

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 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.

3.0 APPROVED EQUIVALENTS/ALTERNATES

- .1 The listing of a manufacturer and his respective type or catalogue number as the basis of design, is to establish the construction features, sizes, quality, and accessories of an item of equipment in addition to the characteristics specified.
- .2 Approval of equivalent products will be granted on the basis of the manufacturer, and general design only. Such approval does not relieve the electrical contractor and/or supplier from providing all necessary components and finishes as called for on the drawings or in the specifications.
- .3 A detailed line-by-line compliance comparison of any product submitted for approval, must be submitted. Exceptions and non-compliance shall be clearly identified. Requests for equals must include the following:
 - .1 A detailed bill of materials correlating each item of equipment to those specified.

- .2 Catalogue product data sheet for each proposed item of equipment. If more than one model is shown on the data sheet, indicate exactly which model is proposed.
- .3 Copy of the specification section with each paragraph marked to show where on the product data sheet the specification requirement is satisfied (use specification cross reference numbers on the product data sheet).
- .4 If compliance with any specification requirement cannot be substantiated by reference to published data provide a typewritten compliance statement signed by an executive officer of the manufacturer. Stating that the executive proposed products comply with all specified requirements.
- .4 A contractor quoting on materials or equipment not thus approved, does so at his own risk and will be required to install those products which are approved.
- .5 The Contractor shall make allowances in his bid for the cost of any associated changes in this division made necessary by the selection of an approved product other than that named as the basis of designs. Additional costs to this division due to the departure from equipment named shall be borne by the contractor.

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 Contracting Officer 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 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.

7.0 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.

8.0 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.

9.0 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.

10.0 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.

11.0 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.

12.0 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:

600 V	Yellow
Fire Alarm	Red
Emergency Power	Orange
Low Voltage Switching	Tan
Computer Data	Blue

13.0 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.

14.0 WIRING TERMINATIONS

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

15.0 MANUFACTURER'S AND CSA LABELS

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

16.0 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.

17.0 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.

18.0 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 Voice/Data outlets: 450 mm (500 mm in concrete block)
 - .10 Motor starters (loose): 1200 mm
 - .11 Emergency lighting units: 2100 mm

- .12 Emergency lighting remote luminaires: 150 mm below finished ceiling to a maximum height of 3000 mm.
- .13 Wall mounted exit lights: 2200 mm (coordinate with door height & ceiling height)

19.0 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.

20.0 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.

21.0 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.

22.0 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.

23.0 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.

24.0 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. Acceptable manufacturers include: Fyre Shield manufactured by Tremco Ltd., Fyre-Sil manufactured by Tremco Ltd., Mineral Wool and FSI Silicone Sealant manufactured by FSI Engineering.

Damping 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.

25.0 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.

26.0 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.

27.0 COORDINATION OF PROTECTIVE DEVICES

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

28.0 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.

29.0 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
 - communications horizontal cabling
 - emergency lighting system
- .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.

30.0 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.

31.0 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.

32.0 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.

33.0 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)
 - .15 Nurse Call Test Report and Verification Report (include in "Nurse Call System" section).
 - .16 Intercom/Paging Test Report and Verification Report (include in "Paging and Intercom System" section).
 - .17 Emergency Power Generation and Transfer Switch Commissioning Report.
 - .18 Voice and Data Cabling Verification and Test Report (include in "Communications Horizontal Cabling" section).

- .19 Intrusion Alarm System Verification and Test Report (include in 'Intrusion Alarm System' section).
 - .20 Audio visual distribution system verification and test report (include in 'Audio Visual Distribution System' section).
 - .21 Card access system verification and test report (include in 'Card Access System' section).
 - .22 Closed circuit video surveillance system verification and test report (include in "CCTV Video Surveillance 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 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
 - Panelboards and Breakers
 - Luminaires, Lamps, and Ballasts
 - Exit Lighting
 - Emergency Lighting
 - Low Voltage Lighting Control System
 - Fire Alarm System
 - Communications Horizontal Cabling
 - Motor Starters and Motor Control Centres
 - Devices:
 - Receptacles
 - Switches
- 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).

34.0 MAINTENANCE MATERIALS

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

35.0 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.
- .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.
- .5 **The instructional training session shall be videotaped**, and one copy of the video (DVD format) shall be included with each of the maintenance manuals.

36.0 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.

37.0 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)

38.0 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								
L.V. Lighting Control								
Fire Alarm System								
Voice & Data Systems								
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

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**1.01 RELATED WORK SPECIFIED ELSEWHERE**

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

Part 2 Products**2.01 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.
- .4 Acceptable manufacturers: Buchanan

Part 3 Execution**3.01 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 26 05 20

Part 1 General**Part 2 Products****2.01 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**3.01 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 Conductors drawn into conduit shall not be pulled more than 30 metres nor more than three 90° bends without pullboxes.
- .6 Lubricant for pulling conductors shall be wax base insoluble in water and non-hardening.
- .7 Conductor length for parallel feeders shall be identical.
- .8 Identify all conductors (including neutral) with “Brady” marker to describe circuit number, wherever they are terminated in a junction box or panelboard.

- .9 Neutral conductors shall not be derated.
- .10 When changing the rotation of three phase motors, the change shall be made at the motor splice box.
- .11 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).
- .12 Low voltage wiring shall be red, blue, and orange in colour, minimum #16 AWG, THHN.
- .13 Fire alarm system signal and initiating circuit conductors shall be red and black in colour.
- .14 Control wiring conductors shall be red in colour (except associated building neutral conductor shall be white in colour).
- .15 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.
- .16 Install a separate insulated (green) ground conductor for each motor circuit.
- .17 Install a separate insulated (green ground) conductor for each panelboard feeder.
- .18 Install a separate insulated conductor (green with yellow band) for each panelboard with an isolated ground buss.
- .19 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).
- .20 Insulation for all conductors installed exterior to the building shall be rated at minus 40 degrees Celsius.
- .21 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.
- .22 Panelboard feeders shall be continuous and free of splices between the overcurrent protection device for the panelboards, and the panelboard.
- .23 Refer to Section 26 05 34 regarding installation of armoured cable.
- .24 Branch wiring for emergency power supply branch circuits shall be banded with yellow identification.

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 Conductors drawn into conduit shall not be pulled more than 30 metres nor more than three 90° bends without pullboxes.

- .6 Lubricant for pulling conductors shall be wax base insoluble in water and non-hardening.
- .7 Conductor length for parallel feeders shall be identical.
- .8 Identify all conductors (including neutral) with "Brady" marker to describe circuit number, wherever they are terminated in a junction box or panelboard.
- .9 Neutral conductors shall not be derated.
- .10 When changing the rotation of three phase motors, the change shall be made at the motor splice box.
- .11 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).
- .12 Low voltage wiring shall be red, blue, and orange in colour, minimum #16 AWG, THHN.
- .13 Fire alarm system signal and initiating circuit conductors shall be red and black in colour.
- .14 Control wiring conductors shall be red in colour (except associated building neutral conductor shall be white in colour).
- .15 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.
- .16 Install a separate insulated (green) ground conductor for each motor circuit.
- .17 Install a separate insulated (green ground) conductor for each panelboard feeder.
- .18 Install a separate insulated conductor (green with yellow band) for each panelboard with an isolated ground buss.
- .19 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).
- .20 Insulation for all conductors installed exterior to the building shall be rated at minus 40 degrees Celsius.

- .21 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.
- .22 Panelboard feeders shall be continuous and free of splices between the overcurrent protection device for the panelboards, and the panelboard.
- .23 Refer to Section 26 05 34 regarding installation of armoured cable.
- .24 Branch wiring for emergency power supply branch circuits shall be banded with yellow identification.

END OF SECTION 26 05 21

Part 1 General**1.01 RELATED WORK SPECIFIED ELSEWHERE**

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

Part 2 Products**2.01 SUPPORT CHANNELS**

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

2.02 FASTENERS

- .1 Acceptable Fasteners: - Hilti "HKD"
 - Hilti "kwik" bolts
 - beam clamps

2.03 MANUFACTURERS

- .1 Acceptable Channel manufacturers: Burndy Ltd., Electrovert Ltd., Unistrut Ltd.

Part 3 Execution**3.01 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 26 05 29

Part 1 General**1.01 SHOP DRAWINGS AND PRODUCT DATA**

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

1.02 OPERATING AND MAINTENANCE DATA

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

Part 2 Products**2.01 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.

2.02 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.

2.03 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**3.01 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.

3.02 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.

3.03 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 26 05 31

Part 1 General**1.01 RELATED WORK SPECIFIED ELSEWHERE**

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

Part 2 Products**2.01 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).

2.02 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**3.01 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 (4 11/16") 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.

END OF SECTION 26 05 32

Part 1 General**1.01 RELATED WORK**

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

Part 2 Products**2.01 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 Type DB2 PVC duct for ductbanks and direct burial: sized as indicated on drawings, to CSA C22.2 No. 211.1.
- .5 Rigid PVC conduit: sized as indicated on drawings to CSA C22.2 No. 211.2.
- .6 Flexible non-metallic tubing: to CSA C22.2 No. 227.3. Ipex "Cor-Line" or approved equivalent.

2.02 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.

2.03 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**3.01 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.

3.02 CONCEALED CONDUITS

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

3.03 IDENTIFICATION

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

END OF SECTION 26 05 34

Part 1 General**1.01 WORK INCLUDED**

- .1 General inspection of all electrical equipment.
- .2 Specific equipment testing as specified herein or in other sections of the specifications.
- .3 Power Distribution System testing including insulation resistance testing, load balance, and voltage testing.
- .4 Building Systems testing.
- .5 Submittal of test reports.
- .6 Instruction for the Owner's staff in the cleaning, maintenance and operation of the building systems, equipment, and finishes.

Part 2 Products

- .1 Provide all instruments, meters, and equipment required to conduct tests during and at the conclusion of the project.

Part 3 Execution**3.01 GENERAL EQUIPMENT INSPECTION**

- .1 Visually inspect all equipment delivered to the site, to identify damage due to transportation, handling, or placing into position. Verify the content of the equipment with the bill of material and note any missing items. Document all defects or damage noted and submit to the Electrical Consultant.
- .2 Check all bus connections, wiring, and other joints that are made at equipment shipping splits and ensure that the equipment sections are properly bolted together.
- .3 Ensure that the equipment is clean and free of debris before proceeding with testing or energization of the equipment.
- .4 Verify the phasing connections of the incoming and / or outgoing connections to the equipment.
- .5 Visually check air gap and surface clearances, phase to phase and phase to ground. Document any clearances that appear to be below the CSA standard for the equipment.
- .6 Ensure that ground connections are provided to C.E.C. requirements and as specified.

3.02 EMERGENCY AND EXIT LIGHTING

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

3.03 LOW VOLTAGE LIGHTING CONTROL

- .1 Confirm operation/control of all lighting units within observation cells via the control post location.

3.04 TEST REPORTING

- .1 Submit general equipment inspection report to confirm that equipment has been tested and noting any damage or defects.
- .2 Submit distribution system electrical test reports including:
 - insulation resistance test results for all feeders and equipment except for 120/208 volt branch circuit wiring.
 - power distribution system voltage readings
 - load balance readings.

END OF SECTION 26 08 00

Part 1 General**1.01 WORK INCLUDED**

- .1 General inspection of all security equipment.
- .2 Specific equipment testing as specified herein or in other sections of the specifications.
- .3 Submittal of test reports.
- .4 Instruction for the Owner's staff in the cleaning, maintenance and operation of the security systems, equipment, and finishes.

Part 2 Products

- .1 Provide all instruments, meters, and equipment required to conduct tests during and at the conclusion of the project.

Part 3 Execution**3.01 GENERAL EQUIPMENT INSPECTION**

- .1 Visually inspect all equipment delivered to the site, to identify damage due to transportation, handling, or placing into position. Verify the content of the equipment with the bill of material and note any missing items. Document all defects or damage noted and submit to the Security Consultant.
- .2 Check all connections, wiring, and ensure that the equipment is properly mounted.
- .3 Ensure that the equipment is clean and free of debris before proceeding with testing or energization of the equipment.
- .4 Verify the phasing connections of all connections to the equipment.
- .5 Ensure that ground connections are provided to C.E.C. requirements and as specified.

3.02 INTERCOMMUNICATION SYSTEM

- .1 Ensure proper location of intercom icon on touchscreen monitor graphic.
- .2 Test all call functions including call request placed, call answered, call connection, and call cancelled from intercom station and touchscreen.
- .3 Adjust call audio level for optimum performance.
- .4 Ensure call audio quality is clear and without any system noise.
- .5 Ensure associated cameras are brought up on video spot monitors.

3.03 DOOR CONTROL SYSTEM

- .1 Ensure proper location of door icon on touchscreen monitor graphic.

- .2 Test all door control functions including door open, door pass, and door lock.
- .3 Ensure associated cameras are brought up on video spot monitors.

3.04 INMATE CELL CALL SYSTEM

- .1 Ensure proper location of intercom icon on touchscreen monitor graphic.
- .2 Test all call functions including call request placed, call answered, call connection, and cancelled from Call Cancellation Device at Cell door.
- .3 Adjust call audio level for optimum performance.
- .4 Ensure call audio quality is clear and without any system noise.
- .5 Ensure proper operation of call cancellation device.

3.05 PPA SYSTEM

- .1 Recalibrate the PPA sensor after mounting in the relocated position.
- .2 Verify proper receiving and locating from PPA transmitters throughout the sensor coverage area.

3.06 VIDEO SURVEILLANCE SYSTEM

- .1 Ensure proper location of camera icon on touchscreen monitor graphic.
- .2 Adjust camera viewing angle and focal length for optimum coverage.
- .3 Ensure proper video streaming for multicasting and recording functions.
- .4 Ensure camera image is clear and compliant with its resolution.
- .5 Verify proper operation of the IR illuminator on cell cameras.
- .6 Ensure cameras are brought up on video spot monitors in relation to door control and intercom functions.

3.07 GUARD TOUR SYSTEM

- .1 Ensure guard tour input devices function properly and tours are properly recorded.

3.08 TEST REPORTING

- .1 Submit general equipment inspection report to confirm that equipment has been tested and noting any damage or defects.

END OF SECTION 26 08 01

Part 1 General**1.01 SHOP DRAWINGS AND PRODUCT DATA**

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

1.02 OPERATING AND MAINTENANCE DATA

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

Part 2 Products**2.01 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.
- .5 Acceptable Manufacturers: Pass and Seymour #2601-W, Hubbell #DS115W, Leviton #5691-2W, Cooper #7601W or approved equal.

2.02 RECEPTACLES

- .1 Receptacles of one Manufacturer throughout project.
- .2 Receptacles to: CSA C22.2 No. 42.
- .3 Hospital 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.
 - .6 Acceptable manufacturers, Pass and Seymour #26262-HGW, Hubbell #2172W, Leviton #16262-HGW, Cooper #8262W or approved equal.
- .4 Hospital grade 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.
 - .8 Acceptable manufacturers Hubbell #GFR8200HWTR, Pass and Seymour #1595HGW, Leviton #N7599-HG, Cooper #VGFH15W or approved equal.
-
- .5 Receptacles energized from an emergency power source shall be red in colour.
 - .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.
 - .7 All receptacles shall be hospital grade type.

2.03 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 Type 302 stainless steel coverplates for all other devices. Thickness shall be minimum .9 mm (.04”). Finish shall be smooth satin without lines.

Part 3 Execution

3.01 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".

END OF SECTION 26 27 26

Part 1 General**1.01 SHOP DRAWINGS AND PRODUCT DATA**

- .1 Submit shop drawings and product data in accordance with Section 26 05 01
- .2 Drawings shall include rating and enclosure dimensions.

1.02 OPERATIONS AND MAINTENANCE DATA

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

1.03 RELATED WORK SPECIFIED ELSEWHERE

- .1 Fuses - Low Voltage - Section 26 28 13.

Part 2 Products**2.01 EQUIPMENT**

- .1 Enclosed manual air break switches in non-hazardous locations: to CSA C22.2 No. 4-M1985.
- .2 Fuseholder assemblies: to CSA C22.2 No. 39-M1987.
- .3 Fusible and non-fusible disconnect switch in CSA Enclosure 1 as indicated.
- .4 Provision for padlocking in "OFF" switch position.
- .5 Mechanically interlocked door to prevent opening when handle in 'ON' position.
- .6 Fuseholders in each switch suitable without adaptors, for type of fuse as indicated.
- .7 Quick-make, quick-break action.
- .8 ON-OFF switch position indication on switch enclosure cover.
- .9 Fusible and non-fusible disconnect switch shall be complete with solid neutral lug assembly.

2.02 MANUFACTURERS

- .1 Acceptable Manufacturers: Square D Company Ltd., Eaton Cutler-Hammer Canada Ltd., Siemens Canada Ltd., Schneider Canada Ltd., General Electric Industrial Systems, or approved equivalent.

Part 3 Execution**3.01 INSTALLATION**

- .1 Install disconnect switches complete with fuses as indicated.

- .2 Mount securely at 1800 mm above finished floor to top of switch. Provide a minimum of 1000 mm clear floor space in front of the switch.

3.02 EQUIPMENT IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 01.
- .2 Nameplate for each disconnect switch Size 5 engraved in accordance with Section 26 05 01. Indicate disconnect load, amperage, voltage, and phase (i.e., rooftop unit, 60 amp, 120/208V, 3 phase).
- .3 Identify circuit number on disconnect switch (i.e. "B-36").

END OF SECTION 26 28 23

Part 1 General**1.01 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.

1.02 OPERATION AND MAINTENANCE DATA

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

1.03 SPARE LAMPS AND BALLASTS

- .1 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.

1.04 GUARANTEE

- .1 Replace:
 - .1 LED modules and drivers that fail within 12 months of substantial Performance of Work.

1.05 APPROVED EQUALS

- .1 Requests for approval of site lighting luminaires other than those specified, must include a computer generated layout of the parking lot showing initial light levels achieved using the proposed fixture. A maximum point by point grid of 3000 mm shall be used for indication of light levels.
- .2 Requests for approval of luminaires denoted with an asterisk in Luminaire Schedule shall be accompanied with photometric data prepared by independent testing laboratories. Photometric data to be IES format suitable for use with lighting software applications. The IES photometric data shall be specifically for the luminaire for which the approval is requested (specified size, lamp, reflector, lense, etc.).

1.06 LUMINAIRE SCHEDULE

- .1 Refer to luminaire schedule.

Part 2 Products

2.01 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: 3000-3500K
- Exterior Lighting: 4000-4500K
- .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%.

2.02 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 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 luminaires shall be minimum 3.175 mm thick.

.5 Provide gasketing, stops and barriers to form tight traps to prevent light leaks.

Part 3 Execution

3.01 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.

3.02 WIRING

- .1 Connect luminaires to lighting circuits as indicated.

END OF SECTION 26 50 00

Part 1 General**1.01 SHOP DRAWINGS AND PRODUCT DATA**

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

1.02 OPERATING AND MAINTENANCE DATA

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

1.03 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**2.01 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 Blank faceplate for the back of single face exit signs, shall not have any knockouts.
- .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, 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 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.
- .5 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.
- .6 Exit light input shall be maximum 2.0 watts.

- .7 Design life for the exit light shall be minimum 25 years.
- .8 Interior exit lights shall have a vandal resistant housing:
 - .1 Shall be constructed of 16ga steel with a baked white powder coat finish.
 - .2 Be complete with a poly-carbonate panel with pictogram and direction arrow indication shall be held in place with a faceplate bracket.
 - .3 An integral polycarbonate shield shall be installed to prevent damage to the pictogram panel.

2.02 MANUFACTURERS

- .1 Interior exit lights: acceptable manufacturers: AimLite #EXVR-SXVR Series, Beghelli #FORTE Series, Lithonia #LV Series or approved equivalent

Part 3 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 Coordinate installation of exit lights with ceiling or wall construction. If necessary, provide hanger to suspend exit light below visual obstructions.

END OF SECTION 26 53 00