

PART 1 – GENERAL

1.1 GENERAL

- .1 The general conditions of this contract as well as the provisions of Division 1 are part of and to be read in conjunction with this section.

1.2 ELECTRICAL WORK INCLUDED

- .1 The specification complements the drawings in describing the supply and installation of a complete electrical system. This system shall include but not necessarily be limited to the following:
 - .1 Small power system including wiring devices;
 - .2 Lighting system including luminaries, including wiring;
 - .3 Demolition of existing as noted.

1.3 CONTRACT DRAWINGS

- .1 The specification together with the drawings are intended to provide a description of a complete electrical system and therefore there shall be no omission of the items necessary or required to make a finished, workmanlike, first class installation, even though each and every item of labour and material may not be mentioned in the specification or shown on the drawings.
- .2 Items indicated on plans and not on riser diagrams, or vice versa, shall be considered fully covered by both.
- .3 Runs of conduit and outlet locations indicated on the drawings are diagrammatic and exact locations must be determined by this contract as the work proceeds, with due regard to the structure and the work of other trades. This contract shall make any changes dictated by structural requirements, or conflicts with other trades, without charge.
- .4 Apparent errors or omissions shall be referred to the Departmental Representative whose decision shall be final.

1.4 CODES AND STANDARDS

- .1 As a minimum standard perform all work in accordance with the requirements of the Provincial Department of Labour, Canadian Electrical Code C22.1-2021 Part 1, CSA Standards CAN Z32.4 and CAN Z32.2, National Building Code, and ULC-S524:2014-AMD1. These standards together with all local or municipal rules, regulations, and ordinances shall be considered as the latest approved editions at the time of tender closing. In no instance, shall the standard established in these contract documents, be reduced by any codes.
 - .2 Do underground systems in accordance with CSA CAN-C22.3 No. 7-94.
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- .3 Abbreviations for electrical terms: to CSA Z85-1983.
- .4 Comply with CSA Certification Standards and Electrical Bulletins in force at the time of tender submission.

1.5 INSPECTIONS, PERMITS AND FEES

- .1 Obtain all inspections and permits required by all laws, ordinances, rules and regulations by the public authority having jurisdiction at the place of the work of this Contract and obtain certificates of such inspections and submit same and pay all charges in connection therewith. The final certificate of inspection shall be obtained before final payment for work shall be considered due.

1.6 QUALITY ASSURANCE

- .1 All electrical work to be carried out by qualified, licensed electricians or apprentices as per the conditions of the Provincial Act respecting manpower vocational training and qualifications. Employees registered in a provincial apprentices program shall be permitted, under the direct supervision of a qualified licenses electrician, to perform specific tasks – the activities permitted shall be determined based on the level of training attained and the demonstration of ability to perform specific duties.

1.7 SHOP DRAWINGS, PRODUCT DATA AND SAMPLES

- .5 Submit shop drawings, product data and samples in accordance with Division 1. Provide all shop drawings within 30 days after contract has been awarded. Failure to do so will delay progress payments.
- .6 Indicate details of construction, dimensions, capacities, weights and electrical performance characteristics of equipment or material.
- .7 Where applicable, include wiring, single line and schematic diagrams.
- .8 Provide shop drawings for poles, panels, light fixtures, contactors and wiring devices.
- .9 Include wiring drawings or diagrams showing interconnection with work of other Sections.
- .10 Keep one copy of shop drawings and product data on site, available for reference at all times.

1.8 OPERATION AND MAINTENANCE DATA

- .1 Provide operation and maintenance data for incorporation into Operation and Maintenance Manuals as specified in Division 1.
 - .2 Include in the operation and maintenance data:
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- .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 description 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.
 - .6 Signed receipt for all spare parts.
- .3 Approvals:
- .1 Submit one draft of Operating and Maintenance Manual to Departmental Representative for approval one month prior to estimated substantial completion date. Submission of individual data will not be accepted unless so directed by Departmental Representative.
 - .2 Make any changes in submission as may be required and re-submit as directed.
 - .3 **Failure to do so will result in delay of progress payment.**
 - .4 Provide two (2) final bound copies of Operation and Maintenance Manuals to Departmental Representative.

1.9 PROJECT RECORD DOCUMENTS

- .1 Provide Project Record Documents in accordance with Division 1.
- .2 Submit record drawings to Departmental Representative showing changes of wire sizes, circuit numbering and location of raceways, fittings, fixtures, panels and equipment, and their sizes, the location of which has changed or deviated during the work.
- .3 Submit reproducible copy of record drawings after record drawings have been approved by the Departmental Representative. Originals shall be made available by the Departmental Representative for the making of reproducible copies of the contract drawings. All changes reflected on record drawings are to be indicated on these record drawings.

1.10 MAINTENANCE MATERIAL

- .1 Provide maintenance materials in accordance with Division 1.

1.11 CARE, OPERATION AND START UP

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

1.12 VOLTAGE RATINGS

- .1 Operating voltages to meet requirements of CAN3-C235.
- .2 Motors, control and distribution equipment to operate satisfactorily at 60 Hz within normal operating limits established by the above standard. Equipment to operate in extreme operating conditions established in the above standard without damage to the equipment.

1.13 MATERIAL AND EQUIPMENT

- .1 Provide materials and equipment in accordance with Division 1.
- .2 Equipment and materials to be C.S.A. certified, and manufactured to standard quoted.
- .3 Where there is no alternative to supplying equipment which is not C.S.A. certified, obtain special approval from C.S.A.
- .4 Factory assemble control panels and component assemblies.
- .5 For the purposes of uniformity similar materials shall be of one manufacturer (i.e. all panels; all motor control equipment; all fixtures in as much as is possible, etc.).
- .6 To avoid the possibility of the work being delayed, order all materials as soon as the shop drawings are reviewed, and report at once to the Departmental Representative any delays in the delivery of materials which would hold up the completion of the job.

1.14 GROUNDING

- .1 All equipment and exposed non-current carrying metal, conduits and parts shall be permanently and effectively grounded to meet minimum requirements of the C.E.C. Section 10, and as indicated on the drawings and further specified. Standards set either by drawings or specifications which are above those covered by C.E.C. Section 10, shall not be reduced under any circumstances.

1.15 ELECTRIC MOTOR, EQUIPMENT AND CONTROLS

- .1 Not Applicable.

1.16 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 Y1-1-1955.
- .2 Clean and touch up surfaces of shop-painted equipment scratched or marred during shipment or installation, to match original paint.
- .3 Clean, prime and paint exposed hangers, racks, and fastenings to prevent rusting.
- .4 Where wire guards are specified in other sections, they are to be constructed of stainless steel. Painted steel is not acceptable.

1.17 EQUIPMENT IDENTIFICATION

- .1 All switchboards, motor control centres, disconnect switches, dry-type transformers starters, pushbuttons, panels, etc., shall have "Lamacoid" nameplates mounted on or adjacent for identification which shall include the panel designation, voltage, phase, wires overcurrent protection, H.P., KW and amperage as applicable. The nameplates shall be affixed to equipment with permanent adhesive backing.
 - .2 Install directories on the back of each door of panel boards, neatly arranged and mounted in frame under transparent cover. Directories shall be typed and shall show system voltage, which outlets are on each circuit and any special information, such as sizes of fuses, etc., necessary for the proper operation and maintenance of the system.
 - .3 All sectionalising panels shall have lamacoid plates affixed adjacent to each breaker.
 - .4 Size of identification shall be suitable for equipment and importance of information.
 - .5 All fused disconnect switches shall have lamacoid plates identifying the equipment they feed and a separate plate indicating maximum fuse size and type.
 - .6 Lettering shall be of sufficient size to be readable from normal viewing distance and the information required on the nameplates shall dictate the physical size of plates.
 - .7 Nameplates shall have **white lettering on black background** except for equipment connection to emergency power source, which shall have **white lettering on red background**.
 - .8 All transformers to have lamacoid plates identifying source of primary feeder and secondary equipment which it feeds plus distribution designation lettering and/or numbers.
 - .9 All "D" and "E" boxes 200 x 200 x 100" or larger and "C" and "T" cabinets shall have lamacoid plates affixed indicating voltages and/or systems housed within.
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.10 Nameplates:

.1 Lamicoid 1/8" thick plastic engraving sheet.

NAMEPLATE SIZES

Size 1	10mm x 50mm	1 line	1/8"	high letters
Size 2	13mm x 69mm	1 line	1/8"	high letters
Size 3	13mm x 69mm	2 lines	1/8"	high letters
Size 4	19mm x 91mm	1 line	3/8"	high letters
Size 5	19mm x 91mm	2 lines	1/4"	high letters
Size 6	25mm x 100mm	1 line	1/2"	high letters
Size 7	25mm x 100mm	2 lines	1/4"	high letters

.11 Labels:

.1 Embossed plastic labels with 6.5mm high letters unless specified otherwise.

.12 Wording on nameplates and labels to be approved by the Departmental Representative prior to manufacture.

.13 Allow for average of twenty-five (25) letters per nameplate and label.

.14 Identification to be English.

1.18 WIRING IDENTIFICATION

.1 Identify wiring with coloured plastic tapes, on both ends of phase conductors for feeders.

.2 Maintain phase sequence and colour coding throughout.

.3 Colour code to meet requirements of CSA C22.1-1998.

.4 Use color coded wires in branch circuit wiring, systems wiring and communication cables.

1.19 CONDUIT AND CABLE IDENTIFICATION

.1 Identify conduit and metallic sheathed cable runs for the various systems with 25mm coloured bands placed on conduit run every 3 metres of length and at least one should appear in each room and at points where conduit or cable enters wall, ceiling or floor.

.2	<u>System</u>	<u>Colour</u>
	600/347V Power	Orange
	120/208V Lighting & Power	Yellow

1.20 WIRING TERMINATION

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

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

1.21 MANUFACTURERS AND CSA LABELS

- .1 Manufacturers and CSA labels shall be visible and legible after equipment is installed.

1.22 WARNING SIGNS

- .1 Provide warning signs, as specified and/or to meet the requirements of the Department of Labour Inspection Department.
- .2 Use decal signs, minimum 175mm x 250mm size.

1.23 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.

1.24 LOAD BALANCE

- .1 Balance all phase currents of transformers, main switchboard, distribution Panel boards, etc., and where applicable, adjust transformer taps to obtain within 2% of the rated voltage of the load being supplied. Make adjustments and/or increase conductor size so as to limit voltage drops to 3% and make such adjustments under average load conditions in presence of Departmental Representative.
- .2 Submit to Departmental Representative, at completion of work, a report listing the voltage, phase and neutral currents on the switchboard, Panel boards and dry-type transformers, operating under normal load. On the report also, state hour and date on which each load was measured.

1.25 TESTS

- .1 Conduct and pay for tests of the following:
 - .1 Power distribution system including phasing, voltage, grounding and load balancing.
 - .2 Circuits originating from branch distribution panels.
 - .3 Lighting and its control.
 - .2 Furnish manufacturer's certificate or letter confirming that entire installation as it pertains to each system has been installed to manufacturer's instructions.
 - .3 Carry out tests in presence of Departmental Representative. Notify Departmental Representative seven (7) days in advance of time testing will take place.
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- .4 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.
- .5 The Departmental Representative reserves the right to use any piece of electrical equipment, device, or material installed under this contract for such reasonable lengths of time and at such times as he may be required to make a complete and thorough test of the same, before the final completion and acceptance of the work.
- .6 Such tests shall not be construed as acceptance of any part of the work.
- .7 Submit test results for Departmental Representative review.

1.26 INSULATION RESISTANCE TESTING

- .1 Test all wiring, included in the work to ensure that there are no shorts and/or grounds are present on phase conductors for feeders or branch circuits and that insulation values are as required by the Canadian Electrical Code.
- .2 All testing of conductors to be done prior to energization of conductors with 600 volt and 1000 volt meggers as required by the Canadian Electrical Code.
- .3 Capacitive leakage testing of all phases and neutral feeder conductors at various systems originating points, are to be recorded for each individual feeder with test results to be submitted to Departmental Representative for approval.
- .4 Systems to be tested for capacitive leakage are as follows: 120/208V/3PH/4W, and 347/600V/3PH./4W.
- .5 Check resistance to ground before energizing. Ensure resistance to ground is not less than 50 megohms.
- .6 Submit test results for Departmental Representative's review. Test results shall include time of test, feeder tested, and instrument readings.

1.27 CLEANING

- .1 Do final cleaning in accordance with Division 1.
 - .2 At time of final cleaning, clean lighting reflectors, lenses and other lighting surfaces that have been exposed to construction dust and dirt.
 - .3 On completion of work, remove debris resulting from work of this Division and leave the site neat and tidy. Equipment shall be checked for proper fitting and alignment, adjusted, cleaned, repainted where necessary, and left in first class condition.
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- .4 This section shall be responsible for the removal of spatters, droppings, soil, labels, and debris from finished surfaces and from surfaces to receive finishes, before the set up. Work and adjacent finished work shall be left in new condition.
- .5 Only cleaning materials which are recommended for the purpose by both the manufacturer of the surface to be cleaned and of the cleaning material shall be used.
- .6 Material at site cannot be burned or buried except where approved by Departmental Representative. Removal shall be as often as required to avoid accumulation in order to ensure site is maintained clean.
- .7 Volatile fluid wastes cannot be disposed of in storm or sanitary sewers or in open drain courses.

1.28 COORDINATION

- .1 Cooperate and investigate with other trades to make maximum use of the spaces. Avoid conflicts with pipes, ducts, etc. Prepare shop drawings indicating the route of main conduits and ducts for submission to the Departmental Representative for approval.
- .2 Cooperate with other trades on the site and carry out the work, in such a way, as not to hinder or hold up the work of other trades.
- .3 Consult with other trades, where their respective installations conflict and re-route conduits, ducts, outlets, equipment, etc., as required, subject to the approval of the Departmental Representative.

1.29 SUPERVISION

- .1 Provide supervision and sufficiently qualified foreman for work of this Contract to ensure that the work proceeds in proper and efficient manner to its completion. If in the opinion of the Departmental Representative, such personnel are not competent to carry out the work, replace these personnel immediately upon written request of the Departmental Representative.

1.30 COMMISSIONING OF ELECTRICAL SYSTEMS

- .1 Upon receipt of written verification from the Contractor that:
 - .1 All systems are complete and operational in all respects.
 - .2 All specified reports and documents have been submitted and approved.
 - .3 All demonstrations have been completed and documented, the Departmental Representative will commence a systems' commissioning period.
 - .2 During this period of not more than 20 working days, the Departmental Representative will verify the operation of all systems. The commissioning process may involve real or simulated conditions to determine the systems full operational capabilities. Copies of all specified reports and documents are to be available on site during the commissioning period.
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- .3 During the commissioning process, the on-site foreman of the electrical subtrade involved in the supervision of the work plus one electrician is to be on site providing full-time assistance to the Departmental Representative. In addition, systems' suppliers' representatives are to be available to be on site providing full-time assistance to the Departmental Representative within 48 hour's notice to assist in the verification of their respective systems.
- .4 All necessary equipment such as meters, load banks, etc., required to fully commission the systems are to be made available to the Departmental Representative.
- .5 Deficiencies or discrepancies discovered during the commissioning process are to be immediately rectified. Exceptional arrangements for labour and materials will be required to correct deficiencies, which prevent the satisfactory completion of the commissioning process.

1.31 UTILITY SERVICES

- .1 Division 26 Contractor is financially responsible to provide complete electrical, system as specified including all necessary equipment and connections to the selected power Utility. Payment of permits and other charges as may be levied by the Utilities shall be included in tender price.

- - END OF SECTION - -

PART 1 – GENERAL

1.1 REFERENCE STANDARDS

- .1 CSA C22.2 No. 18 - Clamps and connectors.
- .2 CSA C22.2 No. 65 Wire Connectors.

PART 2 - PRODUCTS

2.1 MATERIALS

- .1 All connections shall be made electrically and mechanically secure. Sizes of connectors shall be according to manufacturer's recommendations for each size and combination of wires.
- .2 Joints required in branch wiring #10 AWG and smaller shall be made using fixture twist-on type connectors with current carrying parts made of copper.
- .3 Joints for wiring #8 AWG and larger shall be made using pressure type colour keyed compression connectors with current carrying parts made of copper using compression tools. A first layer of tape shall be compound type followed by a layer of Scotch #3 vinyl type.
- .4 Bushing stud connectors: As required to suit conductors.
- .5 Clamps or connectors for armoured cable and flexible conduit as required.

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Remove insulation carefully from ends of conductors and:
 - .1 Install mechanical pressure type connectors and tighten screws with appropriate compression tool recommended by manufacturer. Installation shall meet secureness tests in accordance with CSA C22.2 No. 65.
 - .2 Install fixture type connectors and tighten. Replace insulating cap.
- .2 All connections shall be made electrically and mechanically secure. Sizes of connectors shall be according to manufacturer's recommendations for each wire size and combination of wires. Twist wires together before installing connectors. All stranded conductors shall be twisted together prior to connection around terminal.

- - END OF SECTION - -

PART 1 – GENERAL

1.1 REFERENCE STANDARDS

- .1 CSA C22.2 No. 38 - Thermoset insulated Wires and Cables.
- .2 Wire and cable shall conform to the latest specification of the Canadian Standards Association (CSA), Electrical and Electronic Manufacturers Association of Canada (EEMAC), the Insulated Power Cable Engineers Association (IPCEA), and the American Society of Testing Materials (ASTM).

1.2 SHOP DRAWINGS AND PRODUCT DATA

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

PART 2 - PRODUCTS

2.1 CONDUCTORS

- .1 Conductors: Copper, soft drawn stranded, at least 98% conductivity for #10 AWG and larger. Insulation shall be chemically cross-linked thermosetting polyethylene rated 600 volts on all RW90 conductors and 1000 volts for RWU-90 for incoming service. Size as indicated on drawings and schedules. Conductor insulation shall be colour coded as follows:

Phase A	-	Red
Phase B	-	Black
Phase C	-	Blue
Neutral	-	White
Ground	-	Green

Isolated Power - as indicated hereinafter.

Where extra colours are required for three-way switches, etc., they shall be yellow.
Approved color coded tape is acceptable for color coding phase conductors #1 AWG and larger and for neutral and ground conductors #4/0 and larger.

2.2 CONTROL CABLES

- .1 600 V Type: 2 stranded copper conductors, 95% conductivity, full size AWG gauge, sizes as indicated with PVC insulation Type TW with shielding of magnetic tape wire braid over each pair of conductors and overall covering of thermoplastic jacket. Colour code shall be orange and brown.

2.3 SYSTEM WIRING

- .1 Wiring for auxiliary systems will be as indicated in specification or on drawings and/or as recommended by Manufacturer of the system.
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PART 3 - EXECUTION

3.1 INSTALLATION OF BUILDING WIRES

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

3.2 INSTALLATION OF CONTROL CABLES

- .1 Install control cables in conduit.
- .2 Ground control cable shield.

3.3 INSTALLATION - GENERAL

- .1 Where pulling wires and cables, the use of an approved lubricant only will be permitted. No wires or cables shall be pulled in conduits until such conduits are free from moisture and in no case shall wires be pulled until approval of the Departmental Representative is obtained.
 - .2 All stranded conductors prior to terminating under device bolts such as circuit breakers, light switches, receptacles, etc., to be twisted together to form a single conductor to ensure a reliable mechanical connection.
 - .3 "Labelling" of all branch circuit wiring including phase conductors, neutrals, ground and/or bonding conductors to be done on **both ends** of all circuit wires plus in any junction and/or pull boxes located in between using "Panduit" write-on, self laminating labels as required.
 - .4 The following wiring methods are designed to enhance the ability to perform capacitive leakage tests:
 - .1 All circuit conductors are to be individually tie wrapped to their corresponding labelled neutral conductor in all panelboards, pullboxes and junction boxes. Enough slack conductor length should be left to enable the ability to clamp the ground detector around the individually tie-wrapped circuit conductor and its corresponding labelled neutral. This wiring method is to be neat and of good workmanship quality.
 - .2 The tie wrapping of the neutral with its respective phase conductors is to be made at the closest point of entry into panelboards, pullboxes and junction boxes.
 - .3 The main switchboard, CDP's, panelboards, MCC's etc, are to have their respective feeder phase and neutral conductors tie-wrapped together and enough slack conductor length to enable the ability to clamp the ground detector around each set of feeders. This wiring method is to be neat and of good workmanship quality.
 - .4 After all electrical wiring has been completed by the Electrical Sub-Contractor, he is to test the grounded electrical distribution system to ensure there are not ground shorts and capacitive leakage in the system.
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- .5 All feeders or branch circuits which do not have neutral conductors are to have their respective phase conductors tie-wrapped together in accordance to the methods described previously.
- .6 Run all circuits so that the voltage drop in no case exceeds 3% of the line volts. The neutral wire, wherever it is run, shall be continuous with no fuses, switches, or breaks of any kind.
- .7 For 15 amp, 120 volt circuits the following table shall be used to determine the minimum conductor sizes required to compensate for voltage drop.
- .8 Find below the branch circuit maximum lengths (120 volt one way length from panelboard to load including vertical drops. Do as to limit voltage drop to 3%).
 - .1 From 0.3m to 24m #12 Wire
 - .2 From 24m to 37m #10 Wire
 - .3 From 37m to 55m #8 Wire
- .9 Increased wire sizes where required shall not be decreased in size in any portion of length of run between panelboard and the wiring device itself.
- .10 All wire shall be color coded as per Code requirements and/or as specified herein.

- - END OF SECTION - -

PART 1 – GENERAL

1.1 REFERENCE STANDARDS

- .1 CSA C22.2 No. 41 - Grounding and Bonding Equipment.

1.2 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with local requirements.
- .2 Place materials defined as hazardous or toxic waste in designated containers.
- .3 Ensure emptied containers are sealed and stored safely for disposal away from children.
- .4 Collect and separate plastic, paper packaging and corrugated cardboard in accordance with Waste Management Plan.

PART 2 - PRODUCTS

2.1 EQUIPMENT

- .1 Clamps for grounding of conductor, size as required to electrically conductive ground rods.
- .2 System and circuit, equipment, grounding conductors, bare stranded copper, un-tinned, soft annealed, un-armoured, size as indicated.
- .3 Insulated grounding conductors to Section 26 05 21.
- .4 Non-corroding accessories necessary for grounding system, type, size, material as indicated, including but not necessarily limited to:
 - .1 Grounding and bonding bushings.
 - .2 Protective type clamps.
 - .3 Bolted type conductor connectors.
 - .4 Thermit welded type conductor connectors.
 - .5 Bonding jumpers, straps.
 - .6 Pressure wire connectors.

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Install complete permanent, continuous, system and circuit, equipment, grounding systems including, electrodes, conductors, connectors, busbars, accessories, as indicated, to conform to requirements of Departmental Representative, and local authority having
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jurisdiction over installation. Where EMT is used for panelboard or motor control board feeders, run a separate green ground wire in conduit.

- .2 All conduits for all electrical systems shall contain a minimum # 12 AWG copper bond wire. Wire size shall be increased as required by Table 16 of the CEC or as otherwise noted.
- .3 Install connectors in accordance with manufacturer's instructions.
- .4 Protect exposed grounding conductors from mechanical injury.
- .5 Make buried connections, and connections to electrodes, using compression type connectors.
- .6 Use mechanical connectors for grounding connections to equipment provided with lugs as follows:
 - .1 Copper, one hole, short barrel (single crimp) type lugs shall be used for all wire sizes up to and including #6AWG;
 - .2 Copper, two hole, long barrel (dual crimp) type lugs shall be used for all wire sizes #4AWG and larger;
 - .3 Lugs shall be bolted to bus bars with concave or combination of flat and locking type washers c/w accompanying hardware as required.
- .7 Soldered joints are not permitted.
- .8 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.
- .9 Make grounding connections in radial configuration only, with connections terminating at single grounding point. Avoid loop connections.
- .10 Bond single conductor, metallic armoured cables to cabinet at supply end, and provide non-metallic entry plate at load end.
- .11 Connect building structural steel to ground by welding copper to the steel near service entrance.

3.2 SYSTEM AND CIRCUIT GROUNDING

- .1 Install system and circuit grounding connections to the neutral of the 120/240V systems as required.
 - .2 All cables, feeders and branch circuit conductors installed in conduit shall be complete with a separate minimum size #12AWG solid copper bond/ground wire as follows:
 - .1 Where bond wire sizes larger than #12AWG are required, they shall be increased as required by the Canadian Electrical Code Table 16 or as noted otherwise;
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- .2 #12AWG and larger size bond or ground conductors shall be of soft drawn stranded copper of 98% conductivity, and of full size and AWG gauge;
- .3 Size of ground/bond conductors shall be based upon Table 16 of the Canadian Electrical Code;
- .4 Minimum size #12AWG solid green insulated conductors are acceptable for bonding purposes associated with various other systems rated at 50 volts or less.

3.3 EQUIPMENT BONDING

- .1 Install bonding connections to typical equipment included in, but not necessarily limited to following list: Service equipment, transformers, switchgear, duct systems, frames of motors, starters, control panels, distribution panels, and outdoor lighting.

-- END OF SECTION --

PART 1 - GENERAL

1.1 REFERENCE STANDARDS

- .1 CSA C22.2 No. 18 - Outlet boxes, conduit boxes and fittings.

PART 2 - PRODUCTS

2.1 OUTLET AND CONDUIT BOXES GENERAL

- .1 Size boxes in accordance with Canadian Electrical Code, Part 1.

2.2 PVC BOXES

- .1 Provide cast PVC, reinforced junction and/or pull boxes:
 - .1 With screw down gasketed cover;
 - .2 Stainless steel screws;
 - .3 Conduit hubs;
 - .4 External mounting feet;
 - .5 Corrosion resistant;
 - .6 Approved for wet marine environments;
 - .7 Size as indicated or as per CEC

2.3 CONDUIT SUPPORTS AND FITTINGS

- .1 PVC coated one-hole steel pipe straps for surface conduits less than 50mm and smaller. Two hole PVC coated steel pipe straps for conduits larger than 50mm.
- .2 Galvanized fastening hardware.
- .3 Male and female threaded PVC adapters.

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Support boxes independently of connecting conduits.
 - .2 Mount junction boxes on plywood backboard.
 - .3 Make connections – use split bolt mechanical connectors with heat shrink boots inside JB/PB.
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- - END OF SECTION - -

PART 1 – GENERAL

1.1 REFERENCE STANDARDS

- .1 Canadian Standards Association (CSA)
 - .1 CAN/CSA C22.2 No. 18, Outlet Boxes, Conduit Boxes, and Fittings and Associated Hardware.
 - .2 CSA C22.2 No. 56, Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit, No. 211.2, Rigid PVC Conduit

1.2 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with local requirements.
- .2 Place materials defined as hazardous or toxic waste in designated containers.
- .3 Ensure emptied containers are sealed and stored safely for disposal away from children.
- .4 Collect and separate plastic, paper packaging and corrugated cardboard in accordance with Waste Management Plan as identified in section 01 71 24.

PART 2 - PRODUCTS

2.1 CONDUITS

- .1 Rigid PVC conduit, size as indicated.

2.2 LIQUID TIGHT FLEXIBLE CONDUIT

- .1 Liquid tight flexible conduit to be CSA approved, oil resistant, sun-light resistant, black in color.

2.3 EXPANSION FITTINGS FOR RIGID CONDUIT

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

2.4 FISHCORD

- .1 6.5 mm standard nylon pull rope with tensile strength of 5 kN.

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Use rigid PVC conduit underground and in corrosive areas.
- .2 Install fish cord in empty conduits.
- .3 Dry conduits out before installing wire.

3.2 CONDUITS UNDERGROUND

- .1 Slope conduits to provide drainage.
- .2 Waterproof joints (PVC accepted) with heavy coat of bituminous paint.

-- END OF SECTION --

PART 1 - GENERAL

1.1 RELATED WORK

- .1 Not Applicable.

PART 2 - PRODUCTS

- .1 Not Applicable

PART 3 - EXECUTION

3.1 CABLE INSTALLATION IN DUCTS

- .1 Install cables as indicated, in ducts.
- .2 Do not pull spliced cables inside ducts.
- .3 Install multiple cables in duct simultaneously.
- .4 Use CSA approved lubricants of type compatible with cable jacket to reduce pulling tension.
- .5 To facilitate matching of colour coded multi conductor control cables reel off in same direction during installation.
- .6 Before pulling cable into ducts and until cables are properly terminated seal ends of non-leaded cables with moisture seal tape.
- .7 After installation of cables, seal duct ends with duct sealing compound.

3.2 TESTING

- .1 Perform tests in accordance with Section 26 05 00.
 - .2 Perform tests using qualified personnel. Provide necessary instruments and equipment.
 - .3 Check phase rotation and identify each phase conductor of each feeder.
 - .4 Check each feeder for continuity, short circuits and grounds. Ensure resistance to ground of circuits is not less than 50 megohms.
 - .5 Pre-acceptance tests.
 - .1 After installing cable but before splicing and terminating, perform insulation resistance test with 600 V megger on each phase conductor.
 - .2 Check insulation resistance after each splice and/or termination to ensure that cable system is ready for acceptance testing.
-

- .6 Acceptance Tests
 - .1 Ensure that terminations and accessory equipment are disconnected.
 - .2 Ground shields, ground wires, metallic armour and conductors not under test.
- .7 Provide Departmental Representative with list of test results showing location at which each test was made, circuit tested and result of each test.
- .8 Remove and replace entire length of cable if cable fails to meet any of the test criteria.
- .9 Failure to provide test results will delay progress billing.

-- END OF SECTION --

PART 1 – GENERAL

1.1 REFERENCE STANDARDS

- .1 CSA C22.2 No. 29-M1983 - Panelboards and panelboard enclosures.

1.2 RELATED WORK

- .1 Common Work Results Electrical: Section 26 05 00.

1.3 SHOP DRAWING AND PRODUCT DATA

- .1 Submit shop drawings and product data in accordance with Division 1.
- .2 Drawings to include electrical detail of panel, branch breaker type, quantity, ampacity and enclosure dimension.

PART 2 - PRODUCTS

2.1 PANELBOARDS

- .1 Panelboards: product of one manufacturer.
 - .2 Type: 250V LT, 1 phase, 3 wire as indicated.
 - .3 Cabinets for panelboards shall be minimum number 14 gauge, 316L stainless steel, minimum of 508mm wide and 147mm deep, of dead front construction, and doors shall be single type, 120 degree door swing, with spring latch and lock. Two keys shall be supplied with each panelboard and all shall be keyed alike. Surface mounted panelboards shall be finished in ASA61 baked enamel. Panel bus bars shall be of copper with lugs suitable for copper conductor connections.
 - .4 All 3 phase, 4 wire panelboards rated at 225 amperes or less to have grounding terminal strip supplied and installed by manufacturer capable of terminating a minimum of two #2s, four #6s with balance of terminations to accept #12 conductors.
 - .5 All panelboards rated at 225 amperes or less with voltages and phases as indicated on drawings requiring isolated grounding, to be capable of terminating quantities and sizes as indicated on electrical drawings.
 - .6 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.
 - .7 Ratings: mains, number of circuits, and number and size of main and branch circuit breakers as indicated in panel schedules.
 - .8 Panel to be located in a CSA NEMA 4X stainless steel enclosure.
-

2.2 EQUIPMENT IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 00.
- .2 Nameplate for each panelboard size 4 engraved or as indicated.
- .3 Nameplate for each circuit in distribution panelboards size 2 engraved or as indicated.
- .4 Complete circuit directory with typewritten legend showing location and load of each circuit.

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Locate panelboards as indicated and mount securely, plumb true and square, to adjoining surfaces.
 - .2 Install surface mounted panelboards on plywood backboards.
 - .3 Mount panelboards to height specified in Section 26 05 00 or as indicated.
 - .4 Connect loads to circuits as indicated.
 - .5 Connect neutral conductors to common neutral bus with respective neutral identified.
 - .6 Install a typed directory under transparent cover on the inside of each new panelboard showing the location and load connected to each circuit.
 - .7 Wiring in panelboards shall be secured with tie wrap or equivalent means to present a neat workmanlike appearance. Branch circuitry wiring within panelboards shall have approximately 300mm of "slack" wire installed in 150mm loop adjacent to respective breakers where phase conductors terminate. All branch circuit neutral, ground and/or bond conductors to have approximately 300mm of slack wire neatly "looped" prior to terminations taking place. All feeder conductors to be installed in such a manner as to enable "clip on" type capacitive leakage tester to encompass neutral plus phase conductors together. Feeder conductors to be provided with additional slack wire adjacent to termination lugs.
 - .8 Circuit numbers on drawings do not necessarily correspond to the numbers on the lighting and power panels. Circuits sharing a common neutral shall not be connected to the same phase. Any changes in circuit numbering is to be included on "record drawings". Individual light fixtures fed with two branch circuits are to derive their source from two pole breakers.
 - .9 The Lamacoid identification plate on panelboards shall include the voltage phase and wires and amperage (of breaker or fuse protecting it) in addition to the panel designation itself.
-

- .10 "Labelling" of all branch circuit phase conductors plus neutral and/or bond conductors shall be done with "Panduit" write-on, self laminating labels Nos. PDL-1 and PDL-2 as required or approved equal.
- .11 Maximum size conduits housing 15A or 20A branch circuits to be limited to 25mm in size exiting any panelboard.

-- END OF SECTION --

PART 1 - GENERAL

1.1 REFERENCE STANDARDS

- .1 CSA C22.2 No. 111 – General Use Switches.
- .2 CSA C22.2 No. 42 – General Use Receptacles, Attachment Plugs and Similar Wiring Devices.

1.2 SHOP DRAWINGS AND PRODUCT DATA

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

PART 2 - PRODUCTS

2.1 EXTERIOR RECEPTACLES:

- .1 All receptacles to be provided with weather proof enclosures fabricated from materials resistant to salt spray.
- .2 Receptacles rated 15A and 20A to be of the straight blade type and marine grade. CSA configuration as indicated, on drawings.

2.2 COVER PLATES

- .1 All coverplates to be weather proof in-use and approved for wet marine environments.

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Coverplates:
 - .1 As specified.
- .2 Exterior Receptacles:
 - .1 As specified.

- - END OF SECTION - -

PART 1 – GENERAL

1.1 REFERENCE STANDARDS

- .1 CSA C22.2 No. 5.1 - Moulded Case Circuit Breakers.

1.2 RELATED WORK

- .1 Common Work Results Electrical: Section 26 05 00.

1.3 SHOP DRAWING AND PRODUCT DATA

- .1 Submit shop drawings and product data in accordance with section 01 33 00.

PART 2 - PRODUCTS

2.1 BREAKERS GENERAL

- .1 Bolt-on moulded case circuit breaker, quick-make, quick-break type, de-ionizing arc chambers for manual and automatic operation with temperature compensation for 40 degree C ambient. Breakers to be trip-free of operating handles on overloads with a definite indication when tripping has taken place. Push on type breakers for load centers.
- .2 Mini type circuit breakers are not acceptable.
- .3 Multi-pole breakers shall have common trip mechanisms; tie handles are not acceptable.
- .4 Magnetic instantaneous trip elements in circuit breakers, to operate only when the value of current reaches setting. Trip settings on breakers with adjustable trips to range from 10 to 12 times current rating.
- .5 Circuit breakers with interchangeable trips as indicated.
- .6 Minimum acceptable circuit breaker interrupting rating shall be 10,000 RMS symmetrical amperes or as indicated on the drawings.

2.2 BREAKER TYPE GROUND FAULT INTERRUPTER

- .1 Ground fault protection where required by circuit breakers in branch circuit panelboards shall be CSA listed as Class "A", Group "1", with a sensitivity of 5 milliamps or greater. Breakers shall be of the thermal magnetic type incorporating a solid state ground fault sensing circuit and push to test push button. Breakers shall be of the bolt on design, and interchangeable with other panelboard breakers. Interrupting capacity shall be 22,000 RMS symmetrical amperes or as indicated.

2.3 MANUFACTURERS

- .1 Breaker manufacturer shall match that of panel in which they are installed.

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Circuit breakers shall be securely mounted in switchboards, panelboards, or EEMAC one (1) enclosures as indicated on the drawings and as required by other sections of the specifications.

-- END OF SECTION --

Part 1 GENERAL

1.1 SECTION INCLUDES

- .1 Equipment, fabrication and installation for ground fault protection.

1.2 RELATED SECTIONS

- .1 Section 26 05 00 – Common Work Results - Electrical.

1.3 PAYMENT PROCEDURES

- .1 Pay for field testing of ground fault equipment performed by equipment manufacturer.

1.4 REFERENCES

- .1 Canadian Standards Association (CSA)
 - .1 CAN/CSA-C22.2 No. 144, Ground Fault Circuit Interrupters.
- .2 National Electrical Manufacturers Association (NEMA)
 - .1 NEMA PG 2.2, Application Guide for Ground Fault Protection Devices for Equipment.

1.5 SUBMITTALS

- .1 Submit product data and shop drawings.
- .2 Submit test report for field testing of ground fault equipment to Owner and a certificate that system as installed meets criteria specified.

Part 2 PRODUCTS

2.1 EQUIPMENT

- .1 Ground fault protective equipment: components of one manufacturer.
 - .2 Provide ground fault protection on 125A, 208V, 4 wire, 3 phase branch braker feeding new Panel “C”: to NEMA PG 2.2 and CAN/CSA-C22.2 No. 144.
 - .3 Ground fault unit to contain:
 - .1 Ground sensing relay suitable for operation at 500 mA as indicated on electrical drawings. Control voltage: 120 V.
-

- .2 Ammeter with scale 0 to 5 A to indicate ground current value.
 - .3 Three position sensitivity control switch to select value of leakage current at which relay will operate.
 - .4 Indicating lamp illuminated when no ground fault exists, extinguished on ground fault or test.
 - .5 Switch:
 - .1 SPDT contacts for alarm and trip.
 - .2 Mechanical target indication.
 - .3 Manually reset.
 - .6 Reset button for contacts and target.
 - .7 Suitable for panel mounting.
- .4 Zero sequence transformer toroidal type with 300 - 3000 mA range.
 - .5 Neutral:
 - .1 Use an artificial neutral and grounding resistor.
 - .2 Use neutral ground resistor unit.
 - .6 System to operate instantaneously at ground current setting.

2.2 FABRICATION

- .1 Install following components in equipment specified in other Sections and as indicated.
 - .1 Zero sequence transformer.
 - .2 Ground fault relay.
 - .3 Ground resistor unit.

2.3 RELATED EQUIPMENT

- .1 Shunt trip breakers. Load break disconnect switch.

Part 3 EXECUTION

3.1 INSTALLATION

- .1 Do not ground neutral on load side of sensor.
- .2 Install phase conductors including neutral through zero sequence transformer.
- .3 Install ground fault protection system.
- .4 Make connections as indicated and in accordance with manufacturer's recommendations.

3.2 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 – Common Work Results - Electrical and Section 01 91 13.13 – Commissioning (Cx) Requirements.
- .2 Arrange and pay for field testing of ground fault equipment by ground fault equipment manufacturer before commissioning service.
- .3 Check trip unit settings to ensure proper working operation and protection of components.
- .4 Demonstrate simulated ground fault tests.

END OF SECTION

PART 1 – PRODUCTS

1.1 REFERENCE STANDARDS

- .1 Not Applicable

1.2 RELATED WORK

- .1 Common Work Results for Electrical: Section 26 05 00

1.3 SHOP DRAWINGS AND PRODUCT DATA

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

1.4 OPERATION AND MAINTENANCE DATA

- .1 Not Applicable.

PART 2 – PRODUCTS

2.1 MATERIALS

- .1 Components comprising ground fault protective system to be of same manufacturer.

PART 3 – EXECUTION

3.1 INSTALLATION

- .1 Install ground fault receptacles as specified.

3.2 TESTS

- .1 Perform tests in accordance with Section 26 05 00.
 - .2 Arrange and pay for field-testing of ground fault equipment by ground fault equipment manufacturer before commissioning services.
 - .3 Submit report of tests to Engineer and certificate that system as installed meets criteria specified herein.
 - .4 Demonstrate simulated ground fault tests.
-

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GROUND FAULT CIRCUIT INTERRUPTERS
CLASS A
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END OF SECTION

PART 1 – GENERAL

1.1 REFERENCE STANDARDS

- .1 ANSI C82.-SSL1-20XX – Solid state lighting power, supplies and drivers
- .2 CSA C22.2 No. 250.13-12 - Light emitting diode (LED) equipment for lighting applications

1.2 RELATED WORK

- .1 Common Work Results Electrical: Section 26 05 00

1.3 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings and product data in accordance with Division 1.
- .2 Submit complete photometric data prepared by independent testing laboratory for luminaires where specified or requested for approval by Engineer.
- .3 Submit shop drawings on all lamps, dimming & electronic ballasts.

1.4 OPERATION AND MAINTENANCE DATA

- .1 Not Applicable

1.5 GUARANTEE

- .1 Replace:
 - .1 LED drivers that fail within 12 months of takeover.

PART 2 – PRODUCTS

2.1 LUMINAIRE DETAILS

- .1 Provide fixtures as shown on drawings.
 - .2 Provide supporting devices, surface mounted junction boxes and outlet boxes where required.
 - .3 LED light fixtures shall be Reduction of Hazardous Substances (RoHS)-compliant.
 - .4 LED modules shall comply with IES LM-79 and LM-80 requirements.
 - .5 Minimum CRI of 80 and color temperature of 3500k unless specified otherwise.
 - .6 Minimum rated life of LED fixtures shall be 50,000 hours per IES L70.
-

- .7 Lenses or diffusers shall be of glass or acrylic material, as indicated.
- .8 Include finishes to Section 26 05 00 and as indicated.
- .9 Provide gasketing, stops and barriers to form light traps to prevent light leaks.

2.2 LUMINAIRE MANUFACTURERS

- .1 Supply luminaires as per the light fixture schedule on the drawings.

2.3 LUMINAIRE SUPPORTS

- .1 Not applicable.

PART 3 – EXECUTION

3.1 INSTALLATION

- .1 This work shall include the supplying and installation and connection of all lighting units and allied equipment as specified hereinafter and on the drawings as well as the receiving, storing and testing of same.
- .2 Locate fixtures as indicated on drawings.

3.2 WIRING

- .1 Connect fixtures to lighting circuits as indicated.

3.3 DEFECTIVE OR DAMAGED FIXTURES

- .1 Check fixtures and replace all defective lamps, ballasts and accessories on any fixtures that have been damaged or scratched during construction.
- .2 Replace lamps that have burned out as per paragraph 1.5 of this section.

3.4 TESTS

- .1 Perform tests in accordance with Section 26 05 00.

3.5 OWNER TAKEOVER

- .1 All fixtures shall be operable, undamaged, and as specified at the time of ownertakeover.
- .2 All lamps shall be new and burning at the time of takeover. All fixtures shall be clean and like new condition, at the time of takeover.

END OF SECTION

PART 1 - GENERAL

1.1 GENERAL

- .1 The General Conditions of the contract as well as provisions of Division 1 are part of and to be read in conjunction with this Section.

1.2 RELATED WORK BY OTHER DIVISIONS:

- .1 Excavation and backfilling.

1.3 PRODUCT DATA

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

PART 2 - PRODUCTS

2.1 LUMINAIRES

- .1 Fixtures to be LED, marine rated with distribution types as shown on drawings. Fixture to be salt spray and fog tested for a minimum of 5000 hours and come with a 5 year warranty. Fixture to have a minimum efficacy of 120 lumens per watt.

2.2 PHOTOCELL

- .1 Photocell to be 15A, 120V, stem mount with marine grade housing.

2.3 LIGHTING CONTACTOR

- .1 Lighting contactor to be mechanically operated, electrically held, 2 pole minimum, rated for 30A, 600V, c/w Hand Off Auto. Lighting contactor enclosure to be type NEMA 4X.

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Install brackets on poles, as indicated.
- .2 Install luminaires on pole brackets, connect to pole wiring and install lamps.
- .3 Provide fuse and install in fuse holder.

-- END OF SECTION --
