

PART 1 - GENERAL

- 1.1 References .1 Canadian Standards Association (CSA International)
- .1 Do complete installation in accordance with CSA C22.1-06, Canadian Electrical Code, Part 1 (latest Edition), Safety Standard for Electrical Installations, except where specified otherwise.
 - .2 Comply with CSA Certification Standards and Electrical Bulletins in force at time of Tender submission.
 - .3 CAN/CSA-C22.3 No. 1-01(Update March 2005), Overhead Systems.
 - .4 CAN3-C235-83(R2000), 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 SP1147, The Authoritative Dictionary of IEEE Standards Terms, 7th Edition.
- 1.2 Definitions .1 Electrical and electronic terms: unless otherwise specified or indicated, terms used in these specifications, and on drawings, are those defined by IEEE SP1147.
- 1.3 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.
- 1.4 Submittals .1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit for review single line electrical diagrams under plexiglass and locate in the Main Electrical Room.
- .3 Shop drawings:
- .1 Submit shop drawings, product data and samples in accordance with Section 01 33 00.
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- 1.4 Submittals (Cont'd)
- .3 Shop drawings:(Cont'd)
 - .2 Submit drawings to be stamped and signed by professional engineer.
 - .3 Where applicable, 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.
 - .4 Where applicable, identify on wiring diagrams circuit terminals and indicate internal wiring for each item of equipment and interconnection between each item of equipment.
 - .5 Where applicable, indicate on drawings clearances for operation, maintenance, and replacement of operating equipment devices.
 - .6 If changes are required, notify Engineer of these changes before they are made.
 - .4 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 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 Electrical Inspection Department upon completion of work to Engineer.
- 1.5 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 journeymen 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.
 - .2 Permitted activities: determined based on training level attained and demonstration of ability to perform specific duties.
 - .3 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 29 06 - Health and Safety Requirements.
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- 1.6 Delivery, Storage and Handling
- .1 Material Delivery Schedule: provide Engineer with schedule within 2 weeks after award of Contract.
 - .2 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
- 1.7 System Startup
- .1 Instruct 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.
- 1.8 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.
- 1.9 Operation and Maintenance Data
- .1 Provide operation and maintenance data for incorporation into operation and maintenance manual specified in Section 01 33 00.
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- 1.9 Operation and Maintenance Data (Cont'd)
- .2 Include in operations and maintenance data:
- .1 Details of design elements, construction features, component function and maintenance requirements, to permit effective start-up, operation, maintenance, repair, modification, extension and expansion of any portion or feature of installation.
 - .2 Technical data, product data, supplemented by bulletins, component illustrations, exploded views, technical descriptions of items, and parts lists. Advertising or sales literature not acceptable.
 - .3 Wiring and schematic diagrams and performance curves.
 - .4 Names and addresses of local suppliers for items included in maintenance manuals.
 - .5 Copy of reviewed shop drawings.
- 1.10 Permits, Fees and Inspections
- .1 Submit to Electrical Inspection Department and Supply Authority necessary number of drawings and specifications for examination and approval prior to commencement of work.
 - .2 Pay associated fees.
 - .3 Engineer will provide drawings and specifications required by the Electrical Inspection Department and Supply Authority at no cost.
 - .4 Notify Engineer of changes required by Electrical Inspection Department prior to making changes.
 - .5 Furnish Certificates of Acceptance from Electrical Inspection Department and authorities having jurisdiction on completion of work to Engineer.
- 1.11 Contract Drawings
- .1 The Drawings for the Electrical work are diagrammatic performance Drawings only, intended to convey the scope of work and indicate the general arrangement and approximate location of apparatus and fixtures, and the approximate sizes and locations of equipment and outlets. The Drawings do not intend to show Architectural, Mechanical or Structural details.
 - .2 Do not scale or measure Drawings, but obtain information regarding accurate dimensions, from the dimensions shown on the Architectural Drawings, or by site measurements. Follow the Electrical Drawings for laying out the work.
 - .3 Refer to the other Division's Coordination Drawings, to become familiar with all conditions affecting the work, and verify suitable spaces exist, in which the equipment will be installed.
 - .4 Make, at no additional cost, any changes or additions to materials and equipment necessary to accommodate Structural conditions (offsets around beams, columns, etc.).
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1.11 Contract Drawings (Cont'd)

- .5 Alter at no additional cost, the location of materials and/or equipment as directed, provided that the changes are made before installation, and do not necessitate additional materials.
- .6 Install ceiling mounted components (such as lighting fixtures, heat detectors, speakers, etc.) in accordance with dimensioned reflected ceiling drawings, prepared by the (Architectural) Consultant.
- .7 Leave space clear, and install equipment to accommodate future materials and/or equipment as indicated or specified, or to accommodate equipment and/or materials supplied by other Contractors.
- .8 Verify that the spaces in which the equipment is to be installed is sufficient and install all equipment to maintain head room and clearances, to conserve space, comply with codes, and to ensure adequate space for future servicing.
- .9 Confirm at the site, the exact location of equipment, outlets and fixtures, and the location of outlets for equipment supplied by other Contractors, before installation.

1.12 As-Built Drawings

- .1 Provide As-Built Drawings of the installation from the Record Drawings.

1.13 Completion of Contract

- .1 All the equipment must be cleaned and tested, before final acceptance by the Consultant.
- .2 From the date of issuance of a "Certificate of Substantial Performance", all equipment, materials and workmanship, other than lamps, must be unconditionally warranted for not less than 1 (one) year.
- .3 Defects and deficiencies which originate or become evident during the warranty period must be repaired or replaced, at no cost.
- .4 If, during the warranty period, transformers, ballasts or other noise and vibration producing equipment are considered by the Consultant to exceed acceptable standards, then these must be replaced without delay or additional cost to the Owner. All work relating to the replacement of defective items must be carried out after normal working hours and at a time which is acceptable to the Owner.

1.14 Existing Conditions

- .1 Visit the site and examine existing conditions affecting the work of this Division.
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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 material and equipment are not available, obtain special approval from inspection authorities 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 Supplier and installer responsibility is indicated on the Drawings and in the Motor Control Schedule. Mechanical responsibility is indicated on the Mechanical Drawings and in the Mechanical Specification.
 - .2 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 inspection authorities and Engineer.
 - .2 Decal signs, minimum size 175 x 250 mm (7" x 10").
- 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: lamicoïd 3 mm (1/8") thick plastic engraving sheet, black face, white core, lettering accurately aligned and engraved into core, self adhesive unless specified otherwise.
 - .2 Sizes as follows:

NAMEPLATE SIZES

Size 1	10 x 50 mm(2/5"x 2")	1 line	3 mm(1/8") high
Size 2	12 x 70 mm(1/2"x 2 3/4")	1 line	5 mm(1/5") high
Size 3	12 x 70 mm(1/2"x 2 3/4")	2 lines	3 mm(1/8") high
Size 4	20 x 90 mm(3/4"x 3 1/2")	1 line	8 mm(1/3") high
Size 5	20 x 90 mm(3/4"x 3 1/2")	2 lines	5 mm(1/5") high
Size 6	25 x100 mm(1" x 4")	1 line	12mm(1/2") high
Size 7	25 x100 mm(1" x 4")	2 lines	6 mm(1/4") high

2.5 Equipment
Identification
(Cont'd)

- .1 (Cont'd)
- .2 Sizes as follows:(Cont'd)
- .2 Labels: embossed plastic labels with 6 mm (1/4") high letters unless specified otherwise.
- .3 Wording on nameplates and labels to be approved by Engineer 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, either numbered or coloured plastic tapes, on both ends of phase conductors of feeders and branch circuit wiring.
- .2 Maintain phase sequence and colour coding throughout.
- .3 Colour coding: to CSA C22.1.
- .4 Use colour coded wires in communication cables, matched throughout system.

2.7 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 (1") wide prime colour and 20 mm (3/4") wide auxiliary colour.

	<u>Prime</u>	<u>Auxiliary</u>
up to 250 V	Yellow	
up to 600 V	Yellow	Green
up to 5 kV	Yellow	Blue
up to 15 kV	Yellow	Red

2.7 Conduit and
Cable
Identification
(Cont'd)

.3 Colours:(Cont'd)

Telephone	Green	
Other Communication Systems	Green	Blue
Fire Alarm	Red	
Emergency Voice	Red	Blue
Other Security Systems	Red	Yellow

2.8 Finishes

- .1 Shop finish metal enclosure surfaces by removal of rust and scale, cleaning, application of rust resistant primer inside and outside, and at least two coats of finish enamel.
- .1 Paint outdoor electrical equipment "equipment green" finish to EEMAC Y-1-1-1955.
- .2 Paint indoor switchgear and distribution enclosures light gray to EEMAC 2Y-1-1958.

2.9 Standard of
Acceptance

- .1 Means that item named meets specifications in all respects regarding performance, quality of material and workmanship, and is acceptable to Engineer without qualification. Equipment proposed shall meet same standards and must be approved ten (10) days prior to tender closing.
- .2 Requests for approvals will only be accepted from manufacturers or their representatives.
- .3 "Approved Equals" will be acceptable as a base bid item.
- .4 "Approved Alternates" will be indicated with the tender on the form supplied, indicating price increase or decrease to the bid, should the alternate be accepted.

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: plastic, sized for free passage of conduit, and protruding 50 mm (2").
- .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, where indicated on the Drawings.
- .2 Do not install outlets back-to-back in wall; allow minimum 150 mm (6") horizontal clearance between boxes.
- .3 Change location of outlets at no extra cost or credit, providing distance does not exceed 3000 mm (10') , and information is given before installation.
- .4 Locate light switches on latch side of doors.
- .1 Locate disconnect devices in mechanical and elevator machine rooms on latch side of floor.
- 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.
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3.5 Mounting Heights <u>(Cont'd)</u>	.3	Install electrical equipment at following heights unless indicated otherwise. .1 Local switches: 1200 mm (48"). .2 Wall receptacles: .1 General: 450 mm (18"). .2 Above top of continuous baseboard heater: 200 mm (8"). .3 Above top of counters or counter splash backs: 175 mm (7"). .4 In mechanical rooms: 1400 mm (56"). .3 Panelboards: as required by Code or as indicated.
3.6 Co-ordination of Protective Devices <u></u>	.1	Ensure circuit protective devices such as overcurrent trips, relays and fuses are installed to required values and settings.
3.7 Field Quality Control <u></u>	.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 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 generation and 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	Carry out tests in presence of Engineer.
	.4	Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.

- 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 Protection .1 Protect exposed live equipment during construction for personnel safety.
- .2 Shield and mark live parts "LIVE 120 VOLTS", or with appropriate voltage in English.
- .3 Arrange for installation of temporary doors for rooms containing electrical distribution equipment. Keep these doors locked except when under direct supervision of electrician.
- 3.10 Fireproofing .1 Where cables, cable tray or conduits pass through non fire-rated floors, walls or roof, provide internal and external sealing thereto.
- .2 Retain the service of a specialty sealant contractor for the work required.
- .3 Comply with manufacturer's installation instructions for all sealant applications.
- .4 For non fire-rated locations, sealant shall be silicone that meets the requirements of CGSB 19-GP-23, for the size of the joint required, and the types of materials being bonded.
- .5 For fire rated locations, the fire stop shall meet the requirements of ULC with regards to the type of assembly and the fire separation.
- 3.11 Co-ordination of Protective Devices .1 Ensure circuit protective devices such as overcurrent trips, relays and fuses are installed to values and settings as indicated.
- 3.12 Cutting and Patching .1 All cutting and patching shall be provided by the General Contractor in accordance with Section 01 73 00.
- .2 This Contractor to provide layout drawings for all openings required for the completion of their work.
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- 3.13 Demolition .1 All demolition shall be the responsibility of the General Contractor in accordance with Section 02 41 99.
- 3.14 Noise and Vibration .1 Electrical equipment is to operate without objectionable noise or vibration. If, in the opinion of the Consultant, the equipment operates with excessive noise or vibration, then the equipment must be replaced or noise or vibration eliminated.
- .2 Connections to noise-producing and vibrating equipment (i.e. transformers) must be made with flexible conduit. Use a minimum of 1m (3 ft.) of flexible cable at each device, formed into a 360 deg. loop.
- .3 Vibration isolators are to be provided where indicated or required.