

1 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 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 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 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 Request for equals must be received in the electrical consultant's office not less than seven working days prior to subcontractor bid closing date.
- .4 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.
- .5 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.
- .6 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.

5 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.

6 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.

7 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.

8 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.

Equipment to operate in extreme operating conditions established in above standard without damage to equipment.

9 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.

10 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.

11 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 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.

12 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 Wordings 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.

13 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.

14 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	White
Emergency Power	Orange
Low Voltage Switching	Tan
Computer Data	Blue

15 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.

16 WIRING TERMINATIONS

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

17 MANUFACTURER'S AND CSA LABELS

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

18 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.

19 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.

20 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 Audio visual outlets: 450 mm (500 mm in concrete block)
 - .7 Television cable outlets: 450 mm (500 mm in concrete block)
 - .8 Voice/Data outlets: 450 mm (500 mm in concrete block)
 - .9 Clocks:
 - General: 300 mm below finished ceiling to a maximum height of 3000 mm.
 - .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)

21 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.

22 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.

23 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.

24 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.

25 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.

26 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.

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.

27 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.

28 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.

29 COORDINATION OF PROTECTIVE DEVICES

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

30 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.

31 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: communications horizontal cabling
 digital meter

ground fault protection equipment
adjustable frequency drives
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.

32 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.

33 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. Contractor shall retain the services of a qualified CAD draftsman to transfer the as-built information from the as-built prints to an electronic digital format using the CAD software application used to produce the original drawings. Identify CAD electronic drawing files with "AS BUILT" status. Contractor shall pay all costs associated with transfer of as-built information to electronic digital format.

34 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.

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.

35 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.
 - .14 Emergency Lighting System Verification and Test Report (include in "Emergency Lighting System" Section)
 - .18 Voice and Data Cabling Verification and Test Report (include in "Communications Horizontal Cabling" section).
 - .20 Audio visual distribution system verification and test report (include in 'Audio Visual Distribution 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
- Distribution Equipment
- Disconnect Switches
- Panelboards and Breakers
- Contactors
- Luminaires, Lamps, and Ballasts
- Exit Lighting
- Emergency Lighting
- Communications Horizontal Cabling
- Television System
- Adjustable Frequency Drives
- Motor Starters and Motor Control Centres
- Devices:
 - Receptacles
 - Switches
 - Time Clock
 - Photoelectric Cell
 - Clocks
 - Occupancy Sensors
- Surge Protection Equipment
- 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).

36 MAINTENANCE MATERIALS

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

37 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.

38 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.

39 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)

40 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 26 05 01

SYSTEMS DEMONSTRATIONS

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)

- main distribution centre
- surge suppression units
- emergency lighting units
- adjustable frequency drives
- occupancy sensors

The following persons have witnessed this demonstration:

Owners:

(name) (signature)

(name) (signature)

(name) (signature)

(name) (signature)

Contractor:

(name) (signature)

Manufacturer's Representative:

(name) (signature)

(name) (signature)

1 General

1.1 RELATED WORK SPECIFIED ELSEWHERE

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

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.
- .4 Acceptable manufacturers: Buchanan

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 26 05 20

1 General

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.

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 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

1 General

1.1 RELATED WORK SPECIFIED ELSEWHERE

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

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.

2.2 FASTENERS

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

2.3 MANUFACTURERS

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

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 Beam 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

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.

2 Products

2.1 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.

3 Execution

3.1 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.

3.2 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

1 General

1.1 RELATED WORK SPECIFIED ELSEWHERE

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

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 CAST BOXES

- .1 All exterior outlet boxes shall be cast aluminum with female threaded hubs suitable for surface or recessed mounting as shown and required. (Crouse Hinds FS series)

2.3 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.

2.4 FLOOR BOXES

- .1 Floor boxes to be installed in cement floor shall be fully adjustable both before and after cement pour. Boxes shall be formed galvanized 14 gauge steel, concrete tight, with minimum 1475 cm³ total capacity for two devices, and 2065 cm³ total capacity for three or four devices. Floor box shall be complete with duplex receptacle face plate and wire tunnel as required. The cover for the floor box shall consist of a hinged polyamide top complete with retractable exit with dust seal, and regressed top to accommodate carpet or tile. The cover shall be reinforced with a steel plate.
- .2 Acceptable manufacturers: Thomas & Betts - Steel City, Hubbell, Walkerbox or approved equal.

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 (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

1 General

1.1 RELATED WORK

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

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.

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.

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.
- .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.

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 CONDUITS IN POURED SLABS ON GRADE

- .1 PVC Conduits 25 mm and larger to be run below slab and encased in 75 mm concrete envelope. Provide 50 mm of sand over concrete envelope below floor slab.

3.4 CONDUITS UNDERGROUND

- .1 Slope conduits to provide drainage.
- .2 Thoroughly waterproof joints (PVC excepted) with a heavy coat of bituminous paint.

3.5 IDENTIFICATION

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

END OF SECTION 26 05 34

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.

2 Products

2.1 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 (.173”) wire diameter, 5.08 (2”) x 101.6 (4”) 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 (3/8”) threaded rods at 1524 mm (5’-0”) on centre with centre hanger assembly. Attach to beams and joists with beam clamps.
- .6 Acceptable manufacturers: B-line, Thomas & Betts “Express Tray” ETQ or ETU, Cablofil “EZ Tray”, or approved equal.

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 Use rollers when necessary to pull cables.
- .7 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 26 05 36

1 General

1.1 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.

2 Products

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

3 Execution

3.1 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.

3.2 DISTRIBUTION SYSTEM ELECTRICAL TESTING

- .1 Take voltage readings at all power distribution points including service switchgear motor control centres, distribution panels, transformer primary and secondary terminals, and lighting panelboards.
- .2 Insulation Resistance Testing
 - .1 Megger test all branch circuits, feeders, and equipment buswork prior to energization. Insulation resistance shall conform to the requirements of the Canadian Electrical Code, the local inspection authority, and the Electrical Consultant.
 - .1 Test circuits and equipment rated up to 350 volt with a 500 volt instrument.
 - .2 Test 350 to 600 volt circuits and equipment with a 1000 volt instrument.
 - .2 Insulation resistance less than 1.0 Megohm on any circuit, feeder, or equipment shall be considered unacceptable. Clean, dry out, or replace equipment until acceptable resistance is achieved.
 - .3 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, operating under normal load. State hour and date on which each load was measured, and voltage at time of test.

3.3 BUILDING SYSTEMS TESTING

- .1 Functionally test all building systems components including lighting switches, power outlet receptacles, photoelectric controls, panelboard breakers, contactors, lighting fixtures, emergency battery packs, hand dryers, manual motor starters, etc.
- .2 Assist the manufacturer's representative with the verification and testing of the fire alarm system.

3.4 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)

3.5 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

1 General

1.1 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings and product data in accordance with Section 26 05 01.
- .2 Shop drawing information to include voltage, ampacity, interrupting capacity, enclosure dimensions, branch breaker types, quantity, and amperage.

1.2 OPERATION AND MAINTENANCE DATA

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

1.3 PLANT ASSEMBLY

- .1 Install circuit breakers in panelboards before shipment.
- .2 In addition to CSA requirements, Manufacturer's nameplate must show fault current that panel including breakers has been built to withstand.

1.4 RELATED WORK SPECIFIED ELSEWHERE

- .1 Molded Case Circuit Breakers - Section 26 28 21.

2 Products

2.1 PANELBOARDS

- .1 Panelboards: to CSA C22.2 No. 29.
- .2 Panelboards to be product of one manufacturer, throughout project.
- .3 Sequence phase bussing with odd numbered breakers on left and even on right, with each breaker identified by permanent number identification as to circuit number.
- .4 Panelboards: mains, number of circuits, and number and size of branch circuit breakers as indicated.
- .5 Panelboards to be complete with hinged lockable door. Two keys for each panelboard and key panelboards alike.
- .6 Tin plated aluminum bus with full size neutral.
- .7 Mains suitable for bolt-on breakers.
- .8 Finish trim and door baked grey enamel.

- .9 Panelboards shall be complete with a factory mounted isolated ground bus, with one terminal per circuit.
- .10 Panelboards shall be complete with a factory mounted grounding bus with one terminal per circuit.
- .11 Plastic sleeve for circuit breaker directory secured to inside door of panelboard.
- .12 Include drip hood on panel boards when surface mounted in a room containing fire protection sprinklers.

2.2 BREAKERS

- .1 Breakers to Section 26 28 21.
- .2 Breakers with thermal magnetic-tripping in panelboards except as indicated otherwise.
- .3 Lock-on devices for security system, exit light circuits, and other loads as indicated on the drawings.
- .4 Breakers less than 19mm wide will not be permitted.
- .5 All branch breakers shall be bolt-on type.
- .6 Branch breakers in panelboards shall be rated at not less than 10,000 amps symmetrical interrupting capacity at 240 volts.
- .7 Two and three pole breakers shall have one common simultaneous trip.

2.3 MANUFACTURERS

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

3 Execution

3.1 INSTALLATION

- .1 Locate panelboards as indicated and mount securely, plumb, true and square, to adjoining surfaces.
- .2 Install surface mounted panelboards on plywood backboards (painted white). Where practical, group panelboards on common backboard.
- .3 Mount panelboards to height given in Section 26 05 01 or as indicated.
- .4 Connect loads to circuits as indicated.

- .5 Connect neutral conductors to common neutral bus with respective neutral identified. Circuits sharing a neutral shall be consecutive breakers in the panel (i.e. 1, 3, 5 or 12, 14, 16).
- .6 Co-ordinate the thickness of partition walls in which panelboards are to be located prior to rough-in. Failure to do this work shall require this Contractor to assume any costs for modifying walls, revising panels or electrical components.
- .7 Thoroughly vacuum all panelboards to remove construction debris and dust, prior to installation of panel covers.
- .8 Multi-section double wide panelboard tubs shall be spaced 40 mm apart and secured together using manufacturer's spacers and mounting hardware. A minimum of two close nipples complete with locknuts shall be installed between the tubs.
- .9 Install 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.

3.2 EQUIPMENT IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 01.
- .2 Nameplate for each panelboard size 5 engraved in accordance with Section 26 05 01. Indicate panel designation, voltage, and phase (i.e. "PANEL 2E" 120/208V 3PH 4W). Mount on exterior face of panelboard cover.
- .3 Complete circuit breaker directory with typewritten legend showing location and load of each circuit breaker. Circuit breaker directory shall include all breakers in the panelboard listed on one single face typewritten legend.
- .4 Identify all spare breakers on breaker directory as "SPARE" (in pencil).

END OF SECTION 26 24 17

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.

2 Products

2.1 MULTI-OUTLET RACEWAY

- .1 Provide where shown metallic two piece raceway as indicated on drawings. Raceway shall be Wiremold 2000 Series, Hubbell 20GB series with receptacles spaced as indicated on drawings.
- .2 The raceway shall consist of a base, factory holecut cover, and factory wired receptacle harness. The base section shall have a nominal material thickness of 1.02 mm, manufactured from cold rolled steel. The cover section shall have a nominal thickness of .064 mm, manufactured from cold rolled steel. Base and cover shall be finished in ivory baked enamel paint.
- .3 Overall dimensions of the base and cover when assembled shall be 19 mm D x 32.5 mm H (Wiremold) or 21 mm D x 33 mm H (Hubbell).
- .4 All accessories shall be manufactured fittings including but not limited to the following:
 - Entrance end fitting for connection to isolated power supply panels or outlet modules (Wiremold #2010A, Hubbell #2010A21V)
 - External elbow corner (Wiremold #2018C, Hubbell #2018C1V)
 - Internal elbow coupling (Wiremold #2017TC, Hubbell #2017 TC)

3 Execution

3.1 INSTALLATION

- .1 Install multi-outlet 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 raceways 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, faceplates, blank plates, base couplings, cover clips, and wire clips.

END OF SECTION 26 27 19

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.

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 molding 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.

2.2 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.

- .6 Acceptable manufacturers, Pass and Seymour #26252-W, Hubbell #HBL2152WA, Leviton #16262-W, Cooper #6252W or approved equal.
- .4 Isolated ground surge suppression duplex receptacles shall be CSA type 5-15R, 125V, 15A, U-ground with the following features:
 - .1 Ground contact isolated from mounting strap to establish a separate pure ground path.
 - .2 Audible alarm and LED indicator (LED to be illuminated to indicate normal operating status).
 - .3 Heavy-duty, one-piece, wrap-around steel mounting strap integral ground contacts.
 - .4 Heavy-duty blue nylon rectangular face with isolated ground identification.
 - .5 Suitable for #10 AWG conductors back or side wiring.
 - .6 Triple wipe constant pressure power contacts with fingers in contact when receptacle is not in use.
 - .7 Metal oxide varistor to absorb and dissipate transient surges. 210 Joules minimum surge absorption, 18kA minimum current handling capability per mode.
 - .8 Acceptable manufacturers Hubbell IG5262SA, Pass and Seymour #IG5262-BLSP, Leviton #5280-IGB, Cooper #IG5262BLS or approved equal.
- .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.
 - .8 Acceptable manufacturers Hubbell #GF5262WA, Pass and Seymour #1594-SW, Leviton #8599-W, Cooper #VGF15W or approved equal.
- .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 (.04”). 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 (Lexiton #40834-W) mounted in a white nylon three-port rectangular faceplate that matches the rectangular wiring devices (Leviton #41643-W). Provide and install HDMI cable in 25mm EMT conduit between HDMI outlets.

2.5 PHOTOELECTRIC CONTROL

- .1 Photoelectric control housing shall be constructed of diecast aluminum. The unit shall feature an adjustable shutter, snap action bi-metal switch, built-in time delay, and swivel pipe nipple. Paragon #CW201-70, Intermatic #K4121, Tork #2000, or approval equal, rated at 120 volt, 1800 VA. Position unit so as not to be influenced by stray lighting, or other interference.

2.6 TIME CLOCK

- .1 Time clocks for control of exterior lighting and/or vehicle plug-ins shall be microprocessor based electronic type with the capability of 7 day programming, SPST maintained contacts, rated at minimum 15 amps, 120 volts. Time clock shall be complete with nickel cadmium battery or capacitor carryover. Paragon #EL71, Intermatic #ET1725C, Tork #EW103B, or approved equal.

2.7 CLOCKS

- .1 Clocks shall be flush or surface mounted 120 volt stand alone digital type with 64 mm or 100 mm LED display, flashing colon, 30 meter readability, black trim, and 160 degree viewing angle.
- .2 The clock shall be complete with an internal battery to maintain clock timing and automatically display the correct time upon restoration of 120 volt power supply.
- .3 The clocks shall be mounted on a flush mounted outlet box. (as required by manufacturer)
- .4 Clocks shall be Lathem #DDC4, Franklin F1200-404B, Midwest Time Control Inc. #DIF series or approved equivalent.

2.8 ELECTRONIC TIMER SWITCH

- .1 Digital time switch to automatically turn lights (or fan) off after a pre-set time.
- .2 LCD to indicate time remaining.

- .3 Compatible with electronic ballasts and motor loads.
- .4 120 VAC, 800 Watts.
- .5 Push-button to initiate timer operation.
- .6 User adjustable DIP switch settings for:
 - time out period (10 minutes to 2 hours)
 - time scroll
 - one minute flash warning
 - one minute audible 'beep' warning
- .7 Watt Stopper TS-400, Hubbell #DT1277W or approved equivalent.

2.9 CEILING MOUNTED VACANCY SENSORS

- .1 Sensor shall be combination ultrasonic and passive infrared technology type, ceiling mounted, providing minimum coverage of 186 m² (2000 ft²), 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.
- .5 Occupancy sensor shall be Leviton #ODC2O-MOW, Watt Stopper DT-300, Hubbell #ATD2000C, or approved equal.

2.10 WALL MOUNTED VACANCY SENSOR

- .1 Sensor shall be passive infrared technology type.
- .2 Adjustable time delay of 30 seconds to 30 minutes (set at 20 minutes).
- .3 Adjustable sensitivity from 20% to 100% (set at 60%)
- .4 Minimum 900 square foot coverage, 180° coverage.
- .5 Built in light sensor to hold lighting systems off when natural light levels are above the present levels. Adjustable from 2 to 200 foot candles (set at 90 foot candles).
- .6 Five year warranty.
- .7 The wall mounted occupancy sensor shall be Watt Stopper #WS-250-W, Hubbell #WS120W or approved equivalent.

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 Clocks:

- .1 Secure clocks to wall with two screw fasteners (black head to match frame of clock) and wall anchor.

.6 Vacancy 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 26 27 26

1 General

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.

2 Products

2.1 BASEBOARD CONVECTORS

- .1 Electric baseboard shall be complete with electrical connection box at both ends, aluminum or stainless steel elements, and cabinet finished in white gloss enamel. Element shall be fastened with free floating ends to allow for expansion. A wiring channel shall run the full length of the unit to allow for interconnection of heaters and components. Refer to drawings for heating capacity and voltage ratings.
- .2 Unit shall be controlled by a 24 volt low voltage relay, and remote thermostat (Honeywell #T822D).

2.2 WALL MOUNTED FORCED AIR ELECTRIC HEATERS

- .1 Forced air electric heaters shall be semi-recessed wall mounted complete with single speed direct drive blower, integral 24 volt controls transformer, aluminum or stainless steel elements, and cabinet finished in white gloss enamel. Unit controls shall include, on-off switch and integral thermostat. Refer to drawings for heating capacity and voltage ratings.

2.3 CEILING MOUNTED FORCED AIR ELECTRIC HEATERS

- .1 Forced air electric unit heaters shall be suitable for suspension from ceiling, complete with single speed direct drive blower, integral 24 volt controls transformer, aluminum or stainless steel elements, and cabinet finished in white gloss enamel. Refer to drawings for heating capacity and voltage ratings.
- .2 Unit shall be controlled by a 24 volt low voltage relay, and remote thermostat (Honeywell #T822D).

2.4 MANUFACTURERS

- .1 Acceptable manufacturers: Dimplex/Chromalox, Ouellet Canada Inc., or approved equivalent.

3 Execution

3.1 INSTALLATION

- .1 Install heater as indicated in accordance with manufacturers instructions.
- .2 Make power and control connections.
- .3 Provide lockable thermostat guard for all thermostats.

END OF SECTION 26 27 28

1 General

1.1 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings and product data in accordance with Section 26 05 01.
- .2 Include time-current characteristic curves for breakers with ampacity of 400 and over.

1.2 OPERATION AND MAINTENANCE DATA

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

2 Products

2.1 BREAKERS - GENERAL

- .1 Moulded case circuit breakers: to CSA C22.2 No. 5.1.
- .2 Bolt-on moulded case circuit breaker, quick-make, quick break type, for manual and automatic operation.
- .3 Common-trip breakers with single handle for multi pole applications.
- .4 Magnetic instantaneous trip elements in circuit breakers to operate only when the value of current reaches setting. Trip settings on breakers with adjustable trips to range 3 - 10 times current rating.
- .5 Breakers shall trip to "centre" position.
- .6 All breakers rated at more than 400 amps shall be electronic type with adjustable trip units with adjustable protection settings for long-time pickup, long-time delay, short-time pickup, short-time delay, and instantaneous.

2.2 THERMAL MAGNETIC BREAKERS

- .1 Moulded case circuit breaker to operate automatically by means of thermal and magnetic tripping devices to provide inverse time current tripping under overload conditions and instantaneous magnetic tripping for short circuit protection.

2.3 BREAKER ENCLOSURES

- .1 Breaker enclosures shall be surface mounted unless otherwise noted. The breaker shall be capable of being padlocked either in the "ON" or "OFF" position.

2.4 MANUFACTURERS

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

3 Execution

3.1 INSTALLATION

- .1 Install circuit breakers as indicated.

END OF SECTION 26 28 21

1 General

1.1 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.

1.2 OPERATIONS AND MAINTENANCE DATA

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

1.3 RELATED WORK SPECIFIED ELSEWHERE

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

2 Products

2.1 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.

2.2 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.

3 Execution

3.1 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.

3.2 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

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 1 contact, auxiliary.
 - .2 2 fuses.

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.
- .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 CONTROL TRANSFORMER

- .1 Single phase, dry type, control transformer with primary voltage as indicated and 120 volt secondary, complete with secondary fuse, installed in with starter as indicated.
- .2 Size control transformer for control circuit load plus 20% spare capacity.

2.5 FINISHES

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

2.6 MANUFACTURERS

- .1 Acceptable Manufacturers are: Eaton Cutler-Hammer Canada, Allen-Bradley Canada Company, Siemens Canada Ltd., Square D, General Electric Company, or approved equal.

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 (ie "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 26 29 10

1 General

1.1 SHOP DRAWINGS AND PRODUCT DATA

- .1 Shop drawings and product data in accordance with Section 26 05 01.
- .2 Manufacturer shall provide a complete set of shop drawings for this specific project. Drawings shall include, but not limited to, dimensioned outline drawing, schematic diagram, power and control connection diagram, full list of features, installation instructions, and operating instructions produced specifically for this project. Drawings shall be approved by the Engineer before fabrication and supply of equipment.

1.2 OPERATING AND MAINTENANCE DATA

- .1 Provide data for incorporation into Electrical Maintenance Manual specified in Section 26 05 01.
- .2 Submit a detailed operating, maintenance and testing procedure document prepared specifically for this project.
- .3 The Owner's operating personnel shall be instructed in the operation of the systems for a minimum of one (1) hour. Written documentation bearing name and signature of Owner's personnel who received the above instructions shall be included in the operating instructions and service manuals.
- .4 All AFD parameter settings shall be documented in the operating and maintenance manual.

1.3 SUPPLIER QUALIFICATIONS

- .1 The supplier shall be fully qualified in the performance of work specified herein. Service personnel shall be located within the Province of Saskatchewan and shall be experienced in the installation and operation of the system.

1.4 VERIFICATION

- .1 The AFD manufacturer shall supply on site start-up, commissioning and operator training. Allow for all cost and labour for as many trips as necessary to complete these requirements. Labour, expenses and all parts shall be at the AFD suppliers cost until the warranty period expires. Warranty shall be for a minimum of 24 months after shipment or 18 months after energization.
- .2 Upon completion of installation of the system, a factory trained manufacturer's representative shall perform a completion verification and inspection of all installed equipment. A certificate of verification confirming that the commissioning and inspection have been performed, shall be submitted.
- .3 The factory trained manufacturer's representative shall witness all connections between building automated controls system (BACS) and the AFD and shall assist the controls contractor with all input and output connections between the AFD and the BACS.

1.5 STANDARDS

- .1 The AFD shall be designed, manufactured and tested in accordance with the latest applicable standards of IEC, UL, CUL, CSA and NEMA.

2 Products

- .1 The adjustable frequency drive operation shall be based on Pulse Width Modulation (PWM) design utilizing insulated gate bi-polar transistors (IGBT's). Each unit shall be built to CSA Z299.3 level of quality control or equivalent. The AFD shall be complete with a digital control system.
- .2 All AFD's shall use the same common logic for all units as specified for this project.
- .3 The AFD shall be rated for continuous duty while operating standard squirrel cage induction motors as listed in the motor schedule. The AFD shall have a continuous current rating at least 10% in excess of the motor full load amp rating. An overload service factor of 110% for one minute duty (variable torque) must be supplied to ensure adequate safety margins for all applications.
- .4 For maintenance and testing purposes, the AFD shall have a test mode whereas the AFD shall be capable of stable operation over entire speed range (starting, stopping, running) with the motor disconnected.
- .5 The AFD efficiency shall be a minimum of 95% for all inverters when operated at full speed and load.
- .6 Input voltage shall be rated for the system voltage and have a minimum voltage tolerance of +10% from nominal, and a line frequency variation of 48 to 62 Hz. The output voltage shall vary linearly with the speed to maintain the motors design voltage to frequency ratio from zero speed to 60 hertz. Frequency stability shall be maintained within 1% over the entire speed range.
- .7 AFD shall be enclosed in the motor control centres unless otherwise noted.
- .8 The AFD shall maintain the line side displacement power factor at no less than 0.96 regardless of speed or load.
- .9 The AFD shall be capable of starting a spinning motor. The AFD shall be able to determine the motor speed in any direction and resume operation without tripping.
- .10 Protective devices to be incorporated are:
 - .1 Main incoming door interlocked circuit breaker or disconnect switch.
 - .2 The AFD shall be protected by three Class J high interrupting capacity fuses to supply fault protection of the drive for faults up to 100,000 amps RMS symmetrical.
 - .3 A fully rated external AC line reactor to minimize line current harmonics and provide transient protection for a minimum of 5000 volts, 50 microseconds pulse in accordance with ANSI C42-61.

- .4 A 3% load reactor shall be provided for motor lead length less than 15 meters (50 feet). For motor lead lengths exceeding 15 meters, a dv/dt output filter shall be included.
- .5 Integral electronic motor overload protection adjustable from 50 to 110% of the drive rating to coordinate with actual motor full load ampere rating. Current in excess of this setting will cause a timed overload trip to occur.
- .6 Instantaneous output short circuit protection for phase to phase and phase to ground faults.
- .7 Over voltage DC Bus monitor/protection.
- .8 Supply under voltage protection as required to maintain logic and control during power dips and power loss conditions, such as transfer switch operations.
- .9 Loss of supply voltage and loss of phase protection.
- .10 AFD heat sink over temperature detection circuit to shut down the AFD and provide an O/T fault indication.
- .11 Capable of operating without a motor over the entire frequency range for maintenance and testing purposes.
- .12 Accepts the motor output circuit being opened, while the motor is operating without damaging inverter.
- .13 The following motor protection shall be provided for the motor. The following protection shall be related to the specific motor and not the AFD.
 - separate I^2t overload protection (AFD overload protection not acceptable for motor overload.)
 - stall protection.
 - phase to ground fault protection.
 - instantaneous overcurrent protection.
 - phase to phase fault protection.
 - adjustable torque limit setpoints.
- .14 The AFD shall have an active current limit to prevent the motor from operating in an overload condition. When the current limit setting is reached, the output frequency is reduced such that the load reduces to less than the current limit setpoint. When the actual load decreases, the speed will ramp back to process setpoint.
- .15 Provide an output isolation contactor to provide for a positive isolation between the motor and the inverter. The contactor shall remain energized for power interruptions of up to 0.5 seconds.

.11 Operational Features

- .1 Regenerative override circuit to allow deceleration of high inertia loads without nuisance shutdowns.
- .2 Instantaneous fault shutdown.
- .3 Automatic restart after power outage, if the run command is maintained closed.
- .4 Automatic attempt to restart after any fault. If unable to restart, the drive shall lockout the inverter after 3 unsuccessful attempts within a 90 second time period. The Fault counter will reset to zero automatically after 3 minutes of continuous operation.
- .5 Adjustable minimum speed setting from 0-70% and a maximum speed setpoint from 50-100% of the 60 hertz rating.
- .6 Separately adjustable accelerating and deceleration ramp rates programmable between 1 and 300 seconds. A fast acceleration to minimum speed shall be used on all starts.

- .7 Input speed reference signal shall be 4-20mA DC for remote auto mode operation and local potentiometer or keypad entry for manual mode of operation. The 4-20mA input shall be isolated such that either input line can be grounded or both floating.
 - .8 Output speed monitoring shall be by a 4-20mA isolated signal.
 - .9 Output load monitoring shall be by a 4-20mA isolated signal.
 - .10 Provide digital or analog displays for the following functions on each AFD front panel:
 - speed reference input
 - speed output (%)
 - motor frequency (hertz)
 - current (%)
 - motor voltage (%)
 - .11 High performance inner current loop regulator.
 - .12 Optimized tuning of air gap flux.
 - .13 Programmable V/Hz profiles.
 - .14 The AFD shall have a "SELF TUNE MODE" which will automatically do the calibration of motor parameters to match AFD regulator settings.
 - .15 AFD shall indicate date and time display of all trips (or the time elapsed since failure displayed).
 - .16 AFD shall have elapsed time meter (non-re-settable) or indicate hours and minutes of operation (inverter running).
 - .17 The AFD shall have a rotating restart circuit that will allow for a safe start into a motor that is rotating in the forward or reverse direction and accelerate it to the desired speed in the proper direction.
 - .18 Audible noise generated by AFD shall not exceed 85 dBA at 1 metre intervals around AFD.
- .12 Environmental Capabilities
- .1 The drive shall operate without mechanical or electrical damage under any combination of the following conditions:
 - .1 Ambient temperature 0-40°C.
 - .2 Humidity 0-95% (non condensing).
 - .3 Vibration up to 0.5 G.
 - .4 Altitude 0-1000 metres.
 - .13 AFD self cooled by natural convection shall automatically shutdown if heat sink temperature exceeds setpoint. If forced air cooling is used the AFD shall provide immediate shutdown on cooling air loss and provide annunciation of this shutdown.
 - .14 Customer terminal blocks for control wires shall be separated from power wire connections and shall be able to accept connections for 12 AWG wires. Printed circuit board terminal blocks are not acceptable.
 - .15 The AFD shall be manufactured and tested to quality control CSA Z299.3 standards or better. Each unit shall be full load tested in heat chamber at 40°C for a minimum of four hours of continuous operation without any trips or faults.

.16 Bypass

- .1 Provide a bypass control scheme to safely apply full voltage to the driven motor in the event of a failure to the Adjustable Frequency Drive. The bypass scheme shall meet the following requirements:
 - .1 Provide a sectional CSA Approved enclosed cabinet or use the AFD cabinet with proper shrouding of all live parts, to provide isolation for maintenance of the AFD when in bypass mode.
 - .2 Provide a separate circuit disconnect in parallel to the AFD circuit disconnect to feed the 3 phase power to the bypass section only.
 - .3 Provide high interrupting capacity fuses on the load side of the circuit disconnect for fault clearing capability of 100,000 Amperes RMS Symmetrical.
 - .4 Provide a door mounted Line-Off-AFD selections switch to select operations at constant speed or at adjustable speed.
 - .5 Provide two mechanically and electrically interlocked contactors for line and AFD operations.
 - .6 Provide a thermal overload relay which will protect the motor in either mode of operation.
 - .7 Provide a separate start/stop pushbutton to start the bypass mode manually. In auto mode, the same run command from the DDC will start and stop the motor in either mode.
 - .8 Provide all the necessary control logic, time delay relays and interlocks to provide a safe reliable bypass control scheme. The control scheme shall provide a safe transfer to either mode of operation for all possible operating conditions.
 - .9 Control logic shall maintain all external interlocks active in either mode of operation.

.17 The AFD shall be complete with an open protocol communication card for interface with the building management systems (i.e. BacNet, Johnson N2, Modbus, DeviceNet, Interbus-S, Profibus-DP, Lonworks, IMPAAC, Staefa etc.).

.18 The AFD shall be complete with an input EMI filter to minimize conducted electrical noise to meet the requirements of IEC 61800-3.

.19 Control Functions

- .1 Frequently accessed AFD programmable parameters shall be adjustable from a digital operator keypad located on the front of the AFD. When the AFD is located in a motor control centre, the digital operator keypad shall be located on the face of the motor control centre. The AFDs shall have a 3 line x 16 character alphanumeric programmable display with status indicators. Display shall be adjustable for contrast with large characters easily visible in normal light.
- .2 Standard advanced programming and trouble-shooting functions shall be available by using a personal computer's RS-232 port and Windows™ based software. In addition, the software shall permit control and monitoring via the AFD's RS232 port. The manufacturer shall supply a compact disk with the required software. An easily understood instruction manual and software help screens shall also be provided. The computer software shall be used for modifying the drive set-up and reviewing diagnostic and trend information.

- .3 The operator shall be able to scroll through the keypad menu to choose between the following:
 - .1 Monitor
 - .2 Operate
 - .3 Parameter set-up
 - .4 Actual parameter values
 - .5 Active faults
 - .6 Fault history
 - .7 LCD contrast adjustment
 - .8 Information to indicate the standard software and optional features software loaded.
- .4 The following set-ups and adjustments, at a minimum, are to be available:
 - .1 Start command from keypad, remote or communications port
 - .2 Speed command from keypad, remote or communications port
 - .3 Motor direction selection
 - .4 Maximum and minimum speed limits
 - .5 Acceleration and deceleration times, two settable ranges
 - .6 Critical frequency avoidance
 - .7 Torque limit
 - .8 Multiple attempt restart function
 - .9 Multiple pre-set speeds adjustment
 - .10 Catch a spinning motor start or normal start selection
 - .11 Programmable analog output
 - .12 DC brake current magnitude and time
 - .13 Proportional / integral process control
- .5 The AFDs shall have the following system interfaces:
 - .1 Inputs – a minimum of six (6) programmable digital inputs, two (2) analog inputs and serial communications interface shall be provided with the following available as a minimum:
 - .1 Remote manual / auto
 - .2 Remote start / stop
 - .3 Remote forward / reverse
 - .4 Remote pre-set speeds
 - .5 Remote external trip
 - .6 Remote fault reset
 - .7 Process control speed reference interface, 4-20mA_{dc}
 - .8 Potentiometer and 0-10 V_{dc} speed reference interface
 - .9 RS232 (or DPI Scanport) programming and operation interface port
 - .10 Serial communications port or DPI Scanport (c/w communications module)
 - .2 Outputs – a minimum of two (2) discrete programmable digital outputs, and one (1) programmable analog output shall be provided, with the following available at minimum:
 - .1 Programmable relay outputs with one (1) set of Form C contacts for each, selectable with the following available at minimum:
 - .1 Fault
 - .2 Run
 - .3 Ready
 - .4 Reversing
 - .5 At speed
 - .6 In torque limit

- .7 Motor rotation direction opposite of commanded
- .8 Overtemperature
- .2 Programmable analog output signal, selectable with the following available at minimum:
 - .1 Output current
 - .2 Motor speed
 - .3 Motor torque
 - .4 Motor power
 - .5 Motor voltage
 - .6 DC link voltage
- .6 Monitoring and Displays
 - .1 The AFD's display shall be a LCD type capable of displaying the following indicators:
 - .1 Run
 - .2 Forward
 - .3 Reverse
 - .4 Stop
 - .5 Ready
 - .6 Alarm
 - .7 Fault
 - .2 The AFDs LCD display shall be capable of indicating the following monitoring functions at a minimum:
 - .1 Output frequency
 - .2 Output speed
 - .3 Motor current
 - .4 Motor torque
 - .5 Motor power
 - .6 Motor voltage
 - .7 DC-link voltage
 - .8 Heatsink temperature
 - .9 Total operating days counter
 - .10 Total megawatt hours
 - .11 Voltage level of analog input
 - .12 Current level of analog input
 - .13 Digital inputs status
 - .14 Digital relay outputs status
 - .15 Motor temperature rise, percentage of allowable
- .7 Diagnostic Features
 - .1 Fault History
 - .1 Recorded and log faults
 - .2 Indicate the most recent first, and store up to 4 faults
- .20 Acceptable Manufacturers: Eaton Cutler Hammer "SVX9000", Schneider Electric "Altivar", Rockwell "Powerflex", or approved equivalent.

3 Execution

3.1 INSTALLATION

- .1 Install AFD according to manufacturers recommendations.

END OF SECTION 26 29 23

1 General

1.1 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit 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 Provide verification that the Surge Protection Device (SPD) complies with the latest edition of UL 1449 and CSA approvals.
- .3 Provide spectrum analysis of each unit based on MIL-STD-220A test procedures between 50 kHz and 200 kHz verifying the device's noise attenuation exceeds 44 dB at 100 kHz.

1.3 WARRANTY

- .1 The manufacturer shall provide a full ten (10) year warranty from date of substantial performance, against any surge protection device part failure.

2 Products

2.1 PANELBOARD MOUNTED UNITS

- .1 The Transient Voltage Surge Suppression Unit shall be multiple phase type, suitable for connection to panelboards.
- .2 Performance features of the unit shall include:
 - .1 Frequency: 60Hz
 - .2 Voltage/Phase: as indicated on drawings.
 - .3 Maximum continuous operating voltage (MCOV) shall be greater than 115% of the normal system operating voltage.
 - .4 The surge protection device shall have directly connected suppression elements between line-neutral, line-ground, and neutral-ground.
 - .5 Total surge current rating shall be capable of surviving shall not be less than 120 kA per phase, or 60 kA per mode on L-G, L-N, and N-G.
 - .6 Nominal discharge current rating (In): minimum 20kA.
 - .7 The manufacturer must provide certified UL 1449 voltage protection rating (VPR) on all protected modes (6000V 3000A 8X20µs). The maximum UL 1449 voltage protection rating for the device must not exceed the following:

<u>Mode</u>	<u>120/208V Y</u>	<u>347/600V Y</u>
L-N; L-G; N-G	700V	1500V
L-L	1500V	2500V
 - .8 Surge current shall be equally distributed to all MOV components to ensure equal stressing. The surge suppression platform must be rated to 120 kA per phase and provide equal impedance paths to each matched MOV.

- .9 Each unit shall include a EMI/RFI noise rejection filter to provide noise attenuation for electric line noise exceeding 44 dB at 100 kHz (using MIL-STD-220A insertion loss test method). Filter bandwidth of 100 kHz to 100 MHz.
 - .10 Each surge suppression unit shall be complete with 200 kA interrupting capacity surge rated fuses. Integral diagnostics shall monitor:
 - fusing system
 - individual MOV's (including neutral to ground) using internal infrared sensors
 - overheating in all modes using a thermal detection circuit
 - .11 Unit to be complete with self diagnostics, and neon indicating light per phase (to indicate failure of individual phase protection).
 - .12 The unit shall include both capacitive filtering and voltage dependant metal oxide varistors.
 - .13 The unit shall be concealed behind the hinged lockable door for the panel.
- .3 Transient Voltage Surge Suppression Unit shall be Eaton "SPD" series, Siemens "Sentron TPS", General Electric Industrial Systems "TME", Schneider Electric Ltd. "IMA", or approved equivalent.

3 Execution

3.1 INSTALLATION

- .1 Install Transient Surge Suppression Unit according to manufacturers recommendations.
- .2 SPD shall be factory mounted integral with the panelboard.
- .3 A direct bus bar connection shall be used to mount the SPD component to the panelboard bus bar.

END OF SECTION 26 43 13

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:
 - Total input watts
 - Candela
 - Distribution zonal lumen summary
 - Luminaire efficiency
 - Coefficient of utilization
 - 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 Qty 2).

1.4 GUARANTEE

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

1.5 APPROVED EQUALS

- .1 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.).

1.6 LUMINAIRE SCHEDULE

- .1 Refer to luminaire schedule.

2 Products

2.1 LAMPS

- .1 Provide lamps as indicated in luminaire schedule.
- .2 Fluorescent lamps (unless noted otherwise) shall be T8 diameter bulb, medium bipin, rapid start type, rated at 20,000 hour life, 2400 initial lumens (25W), 3500°K correlated colour temperature, 82 colour rendering index (CRI). Philips #F25T8/TL835/ALTO.

2.2 BALLASTS

- .1 Fluorescent Ballasts (T8)
 - .1 Voltage rating shall be as indicated in luminaire schedule with a range of plus or minus 10% of nominal.
 - .2 Fluorescent ballasts shall be high frequency, electronic programmed start type, operating lamps at a frequency of 20 kHz or higher.
 - .3 Ballasts shall meet all applicable ANSI and IEEE standards regarding harmonic distortion, and as a minimum, input current THD content shall be less than 10%.
 - .4 Ballasts shall not be affected by lamp failure, and shall yield normal lamp life.
 - .5 Lamp current crest factor shall not exceed 1.6.
 - .6 Power factor shall be minimum 98%.
 - .7 Ballast shall carry a minimum five year warranty.
 - .8 Input line amps shall be less than 0.48 for two F32T8 lamps (120 Volt).
 - .9 Maximum total ballast watts (2-F25T8 lamps) shall not exceed 58 input watts.
 - .10 Sound level rating shall be Class A.
 - .11 EMI/RFI emissions shall meet FCC CFR 47 Part 18 Subpart C Class A.
 - .12 Line transient / auto surge protection compliance with ANSI 62.41.
 - .13 Ballast factor: minimum 0.85.
 - .14 Each ballast shall be provided with a linear disconnect means integral with the luminaire that simultaneously opens all circuit conductors between the branch circuit conductors and the ballast. The linear disconnect shall be marked in a conspicuous, legible and permanent manner identifying the specific purpose.
 - .15 Ballasts to be complete with RFI Suppression.

- .16 Ballasts for T8 lamps shall be Universal #B232PUNVHP-A; Advance #10P-2PSP32-SC or approved equal.

2.3 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 colour temperature range of as specified in the luminaire schedule with a colour rendering index of 80 or greater.
- .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)).

2.4 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.
 - .3 Luminaires specified with metal halide ceramic lamps shall be complete with a protected lamp socket that will only accept a ceramic lamp.
- .2 Indoor Luminaires
 - .1 Stamped steel luminaire bodies not to 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 Fluorescent 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 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 Outdoor Luminaires
 - .1 Where luminaires are mounted outdoors exposed to weather, the luminaire shall be complete with gaskets forming a weatherproof assembly. Luminaire shall be constructed of corrosion resistant materials, and ballasts shall be suitable for operation in low ambient temperatures (-30°C).
 - .2 Luminaire housings shall be designed to withstand all of the climatic conditions possible at the site of installation.
 - .3 Luminaire lenses or refractors shall be UV resistant.

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 Provide low temperature rated ballasts for exterior installations.
- .5 Install recessed fluorescent luminaires so that they can be completely removable from below the finished ceiling.

- .6 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.
- .7 Recessed lighting luminaires in inaccessible ceilings shall be secured to blocking attached to building structure.
- .8 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.
- .9 Replace ballasts, which in the opinion of the electrical consultant, are found to exhibit excessive noise.
- .10 Coordinate installation of luminaires with mechanical trades to avoid conflicts between luminaires, and mechanical system components.
- .11 A maximum of two fluorescent luminaires recessed in t-bar shall be energized from one junction box mounted on the underside of the structural ceiling. A separate armoured cable drop shall be provided for each luminaire. Length of drop shall be adequate to allow relocation of luminaire one metre from its specified location.
- .12 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.
- .13 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).
- .14 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.

3.3 MOUNTING OF REMOTE BALLASTS

- .1 Remote ballasts shall be mounted on plywood backing using spacers as required to provide 25 mm space between plywood backing and ballast. Mount ballasts with minimum 150 mm spacing between ballasts (sides) and 300 mm spacing between ballasts (top and bottom). All wiring of remote ballasts shall be contained within wireways. Junction boxes for terminations at remote ballasts are not acceptable. Use rubber grommets when mounting remote ballasts, to reduce noise transmission.

3.4 MOUNTING OF EXTRUDED ALUMINUM FLUORESCENT LINEAR LIGHTING

- .1 Luminaire joints shall be accurately matched and aligned. Linear lighting luminaires shall be mounted parallel to adjacent surfaces. Lenses shall be continuous between extruded aluminium sections.

END OF SECTION 26 50 00

1.1.8

1.2 ~~K12 - DRYWALL~~ Use standard fixtures with plaster frame.1.3 **DEEP CELL PARABOLIC**

1.3.1 305x1219mm TWO LAMP RECESSED FLUORESCENT SUITABLE FOR T-BAR CEILING, C/W ELECTRONIC BALLAST (26 50 00), HINGED PARABOLIC 9 CELL 100mm DEEP LOUVRE, RETURN AIR SLOTS IN SIDE TRIM, CONSTRUCTED OF LOW IRIDESCENT SPECULAR ALUMINUM, AND SHALL MEET IES RP-1 RECOMMENDED CRITERIA.
LITHONIA "OPTIMAX" #PM0GA 232 9LS METALUX #P5GAX-232S19M1
COLUMBIA #4514-232
C/W 2-F32T8/835 LAMPS, 120V.

1.3.2 305x1219mm TWO LAMP RECESSED FLUORESCENT SUITABLE FOR T-BAR CEILING, C/W ELECTRONIC BALLAST (26 50 00), HINGED PARABOLIC 9 CELL 100mm DEEP LOUVRE, CONSTRUCTED OF LOW IRIDESCENT SPECULAR ALUMINUM, AND SHALL MEET IES RP-1 RECOMMENDED CRITERIA.
LITHONIA #PM0GB 232 9LS METALUX #P5GX 232 S19 M1
C/W 2-F32T8/835 LAMPS, 120V.

1.4 **FLUORESCENT WALL WASHER**

1.4.1 251mmx1220mm SINGLE LAMP RECESSED FLUORESCENT SUITABLE FOR T-BAR CEILING, LOW IRIDESCENT SEMI-SPECULAR ASYMMETRIC REFLECTOR AND ELECTRONIC BALLAST (26 50 00).
CFI #WMRL143347 LITECONTROL #GD-1014T8-CWM
COLUMBIA #PW84-132G-LDK-EB8-120 LITHONIA #WWG-132-120IRLS
METALUX #RWW-132-I VISIONEERING #WWR1X41L-T832
C/W 1-F32T8/835 LAMP, 120V.

2. **FLUORESCENT SURFACE**

2.1 SINGLE LAMP SURFACE MOUNTED FLUORESCENT C/W ACRYLIC OPAL LENS, ELECTRONIC BALLAST (26 50 00) AND SPRING LOADED END CAPS.
PEERLESS #CIW SERIES CFI #CSW 100 SERIES
DAYBRITE #CUBE SERIES
C/W 1-F32T8/835 LAMP, 120V. SUFFIX INDICATES NOMINAL IMPERIAL LENGTH (IE -4 IS 4 FT LONG).

2.2 TWO LAMP SURFACE MOUNTED FLUORESCENT C/W ACRYLIC OPAL LENS, ELECTRONIC BALLAST (26 50 00) AND SPRING LOADED END CAPS.
COLUMBIA #TL20 SERIES CF I#CSW 200 SERIES
DAYBRITE #CUBE SERIES PEERLESS #CNW SERIES
C/W 2-T8/835 LAMPS, 120V. SUFFIX INDICATES NOMINAL IMPERIAL LENGTH (IE -4 IS 4 FT LONG).

2.3 305x1220mm TWO LAMP SURFACE FLUORESCENT C/W HINGED FRAMED 3.2mm THICK K12 LENS, ELECTRONIC BALLAST (26 50 00) AND POST PAINTED FINISH.
CFI #SLB ISFSVB240 METALUX #MC-232A125
LITHONIA #M 232 A12125 HEW #11-4-232-FA12125-EB2
C/W 2-F32T8/835 LAMPS, 120V.

2.4

2.5



LUMINAIRE SCHEDULE

- 2.6 1220mm TWO LAMP SURFACE MOUNTED FLUORESCENT SUITABLE FOR WET LOCATIONS. FIXTURE SHALL BE COMPLETE WITH REINFORCED POLYESTER OR FIBREGLASS HOUSING, ACRYLIC DIFFUSER, FULLY GASKETTED, SIX CAPTIVE LATCHES AND ELECTRONIC BALLAST (26 50 00).
LITHONIA # DM-232 CFI #VT248SW OPAL
PEERLESS #FCC 248 DAYBRITE #VCAW232-120
METALUX #VT2-232DR-120-EB81 VISIONEERING #SV 248 RS T8
C/W 2-F32T8/835 LAMPS, 120V. BEGHELLI #BS100-48-T8-2-32-AC-120
- 2.7 1220mm SINGLE LAMP UNDER CABINET FLUORESCENT FIXTURE WITH WHITE SNAP ON LENS. ELECTRONIC BALLAST (26 50 00) AND WHITE HOUSING.
COLUMBIA #UC 7091 METALUX #CL132-120
LITHONIA #2UC-1-32-120
C/W 1-F32T8/835 LAMP.
- 2.8 1220mm TWO LAMP MAXIMUM SECURITY FLUORESCENT LUMINAIRE WITH STAINLESS STEEL TAMPER RESISTANT HARDWARE. HOUSING TO BE 14 ga. DIE FORMED BODY WITH CONTINUOUS WELDS AND GROUND ENDS WITH DIE FORMED BACKPLATE AND PRISMATIC POLYCARBONATE (FIXTURE SIDE) / CLEAR TEMPERED GLASS (ENVIRONMENT SIDE) LENS AND 7W FLUORESCENT NIGHT LIGHT AND ELECTRONIC BALLAST (26 50 00).
FAIL-SAFE #FCC-X 232 120 81/97 EB18 7W FNL
HOLCOR #PCF9-2/32-14-15PP-37CG-12(NL7)-TX
C/W 2-F32T8/835 LAMPS, 120V.
- 2.10 305x1220mm TWO LAMP SURFACE FLUORESCENT C/W 32 CELL PARABOLIC LENS (MEETING IES RP-1 RECOMMENDED 1993 CRITERIA) AND ELECTRONIC BALLAST (26 50 00). LUMINAIRE HOUSING SHALL BE MAXIMUM 102mm DEEP.
CFI #ADBIS32MS240
C/W 2-F32T8/835 LAMPS, 120V.
- 2.11 305x1220mm TWO LAMP SURFACE MOUNTED FLUORESCENT C/W HINGED PARABOLIC 75mm DEEP LOUVRE CONSTRUCTED OF LOW IRIDESCENT SPECULAR ALUMINUM AND ELECTRONIC BALLAST (26 50 00).
LITHONIA #PM3X232-12 CFI #ADB1S32MS240
METALUX #P3MX232S28M1 120 EB81
C/W 2-F32T8/835 LAMPS AND ELECTRONIC BALLAST, 120V.
- 2.12 305x1220mm SURFACE MOUNTED LUMINAIRE SUITABLE FOR CLASS I, DIVISION 2 GROUPS A, B, C, AND D C/W ELECTRONIC BALLAST (26 50 00).
NRL #HP4-211 THOMAS #VTW232TG
HUBBELL #DBF 4012 RAL #HEF265-2L-TM-A-120EL
KILLARK DBF Series CFI #HSCVT240
C/W 2-F32T8/835 LAMPS, 120V.
- 2.13 610x610mm THREE LAMP SURFACE FLUORESCENT WITH MITRED CORNERS, LATCHED, HINGED FRAME WITH 3.2mm THICK K12 LENS, ELECTRONIC BALLAST (26 50 00) AND POST-PAINTED FINISH.
CFI #SLB2SFSVA LITHONIA #2M-3-17-A12125-120
C/W 3-F17T8/835 LAMPS, 120V.
- 2.14 610 X 610mm FOUR LAMP SURFACE FLUORESCENT WITH MITRED CORNERS LATCHED, HINGED FRAME WITH 3.2mm THICK K12 LENS, ELECTRONIC BALLAST (26 50 00) AND POST-PAINTED FINISH.
CFI #SLB25FSVA-417 LITHONIA #2M-17-A12125-120



C/W 4-F17T8/835 LAMPS, 120V.

- 2.15 1220mm TWO LAMP SURFACE MOUNTED FLUORESCENT C/W PERFORATED 20ga STEEL FACE, ACRYLIC OPAL OVERLAY, SPECULAR KICK REFLECTOR, ELECTRONIC BALLAST (26 50 00).
PRUDENTIAL LIGHTING #WAL-14-P-2T8-04-TMW-SC-347-WM
CFI #QVW8SPF0P232
LAM #KADA-B-2-T8-4-SGW
C/W 2-F32T8/835 LAMPS, 120V. SUFFIX INDICATES NOMINAL IMPERIAL LENGTH (IE 4 IS 4 FT LONG)

3. **FLUORESCENT STRIPS**

- 3.1 SINGLE LAMP SURFACE MOUNTED FLUORESCENT STRIP C/W ELECTRONIC BALLAST (26 50 00).
LITHONIA #S SERIES CFI #SB1 SERIES
METALUX #SNF SERIES VISIONEERING #COM1 SERIES
C/W 1-T8/835 LAMP, 120V. SUFFIX INDICATES NOMINAL IMPERIAL LENGTH (IE -4 IS 4 FEET IN LENGTH).
- 3.2 TWO LAMP SURFACE MOUNTED FLUORESCENT STRIP C/W ELECTRONIC BALLAST (26 50 00).
LITHONIA #C2 SERIES VISIONEERING #COM2 SERIES
CFI #SB2 SERIES METALUX #SNF SERIES
C/W 2-T8/835 LAMPS, 120V. SUFFIX INDICATES NOMINAL IMPERIAL LENGTH (IE -4 IS 4 FEET IN LENGTH).
- 3.3 1220mm TWO LAMP SURFACE MOUNTED FLUORESCENT STRIP C/W SLOTTED REFLECTOR AND ELECTRONIC BALLAST (26 50 00).
LITHONIA #LA-232 CFI #FF248
METALUX #IAF-232 VISIONEERING #MIND248-R03
C/W 2-F32T8/835 LAMPS, 120V.
- 3.4 1220mm TWO LAMP FLUORESCENT STRIP C/W SOLID REFLECTOR AND ELECTRONIC BALLAST (26 50 00).
LITHONIA #L-232 CFI #EE248
VISIONEERING #MIND248 METALUX #ICF-232
C/W 2-F32T8/835 LAMPS, 120V.
- 3.5 610mm ONE LAMP SURFACE MOUNTED FLUORESCENT STRIP C/W SOLID REFLECTOR AND ELECTRONIC BALLAST (26 50 00).
LITHONIA #L-117 CFI #EE117
VISIONEERING #MIND124 METALUX #ICF-117
C/W 1-F17T8/835 LAMP, 120V.
- 3.6 2440mm FOUR LAMP TANDEM FLUORESCENT INDUSTRIAL LUMINAIRE WITH SLOTTED REFLECTOR AND ELECTRONIC BALLAST (26 50 00).
CFI #FF248T LITHONIA #TLA-232-120
METALUX #8TIAF-232-347V-EB81 VISIONEERING #IND496/2-T832
C/W 4-F32T8/835 LAMPS, 120V

6. **INCANDESCENT - SURFACE AND MISCELLANEOUS**

- 6.1 INCANDESCENT LAMPHOLDER C/W 150W A-19 LAMP, 120V.
- 6.4 EXPLOSION PROOF INCANDESCENT FIXTURE C/W OUTLET BOX MOUNTING, GLASS



- GLOBE AND WIRE GUARD.
 RAB #1/2 EX123
 APPLETON #VHGP1700G
 C/W 1-250W INCANDESCENT LAMP, 120V.
 CROUSE HINDS #VHXF13GP
 HUBBELL #HX-1-200-HG-200
- 6.5
- 6.6 200W VAPOUR TIGHT INCANDESCENT SURFACE MOUNTED FIXTURE CAST ALUMINUM GASKETTED HOUSING, GLASS GLOBE, DIE-CAST ALUMINUM GUARD.
 RAL #VPC200GG75
 C/W 1-150W A-19 LAMP, 120V.
- 6.7 75W SUSPENDED INCANDESCENT DARKROOM SAFELIGHT CORD SUSPENDED.
 KODAK #152 1178
 C/W 1-15W A19 LAMP, 120V.
- 6.8 500W VARIABLE FOCUS FRESNEL SPOTLIGHT, COMPLETE WITH HOUSING CONSTRUCTED OF EXTRUDED ALUMINUM, DIE CAST ALUMINUM ACCESSORY CLIPS, HINGED STEEL LENS DOOR, 152mm HEAT RESISTANT BOROSILICATE GLASS LENS, THERMALLY INSULATED SWEEP ARM AND CALIBRATED SCALE FOR FLOOD-SPOT FOCUS ADJUSTMENTS, C-CLAMP TO GRIP 51mm PIPE, STEEL YOKE, 900mm CORD AND FIBREGLASS SLEEVING, COLOUR / DIFFUSER FRAME, EIGHT-WAY BARN DOOR, SAFETY CABLE, BLACK BAKED ENAMEL FINISH. STRAND #12081/18105/18118/82003
 ALTMAN #65Q SERIES
 C/W 1-500W BTR LAMP, 120V.
- 6.9 250W INCANDESCENT 203mm DIAMETER X 365mm HIGH SUSPENDED CYLINDER WITH WHITE SPUN ALUMINUM HOUSING, CLEAR SPECULAR ALZAK REFLECTOR, WHITE PENDANT ROD MOUNTING ON SWIVEL.
 HALO #H8800P-1800C-H836P
 LITHONIA #CP8B-AR
 PRESCOLITE #1138-462
 C/W 1-250W A23 LAMP, 120V.
9. **HID - OUTDOOR BUILDING MOUNT**
- 9.1 70W HPS WALL MOUNTED LUMINAIRE WITH DIE-CAST ALUMINUM BACKPLATE AND POLYCARBONATE HOOD AND LENS AND TYPE 3 DISTRIBUTION.
 KEENE "LYTE PRO" #LPSC07-3-LXL-1
 C/W 1-70W HPS LAMP, 120V.
- 9.2 70W HPS RECESSED WALL MOUNTED LUMINAIRE WITH ONE PIECE DIE CAST ALUMINUM OR POLYCARBONATE HOUSING SUITABLE FOR RECESSED MOUNTING AND FOR UP OR DOWNLIGHTING. THE LENS SHALL BE INJECTION MOLDED POLYCARBONATE. THE REFLECTOR SHALL HAVE A MIRROR SPECULAR ALZAK FINISH. LUMINAIRE TO BE COMPLETE WITH TAMPER PROOF HARDWARE.
 MOLDCAST #MDL1-04-70-12-TPH
 HYDREL #HP3/C/03/1/S
 IDEALITE #FP-LLA-70HPS-120V-LPL-TP
 C/W 1-70W HPS LAMP, 120V.
- 9.3 70W EXTERIOR WALL MOUNTED HPS LUMINAIRE C/W POLYCARBONATE HOUSING AND LENS, AND METAL BACK PLATE.
 LANDMARK #L-4-ESZL-70
 LITHONIA TWL70S
 LUMARK #HPWM70
 C/W 1-70W HPS LAMP, 120V.
- 9.4 100W EXTERIOR WALL MOUNTED HPS LUMINAIRE, C/W DIE CAST ALUMINUM BASE,

- UV STABILIZED, POLYCARBONATE LENS, ANODISED ALUMINUM CUT-OFF REFLECTOR, (ADJUSTABLE FROM 70° THROUGH 86°), HPF BALLAST.
MOLDCAST #PCL-1-02-10-12-BZP
C/W 1-100W HPS LAMP, 120V.
- 9.5 150W EXTERIOR WALL MOUNTED HPS LUMINAIRE C/W DIE CAST ALUMINUM BASE, UV STABILIZED POLYCARBONATE LENS, ANODISED ALUMINUM CUT-OFF REFLECTOR, HPF BALLAST.
CROUSE HINDS #215229BZ HUBBELL #PR-01505-118
HYDREL HP4/04/1/1/2 MOLDCAST #PCL-1-02-15-12-BZP
C/W 1-150W HPS LAMP, 120V.
- 9.6 150W EXTERIOR WALL MOUNTED HPS LUMINAIRE C/W DIE CAST ALUMINUM BASE, UV STABILIZED POLYCARBONATE LENS, FULL CUT OFF, ANODISED ALUMINUM REFLECTOR AND HPF BALLAST.
HUBBELL PVL-01505-118 DEVINE LWP60-150HPS
KEENE LPM2-C-150LXL-1 CROUSE-HINDS WALP-150LECZ-120
C/W 1-150W HPS LAMP, 120V.
- 9.7 250W EXTERIOR WALL MOUNTED HPS LUMINAIRE C/W DIE CAST ALUMINUM BASE, UV STABILIZED POLYCARBONATE LENS, ANODISED ALUMINUM CUT OFF REFLECTOR AND HPF BALLAST.
MOLDCAST PCL-1-02-25-12-BZP HYDREL HP4/11/1/1/2/
C/W 1-250W HPS LAMP, 120V.
- 9.8 400W EXTERIOR WALL MOUNTED HPS LUMINAIRE C/W DIE CAST ALUMINUM ENCLOSURE, UV STABILIZED POLYCARBONATE LENS, ANODISED ALUMINUM CUT OFF REFLECTOR HPF BALLAST.
MOLDCAST PCL-900-40-12-BZP CROUSE-HINDS WL240219BZ
C/W 1-400W HPS LAMP, 120V.
- 9.9 50W METAL HALIDE WALL MOUNTED LUMINAIRE WITH DIE-CAST ALUMINUM HOUSING, WHITE FINISH.
McPHILBEN #102-FT-50MH-120V-WP LITHONIA #WSR 50M FT 120 LPI DWHG CSA
KEENE #GS3-D-50-4-MA-L-120-WHITE LUMARK #MH-IP-W-50-120
C/W 1-50W MH LAMP, 120V.
- 9.10 100W METAL HALIDE WALL MOUNTED LUMINAIRE WITH DIE-CAST ALUMINUM HOUSING, WHITE FINISH.
McPHILBEN #102-FT-100MH-120V-WP LITHONIA #WSR100M FT 120 LPI DWHG
KEENE #GS3-D-100-4-MA-L-120-WHITE McGRRAW-EDISON # ISC-100-MP-120-WH
C/W 1-100W MH LAMP, 120V.
- 10.1 **UNIVERSITY**
70W HPS POLE MOUNTED LUMINAIRE WITH IES TYPE V DISTRIBUTION AND 3 METER FLARED ALUMINUM POLE FINISHED WITH METHACRYLATE.
GRADE 2 POLES 3mm THICK BASES
#1246 CAST SHOE BASE
#1469 TOP LOCKING COLLAR
#X652348 BASE COVER
LANDMARK #10FR5-175MM C/W POLE AND ACCESSORIES LESS ANCHOR BOLTS.
C/W 1-70W HPS LAMP, 120V.
- 250W HPS POLE MOUNTED LUMINAIRE WITH IES TYPE V DISTRIBUTION AND 6 METER FLARED ALUMINUM POLE FINISHED WITH METHACRYLATE.

- GRADE 2 POLES 3mm THICK BASES
 - #1246 CAST SHOE BASE
 - #1469 TOP LOCKING COLLAR
 - #X652348 BASE COVER
- LANDMARK #10FR5-175MM C/W POLE AND ACCESSORIES LESS ANCHOR BOLTS.
C/W 1-250W HPS LAMP, 120V.

10.2 **TYPE A - INEXPENSIVE**

400W HIGH PRESSURE SODIUM EXTERIOR POLE MOUNTED LUMINAIRE CONSTRUCTED OF AN ARM MOUNTED, FORMED ALUMINUM HOUSING WITH PAINTED/BRONZE FINISH, SPECULAR ANODISED REFLECTOR (TYPE III ASYMMETRIC LIGHT PATTERN), AND CLEAR TEMPERED GLASS LENS WITH CAST ALUMINUM FRAME. POLE SHALL BE 9.1m LONG, ROUND, NON-TAPERED STEEL WITH PAINTED BRONZE FINISH.
LITHONIA TYPE KAD COOPER #CS7253-120
C/W 1-400W HPS LAMP.

11 **LED EXTERIOR BUILDING MOUNT**

11.1a LED WALL EXTERIOR WALL MOUNT LUMINAIRE WITH EPOXY-COATED DIE-CAST ALUMINUM HOUSING AND BACKPLATE. TYPE 3 DISTRIBUTION, FULL CUT OFF, 40 LEDS, WHITE FINISH, 4300°K COLOUR TEMPERATURE.
RUUD "THE EDGE" # X-SE-0-3-04-C-1-W-7
McGRAW EDISON #ISC-B02-LED-E1-BL3-GM-LCF
WIDELITE #ASW-32G1-3L0-120-SAM
LITHONIA # DSXW2 LED 20C 700 40K TES 120 DNAXD
120V.

11.1b LED WALL MOUNT EXTERIOR LUMINAIRE WITH EPOXY-COATED DIE-CAST ALUMINUM HOUSING AND BACKPLATE. TYPE 3 DISTRIBUTION, FULL CUT OFF, 120 LEDS, SILVER FINISH, 4300°K COLOUR TEMPERATURE.
RUUD # X-SE-0-3-12-C-1-W-7
McGRAW EDISON #ISC-B02-LED-E1-BL3-GM-LCF
WIDELITE #ASW-80G1-3L0-120-SAM
LITHONIA #DSX1LED 2 30B530/40K SR3 120
120V.

11.2 **LED EXTERIOR POLE MOUNT**

11.2a TWO LED LUMINAIRES, MOUNTED AT 180 DEGREES ON EXTERIOR POLE, WITH EPOXY-COATED DIE-CAST ALUMINUM HOUSING, UNIVERSAL BALLAST. TYPE 3 MEDIUM DISTRIBUTION, FULL CUT OFF, 2x120 LEDS, WHITE FINISH, 4300°K COLOUR TEMPERATURE, 6100mm STEEL POLE.
RUUD "THE EDGE" #X-AL-1-3-12-C-4-W-7, 208V.

11.2b LED EXTERIOR POLE MOUNTED LUMINAIRE WITH EPOXY-COATED DIE-CAST ALUMINIUM HOUSING, UNIVERSAL BALLAST. TYPE 3 DISTRIBUTION, FULL CUT OFF, 40 LEDS, WHITE FINISH, 4300°K COLOUR TEMPERATURE, 3660mm STEEL POLE.
RUUD "THE EDGE" #X-AL-1-2-04-C-4-W-7, 208V.

11.2c SINGLE LED LUMINAIRE MOUNTED ON EXTERIOR POLE WITH EPOXY-COATED DIE-CAST ALUMINUM HOUSING, UNIVERSAL BALLAST. TYPE 4 MEDIUM DISTRIBUTION, FULL CUT OFF, 120 LEDS, WHITE FINISH, 4300°K COLOUR TEMPERATURE, 6100mm STEEL POLE.
RUUD "THE EDGE" # X-AL-1-4-12-C-4-W-7, 208V.

11.2d SINGLE LED LUMINAIRE MOUNTED ON EXTERIOR POLE WITH EPOXY-COATED DIE-

CAST ALUMINUM HOUSING, UNIVERSAL BALLAST. TYPE 3 MEDIUM DISTRIBUTION,
FULL CUT OFF, 120 LEDS, WHITE FINISH, 4300°K COLOUR TEMPERATURE, 6100mm
STEEL POLE.
RUUD "THE EDGE" # X-AL-1-3-12-C-4-W-7, 208V.

13. COMPACT FLUORESCENT - RECESSED**13.2B 32W TRIPLE TUBE – VERTICAL LAMP**

13.2B.1 32 W COMPACT FLUORESCENT OPEN DOWNLIGHT COMPLETE WITH 152mm APERTURE, SPECULAR CLEAR ALZAK IRIDESCENT FREE REFLECTOR, WHITE TRIM RING, ALUMINUM DIE CAST LAMP HOUSING AND DIE CAST ALUMINUM OR 16 GAUGE STEEL MOUNTING FRAME, ELECTRONIC BALLAST (26 50 00).
 LIGHTOLIER #8021CL / 612632BG120 HALO #C60321E-6050-LI
 LITHONIA #AFV/32TRT-6AR-120GEB-TRW
 JUNO #C6V-126/42T/C6000CL-WH/HBTL
 C/W 1-32W TRIPLE TUBE AMALGAM LAMP (2400 LAMP LUMENS), 120V.

13.2B.2 32W COMPACT FLUORESCENT OPEN DOWNLIGHT COMPLETE WITH 152mm APERTURE, SPECULAR CLEAR ALZAK IRIDESCENT FREE REFLECTOR, WHITE TRIM RING, ALUMINUM DIE CAST LAMP HOUSING AND DIE CAST ALUMINUM OR 16 GAUGE STEEL MOUNTING FRAME, ELECTRONIC DIMMING BALLAST (26 50 00).
 LIGHTOLIER #8021CL/612632BG120 HALO #C6032-1D-6000-LI
 LITHONIA #AFV-32TRT-6AR-120
 C/W 1-32W TRIPLE TUBE AMALGAM LAMP (2400 LUMENS), 120V.

13.2B.3 32W COMPACT FLUORESCENT RECESSED **SHOWER** LIGHT WITH DROPPED OPAL LEXAN OR REGRESSED FRESNEL LENS, WHITE TRIM RING, AND ELECTRONIC BALLAST (26 50 00).
 LIGHTOLIER #1126WH/1102P32VG120 LITHONIA #LP6F-32TRT-120/6LD3
 PATHWAY #FF7132TS-IE-SPD760T-WL
 C/W 1-32W TRIPLE TUBE AMALGAM LAMP, 120V.

13.3B 26W TRIPLE TUBE – VERTICAL LAMP

13.3B.1 26W COMPACT FLUORESCENT OPEN DOWNLIGHT COMPLETE WITH 152mm APERTURE, SPECULAR CLEAR ALZAK REFLECTOR, WHITE TRIM RING, ALUMINUM DIE-CAST LAMP HOUSING AND DIE CAST ALUMINUM OR 16 GAUGE STEEL MOUNTING FRAME. ELECTRONIC BALLAST (26 50 00).
 LIGHTOLIER #8021CCL/612632BG120 HALO #C6032-E-6000-L1
 LITHONIA #AFV1/26TRT-6AR-120GEB-TRW
 C/W 1-26W TRIPLE TUBE AMALGAM LAMP (1800 LAMP LUMENS), 120V.

13.3B.2 26W COMPACT FLUORESCENT RECESSED DOWNLIGHT COMPLETE WITH DIE-CAST ALUMINUM LAMP HOUSING AND DIE CAST ALUMINUM OR 16 GAUGE STEEL MOUNTING FRAME, SPECULAR ALZAK ALUMINUM IRIDESCENT FREE REFLECTOR. 152mm DIAMETER SPECULAR CLEAR ALZAK APERTURE CONE. ELECTRONIC BALLAST (26 50 00).
 LIGHTOLIER #8021CCL/612632BCU120 HALO #C6032-1DCP-6000L1
 LITHONIA #AFV1/26 TRT-6AR-120GEB-TRW
 C/W 1-26W TRIPLE TUBE AMALGAM LAMP, 120V.

13.3A.3 26W COMPACT FLUORESCENT OPEN WALL WASH DOWNLIGHT COMPLETE WITH 152mm APERTURE WITH SPECULAR ALZAK IRIDESCENT FREE REFLECTOR, DIE CAST ALUMINUM LAMP HOUSING AND ALUMINUM DIE CAST OR 16 GAUGE STEEL MOUNTING FRAME AND ELECTRONIC DIMMING BALLAST (26 50 00).
 LIGHTOLIER #8081CL/6132BC120
 C/W 1-26W TRIPLE TUBE AMALGAM LAMP, 120V.

13.5 42W TRIPLE TUBE

13.5.1 42W COMPACT FLUORESCENT VERTICAL LAMP OPEN DOWNLIGHT COMPLETE WITH 203mm APERTURE, SPECULAR CLEAR ALZAK IRIDESCENT FREE REFLECTOR, WHITE



TRIM RING, ALUMINUM DIE CAST LAMP HOUSING AND DIE CAST ALUMINUM OR 16 GAUGE STEEL MOUNTING FRAME, ELECTRONIC BALLAST (26 50 00). LIGHTOLIER #8023CCL / 8142VU120 HALO #C8042E-8400-LI LITHONIA #AFV42TRT-8AR-120GEB-TRW C/W 1-42W TRIPLE TUBE AMALGAM LAMP (3200 LAMP LUMENS), 120V.

LED Downlights

1100-1300 lumens

- 14.1 1100 LUMEN LED RECESSED DOWNLIGHT WITH 150mm APERTURE, SPECULAR ALZAK IRIDESCENT FREE REFLECTOR, WHITE TRIM RING, DIE CAST ALUMINUM OR 16 GAUGE STEEL MOUNTING FRAME.
 INDY #L6-13-30-?/L600-C-L-WH
 PATHWAY #6VLED-1100-3K
 GOTHAM #EVO 30/10 6AR

Mini-downlights

- 14.2 MINI LED RECESSED GIMBAL DOWNLIGHT COMPLETE WITH HOUSING, SATIN NICKEL FINISH, 12 VAC TRANSFORMER, 24° LED NARROW FLOOD LAMP (5W) 3000°K COLOUR TEMPERATURE.
 JUNO #MG1L3K-NFL-SN (no housing needed)
 SENSO #510-559-611-70-08 (has housing)
 Phoster #PLE-9W-RDL-36D-30K PLD-RDL1P-DDD-350
 IP LIGHTING #IP53-600330-A-9W3K-120-S (haven't seen sample)

LED Downlights suitable for exterior canopy

1100-1300 lumens

- 14.3 1300 LUMEN LED OPEN DOWNLIGHT COMPLETE WITH 152mm APERTURE, SPECULAR CLEAR ALZAK IRIDESCENT FREE REFLECTOR, WHITE TRIM RING, DIE CAST ALUMINUM OR 16 GAUGE STEEL MOUNTING FRAME, AND 120V LED DRIVER. LUMINAIRE TO BE SUITABLE FOR WET LOCATIONS.
 INDY #SD6-13-40-SAF-3-PF-WL
 PORTFOLIO #LD615DO10-ERM6830-6LMOLI-HB26
 GOTHAM #EVO41/14-6AR-LS-MVOLT-TRW
 120V.

LED Surface Cylinders (Georges Vanier School - gymnasium) - 2700K

- 14.4 3500 LUMEN 2700K 150mm APERTURE SURFACE MOUNTED LED CYLINDER WITH HEAVY-GAUGE ROLLED ALUMINUM WITH NO VISIBLE SEAM.
 GOTHAM #ICO-CYL 27/35 5AR 20 120 DMXR DWHG
 SOLERA #SRBC-6-30W-120V-CXA2530-WW-NB-CM-E-WH
 CREE #ESA-C10-NS-S-42-D-U-WH-SSGC-27K (700mA)
 WILA #S608-862/120-SSA20-80-DFS6-BDIM

1 General

1.1 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings and product data in accordance with Section 26 05 01.
- .2 Data to indicate system components, mounting method, source of power special attachments, operating instructions, and guarantee.

1.2 OPERATING AND MAINTENANCE DATA

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

1.3 GUARANTEE

- .1 Provide written guarantee stating that the emergency lighting unit is guaranteed against defects in material and workmanship for a period of three years from date of Substantial Performance of Work.

1.4 VERIFICATION

- .1 The emergency lighting system shall be tested and certified as fully operational by the manufacturer's agent or the contractor. Submit a certificate of test indicating test results for each remote head as well as each emergency lighting unit.
- .2 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 Products

2.1 BATTERY/CHARGER UNIT

- .1 A battery powered automatic charging emergency lighting unit shall be supplied and installed where shown on the plans. The unit shall comply with CSA C22.2 No. 141-02 electrical and performance approvals and be complete with mounting bracket, cord and cap, and lamp heads to match remote heads where indicated on drawings.
- .2 Cabinet shall be of 18 gauge steel finished in standard enamel complete with removable front panel and knockouts for conduit connections.
- .3 Emergency lighting unit batteries shall be low maintenance long life sealed lead type with a minimum life expectancy of ten years.

- .4 Unit shall be complete with automatic unit cyclor option which shall place the unit into a simulated power failure condition at 30 day intervals, as well as annually (for a minimum of 30 minutes).
- .5 Charger shall be fully automatic solid state type with rectifier fuse protection and battery disconnect device to limit battery discharge to 91% of rated voltage. Charger shall have automatic equalize feature, brownout protection and shall be capable of compensating for variance in ambient temperature by inversely changing charge voltage.
- .6 Unit shall be complete with the following:
 - push to test switch
 - LED indicator lights to indicate unit "on", "charge", "lamp failure", "automatic discharge".
 - Audible buzzer to indicate low battery capacity during test, and remote lamp failure.
- .7 Heads on battery/charger unit shall match remote heads

2.2 REMOTE HEADS

- .1 White die-cast aluminum housing providing 359 degrees rotation, 56 mm diameter lens, 5.7W MR16 LED lamps (double head). Lumacell "DR2130" series, Emergilite "EF150D" series, Ready Lite "RL150D" series, AimLite "RMMD" series, or approved equal.

2.3 MANUFACTURERS

- .1 Acceptable manufacturers: Lumacell RGS series, Emergilite ESL series, Ready-Lite LD10 series, AimLite EBST series, or approved equivalent.

3 Execution

3.1 INSTALLATION

- .1 Mount emergency lighting units on a wall bracket at a conveniently accessible location to permit easy servicing. Locate a duplex receptacle adjacent to unit.
- .2 All wiring for remote emergency lighting fixtures shall be #10 AWG (minimum) installed in conduit.
- .3 Adjust aiming of emergency lighting fixtures to provide illumination in the appropriate locations to permit ready access to all required means of egress.
- .4 Install unit equipment for emergency lighting in accordance with the latest edition of CSA C22.1.
- .5 Mount remote light heads on wall at 150 mm below finished ceiling (to centre) unless otherwise noted.
- .6 Provide and install factory mounting shelf for emergency lighting unit.

- .7 Mount emergency lighting cabinet at 2,100mm AFF.

3.2 EQUIPMENT IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 01.
- .2 Nameplate for each emergency lighting unit size 5 engraved in accordance with Section 26 05 01. Indicate emergency lighting unit number, as well as the branch circuit energizing the emergency lighting unit (ie. "EMERGENCY LIGHTING UNIT #6 FED FROM BRANCH CIRCUIT C-26").
- .3 Nameplate for each remote emergency head size 1 indicating the emergency lighting unit that the remote head is fed from (ie. "UNIT #6").

END OF SECTION 26 52 00

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:
 - 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)

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 aluminum 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 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 2.0 watts.

- .9 LED's shall operate on 120 volt, as well as DC voltage provided by remote emergency battery units (refer to drawings for voltage), without the use of any external transformer.
- .10 Design life for the exit light shall be minimum 25 years.

2.2 MANUFACTURERS

- .1 Acceptable Manufacturers: Lumacell #LA Series, Emergilite, Ready-Lite #RA Series, AimLite RPALW or approved equivalent.

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 26 53 00