

1.0 CODES AND STANDARDS

- .1 Complete installation in accordance with the latest edition of the Canadian Electrical Code Part I (CSA C22.1) and the Saskatchewan Supplement, as well as Municipal and Provincial Codes and Regulations and the local authorities having jurisdiction. Where this specification is at variance with applicable Codes and Standards, the more stringent shall apply.
- .2 Comply with CSA Electrical Bulletins and Certification Standards in force at time of bid submission. While not identified and specified by number in this Division, these Bulletins and Standards are to be considered as forming part of related CSA Part II Standard.
- .3 All references to Codes and Standards refer to the latest edition in force at the time of bid unless specified otherwise.
- .4 Under no circumstances shall the Codes and Standards referred to above and herein, be interpreted to allow a lower standard than specified elsewhere herein.
- .5 Complete overhead systems in accordance with CSA C22.3 No. 1 and underground systems in accordance with C22.3 No. 7 except where specified otherwise.
- .6 Abbreviations for electrical terms: to CSA Z85.
- .7 Complete all work in a neat manner performed by qualified tradesmen. All work shall be completed under the on-site direction of a journeyman electrician.

2.0 QUALIFICATIONS

- .1 Designate a foreman / superintendent holding a journeyman's certificate to assume complete responsibility for the electrical construction work. Minimum experience requirement for this position is five (5) years experience as a journeyman foreman / superintendent. Submit the name, qualifications, and experience to the electrical consultant for approval.
- .2 Furnish qualified personnel to continuously direct and monitor electrical construction work.
- .3 Attend site meetings.

3.0 PERMITS, FEES

- .1 The electrical consultant will submit to the Electrical Inspection Department and Supply Authority the necessary number of drawings and specifications for examination and approval prior to commencement of work. The electrical contractor shall pay all fees associated with this examination and approval.
- .2 Obtain and pay fees associated with all electrical inspections.

4.0 SHOP DRAWINGS, PRODUCT DATA AND SAMPLES

- .1 Submit shop drawings, product data and samples in accordance with the requirements of General Conditions.
- .2 Indicate details of construction, dimensions, capacities, weights and electrical performance characteristics of equipment or material. All shop drawings shall be identified with the project name.
- .3 Where applicable, include wiring, single line and schematic diagrams.
- .4 Include wiring drawings or diagrams showing interconnection with work of other Sections.
- .5 Submit a copy of each shop drawing in electronic PDF format to the electrical consultant for review. PDF documents must be generated by manufacturer's software, or from electronically published documentation. PDF documents generated by scanning technology are not acceptable. Consultant will return shop drawing submittals via email for distribution. It is the responsibility of the Contractor to ensure adequate copies of the shop drawings are distributed to required parties, including a copy at the construction site.
- .6 If hard copies are submitted, submit three (3) copies of each shop drawing to the electrical consultant for review. Two copies will be returned to the architect who will subsequently return one copy to the Contractor (to produce required copies at his expense).
- .7 All electrical shop drawings for the project shall be submitted at one time and within 30 days of contract signing.

5.0 DRAWINGS AND SPECIFICATIONS

- .1 Examine also the architectural, structural, and mechanical drawings and specifications.
- .2 Drawings do not indicate all construction details. Any installation involving accurate measurements of the building shall be coordinated with construction drawings and/or actual on-site measurements.
- .3 Drawings and specifications are intended to supplement each other, and any information indicated on one and omitted on the other shall be assumed as included on both.
- .4 Refer to architectural reflected ceiling plan for exact location of lighting fixtures in t-bar ceiling grids.
- .5 The electrical sub-contractor shall peruse the mechanical drawings and specifications to confirm size and location of all motors, controls, and other equipment in order to determine exact electrical requirements of all mechanical equipment. Ensure that all electrical work noted on mechanical drawings and specifications are included in the electrical contract bid price.
- .6 In order to provide sufficient detail and clarity, the symbols used for various electrical devices, occupy more space on the drawing, than the device actually occupies when installed. The electrical sub-contractor shall use common sense when actually placing

these devices, ensuring that devices are grouped wherever possible. Do not space devices along wall to coincide with the scale location of the electrical device symbol.

- .7 Bidders finding discrepancies or omissions in the specifications or drawings, or having doubt as to the meaning or intent thereof, shall at once notify the Consultant who will, if necessary, send written instructions or explanation to all bidders. Oral interpretations made to any bidder shall not effect a modification of any provision of the bid documents.

6.0 EXAMINATION OF THE SITE

- .1 Prior to submitting bid, visit the site and thoroughly investigate the location, connection points, and details of all services and systems which, in any way, may affect or tie-in with the work covered in these specifications and accompanying drawings. No extra will be considered for work resulting from conditions that would have been evident upon thorough examination of the site.
- .2 Any discrepancies, points of doubt, or contention shall be made known to the electrical consultant in writing not later than seven (7) days prior to closing date of tender; otherwise, allow for the most expensive alternative.

7.0 VOLTAGE RATINGS

- .1 Operating Voltages: to CAN3 C235.
- .2 Motors, electrical heating, control and distribution devices and equipment to operate satisfactorily at 60 Hz within normal operating limits established by above standard.
- .3 Equipment to operate in extreme operating conditions established in above standard without damage to equipment.

8.0 MATERIALS AND EQUIPMENT

- .1 Provide materials and equipment in accordance with the requirements of General Conditions.
- .2 Equipment and material to be CSA certified, and manufactured to standard quoted.
- .3 Where there is no alternative to supplying equipment which is not CSA certified, obtain special approval from Inspection Department.
- .4 Factory assemble control panels and component assemblies.
- .5 Uniformity of manufacturer shall be maintained for any particular item or type of equipment throughout the building.

9.0 ELECTRICAL MOTORS, EQUIPMENT AND CONTROLS

- .1 Supplier and Installer responsibility is indicated in Motor Control and Equipment Schedule on electrical drawings and related Mechanical responsibility is indicated on Mechanical Equipment Schedule on mechanical drawings.

- .2 Control wiring and conduit is specified in Division 26 except for conduit, wiring, and connections below 50V which are related to control systems specified in Division 25 and shown on mechanical drawings.

10.0 FINISHES

- .1 Shop finish metal enclosures by removal of rust and scale, cleaning, application of rust resistant primer inside and outside, and at least two coats of finished enamel.
 - .1 Paint outdoor electrical equipment "equipment green" finish to EEMAC Y1-1.
 - .2 Paint indoor switchgear and distribution enclosures light grey to EEMAC 2Y-1.
- .2 Clean and touch up surfaces to shop-painted equipment scratched or marred during shipment or installation, to match original paint.
- .3 Clean, prime, and paint exposed hangers, racks, fastenings to prevent rusting.
- .4 All electrical fittings, supports, hanger rods, pull boxes, channel fittings, conduit racks, outlet boxes, brackets, clamps, etc. shall either have a galvanized finish, or have a painted finish over corrosion resistant primer.
- .5 Where indicated herein and on drawings, provide finishes to match samples as provided by the architectural consultant.

11.0 EQUIPMENT IDENTIFICATION

- .1 Identify electrical equipment with nameplates as follows:

Nameplates:

 - .1 Plastic laminate engraving sheet, 3 mm thick, black face, white core, self-adhesive. Nameplates identifying emergency power system circuits shall be red face with white core.
 - .2 Nameplate sizes:
 - Size 1 7 X 25 mm 1 line 3 mm high lettering
 - Size 2 7 x 40 mm 1 line 5 mm high lettering
 - Size 3 12 x 70 mm 2 lines 3 mm high lettering
 - Size 4 20 x 90 mm 1 line 8 mm high lettering
 - Size 5 20 x 90 mm 2 lines 5 mm high lettering
 - Size 6 25 x 100 mm 1 line 12 mm high lettering
 - Size 7 25 x 100 mm 2 lines 6 mm high lettering
 - .3 Wording on nameplates to be approved prior to manufacture.
 - .4 Allow for average of twenty-five (25) letters per nameplate.
 - .5 Identification to be English.
 - .6 Nameplates for terminal cabinets and junction boxes to indicate system and/or voltage characteristics.

- .7 Nameplates for disconnects, starters, contactors and control stations shall indicate equipment being controlled, and voltage.
- .8 Nameplates for transformers shall indicate capacity, primary, and secondary voltages.
- .9 All nameplates shall be mechanically attached with a minimum of two chrome self tapping screws as well as the self adhesive.
- .10 All equipment shall be identified in a style that matches the existing scheme utilized in the current building. Confirm all equipment names prior to labelling.

12.0 WIRING IDENTIFICATION

- .1 Identify wiring with permanent indelible identifying markings either numbered or coloured plastic tapes, on both ends of phase conductors or feeders and branch circuit wiring.
- .2 Maintain phase sequence and colour coding throughout.
- .3 Colour Code: to CSA C22.1.
- .4 Use colour coded wires in communication cables, matched throughout system.
- .5 Wiring to be identified in a scheme to match existing throughout the building as applicable.

13.0 CONDUIT AND CABLE IDENTIFICATION

- .1 Colour code conduits, and metallic sheathed cables.
- .2 Code with 305 mm band of coloured spray paint at points where conduit or cable enters wall, ceiling, or floor, and at 15 m intervals in accessible ceiling spaces and service spaces:

Telephone	Light Green
Sound Systems	Purple
Fire Alarm	Red
Emergency Power	Orange
Low Voltage Switching	Tan
Intrusion Alarm System	White
Audio Visual Signal Distribution System	Pink
Computer Data	Blue
Card Access	Brown
CCTV Video Surveillance System	White Striped

- .3 Utilize wiring colours to match existing in use within the building as applicable. Were the above noted colours contradict those currently in use, the existing style within the building shall be the standard.

14.0 JUNCTION BOX IDENTIFICATION

- .1 Identify all system junction boxes with enamel spray paint on entire cover. Colour shall match those specified for conduit and cable identification.
- .2 Identify all junction boxes, containing branch circuit conductors, with neat hand lettering using black felt marker indicating panel and breaker number (i.e. "B-24). Provide corresponding identification on surface adjacent to junction box as well.

15.0 WIRING TERMINATIONS

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

16.0 MANUFACTURER'S AND CSA LABELS

- .1 Manufacturer's nameplates and CSA labels to be visible and legible after equipment is installed.

17.0 WARNING SIGNS

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

18.0 LOCATIONS OF OUTLETS

- .1 Do not install outlets back-to-back in wall; allow minimum 150 mm horizontal clearance between boxes.
- .2 Change location of outlets at no extra cost or credit, providing distance does not exceed 3 meters, and information is given before installation.
- .3 Locate light switches on latch side of doors (determine direction of door swings from architectural drawings). Locate disconnect devices in mechanical and elevator machine rooms on latch side of door.
- .4 Coordinate the rough-in location of all outlets with architectural, structural, and mechanical drawings. Ensure compatibility with finishes, accessories, and devices by others.

19.0 MOUNTING HEIGHTS

- .1 Mounting heights of equipment are from finished floor to centerline of equipment unless specified or indicated otherwise.
- .2 If mounting height of equipment is not indicated, verify before proceeding with installation.
- .3 Install electrical equipment at the following heights unless indicated otherwise (assuming a minimum ceiling height of 2400 mm).
 - .1 Local switches: 1200 mm (1300 mm in concrete block)

- .2 Wall receptacles:
 - General: 450 mm (500 mm in concrete block)
 - Above top of continuous baseboard heater: 200 mm
 - Above top of counters or splashback: 150 mm
 - In mechanical rooms: 1300 mm
 - For microwaves: coordinate with architectural millwork.
- .3 Panelboards: 1800 mm to top of panel
- .4 Telephone outlets: 450 mm (500 mm in concrete block)
- .5 Wall-mounted telephone outlets: 1500 mm
- .6 Fire alarm pull stations: 1100 mm
- .7 Audible/visual fire alarm signal device: 2300 mm
- .8 End of line resistor for signal circuit: 2100 mm
- .9 Audio visual outlets: 450 mm (500 mm in concrete block)
- .10 Television cable outlets: 450 mm (500 mm in concrete block)
- .11 Voice/Data outlets: 450 mm (500 mm in concrete block)
- .12 Motor starters (loose): 1200 mm
- .13 Emergency lighting units: 2100 mm
- .14 Emergency lighting remote luminaires: 150 mm below finished ceiling to a maximum height of 3000 mm.
- .15 Wall mounted exit lights: 2200 mm (coordinate with door height & ceiling height)
- .16 Pushbutton for power assist door operator: 900 mm.
- .17 Intrusion alarm keypad control station: 1500 mm
- .18 Hand Dryers: 1010 mm (to bottom of hand dryer).
- .19 Closed circuit video surveillance system cameras: 2100 mm
- .20 Proximity reader for card access system: 950 mm

20.0 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.

21.0 OWNER'S EQUIPMENT

- .1 This Contractor is responsible for electrical service connections to all Owner's equipment being supplied and installed in the building and that are shown in the contract documents. All Owner's equipment will be supplied complete with starters and disconnects as required.

22.0 WORK PROVIDED FOR OTHER DIVISIONS

- .1 Provide information as to the exact size and location of all required concrete foundations and curbs for equipment.
- .2 All bus ducts, cable tray, and conduit openings through floor, walls, and ceilings shall be sleeved 25 mm larger all around the duct, tray, or conduit. Fill the opening with 3#

density acoustic media under 50% compression and seal both ends with the appropriate caulking compound. Refer to "Firestopping" specific requirements.

- .3 Supply and installation of control wiring for all line voltage thermostats, for unit heaters, force flow, and cabinet heaters.
- .4 Supply and installation of all electric heaters.

23.0 WORK NOT INCLUDED IN THIS DIVISION

- .1 Low voltage and control wiring for the mechanical equipment associated with the heating and cooling of the building will not be included in this Division.

24.0 CONDUIT AND CABLE INSTALLATION

- .1 Install conduit, and sleeves, prior to pouring of concrete. Sleeves through concrete: schedule 40 steel pipe, sized for free passage of conduit, and protruding 50 mm.
- .2 Install cables, conduits, and fittings neatly and close to building structure so furring can be kept to minimum.
- .3 Conduit shall be laid out to avoid interference with other trades, and to maintain maximum headroom. Arrange conduit to conserve space, allow maintenance, and avoid crossovers where possible.
- .4 Holes through exterior walls and roof shall be flashed and made completely weatherproof.

25.0 FIRESTOPPING

- .1 Provide firestopping in accordance with the requirements of General Conditions.
- .2 Provide fire stopping and smoke seal system materials in accordance with CAN4-S115. Materials shall be asbestos free and systems shall be capable of maintaining an effective barrier against gases, flame and smoke in compliance with CAN4-S115, not exceeding opening sizes stated and conforming to all requirements of the Standard. Fire-resistance rating of fire stopping material assembly shall meet or exceed the fire-resistance rating of the floor, wall or partition being penetrated.
- .3 Damming and backup materials, supports and anchoring devices to manufacturer's recommendations and in strict accordance with tested assembly being installed, and as acceptable to the Authority Having Jurisdiction.

26.0 ACCESS

- .1 Provide access doors for installation in walls and ceiling to service electrical equipment. Supply to appropriate trade for installation. Doors shall be ULC labelled when installed in fire separations. Wherever finish and construction allow, access doors shall be installed flush with the finished surface. Access doors shall have 16 gauge frames, 14 gauge door panels, piano hinge, screw driver latch, and mounting channels as required for installation. Minimum size shall be 300 mm x 300 mm.

27.0 INSULATION RESISTANCE TESTING

- .1 Megger circuits, feeders, and equipment up to 350V with a 500V instrument.
- .2 Megger 350 - 600V circuits, feeders, and equipment with 1000V instrument.
- .3 Check resistance to ground before energizing.

28.0 COORDINATION OF PROTECTIVE DEVICES

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

29.0 CLEANING

- .1 Complete final cleaning in accordance with the requirements of General Conditions.
- .2 Protect all equipment and material from weather and the work of other trades. Remove waste periodically. Clean all materials and equipment prior to acceptance of the Work.
- .3 At time of final cleaning, clean lighting reflectors, lenses, and other lighting surfaces that have been exposed to construction dust and dirt. The electrical installation shall be left in a clean and finished condition, to the satisfaction of the electrical consultant.

30.0 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.
 - .4 Motors, heaters, and associated control equipment including sequenced operation of systems where applicable. Take clip on ammeter readings on all phases of motor feeders, with motor operating under full load conditions. Submit test readings to electrical consultant.
 - .5 Systems:
 - fire alarm system
 - emergency lighting system
 - exit lighting system
 - occupancy sensors
- .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 Notify electrical consultant a minimum of 48 hours prior to test.
- .4 Provide instruments, meters, equipment, and personnel required to conduct tests during and at conclusion of project.
- .5 Submit test results for electrical consultant's review.

31.0 LOAD BALANCE

- .1 Measure phase current to panelboards and distribution centres with all possible loads operating. Adjust branch circuit connections as required to obtain best balance of current between phases and record final measurements after adjustments have been completed. Load unbalance shall not exceed fifteen percent (15%).
- .2 Measure phase voltages at loads and adjust transformer taps to within 2% of rated voltage of equipment.
- .3 Submit, on completion of work, a report listing phase and neutral currents on panelboards, dry type transformers, and motor control centres operating under normal load. State hour and date on which each load was measured, and voltage at time of test.

32.0 RECORD DRAWINGS

- .1 Submit record drawings in accordance with requirements of General Conditions.
- .2 Obtain one set of solid white prints to be used for record work as actually installed. Record on this set, all changes associated with the work.
- .3 Obtain one set of electrical drawing prints, and upon completion of the work, transcribe all information from the on-site record prints to the as-builts. Include all changes to the electrical contract including addenda, site instructions, change orders, and site conditions.

33.0 WARRANTY

- .1 Submit a written warranty stating that all materials and workmanship will be free from defects for a period of one (1) year from date of Substantial Performance of Work. The warranty period shall not begin until:
 - Electrical Operating and Maintenance Manuals are submitted and approved.
 - Systems Demonstration and Training is completed and Systems Demonstration certificate is submitted.
- .2 The electrical sub-contractor shall remain responsible for all electrical equipment and systems until the Electrical Operating and Maintenance Manuals are submitted and approved, and the Systems Demonstration and Training has been completed.

34.0 OPERATION AND MAINTENANCE DATA

- .1 Provide operation and maintenance data for incorporation into an electrical operation and maintenance manual as specified herein. The following are minimum requirements.
- .2 Include in operations and maintenance data:
 - .1 Cover page including project name, year, name of owner, electrical consultant, and electrical contractor. Cover page shall be enclosed in a clear plastic cover.
 - .2 Index.
 - .3 Electrical Contractor's Guarantee.
 - .4 List of manufacturer and supplier for all items.
 - .5 Name, address and phone number of local suppliers for items included in Maintenance Manual.

- .6 "SYSTEMS DEMONSTRATION" certificate (refer to document included in Section 26 05 01).
 - .7 Load Balance report.
 - .8 A copy of all panelboard directories.
 - .9 8 1/2" x 11" drawing indicating Single Line Diagram for electrical distribution system.
 - .10 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.
 - .11 Technical data, product data, supplemented by bulletins, component illustrations, exploded views, technical descriptions of items and parts lists. Advertising or sales literature not acceptable.
 - .12 Operating Instructions for All Systems.
 - .13 Fire Alarm Test Report and Verification Report (include in "Fire Alarm" section).
 - .14 Emergency Lighting System Verification and Test Report (include in "Emergency Lighting System" Section)
- .3 Operation and Maintenance Data shall be contained within a 76 mm thick, black, hard cloth three ring binder. Binder shall be labelled directly on the front cover as well as the spine ("ELECTRICAL OPERATION AND MAINTENANCE MANUAL - PROJECT NAME - YEAR") with gold embossed lettering. Plastic sleeves for identification will not be accepted.
- .4 The following index tabs and associated product in information shall be contained within the binder:
- Index
 - Contractor Guarantee
 - Manufacturer and Supplier List
 - Supplier Addresses and Phone Numbers
 - Systems Demonstration Certificate
 - Panelboard Directories
 - Load Balance Report
 - Single Line Diagram
 - Disconnect Switches
 - Panelboards and Breakers
 - Luminaires, Lamps, Ballasts, and/or Drivers
 - Exit Lighting
 - Emergency Lighting
 - Fire Alarm System
 - Motor Starters
 - Devices:
 - Receptacles
 - Switches
 - Hand Dryers
 - Service Poles
 - Occupancy Sensors
 - Cable Tray

Divider tab pages shall be laminated mylar plastic with reinforced holes. Plastic tabs with typed insertions will not be accepted.

- .5 Provide three (3) operating and maintenance manuals as well as three electronic copies (CD disk containing O & M manual contents in PDF electronic format).

35.0 MAINTENANCE MATERIALS

- .1 Provide maintenance materials in accordance with the requirements of General Conditions.

36.0 CARE, OPERATION AND START-UP

- .1 Instruct owner's maintenance and operating personnel in the operation, care, and maintenance of equipment. A minimum of four (4) hours of instruction shall be provided. Provide documentation in maintenance manual confirming that instruction has been provided including description of system, owner representatives in attendance, date, and signatures.
- .2 Arrange and pay for services of Manufacturer's factory service representative to supervise start-up of installation, check, adjust, balance, and calibrate components as applicable.
- .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.
- .4 Complete the "SYSTEMS DEMONSTRATION" document (Refer to document in this section) and include in maintenance manual.

37.0 REVIEW OF WORK

- .1 When the contractor is satisfied that the work is completed, and after making his own inspection of work to verify completion, the electrical contractor shall submit a written request to the electrical consultant requesting a review of work.
- .2 Any deficiencies noted by the electrical consultant during the review of work, will be listed by the electrical consultant, and issued to the contractor.
- .3 Such deficiencies shall be corrected within three (3) weeks of the issuance of the deficiency list, or by a mutually agreed upon date. Once complete, the contractor shall submit a written request to the electrical consultant requesting a final deficiency review.
- .4 If subsequent site visits are required by the electrical consultant because the deficiencies listed were not complete, all time and expense costs incurred by the electrical consultant will be the responsibility of the electrical contractor.
- .5 During construction, the electrical contractor shall make any equipment or wiring accessible for review purposes, as requested by the electrical consultant.

38.0 DEMOLITION

- .1 Remove all redundant conduit and conductors to the source of supply. Where conduit is embedded in concrete or other inaccessible locations, it shall be abandoned.

- .2 Boxes, fittings, equipment and accessories which become redundant shall be completely removed. All such material shall become the property of the Contractor and he shall remove it from the site. Re-useable items of electrical equipment shall be re-installed where indicated on the drawings.
- .3 Remove all redundant light fixtures, speakers, starters, safety switches, contactors, enclosed breakers, panelboards, transformers, and other re-useable items of electrical equipment. These items shall be reinstalled where indicated on the drawings or shall be turned over to the Owner.
- .4 Where existing equipment is shown to be reinstalled, only the best quality items shall be selected for re-use.
- .5 The Contractor shall visit the site prior to submitting a bid to determine the amount of demolition work involved. No extras will be considered for work resulting from conditions that would have been evident upon thorough examination of the site.
- .6 Contractor shall dispose of luminaire ballasts containing polychlorobiphenyl contaminants, in accordance with the latest edition of all applicable local, provincial and federal codes and standards including but not limited to the following:

Environmental Contaminants Act – Chlorobiphenyl
Regulations #1 (July 1, 1985)
Regulations #2 (August 1, 1985)

39.0 BREAKDOWN AND PRICES

- .1 During the course of construction, when the Contractor is requested to submit a price for the performance of additional work, the price shall be broken down as requested by the electrical consultant to show quantity, material, and labour charges for each item.
- .2 Submit the following Contract Price Breakdown to the electrical consultant within 30 days of award of the contract, and with each monthly progress claim during construction. Alternate formats for Contract Price Breakdown are not acceptable. Submit invoices to support claims for material on site, when requested.

END OF SECTION

BREAKDOWN AND PRICES

PROJECT: _____

PROGRESS CLAIM #: DATE: _____

	Contract Amount				Amount Complete to Date			
	Material	Labour	Total	% of Contract	Material	Labour	Total	% Complete
General								
Conduit, Outlet Boxes								
Cable Tray								
Conductors								
Devices								
Panelboards								
Luminaires								
Exit Lighting								
Emergency Lighting								
Fire Alarm System								
Audio Visual System								
Motor Control Equip.								
Sub Total								
Change Orders								
TOTAL								

SYSTEMS DEMONSTRATION

PROJECT: _____

DATE: _____

TIME: _____ to _____

A demonstration of electrical systems was conducted on site, to instruct owner's personnel in the operation, care, and maintenance of electrical equipment and systems.

Systems included: (indicate)

- ___ Fire Alarm System
- ___ Emergency Lighting Units
- ___ Occupancy Sensors

The following persons have witnessed this demonstration:

Owners: _____
(name) (signature)

(name) (signature)

(name) (signature)

Contractor: _____
(name) (signature)

Manufacturer's Representative:

(name) (signature)

Part 1 General

1.1 RELATED WORK SPECIFIED ELSEWHERE

- .1 Wire and Cable: Section 26 05 21.
- .2 Outlet Boxes: Section 26 05 32.

Part 2 Products

2.1 MATERIALS

- .1 All fixture and branch wiring joints in junction and outlet boxes shall be made with a CSA certified pressure type connector rated at 600 volts maximum. Connector body shall consist of a cone shaped coil spring insert, insulated with a colour coded flame retardant, thermoplastic shell, which shall be knurled for easy grip.
- .2 Lugs, terminals, and screws used for termination of conductors, shall be suitable for type of conductor used.
- .3 Wire connectors to CSA C22.2 No. 65-93.

Part 3 Execution

3.1 INSTALLATION

- .1 Remove insulation carefully from ends of conductors and:
 - .1 Install mechanical pressure type connectors and tighten as recommended by Manufacturer as specified in CSA C22.2 No. 65-93. Installation shall meet secureness tests.

END OF SECTION

Part 1 General

Part 2 Products

2.1 MATERIALS

- .1 Conductors: copper, sized as indicated, with 600 volt insulation rated at 90°C. The conductor shall have PVC insulation with an overall nylon jacket (T90 or THHN), or cross-linked polyethylene insulation (R90 XLPE or RW90 XLPE).
- .2 Conductor shall be stranded for sizes #10 AWG and larger.
- .3 Conductors: to CSA C22.2 38.
- .4 Armoured cable: Copper conductors, interlocking armour fabricated galvanized steel strip.
- .5 Teck cable: copper conductors sized as indicated with 600 volt insulation rated at 90°C. Chemically cross-linked thermosetting polyethylene insulation, inner jacket of polyvinyl chloride material, interlocking aluminium armour, polyvinyl chloride overall coating (FT-4 flame test rated).

Part 3 Execution

3.1 INSTALLATION – GENERAL

- .1 In conduit systems in accordance with Section 26 05 34.
- .2 #12 AWG shall be the minimum wire size used for branch circuits. All building conductors shall be sized to allow for a maximum of 2% voltage drop.
- .3 Conductor phasing for three phase electrical distribution equipment shall be made phase A, B, C, from left to right when facing equipment. The A, B, C, phasing shall be continuous from the incoming utility supply, throughout the electrical system, including panels, motor control centres, transformers, etc. and shall continue through to all the branch circuitry to the final connection of the outlet or device. Phase colour coding shall be red, black and blue for phases A, B and C respectively (X, Y, Z sequence). Continuous colour coding of insulation is required for conductors sized #2 AWG and smaller. Colour code phase taping for conductors sized #2 AWG and smaller will not be allowed.
- .4 Neutral conductors shall be white, ground conductors green, and isolated ground conductors green with yellow striped identification.
- .5 #14 AWG may be used for armoured cable drop to lighting fixtures only.
- .6 Conductors drawn into conduit shall not be pulled more than 30 metres nor more than three 90° bends without pullboxes.
- .7 Lubricant for pulling conductors shall be wax base insoluble in water and non-hardening.
- .8 Conductor length for parallel feeders shall be identical.

- .9 Identify all conductors (including neutral) with “Brady” marker to describe circuit number, wherever they are terminated in a junction box or panelboard.
- .10 Neutral conductors shall not be derated.
- .11 When changing the rotation of three phase motors, the change shall be made at the motor splice box.
- .12 Switch leg conductors shall be orange in colour (including low voltage relays). Traveller conductors for three-way and four-way switching of lighting circuits shall be yellow in colour. It is acceptable to use armoured cable between the switch outlet box and the junction box in the ceiling space above the switch outlet box (no orange conductor).
- .13 Low voltage wiring shall be red, blue, and orange in colour, minimum #16 AWG, THHN.
- .14 Fire alarm system signal and initiating circuit conductors shall be red and black in colour.
- .15 Control wiring conductors shall be red in colour (except associated building neutral conductor shall be white in colour).
- .16 Ground conductors shall be green in colour **A separate insulated (green) ground conductor shall be installed in each conduit system.** The conduit system will not constitute an adequate ground.
- .17 Install a separate insulated (green) ground conductor for each motor circuit.
- .18 Install a separate insulated (green ground) conductor for each panelboard feeder.
- .19 Install a separate insulated conductor (green with yellow band) for each panelboard with an isolated ground buss.
- .20 Install a separate insulated (green with yellow trace stripe or yellow band) conductor for each group of three isolated ground circuits installed with a common neutral (one isolated ground conductor per common neutral).
- .21 Insulation for all conductors installed exterior to the building shall be rated at minus 40 degrees Celsius.
- .22 Circuits sharing a neutral shall be consecutive breakers in the panel (i.e. 1, 3, 5 or 8, 10, 12). Circuits energizing receptacles in computer labs, or dimming circuits shall not share neutrals.
- .23 Panelboard feeders shall be continuous and free of splices between the overcurrent protection device for the panelboards, and the panelboard.
- .24 Refer to Section 26 05 34 regarding installation of armoured cable.
- .25 Branch wiring for emergency power supply branch circuits shall be banded with yellow identification.

END OF SECTION

Part 1 General

1.1 RELATED WORK SPECIFIED ELSEWHERE

- .1 Conduit, conduit fastenings, and conduit fittings: Section 26 05 34.

Part 2 Products

2.1 SUPPORT CHANNELS

- .1 Support channels, length as indicated, U-shape, size 41 mm x 41 mm, 2.5 mm thick, surface mounted or suspended.

Part 3 Execution

3.1 INSTALLATION

- .1 Lead anchors and plastic anchors will not be permitted.
- .2 Secure equipment to poured concrete with expandable inserts.
- .3 Secure equipment to hollow masonry walls or suspended ceilings with toggle bolts.
- .4 Secure surface mounted equipment with twist clip fasteners to inverted "T" bar ceilings. Ensure that "T" bars are adequately supported to carry weight of equipment specified before installation of same.
- .5 Support equipment, conduit or cables using clips, spring-loaded bolts, cable clamps designed as accessories to basic channel members.
- .6 Fasten 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 Clamps to secure conduit to exposed steel work.
- .7 Suspended support systems:
 - .1 Support individual cable or conduit runs with 6 mm diameter threaded rods and spring clips.
 - .2 Support 2 or more cables or conduits on channels supported by 6 mm diameter threaded rod hangers where direct fastening to building construction is impractical.
- .8 Provide metal brackets, frames, hangers, clamps and related types of support structures where indicated or as required to support conduit and cable runs.
- .9 Provide adequate support for raceways and cables dropped vertically to equipment where there is no wall support.

- .10 Do not use wire lashing, tie wraps, or perforated strap to support or secure raceways or cables.
- .11 Do not use supports or equipment installed for other trades for conduit or cable support except with permission of other trade and approval of the electrical consultant.
- .12 Install fastenings and supports as required for each type of equipment cables and conduits, and to Manufacturer's installation recommendations.
- .13 Do not install screws through upper flute portion of metal roof deck when roof membrane is located directly on top of metal roof deck. Confirm with general contractor.

END OF SECTION

Part 1 General

1.1 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings and product data for cabinets in accordance with Section 26 05 01.

1.2 OPERATING AND MAINTENANCE DATA

- .1 Provide data for incorporation into Electrical Maintenance Manual specified in Section 26 05 01.

Part 2 Products

2.1 SPLITTER BOXES

- .1 Splitter box: to CSA C22.2 No. 76, sheet metal, welded corners and formed hinged cover suitable for locking in closed position.
- .2 Main and branch lugs to match required size and quantity of incoming and outgoing conductors as indicated.
- .3 At least three spare terminals on each set of lugs in splitters less than 400A.
- .4 Full length of equipment arrangement except where indicated.
- .5 Exterior splitter boxes for connection of utility conductors to consumer service conductors shall have the following features:
- CSA approved for outdoor use (CEMA 3)
 - hinged door with three point latching
 - handle with provision for padlocking (key not acceptable)
 - bus bars sized to accommodate load
 - bus bar terminals shall be arranged to allow for bending radius of not less than 180 mm
 - ground lug for #2/0 copper conductor.

2.2 JUNCTION AND PULL BOXES

- .1 Junction and pull boxes: to CSA C22.2 No. 40, welded steel construction with screw-on flat covers for surface mounting.
- .2 Covers with 25 mm minimum extension all around, for flush-mounted pull and junction boxes.

2.3 CABINETS

- .1 Type T: sheet steel cabinet with hinged door, latch, lock (2 keys), containing 19mm G1S painted plywood backboard, suitable for flush or surface mounting as noted.

Part 3 Execution

3.1 SPLITTER INSTALLATION

- .1 Install splitters as indicated and mount plumb, true and square to the building lines.
- .2 Exterior splitter box shall be mounted 600 mm from bottom of box to grade.

3.2 JUNCTION AND PULL BOXES

- .1 Install junction and pull boxes in accessible locations.
- .2 Support boxes independently of connecting conduits. Secure boxes to building structure.
- .3 Mount cabinets with top not greater than 2 m above finished floor.
- .4 Extension rings will not be allowed on junction or pullboxes.
- .5 Only main junction and pull boxes are indicated. Provide pull boxes so as not to exceed 30 meters of conduit run between pull boxes.

3.3 IDENTIFICATION

- .1 Junction, pull boxes, and splitters with size 2 identification labels indicating system name, ampacity, voltage and phase in accordance with Section 26 05 01.
- .2 Identify all 100 mm square or 100 mm octagon junction boxes, containing branch circuit conductors, with black felt marker indicating panel and breaker number (i.e. "B-24").

END OF SECTION

Part 1 General

1.1 RELATED WORK SPECIFIED ELSEWHERE

- .1 Electrical General Provisions: Section 26 05 01.

Part 2 Products

2.1 SHEET METAL BOXES

- .1 All octagon boxes shall be hot dipped galvanized steel, minimum 100 mm in diameter #54151. All 100 mm square boxes shall be minimum 40 mm deep #52151. Deep boxes #52171 shall be installed where specified and where six or more conductors enter the box.
- .2 Device boxes shall be minimum 64 mm deep (#1104).

2.2 PVC BOXES

- .1 PVC outlet boxes shall be CSA approved, two gang with gaskets cover unless otherwise stated. Size and quantity of knockouts shall be coordinated with conduit entrances.
- .2 PVC boxes and fittings to: CSA C22.2 No. 85.

Part 3 Execution

3.1 INSTALLATION

- .1 Support boxes independently of connecting conduits. Secure outlet boxes to building structure.
- .2 Fill boxes with paper to prevent entry of construction material.
- .3 Provide correct size of openings in boxes for conduit, mineral insulated and armoured cable connections. Reducing washers not allowed.
- .4 Outlet boxes shall not be mounted back-to-back within the same stud space (separate by at least one stud).
- .5 Boxes installed in exterior stud walls shall be surrounded with a "poly pan" vapour barrier box prior to mounting. Openings through poly wrap for cables or conduit shall be sealed with caulking by this contractor prior to installation of wallboard. The "poly pan" vapour barrier box shall be installed with stud strapping supports on all four sides, so that a bead of caulking may be compressed between the poly pan flange and the wallboards. The stud strapping supports shall be installed by the framing contractor.
- .6 Outlet boxes that penetrate opposite sides of a wall assembly forming a fire separation, shall be offset to maintain the integrity of the fire separation. Boxes shall not be installed back-to-back.

- .7 Coordinate location of outlet boxes in masonry walls, so that the outlet box is centred between masonry block course lines. All cutting of masonry for installation of electrical equipment shall be completed using rotary cutting equipment.
- .8 Extension rings shall **not** be utilized to accommodate conductor fill requirements.
- .9 Where 25 mm conduit is utilized, outlet boxes must be minimum 119 mm square.
- .10 Where outlet boxes are installed in a stud framed wall, a 300 mm length of stud shall be fastened to the side of the outlet box opposite the framing stud to which the outlet box is attached. This 300 mm length of stud will become sandwiched between the gypsum board wall finishes thereby supporting the outlet box on the "unsupported" side of the box.
- .11 Spacing of outlet boxes mounted side by side shall be maximum 125 mm (including installation in masonry, brick, and concrete, etc.).
- .12 For flush mounted device (switch or duplex receptacle) outlet boxes, utilize a 102 x 102 mm square outlet box (64mm deep) with a square cut single device raised cover. Face of wall finish shall come within 5 mm from face of outlet. Plaster rings will not be permitted.
- .13 All outlet boxes installed in masonry walls shall be approved masonry boxes.
- .14 Confirm the direction of door swings with architectural drawings, and on site, to confirm that outlet boxes for light switches are located on the latch side of the door.
- .15 Coordinate rough-in location of all outlet boxes with architectural, structural, and mechanical drawings. Review all architectural room elevations prior to rough-in of outlet boxes to ensure that there are no conflicts with other building components.
- .16 Where devices are located adjacent to one another they shall be grouped in a multi gang outlet box. Provide and install barriers where required.
- .17 347 volt outlet boxes shall be utilized for 347 volt switch devices.

END OF SECTION

Part 1 General

1.1 RELATED WORK

- .1 Fastenings and Supports: Section 26 05 29.

Part 2 Products

2.1 CONDUITS

- .1 Rigid metal conduit: to CSA C22.2 No. 45.
- .2 Electrical metallic tubing (EMT): to CSA C22.2 No. 83. EMT shall be thin-walled electroplated steel.
- .3 Flexible metal conduit and liquid-tight flexible metal conduit: to CSA C22.2 No. 56.
- .4 Rigid PVC conduit: sized as indicated on drawings to CSA C22.2 No. 211.2.
- .5 Flexible non-metallic tubing: to CSA C22.2 No. 227.3.
- .6 Minimum size for all conduit : 19C (21mm).

2.2 CONDUIT FASTENINGS

- .1 One hole galvanized steel straps to secure surface conduits 50 mm and smaller. Use two hole galvanized 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 the following maximum spacings:
 - 1500 mm for 13 mm and 19 mm conduits
 - 2000 mm for 25 mm and 32 mm conduits
 - 3000 mm for 40 mm and larger conduits
- .4 6 mm diameter threaded rods to support suspended channels.
- .5 Conduit clamps for conduits on channels.

2.3 CONDUIT FITTINGS

- .1 Fittings for raceways: to CSA C22.2 No. 18-97.
- .2 Fittings manufactured for use with conduit specified.
- .3 Factory "ells" where 90 degree bends are required for 19 mm and larger conduits.

Part 3 Execution

3.1 INSTALLATION

- .1 Drawings do not show all conduits. Those shown are in diagrammatic form. Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass.
- .2 Conceal conduits except in unfinished areas and concealed ceiling spaces.
- .3 Use rigid conduit in any location which, in the opinion of the electrical consultant is subjected to mechanical damage or corrosion.
- .4 Use flexible metal conduit or armoured cable only for the following:
 - .1 Connection to surface or recessed fixtures in t-bar ceilings (maximum 3000 mm length).
 - .2 Vertical branch circuit wiring to outlets in steel stud partition walls. Do not use for horizontal branch circuit wiring within partition walls. Convert armoured cable to EMT at junction box located in ceiling space directly above the outlet in the wall.
- .5 Use rigid P.V.C. underground or in concrete slabs only. PVC conduit is not acceptable above floor slab.
- .6 Use flexible non-metallic tubing in concrete slabs only. Flexible non-metallic tubing is not acceptable above concrete floor slab (adapt to EMT).
- .7 Use liquid-tight flexible metal conduit and liquid-tight connectors for connection to all motors and transformers.
- .8 Bend conduits cold, so that conduit at any point is not flattened more than 1/10th of its original diameter. Consider conduits bent more than this or kinked as defective and replace.
- .9 Mechanically bend steel conduit over 19 mm diameter.
- .10 Field threads on rigid conduit shall be sufficient length to draw conduits up tight.
- .11 Provide polypropylene pull cord in empty conduits to facilitate pulling wiring in future.
- .12 Run 3 - 25 mm spare conduits up to ceiling space from each flush panel. Terminate these conduits in 152 x 152 x 102 mm junction boxes located in the accessible ceiling space above or in case of an exposed concrete slab, terminate each conduit in a surface type box mounted on the underside of the slab.
- .13 Where conduits become blocked, use of corrosive agents is prohibited. Remove and replace blocked section.
- .14 Dry conduits out thoroughly before installing wire.
- .15 Conduits shall not pass through structural members without the knowledge and consent of the structural consultant.
- .16 Locate conduits not less than 75 mm parallel to steam or hot water lines with a minimum of 25 mm at crossovers.

- .17 All conduit connectors shall be complete with a nylon insulated throat wherever conduit terminates in an outlet or junction box.
- .18 Conduit shall be secured to building structure. Do not fasten conduit to suspended ceiling or its support.
- .19 Run conduit parallel or perpendicular to building lines, when installed exposed or in ceiling spaces.
- .20 Locate conduits a minimum of 1.5 metres from infrared or gas fired heaters.
- .21 Conduits to be run in flanged portion of structural steel.
- .22 Group conduits wherever possible on surface channels.
- .23 Install CSA approved expansion fittings complete with grounding jumpers where conduits cross building expansion joints. Provide offsets in conduit adjacent to building expansion joints, where conduit is installed above suspended ceilings.
- .24 Conduits installed between heated and unheated spaces shall be sealed internally with a silicone sealant at the wall between the two spaces.
- .25 PVC conduit stubbed below grade for utility service entrance conduits, shall be sleeved (minimum 600 mm in length) with an O.D. 25 mm larger than the PVC conduit.
- .26 A minimum of one expansion joint shall also be installed in each 3000 mm length of PVC conduit installed on the exterior of the building.
- .27 Use explosion proof flexible connection for connection to explosion proof motors.
- .28 Install conduit sealing fittings in hazardous areas. Fill with compound.

3.2 CONCEALED CONDUITS

- .1 Horizontal runs are not permitted in masonry walls.
- .2 Conduits are not permitted in terrazzo or concrete toppings.

3.3 IDENTIFICATION

- .1 Refer to General Provisions – Conduit and Cable Identification: Section 26 05 01.

END OF SECTION

1.0 General**1.1 SHOP DRAWINGS AND PRODUCT DATA**

- .1 Submit shop drawings and product data in accordance with Section 26 05 01.

1.2 OPERATING AND MAINTENANCE DATA

- .1 Provide data for incorporation into Electrical Maintenance Manual Specified in Section 26 05 01.

2.0 Products**2.1 DECORATIVE METAL SURFACE RACEWAY**

- .1 The metal raceway shall be a one-piece design with a base and cover factory assembled. Total shall be 0.75" by 0.53" deep with a cross sectional area of 0.20 square inches. The raceway base and cover shall have an approximate thickness of .040". The covers shall be painted with an enamel finish, ivory in colour to match the raceway.
- .2 Provide all necessary components required for complete installation including but not limited to low voltage dividers/barriers, floor boxes (with devices as indicated on the drawings), transitions components, etc.

2.2 FITTINGS

- .1 All accessories shall be manufactured fittings included, but no limited to, clips and straps, couplings, flat, internal and external elbows, cover clips, tees, entrance fittings, conduit connectors and bushings. All fittings shall be supplied with a base where applicable.

2.3 DEVICE AND FIXTURE BOXES

- .1 All device and fixture boxes and covers shall be painted with an enamel finish, ivory in colour to match the raceway cover.

3.0 Execution**3.1 INSTALLATION**

- .1 Install decorative metal raceway where shown on drawings. Assume any incidental costs for accessories required to complete the installation. Install only manufactured fittings. Do not provide field fabricated fittings.
- .2 Mount decorative metal raceway level and in harmony with ceilings, walls and millwork.

- .3 Exercise care to avoid damage or defacing and arrange for touch up or repainting as required.
- .4 Visit site prior to ordering material to determine exact requirements. Location of raceway is shown schematically on drawings, and all fittings are not necessarily indicated.
- .5 Provide and install all fittings required to complete the installation including but not limited to end caps, wire guards, base couplings, cover clips, and wire clips.
- .6 All raceway systems shall be mechanically continuous and connected to all electrical outlets, boxes, and cabinets, in accordance with manufacturer's installation instructions.
- .7 All metal raceway shall be electrically continuous and bonded in accordance with the applicable codes for proper grounding.
- .8 Raceway shall be securely supported at intervals not exceeding 1000 mm and in accordance with manufacturer's installation instructions.
- .9 All raceway systems shall be installed complete, including insulating bushings and inserts where required by manufacturer's installation sheets. All unused raceway openings shall be closed.

END OF SECTION

Part 1 General

1.1 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings and product data in accordance with Section 26 05 01

1.2 OPERATING AND MAINTENANCE DATA

- .1 Provide data for incorporation into Electrical Maintenance Manual specified in Section 26 05 01.

Part 2 Products

2.1 ELECTRICAL CABLE TROUGH

- .1 Cable tray and fittings: to EEMAC F5-1 and CSA C22.2 No. 126.
- .2 Load Class D1, ladder type, minimum inside depth 40 mm, 450 mm wide unless otherwise noted, or required.
- .3 Cable tray shall be constructed of hot dipped galvanized steel.
- .4 Factory manufactured horizontal elbows, end plates, drop outs, vertical risers, drops, tees, wyes, expansion joints, and reducers as required. Fittings manufactured on site will not be accepted.
- .5 Cable tray shall be supported on a trapeze style hanger constructed of 41 mm x 41 mm galvanized steel channel. Channel shall be supported by two 12.5 mm threaded rods. Install trapeze hangers minimum 3 metres on centre, as well as at all elbows and fittings.

2.2 COMMUNICATIONS CABLE TRAY

- .1 Cable tray and fittings: to EEMAC F5-1-1977 and CSA C22.2 No. 126-M91.
- .2 Communication Cable Tray – Wire basket cable runway type, minimum inside depth 50 mm, minimum inside width 300 mm, minimum 4.4 mm wire diameter, 5.08 x 101.6 mesh pattern, tested load capacity of 43 lbs./ft. (with supports @ 1524 mm on centre).
- .3 Cable tray shall be constructed of ASTM A510 high strength steel wires with electro-plated zinc galvanized finish.
- .4 Horizontal elbows, end plates, drop outs, vertical risers, drops, tees, wyes, expansion joints, and reducers as required to be manufactured on site according to manufacturer's instructions.
- .5 Suspend tray on 9.5mm threaded rods at 1524 mm on centre with centre hanger assembly. Attach to beams and joists with beam clamps.

Part 3 Execution

3.1 INSTALLATION

- .1 Install complete cable tray system. Remove sharp burrs or projections to prevent damage to cables or injury to personnel.
- .2 Arrange for opening in fire rated walls, and floors for width and depth of cable tray. Make good, fire rating of floors and walls after cables have been installed.
- .3 Install tray so as to be fully accessible at all locations.
- .4 Install a continuous green insulated ground conductor (#6 AWG minimum) the entire length of the cable tray system. Bond the ground conductor to each section of the cable tray. Terminate ground conductor at the main building ground grid.
- .5 Install cables individually and secure cables in cable tray at 3 metres on centre with Velcro straps.
- .6 For power cables, maintain minimum air space of 100% of the largest cable diameter between cables.
- .7 Use rollers when necessary to pull cables.
- .8 Locate cable trays a minimum of 200 mm clear above suspended ceiling tile grid to accommodate installation / removal of luminaires and ceiling tiles. Coordinate with depth of luminaires to allow a minimum of 75 mm clearance between top of recessed luminaires and bottom of cable tray.

END OF SECTION

Part 1 General

1.1 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings and product data in accordance with 26 05 01.

1.2 OPERATING AND MAINTENANCE DATA

- .1 Provide data for incorporation into Electrical Maintenance Manual specified in Section 26 05 01.

Part 2 Products

2.1 SWITCHES

- .1 15 amp, 120V, single pole, three-way, four-way switches as indicated.
- .2 Manually operated specification grade AC switches as indicated and with following features:
 - .1 Terminals approved for #10 AWG wire.
 - .2 Silver alloy contacts.
 - .3 Urea or melamine moulding for parts subject to carbon tracking.
 - .4 White rectangular rocker type operator ("decorator" style).
 - .5 Grounding terminal or self-grounding clip.
- .3 Switches of one Manufacturer throughout project.
- .4 Switches to: CSA C22.2 No. 111.

2.2 RECEPTACLES

- .1 Receptacles of one Manufacturer throughout project.
- .2 Receptacles to: CSA C22.2 No. 42.
- .3 Specification grade duplex receptacle shall be CSA type 5-15R, 125V, 15A, U-ground with the following features:
 - .1 Heavy-duty, one-piece, chromate plate steel mounting strap secured to body of receptacle at both ends.
 - .2 Heavy-duty white nylon rectangular face ("decorator" style).
 - .3 Suitable for #10 AWG conductors side and back wiring.
 - .4 Break off links for use as split receptacle.
 - .5 Triple wipe constant pressure power contacts with fingers in contact when receptacle is not in use.
- .4 Receptacles energized from an emergency power source shall be red in colour.
- .5 Ground fault circuit interrupter receptacles shall be CSA type 5-15R, 125V U-ground, Class A rated, with the following features:

- .1 Must meet or exceed latest UL943 Class A GFCI, UL498 requirements.
 - .2 Reset button lock-out feature to protect from miswired line load connections and GFCI circuitry damage due to disabling voltage surge spikes.
 - .3 Heavy-duty, one-piece, chromate steel mounting strap secured to body of receptacle at both ends.
 - .4 Heavy-duty white rectangular face.
 - .5 Constant pressure power contacts with fingers in contact when receptacle is not in use.
 - .6 Device shall automatically disconnect power to the receptacle if critical components are damaged and ground fault protection is lost.
 - .7 Trip indicator light to indicate “tripped” condition.
- .6 Receptacles other than 120 volt, 15 amp, 5-15R type, shall be provided with a matching nylon cord end connectors. Install cord end connector on owner supplied equipment.

2.3 COVERPLATES

- .1 Coverplates from one Manufacturer throughout project.
- .2 Sheet steel utility box cover for wiring devices installed in surface mounted utility boxes.
- .3 Cast coverplates for wiring devices mounted in surface mounted FS or FD type conduit boxes.
- .4 Weatherproof “while in use” coverplates, complete with gaskets for duplex receptacles as indicated. Coverplates shall be suitable for wet locations whether or not a plug is inserted into the receptacle.
- .5 Type 302 stainless steel coverplates for all other devices. Thickness shall be minimum .9 mm. Finish shall be smooth satin without lines.

2.4 HDMI OUTLETS

- .1 HDMI outlets shall consist of a HDMI feed through quick port connector with White housing mounted in a white nylon three-port rectangular faceplate that matches the rectangular wiring devices. Provide and install HDMI cable in 25mm EMT conduit

2.5 DECORATIVE SURFACE RACEWAY

- .1 Surface raceway shall be non-metallic, flame resistant, single channel complete with hinged cover, and finished in white. All accessories shall be manufactured fittings.

2.6 SERVICE POLES

- .1 Service poles shall be constructed of clear anodized aluminum with cross section of 57 mm x 57 mm and two separate compartments (power and communication). Poles shall be complete with two isolated ground surge protected duplex receptacles, two standard decorator style duplex receptacles, one decorator style faceplate complete with three CAT 6 computer data jacks, and one decorator style faceplate complete with three CAT 6 telephone voice jacks. The service pole divider shall be offset within the service pole to accommodate the depth of surge protected duplex receptacles and data / voice jacks.

2.7 CEILING MOUNTED OCCUPANCY SENSORS

- .1 Sensor shall be combination ultrasonic and passive infrared technology type, ceiling mounted, providing minimum coverage of 186 m², 360°.
- .2 Manual timer adjustment of 8, 16 or 32 minutes for delayed off time setting.
- .3 Automatic self adjusting delayed off time interval from 8 to 100 minutes.
- .4 Sensor to be complete with power pack to provide a 24V DC power supply for the occupancy sensor and a 13 amp relay for switching 120V loads.

Part 3 Execution

3.1 INSTALLATION

- .1 Switches:
 - .1 Install single throw switches with handle in "UP" position when switch closed.
 - .2 Install switches in gang type outlet box when more than one switch is required in one location.
 - .3 Mount toggle switches at height specified in Section 26 05 01 or as indicated.
 - .4 Locate light switches on latch side of doors.
- .2 Receptacles:
 - .1 Install receptacles in gang type outlet box when more than one receptacle is required in one location.
 - .2 Mount receptacles at height specified in Section 26 05 01 or as indicated.
 - .3 Where split receptacle has one portion switched, mount vertically and switch upper portion.
 - .4 Install GFCI receptacles where receptacles are located in bathrooms or washrooms and installed within 1500 mm of sinks, bathtubs, or shower stalls.
- .3 Coverplates:
 - .1 Protect coverplate finish with paper or plastic film until painting and other work is finished.
 - .2 Install suitable common coverplates where wiring devices are grouped.
 - .3 Do not use coverplates meant for flush outlet boxes on surface mounted boxes.
- .4 Device Identification:
 - .1 Identify branch circuit number on all receptacles with fine tipped black felt permanent marker on side of receptacle body. Identification shall be visible only when coverplate is removed.
 - .2 Identify all receptacle coverplates with clear self-adhesive mylar tape with black lettering (i.e. "A-32"). Alternatively, coverplates can be mechanically engraved.
 - .3 Identify all surge protected isolated ground receptacle coverplates with additional label (as above) indicating "COMPUTER ONLY".

.5 Occupancy Sensor:

- .1 Position occupancy sensors based upon manufacturer's recommendations so that sensor is not activated by movement outside the room door.

END OF SECTION

Part 1 Products

1.1 SHOP DRAWINGS AND PRODUCT DATA

- .1 Shop drawings and product data in accordance with Section 26 05 01.
- .2 Data shall include dimensions, mounting, kW rating, finish, and controls

1.2 OPERATING AND MAINTENANCE DATA

- .1 Provide data for incorporation into Electrical Maintenance Manual specified in Section 26 05 01.

Part 2 Products

2.1 DUCT HEATER

- .1 Duct heaters: As specified.
- .2 Elements:
 - .1 Helical coils of nickel chrome alloy resistance wire.
 - .2 Finned tubular.
- .3 Maximum temperature at discharge: 30 degree C.
- .4 Controls:
 - .1 Factory mounted and wired in control box. Use terminal blocks for power and control wiring to thermostat and DDC. Provide any relays and wiring required.
 - .2 Remote mounted as indicated with terminal strips in heater terminal box for power and control wiring.
 - .3 Controls mounted in a CSA approved manner.
 - .4 For controls mounted in heater, exercise care in mounting contactors to minimize switching noise transmission through ductwork.
 - .5 High temperature cut-out, modulating heat output and air proving switch.
- .5 Main isolation disconnect switch.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other sections or contracts are acceptable for duct heaters installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Consultant

- .2 Inform Consultant of unacceptable conditions immediately upon discovery.
- .3 Proceed with installation only after unacceptable conditions have been remedied.

3.2 INSTALLATION

- .1 Make power and control connections to CSA C22.2 No. 46.

3.3 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 01 91 13 – General Commissioning (Cx).
 - .1 Provide test report and include copy with Operations and Maintenance Manuals.

3.4 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 – Cleaning.
 - .1 Leave work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 – Cleaning.
- .3 Waste Management: separate waste materials for reuse or recycling in accordance with Section 01 74 21 – Construction/Demolition Waste Management and Disposal.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

Part 1 General

1.1 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings and product data in accordance with Section 26 05 01.
- .2 Indicate:
 - .1 Mounting method and dimensions.
 - .2 Starter size and type.
 - .3 Layout of identified internal and front panel components.
 - .4 Enclosure types.
 - .5 Wiring diagram for each type of starter.
 - .6 Interconnection diagrams.
 - .7 Identify motor that starter energizes.

1.2 OPERATION AND MAINTENANCE DATA

- .1 Provide data for incorporation into Maintenance Manual specified in Section 26 05 01.
- .2 Include operation and maintenance data for each type of starter.

1.3 MAINTENANCE MATERIALS

- .1 Provide listed spare parts for each different size and type of starter.
 - .1 One (1) contact, auxiliary.
 - .2 Two (2) fuses.

Part 2 Products

2.1 MATERIALS

- .1 Starters to CSA C22.2 No. 14-M91, EEMAC E14-1.
 - .1 Half size starters not acceptable.
- .2 Control transformers - to CSA C22.2 No. 66-1988.
- .3 Resistors - to EEMAC 13E-1-1965.
- .4 Auto transformers - to CSA C22.2 No. 47-M90.

2.2 MANUAL STARTING SWITCHES

- .1 Single phase manual motor starters of size, type, rating, and enclosure type as required, with components as follows:
 - .1 Switching mechanism, quick-make and break.
 - .2 One overload heater, manual reset, trip indicating handle.

.2 Accessories

- .1 Toggle switch heavy duty labelled as indicated.
- .2 Indicating light: heavy duty LED type, red colour.
- .3 Locking tab to permit padlocking in "ON" or "OFF" position.

2.3 FULL VOLTAGE MAGNETIC STARTER

- .1 Magnetic and combination starters of size, type, rating and enclosure type as indicated with components as follows:
 - .1 Contactor solenoid operated, rapid action type.
 - .2 Motor overload protective device in phase, manually reset from outside enclosure.
 - .3 Power and control terminals.
 - .4 Wiring and schematic diagram inside starter enclosure in visible location.
 - .5 Identify each wire and terminal for external connections, within starter, with permanent number marking identical to diagram.
 - .6 Intelligent Motor Protection Relay (IMPR) or approved equivalent.
- .2 Combination type starters to be circuit breaker with operating handle on outside of enclosure to control circuit breaker, and provision for:
 - .1 Locking in "OFF" position with up to 3 padlocks.
 - .2 Locking in "ON" position.
 - .3 Independent locking of enclosure door.
 - .4 Provision for preventing switching to "ON" position while enclosure door open.
- .3 Accessories:
 - .1 Selector switches: heavy duty H.O.A. unless otherwise indicated.
 - .2 Indicating lights: heavy duty neon type, red color.
 - .3 1-N/O and 1-N/C spare auxiliary contacts unless otherwise indicated.

2.4 INTELLIGENT MOTOR PROTECTION RELAYS

- .1 IMPR's shall be CSA and UL approved.
- .2 IMPR's shall be fully programmable electronic relays, TeSys T or equivalent.
- .3 The IMPR shall feature a Test/Rest button.
- .4 I/O shall consist of six discrete logic inputs, three relay outputs (1 NO) and one relay output for fault signaling (1 NO + 1 NC).
- .5 Control voltage shall be 120V AC or 24V DC.
- .6 Network, electronic and manual reset functions shall be supported.

.7 The following status and monitoring functions shall be provided based on user configurable parameters:

.1 Metering

a. Measurement:

- (i) Line Currents
- (ii) Ground current
- (iii) Average Current
- (iv) Current Phase Imbalance
- (v) Thermal capacity Level
- (vi) Motor Temperature Sensor
- (vii) Frequency

b. Statistics:

- (i) Protection Fault Counts
- (ii) Protection Warning counts
- (iii) Diagnostic fault counts
- (iv) Motor Control Function counts
- (v) Fault History

c. Diagnostics:

- (i) Internal watchdog results
- (ii) Controller Internal Temperature
- (iii) Temperature Sensor Connections
- (iv) Current Connections
- (v) Control Commands (start, stop, run, check back and stop check back)
- (vi) Control configuration checksum
- (vii) Communication loss

d. Motor States:

- (i) Motor control states motor starter/LO1 starts/ LO2 starts
- (ii) Operating time
- (iii) Motor starts per hour
- (iv) Last start max current
- (v) Last start time
- (vi) Time to trip
- (vii) Time to reset

.2 Fault Monitoring:

a. Diagnostic:

- (i) Run command check
- (ii) Stop command check
- (iii) Run check back
- (iv) Stop check back

b. Wiring/ Configuration errors:

- (i) PTC Connection
- (ii) CT Reversal
- (iii) Current Phase Reversal
- (iv) Phase Configuration

- c. Internal:
 - (i) Stack Overflow
 - (ii) Watchdog
 - (iii) ROM Checksum
 - (iv) EEROM
 - (v) CPU
 - (vi) Internal Temperature
 - d. Motor temp sensor:
 - (i) PTC Binary
 - (ii) PTC Analog
 - (iii) NTC Analog
 - e. Thermal overload:
 - (i) Definite
 - (ii) Inverse Thermal
 - f. Current:
 - (i) Long Start
 - (ii) Jam
 - (iii) Current Phase Imbalance
 - (iv) Current Phase Loss
 - (v) Overcurrent
 - (vi) Undercurrent
 - (vii) Internal Ground Current
 - (viii) External Ground Current
 - g. Communication loss
 - (i) PLC to IMPR
- .3 Protection:
- a. Thermal overload
 - b. Current phase imbalance
 - c. Current phase loss
 - d. Current phase reversal
 - e. Long start
 - f. Jam (locked rotor during run)
 - g. Undercurrent
 - h. Overcurrent
 - i. Ground current
 - j. Motor temperature sensor
 - k. Rapid cycle lockout
- .4 Control Functions:
- a. Motor control modes
 - (i) Local terminal strip
 - (ii) Local HMI
 - (iii) Network
 - b. Operating mode:
 - (i) Overload
 - (ii) Independent

- (iii) Reverser
 - (iv) Two-step
 - (v) Two-speed
 - (vi) Custom Mode
 - c. Fault Management:
 - (i) Manual reset
 - (ii) Automatic reset
 - (iii) Remote reset
- .8 In addition to the status and monitoring functions listed in section G, the following functions shall be provided if the power monitoring and measurement option is selected:
 - .1 Metering
 - a. Measurement:
 - (i) Line to Line Voltage
 - (ii) Line Voltage Imbalance
 - (iii) Active Power
 - (iv) Reactive Power
 - (v) Active Power Consumption
 - (vi) Reactive Power Consumption
 - b. Diagnostics:
 - (i) Voltage Connections
 - .2 Fault Monitoring
 - a. Wiring/Configuration errors:
 - (i) Voltage Phase Reversal
 - (ii) Voltage Phase Loss
 - b. Voltage
 - (i) Overvoltage
 - (ii) Undervoltage
 - (iii) Voltage Phase
 - (iv) Imbalance
 - c. Power
 - (i) Underpower
 - (ii) Overpower
 - (iii) Under Power Factor
 - (iv) Over Power Factor
 - .3 Protection:
 - a. Voltage phase imbalance
 - b. Voltage phase loss
 - c. Voltage phase reversal
 - d. Under voltage
 - e. Over voltage
 - f. Voltage load shedding
 - g. Under power

- h. Overpower
- i. Under power factor
- j. Over power factor

.9 Metering and Monitoring

- .1 The IMPR shall include accurate measurement processing functions [and shall display the metering data on the HMI] to operate the different applications and carry out commissioning and maintenance.
- .2 For measurement, the IMPR shall include Current transformers up to 100 A, for all measurements required (current, power, voltage, frequency...). It is not possible to use external special CTs for measurement.

.10 Motor Protection Functions

- .1 The IMPR shall integrate all motor protection functions described above.
- .2 The thermal overload trip curve shall be selectable between inverse (I^2t) or definite time (I_{xt}) curve. The Auxiliary Fan Cooling application shall be also selectable.
- .3 It shall include Ground Fault Protection internally, and it shall be possible to use an external zero sequence CT to accomplish this, without the need for additional modules or devices.

.11 Programming and configuration software:

- .1 The IMPR shall use user-friendly settings and operate multi-lingual software in a Windows environment with menus and icons for fast direct access to the data required, guided navigation to go through all the data for the same function on the same screen and with file management.
- .2 The PC can be connected in a 1-to-1 configuration to a single controller, or in a 1-to-many configuration to multiple controllers.
- .3 The IMPR shall provide a "Custom Mode", a logic customized by the end user.

.12 User Machine Interface:

- .1 The IMPR shall include a local Human-Machine Interface (HMI), to commission, configure or receive information from 1 or more controllers using the keypad. The HMI can be used in a 1- to-1 configuration or a 1-to-many configuration connected up to 8 controllers.
- .2 The HMI can commission and configure the controller using:
 - a. operator button commands
 - b. navigation button commands
 - c. configuration information through menu entries or selections
 - d. communication status information
- .3 At all times, the HMI keypad provides access to the controller's:
 - a. LED status information
 - b. read/write controller parameters
 - c. fault and warning status information

.13 Self-Test:

- .1 The IMPR shall be capable of self-tests. It shall perform internal checks such as a watch-dog check and RAM check, in order to maximize availability and minimize the risk of malfunctioning.

2.5 FINISHES

- .1 Apply finish to enclosure in accordance with Section 26 05 01.

Part 3 Execution

3.1 INSTALLATION

- .1 Install starters, connect power and control as indicated.
- .2 Ensure correct fuses and overcurrent devices are sized to accommodate actual motor loads prior to ordering electrical equipment. Actual motor electrical loads may vary depending upon manufacturer of the mechanical equipment. Refer to mechanical shop drawings and manufacturer specifications.
- .3 Provide the necessary conduit for mechanical heating and ventilation control to the starters as required under the mechanical contract. Confirm with the Mechanical Contractor the conduit requirements prior to installation.
- .4 The Electrical Contractor shall complete all control wiring required which is not specifically related to the controls systems as outlined in the mechanical specifications. All control wiring outlined in the mechanical specifications as part of the controls systems shall be completed by the Controls Contractor. The Electrical Contractor shall supply all control equipment specifically noted on plans or specifications. All other equipment required shall be supplied by Mechanical or other trades. The Electrical Contractor shall co-operate with the Mechanical trades to ensure that all control sequences and equipment are correct. The Electrical Contractor shall be supplied with all electrical equipment from other trades and shall verify that its characteristics are correct. It will be the responsibility of the Electrical Contractor to obtain from the Mechanical Contractor, and all other trades, complete detailed wiring diagrams for all equipment supplied by these trades requiring electrical wiring by the Electrical Contractor's work and the work of other trades. It is the Electrical Contractor's responsibility to point out immediately any discrepancies in these diagrams or any reason they cannot be adhered to. All control equipment such as immersion type thermostats, coil freeze protection, pneumatic control devices, etc. shall be installed by the trade responsible for its supply and operation.
- .5 It is the responsibility of the electrical contractor to provide a dedicated line voltage power source where required for control systems. Coordinate locations of power source for controls systems with mechanical contractor.
- .6 It is the responsibility of the electrical contractor to provide all control devices such as pushbutton stations, when they do not form part of a control panel.

3.2 TESTS

- .1 Perform tests in accordance with Section 26 05 01.
- .2 Perform tests in accordance with Manufacturer's instructions.
- .3 Operate switches, contactors to verify correct functioning, related starters, equipment, control devices, operate as indicated.
- .4 Perform starting and stopping sequences of contactors and relays.
- .5 Check that sequence controls, interlocking with other separate related starters, equipment, control devices, operate as indicated.

3.3 EQUIPMENT IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 01.
- .2 Provide a size 1 plastic laminate identifying both name of motor as well as motor designation (i.e. "EXHAUST FAN EF-1").
- .3 Provide a 150 mm x 150 mm plastic laminate label (red face, white core) at starter for dry sprinkler system air compressor reading "THIS SWITCH CONTROLS THE AIR COMPRESSOR FOR THE DRY SPRINKLER SYSTEM. DO NOT TURN TO OFF POSITION UNLESS SERVICING MOTOR" (if applicable).

END OF SECTION

Part 1 General

1.1 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings and product data in accordance with Section 26 05 01.
- .2 Submit complete photometric data prepared by independent testing laboratory for all luminaires.
- .3 Photometric data to include:
 - .1 Total input watts
 - .2 Candela
 - .3 Distribution zonal lumen summary
 - .4 Luminaire efficiency
 - .5 Coefficient of utilization
 - .6 Lamp type
- .4 Shop drawings for luminaires will not be reviewed unless associated lamp and ballast shop drawings are included.

1.2 OPERATION AND MAINTENANCE DATA

- .1 Provide data for incorporation into Electrical Maintenance Manual specified in Section 26 05 01.

1.3 SPARE LAMPS AND BALLASTS

- .1 Provide spare lamps as follows:
 - .1 5% of each lamp type (minimum two spare lamps for each lamp type).
- .2 Provide spare ballasts as follows:
 - .1 Two (2) spare ballasts for each type and wattage of fluorescent ballast.
- .3 Provide spare LED modules and drivers as follows:
 - .1 5% of each module and driver type (minimum quantity of 2) if replaceable type. Otherwise provide one spare luminaire for each type.

1.4 GUARANTEE

- .1 Replace:
 - .1 Incandescent and tungsten halogen lamps burning out within 3 months of Substantial Performance of Work.
 - .2 Fluorescent and HID lamps burning out within 6 months of takeover.
 - .3 Ballasts that fail or exceed their original noise level rating within 12 months of Substantial Performance of Work.
 - .4 LED modules and drivers that fail within 12 months of substantial Performance of Work.

1.5 LUMINAIRE SCHEDULE

- .1 Refer to luminaire schedule on drawing(s).

Part 2 Products

2.1 LED LIGHT SOURCES

- .1 LED luminaires shall include circuit board mounted arrays of Class 1 high output LED's and pre-wired LED driver modules.
- .2 Each LED shall be equipped with an optical element designed to provide the desired IESNA distribution Type. All LED optical assemblies shall be oriented in the same direction so that failure of any LED or array will not affect the light distribution pattern of the luminaire. Optical elements shall limit light projection above 80° from vertical to 10% or less.
- .3 Luminaires shall be designed so that failure of one LED will not result in the loss of the entire luminaire. LED modules shall be replaceable without replacement of the entire luminaire.
- .4 LED luminaires shall be rated for a minimum operational life of 80,000 hours based on an average 10 hours per operation cycle at a temperature of 25°C. Lumen output depreciation shall be less than 30% over the life of the LED.
- .5 Light output shall have a color temperature range of as specified in the luminaire schedule with a color rendering index of 80 or greater.

Interior Lighting: 3500K
- .6 LED luminaires shall be designed with passive thermal management features of sufficient capacity to ensure the LED maximum junction temperature is not exceeded over the operating temperature range of -40°C to + 40°C.
- .7 LED luminaires shall rated to operate on a 120/208 Volt system at 60 Hz with a power factor of 0.9 or greater and THD of less than 20% over the entire load range of 0-100%.
- .8 LED luminaires shall be equipped with on-board surge suppression devices to withstand transient peak voltages up to 10 KV and transient peak currents up to 5KA. Surge protection devices shall fail to the 'luminaire inoperable' state.
- .9 LED luminaires shall meet Class A RF emission limits.
- .10 Luminaire to have minimum efficiency of 75 lumens/watt.
- .11 All photometric data shall be measured by the latest edition of the IESNA LM-79 standard and formatted the per latest edition of IESNA LM-63 as an electronic .ies file.
- .12 The LED lumen maintenance characteristics shall be measured in accordance with the latest edition of IESNA LM-80 "Approved Method for Lumen Maintenance Testing of LED Light Sources." Submit copy of manufacturer's

LM-80 report accompanied by lumen depreciation estimates for 10, 15 and 25 degrees Celsius luminaire ambient operating temperatures.

- .13 The power supply driver enclosure shall be sealed to protect against the entry of dust and water (minimum ingress protection level of 65 (IP65)).
- .14 LED power supply drivers shall be suitable for dimming to 1%.

2.2 LUMINAIRE DETAILS

.1 General

- .1 Provide luminaires as indicated in luminaire schedule.
- .2 Provide supporting devices, ceiling canopies, junction boxes and outlet boxes where required.

.2 Indoor Luminaires

- .1 Stamped steel luminaire bodies for troffer style luminaires shall not be less than 0.76 mm (22 gauge) thick cold rolled steel. Reflective steel plates of minimum 0.76 mm (22 gauge) thick metal.
- .2 Luminaire housing and reflective surfaces shall be finished in two coats of baked white enamel paint after assembly, with a minimum 85% reflectance rating.
- .3 Fluorescent and linear LED luminaire lens frames shall be hinged complete with latches, to permit operation without the use of tools.
- .4 Provide lenses or diffusers of glass or 100% pure virgin acrylic material as indicated. Lenses for fluorescent luminaires shall be minimum 3.175 mm thick.
- .5 Provide gasketing, stops and barriers to form tight traps to prevent light leaks.

.3 Accessories

- .1 Provide wireguards for all luminaires located in areas where the luminaire may be subject to damage. Wireguards shall be 11 gauge minimum.

Part 3 Execution

3.1 INSTALLATION

- .1 Locate luminaires as indicated.
- .2 Provide plaster frame and trim as required, and turn over to trade providing ceiling installation.
- .3 Support luminaires directly from building structure.
- .4 Install recessed luminaires so that they can be completely removable from below the finished ceiling.

- .5 Recessed downlights installed in t-bar ceilings shall be secured to metal support blocking (metal stud) spanning between ceiling grid members. Secure recessed downlight to blocking to ensure that luminaire does not move when trim is adjusted, or removed for relamping.
- .6 Recessed lighting luminaires in inaccessible ceilings shall be secured to blocking attached to building structure.
- .7 Where no finished ceiling exists, luminaires shall be suspended on rigid conduit hangers complete with ball aligner, and outlet box canopy. All suspension components shall be degreased and painted white, unless otherwise noted.
- .8 Coordinate installation of luminaires with mechanical trades to avoid conflicts between luminaires, and mechanical system components.
- .9 All luminaires shall be installed level, and in-line. Luminaires shown in continuous rows or broken lines shall be aligned so that all rows appear as straight lines. Luminaires installed crooked will not be accepted.
- .10 Exterior wall mounted luminaires shall be mounted on recessed flush mounted box (except where luminaire is complete with an integral outlet box, in which case the recessed luminaire housing should be installed during rough-in).
- .11 Where luminaires are specified with a safety chain (or cable), the chain (or cable) should be secured neatly to the down rod supporting the luminaire. The top of the safety chain (or cable) shall be secured to the structure via an eye hook fastened to the structure (not the same eye hook supporting the luminaire).

3.2 WIRING

- .1 Connect luminaires to lighting circuits as indicated.

END OF SECTION

Part 1 General

1.1 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings and product data in accordance with Section 26 05 01.

1.2 OPERATING AND MAINTENANCE DATA

- .1 Provide data for incorporation into Electrical Maintenance Manual specified in Section 26 05 01.

1.3 VERIFICATION

- .1 Confirm operation of all exit lights on both normal, and emergency power. Record the following for each exit light:
 - .1 room locations
 - .2 which emergency lighting unit energizes the exit light
 - .3 status of operation on normal power (pass or fail)
 - .4 status of operation on emergency power (pass or fail)

Part 2 Products

2.1 MATERIAL

- .1 Exit lights shall meet the requirements of CSA C860, and CSA C22.2 No. 141 (latest edition). Exit lights shall be NRCan C860 registered.
- .2 Housing shall be constructed of one piece extruded aluminum with a thickness of 1.3 mm and a baked white enamel finish.
- .3 Faceplate shall be constructed of extruded aluminium with a thickness of 2.0 mm, and a baked white enamel finish with poly-carbonate panel, green pictogram, and direction indication. The faceplate shall remain captive while relamping. Snap-out arrow knockouts shall be included on the faceplate to allow field selection of directional indication.
- .4 Exit light shall be suitable for wall, end, or ceiling mounting as indicated on drawings and confirmed on site.
- .5 Blank faceplate for the back of single face exit signs, shall not have any knockouts.
- .6 The exit light shall be illuminated with high brightness LED's enclosed in an acrylic module which shall evenly distribute light on the lettering. The module containing the LED's shall be capable of illuminating both single and double face exit signs. Illuminance characteristics shall meet the requirements of CSA-C860.

- .7 LED's shall be connected in parallel (not series) so that failure of an LED shall not cause more than 5 LED's to be extinguished.
- .8 Exit light input shall be maximum 2.5 watts.
- .9 Exit light shall contain maintenance free nickel-cadmium battery, and charger providing a minimum of 30 minutes of illumination during failure of 120V power. Battery and charger shall be contained within the standard external dimensions of the exit light enclosure. Solid state transfer technology shall be utilized to transfer power from 120V to the battery. An LED indicator light shall indicate AC "on." A pushbutton test switch shall be included to allow confirmation of operational status of the exit sign upon failure of 120V power.
- .10 Design life for the exit light shall be minimum 25 years.

Part 3 Execution

3.1 INSTALLATION

- .1 Install exit lights in plain view as indicated, and in accordance with the latest edition of the National Building Code.
- .2 Exit lighting shall be connected to a separate AC circuit dedicated to exit lighting only, and shall also be connected to an emergency power supply source.
- .3 Wireguard shall be included for all exit lights located in areas where the exit light may be subject to damage.
- .4 Coordinate installation of exit lights with ceiling or wall construction. If necessary, provide hanger to suspend exit light below visual obstructions.

END OF SECTION