid galvanized steel conduit within 2.4 m of the floor if conduit may be subject to mechanical injury.
	.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. Replace conduit if kinked or flattened more than 1/10th of its original diameter.
	.9	Use a pipe bender to bend steel conduit up to 21 mm diameter. Use a hydraulic bender or factory bends for conduit larger than 21 mm in diameter.
	.10	Field threads on rigid conduit must conform to table 40 in the CEC.
	.11	Install fish cord in empty conduits.
	.12	Remove and replace blocked conduit sections. Do not use liquids

to clean out conduits.

.13 Dry conduits out before installing wire.

**3.2 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.

**3.3 CONCEALED
CONDUITS**

.1 Run parallel or perpendicular to building lines.

.2 Do not install horizontal runs in masonry walls.

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

END OF SECTION

- .1 Shunt trip.
- .2 Auxiliary switch.
- .3 On-off locking device.

Part 3 Execution

- 3.1 INSTALLATION** .1 Install circuit breakers as indicated.

END OF SECTION

Part 1 General

**1.1 RELATED
REQUIREMENTS**

- .1 Division 01 – General Requirements.
- .2 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 and Dead Front Switches.
 - .2 CSA C22.2 No. 39-13, Fuseholder Assemblies.

1.3 SUBMITTALS

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

**1.4 WASTE
MANAGEMENT AND
DISPOSAL**

- .1 Waste management and disposal to be in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

Part 2 Products

**2.1 DISCONNECT
SWITCHES**

- .1 Fusible and non-fusible, horsepower rated disconnect switch in CSA Enclosure Type as indicated to CAN/CSA C22.2 No.4 size as indicated.
- .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 Fuseholders: to CSA C22.2 No.39 suitable without adaptors, for type and size of fuse indicated.
- .5 Quick-make, quick-break action.
- .6 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

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- 3.1 INSTALLATION** .1 Install disconnect switches complete with fuses if applicable.

END OF SECTION