

Part 1 General

1.1 REFERENCES

- .1 Definitions:
 - .1 Electrical and electronic terms: unless otherwise specified or indicated, terms used in these specifications, and on drawings, are those defined by IEEE SP1122.
- .2 Reference Standards:
 - .1 CSA Group
 - .1 CSA C22.1-15, Canadian Electrical Code, Part 1 (23rd Edition), Safety Standard for Electrical Installations.
 - .2 CSA C22.2
 - .3 CAN3-C235-83(R2015), Preferred Voltage Levels for AC Systems, 0 to 50,000 V.
 - .2 Institute of Electrical and Electronics (IEEE)/National Electrical Safety Code Product Line (NESC)
 - .1 IEEE SP1122-2000, The Authoritative Dictionary of IEEE Standards Terms, 7th Edition.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Shop drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Manitoba, Canada.
 - .2 Submit wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, ductwork, and other items that must be shown to ensure co-ordinated installation.
 - .3 Identify on wiring diagrams circuit terminals and indicate internal wiring for each item of equipment and interconnection between each item of equipment.
 - .4 Indicate of drawings clearances for operation, maintenance, and replacement of operating equipment devices.
 - .5 Submit two (2) number of copies of 600 x 900 mm minimum size drawings to authority having jurisdiction.
 - .6 If changes are required, notify Departmental Representative of these changes before they are made.
- .3 Certificates:
 - .1 Provide CSA certified equipment.
 - .2 Where CSA certified equipment is not available, submit such equipment to inspection authorities for approval before delivery to site.
 - .3 Submit test results of installed electrical systems and instrumentation.
 - .4 Permits and fees: in accordance with General Conditions of contract.

- .5 Submit, upon completion of Work, load balance report as described in PART 3 - LOAD BALANCE.
- .6 Submit certificate of acceptance from authority having jurisdiction upon completion of Work to Departmental Representative.

1.3 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for lighting, lighting controls, fire alarm, access control, and intrusion alarm for incorporation into manual.
 - .1 Provide for each system and principal item of equipment as specified in technical sections for use by operation and maintenance personnel.
 - .2 Operating instructions to include following:
 - .1 Wiring diagrams, control diagrams, and control sequence for each principal system and item of equipment.
 - .2 Start up, proper adjustment, operating, lubrication, and shutdown procedures.
 - .3 Safety precautions.
 - .4 Procedures to be followed in event of equipment failure.
 - .5 Other items of instruction as recommended by manufacturer of each system or item of equipment.
 - .3 Print or engrave operating instructions and frame under glass or in approved laminated plastic.
 - .4 Post instructions where directed.
 - .5 For operating instructions exposed to weather, provide weather-resistant materials or weatherproof enclosures.
 - .6 Ensure operating instructions will not fade when exposed to sunlight and are secured to prevent easy removal or peeling.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

Part 2 Products

2.1 DESIGN REQUIREMENTS

- .1 Operating voltages: to CAN3-C235.
- .2 Motors, electric heating, control and distribution devices and equipment to operate satisfactorily at 60 Hz within normal operating limits established by above standard.
 - .1 Equipment to operate in extreme operating conditions established in above standard without damage to equipment.
- .3 Language operating requirements: provide identification nameplates for control items in English.

2.2 MATERIALS AND EQUIPMENT

- .1 Provide material and equipment in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Material and equipment to be CSA certified. Where CSA certified material and equipment are not available, obtain special approval from inspection authorities before delivery to site and submit such approval as described in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS.
- .3 Factory assemble control panels and component assemblies.

2.3 ELECTRIC MOTORS, EQUIPMENT AND CONTROLS

- .1 Verify installation and co-ordination responsibilities related to motors, equipment and controls, as indicated.
- .2 Control wiring and conduit: in accordance with mechanical specifications and drawings.

2.4 WARNING SIGNS

- .1 Warning Signs: in accordance with requirements of authority having jurisdiction.
- .2 Decal signs, minimum size 175 x 250 mm.

2.5 WIRING TERMINATIONS

- .1 Ensure lugs, terminals, screws used for termination of wiring are suitable for either copper or aluminum conductors.

2.6 EQUIPMENT IDENTIFICATION

- .1 Identify electrical equipment with nameplates and labels as follows:
 - .1 Nameplates: lamicoid 3 mm black face, white core, lettering accurately aligned and engraved into core mechanically attached with self tapping screws.
 - .2 Sizes as follows:

NAMEPLATE SIZES			
Size 1	10 x 50 mm	1 line	3 mm high letters
Size 2	12 x 70 mm	1 line	5 mm high letters

Size 3	12 x 70 mm	2 lines	3 mm high letters
Size 4	20 x 90 mm	1 line	8 mm high letters
Size 5	20 x 90 mm	2 lines	5 mm high letters
Size 6	25 x 100 mm	1 line	12 mm high letters
Size 7	25 x 100 mm	2 lines	6 mm high letters

- .2 Labels: embossed plastic labels with 6 mm high letters unless specified otherwise.
- .3 Wording on nameplates to be approved by Departmental Representative prior to manufacture.
- .4 Allow for minimum of twenty-five (25) letters per nameplate.
- .5 Nameplates for terminal cabinets and junction boxes to indicate system and/or voltage characteristics.
- .6 Identify equipment with Size 3 labels engraved "ASSET INVENTORY NO. ____" as directed by Departmental Representative.
- .7 Disconnects, starters and contactors: indicate equipment being controlled and voltage.
- .8 Terminal cabinets and pull boxes: indicate system and voltage.

2.7 WIRING IDENTIFICATION

- .1 Identify wiring with permanent indelible identifying markings, numbered, on both ends of phase conductors of feeders and branch circuit wiring.
- .2 Maintain phase sequence and colour coding throughout.
- .3 Colour coding: to CSA C22.1.
- .4 Use colour coded wires in communication cables, matched throughout system.

2.8 CONDUIT AND CABLE IDENTIFICATION

- .1 Colour code conduits, boxes and metallic sheathed cables.
- .2 Code with plastic tape or paint at points where conduit or cable enters wall, ceiling, or floor, and at 15 m intervals.
- .3 Colours: 25 mm wide prime colour and 20 mm wide auxiliary colour.

	Prime	Auxiliary
up to 250 V	Yellow	
up to 600 V	Yellow	Green
up to 5 kV	Yellow	Blue
up to 15 kV	Yellow	Red
Telephone	Green	
Other Communication Systems	Green	Blue
Fire Alarm	Red	
Emergency Voice	Red	Blue
Other Security Systems	Red	Yellow

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied.

3.2 INSTALLATION

- .1 Do complete installation in accordance with CSA C22.1 except where specified otherwise.

3.3 NAMEPLATES AND LABELS

- .1 Ensure manufacturer's nameplates, CSA labels and identification nameplates are visible and legible after equipment is installed.

3.4 CONDUIT AND CABLE INSTALLATION

- .1 Install cables, conduits and fittings embedded or plastered over, close to building structure so furring can be kept to minimum.

3.5 LOCATION OF OUTLETS

- .1 Locate outlets in accordance with Section 26 05 32 - Outlet Boxes, Conduit Boxes and Fittings.
- .2 Do not install outlets back-to-back in wall; allow minimum 150 mm horizontal clearance between boxes.
- .3 Change location of outlets at no extra cost or credit, providing distance does not exceed 3000 mm, and information is given before installation.
- .4 Locate light switches on latch side of doors.
 - .1 Locate disconnect devices in mechanical and elevator machine rooms on latch side of floor.

3.6 MOUNTING HEIGHTS

- .1 Mounting height of equipment is from finished floor to centreline of equipment unless specified or indicated otherwise.
- .2 If mounting height of equipment is not specified or indicated, verify before proceeding with installation.
- .3 Install electrical equipment at following heights unless indicated otherwise.
 - .1 Local switches: 1200 mm.
 - .2 Wall receptacles:

- .1 General: 400 mm.
- .2 Above top of continuous baseboard heater: 200 mm.
- .3 Above top of counters or counter splash backs: 175 mm.
- .4 In mechanical rooms: 1400 mm.
- .3 Panelboards: as required by Code or as indicated.
- .4 Telephone and data outlets: 400 mm.
- .5 Fire alarm stations: 1200 mm.
- .6 Fire alarm bells: 2100 mm.
- .7 Television outlets: Coordinate behind television location.

3.7 CO-ORDINATION OF PROTECTIVE DEVICES

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

3.8 FIELD QUALITY CONTROL

- .1 Load Balance:
 - .1 Measure phase current to panelboards with normal loads (lighting) operating at time of acceptance; adjust branch circuit connections as required to obtain best balance of current between phases and record changes.
 - .2 Measure phase voltages at loads and adjust transformer taps to within 2% of rated voltage of equipment.
 - .3 Provide upon completion of work, load balance report as directed in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS, phase and neutral currents on panelboards, dry-core transformers and motor control centres, operating under normal load, as well as hour and date on which each load was measured, and voltage at time of test.
- .2 Conduct following tests in accordance with Section 01 45 00 - Quality Control.
 - .1 Power distribution system including phasing, voltage, grounding and load balancing.
 - .2 Circuits originating from branch distribution panels.
 - .3 Lighting and its control.
 - .4 Motors, heaters and associated control equipment including sequenced operation of systems where applicable.
 - .5 Systems: fire alarm.
 - .6 Insulation resistance testing:
 - .1 Megger circuits, feeders and equipment up to 350 V with a 500 V instrument.
 - .2 Megger 350-600 V circuits, feeders and equipment with a 1000 V instrument.
 - .3 Check resistance to ground before energizing.
- .3 Carry out tests in presence of Departmental Representative.

- .4 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.

3.9 SYSTEM STARTUP

- .1 Instruct operating personnel in operation, care and maintenance of systems, system equipment and components.

3.10 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 CSA International
 - .1 CAN/CSA-C22.2 No.18-98(R2003), Outlet Boxes, Conduit Boxes and Fittings.
 - .2 CAN/CSA-C22.2 No.65-03(R2008), Wire Connectors (Tri-National Standard with UL 486A-486B and NMX-J-543-ANCE-03).
- .2 Electrical and Electronic Manufacturers' Association of Canada (EEMAC)
 - .1 EEMAC 1Y-2-1961, Bushing Stud Connectors and Aluminum Adapters (1200 Ampere Maximum Rating).
- .3 National Electrical Manufacturers Association (NEMA)

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.

1.3 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect wire and box connectors from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

Part 2 Products

2.1 MATERIALS

- .1 Pressure type wire connectors to: CAN/CSA-C22.2 No.65, with current carrying parts of copper sized to fit copper conductors as required.
- .2 Fixture type splicing connectors to: CAN/CSA-C22.2 No.65, with current carrying parts of copper sized to fit copper conductors 10 AWG or less.
- .3 Clamps or connectors for aluminum sheathed cable and flexible conduit as required to: CAN/CSA-C22.2 No.18.

Part 3 Execution

3.1 INSTALLATION

- .1 Remove insulation carefully from ends of conductors and cables:
 - .1 Apply coat of zinc joint compound on aluminum conductors prior to installation of connectors.
 - .2 Install mechanical pressure type connectors and tighten screws with appropriate compression tool recommended by manufacturer. Installation shall meet secureness tests in accordance with CAN/CSA-C22.2 No.65.
 - .3 Install fixture type connectors and tighten to CAN/CSA-C22.2 No.65. Replace insulating cap.

3.2 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

END OF SECTION

Part 1 General

1.1 NOT USED.

Part 2 Products

2.1 BUILDING WIRES

- .1 Conductors: stranded for 10 AWG and larger. Minimum size: 12 AWG.
- .2 Copper conductors: size as indicated, with thermoplastic insulation type T90 Nylon rated at 600 V.

2.2 ARMOURED CABLES

- .1 Conductors: insulated, copper, size as indicated.
- .2 Type: AC90.
- .3 Armour: interlocking type fabricated from galvanized steel strip.
- .4 Connectors: anti short connectors.

2.3 CONTROL CABLES

- .1 Type: LVT: 2 soft annealed copper conductors, sized as indicated:
 - .1 Insulation: thermoplastic.
 - .2 Sheath : thermoplastic jacket, and armour of closely wound aluminum wire.

Part 3 Execution

3.1 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Perform tests using method appropriate to site conditions and to approval of Departmental Representative and local authority having jurisdiction over installation.
- .3 Perform tests before energizing electrical system.

3.2 GENERAL CABLE INSTALLATION

- .1 Terminate cables in accordance with Section 26 05 20 - Wire and Box Connectors - (0-1000 V).
- .2 Cable Colour Coding: to Section 26 05 00 - Common Work Results for Electrical.
- .3 Conductor length for parallel feeders to be identical.
- .4 Lace or clip groups of feeder cables at distribution centres, pull boxes, and termination points.

- .5 Wiring in walls: typically drop or loop vertically from above to better facilitate future renovations. Generally wiring from below and horizontal wiring in walls to be avoided unless indicated.
- .6 Branch circuit wiring for surge suppression receptacles and permanently wired computer and electronic equipment to be 2-wire circuits only, i.e. common neutrals not permitted.
- .7 Provide numbered wire collars for control wiring. Numbers to correspond to control shop drawing legend. Obtain wiring diagram for control wiring.

3.3 INSTALLATION OF BUILDING WIRES

- .1 Install wiring as follows:
 - .1 In conduit systems in accordance with Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.

3.4 WIRING METHODS

- .1 Concealed Dry Interior Locations: Use only building wire in raceway. Armoured cabling may be used for individual drops to equipment and devices only.
- .2 Exposed Dry Interior Locations: Use only building wire in raceway.
- .3 Above Accessible Ceilings: Use only building wire in raceway. Armoured cabling may be used for individual drops to equipment and devices only.

3.5 INSTALLATION OF ARMOURED CABLES

- .1 Group cables wherever possible on channels.

3.6 INSTALLATION OF CONTROL CABLES

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

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 CSA-C22.1-15 - Canadian Electrical Code, Part I (23rd Edition), Safety Standard for Electrical Installations.

Part 2 Products

2.1 EQUIPMENT

- .1 Grounding conductors: bare stranded copper, soft annealed, size as indicated.
- .2 Insulated grounding conductors: green, copper conductors, size as indicated.
- .3 Ground bus: copper, size as indicated, complete with insulated supports, fastenings, connectors.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for grounding equipment installation in accordance with manufacturer's written instructions.
 - .1 Inform Departmental Representative and Consultant of unacceptable conditions immediately upon discovery.
 - .2 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative or Consultant.

3.2 INSTALLATION GENERAL

- .1 Protect exposed grounding conductors from mechanical injury.
- .2 Use mechanical connectors for grounding connections to equipment provided with lugs.
- .3 Provide bonding to meet Regulatory Requirements.
- .4 Mechanical connections shall be used for bonding connections to equipment. Soldered joints shall not be permitted.
- .5 Provide bonding wire connected to both ends of flexible conduit. Neatly attach to exterior of flexible conduit.
- .6 Bonding connections shall be made using a star configuration. Loop connections shall be avoided.
- .7 Single conductor cables with metallic armour shall be bonded at the supply end only. Provide non-metallic entry plates for load end terminations. Provide a separate bonding conductor.

- .8 Provide separate bonding conductor in all non-metallic raceways.
- .9 Bond together metal siding not attached to grounded structure; bond to ground.
- .10 Install ground grid under access floors. Construct grid of #6 AWG bare copper wire bonded to every fourth pedestal.
- .11 Bond together each metallic raceway, pipe, duct and other metal object entering space under access floors. Bond to underfloor ground grid. Use #6 AWG bare copper conductor.
- .12 Equipment Grounding Conductor: Provide separate, insulated conductor within each feeder and branch circuit raceway. Terminate each end on suitable lug, bus, or bushing.

3.3 COMMUNICATION SYSTEMS

- .1 Install communications grounding system for bonding of all telephone, data, fire alarm, paging as follows:
 - .1 When placed in ferrous metallic conduit or EMT longer than 1 m, bond to each end of conduit or EMT using 6 AWG bare copper conductor.

3.4 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Perform tests before energizing electrical system.
- .3 Disconnect ground fault indicator during tests.

3.5 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

END OF SECTION

Part 1 General

1.1 WASTE MANAGEMENT AND DISPOSAL

- .1 Remove from site and dispose of all packaging materials at appropriate recycling facilities.
- .2 Divert unused metal materials from landfill to metal recycling facility as approved by Departmental Representative.
- .3 Fold up metal banding, flatten and place in designated area for recycling.

Part 2 Products

2.1 SUPPORT CHANNELS

- .1 U shape, size 41 x 41 mm, 2.5 mm thick, surface mounted and suspended.

Part 3 Execution

3.1 INSTALLATION

- .1 Secure equipment to solid masonry, tile and plaster surfaces with lead anchors.
- .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.
- .5 Support equipment, conduit or cables using clips, spring loaded bolts, cable clamps designed as accessories to basic channel members.
- .6 Fasten exposed 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 dia threaded rods and spring clips.
 - .2 Support 2 or more cables or conduits on channels supported by 6 mm dia threaded rod hangers where direct fastening to building construction is impractical.
- .8 For surface mounting of two or more conduits use channels at 900mm on centre spacing.
- .9 Provide metal brackets, frames, hangers, clamps and related types of support structures where indicated or as required to support conduit and cable runs.

- .10 Ensure adequate support for raceways and cables dropped vertically to equipment where there is no wall support.
- .11 Do not use wire lashing or perforated strap to support or secure raceways or cables.
- .12 Do not use supports or equipment installed for other trades for conduit or cable support except with permission of other trade and approval of Departmental Representative.
- .13 Install fastenings and supports as required for each type of equipment cables and conduits, and in accordance with manufacturer's installation recommendations.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 Canadian Standards Association (CSA International)
- .1 CSA C22.1-15, Canadian Electrical Code, Part 1, 22nd Edition.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.

Part 2 Products

2.1 JUNCTION AND PULL BOXES

- .1 Construction:welded steel enclosure.
- .2 Covers Flush Mounted: 25 mm minimum extension all around.
- .3 Covers Surface Mounted: screw-on flat turned edge covers.
- .4 All covers for junction and pull boxes with a dimension larger than 250mm shall have hinged covers.

Part 3 Execution

3.1 JUNCTION, PULL BOXES AND CABINETS INSTALLATION

- .1 Install pull boxes in inconspicuous but accessible locations.
- .2 Mount cabinets with top not higher than 2 m above finished floor except where indicated otherwise.
- .3 Only main junction and pull boxes are indicated. Install additional pull boxes as required by CSA C22.1.

3.2 IDENTIFICATION

- .1 Equipment Identification: to Section 26 05 00 - Common Work Results for Electrical.
- .2 Identification Labels: size 2 indicating system name, voltage and phase or as indicated.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CSA C22.1-15, Canadian Electrical Code, Part 1, 22nd Edition.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.

1.3 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.

Part 2 Products

2.1 OUTLET AND CONDUIT BOXES GENERAL

- .1 Size boxes in accordance with CSA C22.1.
- .2 102 mm square or larger outlet boxes as required.
- .3 Gang boxes where wiring devices are grouped.
- .4 Blank cover plates for boxes without wiring devices.
- .5 Combination boxes with barriers where outlets for more than one system are grouped.

2.2 GALVANIZED STEEL OUTLET BOXES

- .1 One-piece electro-galvanized construction.
- .2 Single and multi gang flush device boxes for flush installation, minimum size 76 x 50 x 38 mm or as indicated. 102 mm square outlet boxes when more than one conduit enters one side with extension and plaster rings as required.
- .3 Utility boxes for outlets connected to surface-mounted EMT conduit, minimum size 102 x 54 x 48 mm.
- .4 102 mm square or octagonal outlet boxes for lighting fixture outlets.
- .5 Extension and plaster rings for flush mounting devices in finished walls.

2.3 FITTINGS - GENERAL

- .1 Bushing and connectors with nylon insulated throats.
- .2 Knock-out fillers to prevent entry of debris.
- .3 Conduit outlet bodies for conduit up to 35mm and pull boxes for larger conduits.
- .4 Double locknuts and insulated bushings on sheet metal boxes.

Part 3 Execution

3.1 INSTALLATION

- .1 Support boxes independently of connecting conduits.
- .2 Fill boxes with paper, sponges or foam or similar approved material to prevent entry of debris during construction. Remove upon completion of work.
- .3 For flush installations mount outlets flush with finished wall using plaster rings to permit wall finish to come within 6 mm of opening.
- .4 Provide correct size of openings in boxes for conduit, mineral insulated and armoured cable connections. Do not install reducing washers.
- .5 Vacuum clean interior of outlet boxes before installation of wiring devices.
- .6 Identify systems for outlet boxes as required.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CAN/CSA C22.2 No. 18-98(R2003). Outlet Boxes, Conduit Boxes, Fittings and Associated Hardware, A National Standard of Canada.
 - .2 CSA C22.2 No. 83-M1985(R2003), Electrical Metallic Tubing.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.

Part 2 Products

2.1 CONDUITS

- .1 Electrical metallic tubing (EMT): to CSA C22.2 No. 83, with couplings.

2.2 CONDUIT FASTENINGS

- .1 One hole steel straps to secure surface conduits 50 mm and smaller.
 - .1 Two hole 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 900mm on centre.
- .4 Threaded rods, 6 mm diameter, to support suspended channels.

2.3 CONDUIT FITTINGS

- .1 Fittings: to CAN/CSA C22.2 No. 18, manufactured for use with conduit specified.
Coating: same as conduit.
- .2 Ensure factory "ells" where 90 degrees bends for 25 mm and larger conduits.
- .3 Watertight connectors and couplings for EMT.
 - .1 Set-screws are not acceptable.

2.4 FISH CORD

- .1 Polypropylene.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 INSTALLATION

- .1 Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass.
- .2 Conceal conduits except in mechanical and electrical service rooms.
- .3 Use electrical metallic tubing (EMT).
- .4 Use flexible metal conduit for connection to motors in dry areas, connection to recessed incandescent fixtures without prewired outlet box, connection to surface or recessed fluorescent fixtures, and work in movable metal partitions.
- .5 Minimum conduit size for lighting and power circuits: 19 mm.
- .6 Bend conduit cold:
 - .1 Replace conduit if kinked or flattened more than 1/10th of its original diameter.
- .7 Mechanically bend steel conduit over 19 mm diameter.
- .8 Install fish cord in empty conduits.
- .9 Remove and replace blocked conduit sections.
 - .1 Do not use liquids to clean out conduits.
- .10 Dry conduits out before installing wire.

3.3 SURFACE CONDUITS

- .1 Run parallel or perpendicular to building lines.
- .2 Locate conduits behind infrared or gas fired heaters with 1.5 m clearance.
- .3 Run conduits in flanged portion of structural steel.
- .4 Group conduits wherever possible on suspended channels.
- .5 Do not pass conduits through structural members except as indicated.
- .6 Do not locate conduits less than 75 mm parallel to steam or hot water lines with minimum of 25 mm at crossovers.

3.4 CONCEALED CONDUITS

- .1 Run parallel or perpendicular to building lines.
- .2 Do not install horizontal runs in masonry walls.
- .3 Do not install conduits in terrazzo or concrete toppings.

3.5 CLEANING

- .1 Proceed in accordance with Section 01 74 11 - Cleaning.
- .2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 26 90 00.

1.2 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CSA C22.2 No. 100-04, Motors and Generators.
- .2 Electrical and Electronic Manufacturers' Association of Canada (EEMAC)
 - .1 EEMAC M1-7-1992, Standard for Motors and Generators.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data: submit WHMIS MSDS - Material Safety Data Sheets in accordance with Section 01 47 15 - Sustainable Requirements: Construction and Section 02 81 01 - Hazardous Materials and include: product characteristics, performance criteria, physical size, horsepower, watt rating, limitations and finish.
- .3 Shop drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Manitoba, Canada.
 - .2 Indicate dimensions, recommended installation procedure, wiring diagrams, sizes and location of mounting bolt holes and recommended support method.
- .4 Quality Assurance Submittals:
 - .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
 - .2 Manufacturer's Instructions: submit manufacturer's installation instructions.
- .5 Closeout Submittals:
 - .1 Provide maintenance data for fractional horsepower motors for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

Part 2 Products

2.1 FRACTIONAL HORSEPOWER MOTOR

- .1 Non-hazardous locations: to CSA C22.2 No. 100 EEMAC M1-7.
- .2 Motor with inherent overheating protectors.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 INSTALLATION

- .1 Install wiring, flexible connections and grounding.
- .2 Check rotation before coupling to driven equipment.

3.3 CLEANING

- .1 Proceed in accordance with Section 01 74 11 - Cleaning.
- .2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 The lighting control system specified in this section shall provide time-based, sensor-based (both occupancy and daylight), and manual lighting control.
- .2 The system shall be capable of turning lighting loads on/off as well as dimming lights (if lighting load is capable of being dimmed)
- .3 All system devices shall be networked together enabling digital communication and shall be individually addressable.
- .4 The system architecture shall be capable of enabling stand-alone groups (rooms) of devices to function in some default capacity even if network connectivity to the greater system is lost.
- .5 The system architecture shall facilitate remote operation via a computer connection.
- .6 The system shall not require any centrally hardwired switching equipment.

1.2 SUBMITTALS

- .1 Product Datasheets (general device descriptions, dimensions, wiring details, nomenclature)
- .2 Riser Diagrams – typical per room type (detailed drawings showing device interconnectivity of devices)
- .3 Other Diagrams – as needed for special operation or interaction with other system(s)
- .4 Example Contractor Startup/Commissioning Worksheet – must be completed prior to factory start-up
- .5 Hardware and Software Operation Manuals
- .6 Other operational descriptions as needed
- .7 All lighting control products shall be submitted along with interior luminaires to ensure a full integrated package.

1.3 QUALITY ASSURANCE

- .1 All components and the manufacturing facility where product was manufactured must be ROHS compliant.
- .2 In high humidity or cold environments, the sensors shall be conformably coated and rated for condensing humidity and -40 degree Celsius operation.
- .3 All applicable products must be ULC / CSA Listed or other acceptable national testing organization.

1.4 COORDINATION

- .1 Coordinate lighting control components to form an integrated interconnection of compatible components.
- .2 Coordinate lighting controls with BAS (if necessary) either through IP based intercommunication of system or hardwired auxiliary relay outputs.
- .3 The installing contractor shall be responsible for a complete and functional system in accordance with all applicable local and national codes.
- .4 Coordinate color of CAT5e cable with departmental representative and shared services Canada (SSC).

1.5 WARRANTY

- .1 All devices in lighting control system shall have a 5 year warranty.

Part 2 Products

2.1 SYSTEM REQUIREMENTS

- .1 System shall have an architecture that is based upon three main concepts; 1) intelligent lighting control devices 2) standalone lighting control zones 3) network backbone for remote or time based operation.
- .2 Intelligent lighting control devices shall consist of one or more basic lighting control components; occupancy sensors, photocell sensors, relays, dimming outputs, manual switch stations, and manual dimming stations. Combining one or more of these components into a single device enclosure should be permissible so as to minimize overall device count of system.
- .3 System must interface directly with intelligent LED luminaires such that only CAT-5e cabling is required to interconnect luminaires with control components such as sensors and switches. (see *Networked LED Luminaire* section)
- .4 Intelligent lighting control devices shall communicate digitally, require <4 mA of current to function (Graphic wall stations excluded), and possess RJ-45 style connectors.
- .5 Lighting control zones shall consist of one or more intelligent lighting control components, be capable of stand-alone operation, and be capable of being connected to a higher level network backbone.
- .6 Devices within a lighting control zone shall be connected with CAT-5e low voltage cabling in any order.
- .7 Lighting control zone shall be capable of automatically configuring itself for default operation without any start-up labor required.
- .8 Individual lighting zones must continue to provide a user defined default level of lighting control in the event of a system communication failure with the backbone network or the management software becoming unavailable.
- .9 Power for devices within a lighting control zone shall come from either resident devices already present for switching (relay device) or dimming purposes, or from the network backbone. Standalone "bus power supplies" shall not be required in all cases.

facilitate system robustness and minimize wiring requirements. Specific applications that require centralized or remote switching shall be capable of being accommodated.

- .11 System shall have one or more primary wall mounted network control “gateway” devices that are capable of accessing and controlling connected system devices and linking into an Ethernet LAN.
- .12 System shall use “bridge” devices that route communication and distribute power for up to 8 directly connected lighting zones together for purposes of decreasing system wiring requirements.
- .13 System shall have a web-based software management program that enables remote system control, status monitoring, and creation of lighting control profiles.
- .14 Individual lighting zones shall be capable of being segmented into several “local” channels of occupancy, photocell, and switch functionality for more advanced configurations and sequences of operation.
- .15 Devices located in different lighting zones shall be able to communicate occupancy, photocell, and switch information via either the wired or WiFi backbone.
- .16 System shall be capable of operating a lighting control zone according to several sequences of operation. System shall be able to change a spaces sequence of operation according to a time schedule so as to enable customized time-of-day, day-of-week utilization of a space. Note operating modes should be utilized only in manners consistent with local energy codes.
 - .1 Auto-On / Auto-Off (via occupancy sensors)
 - .1 Zones with occupancy sensors automatically turn lights on when occupant is detected.
 - .2 Zones with occupancy and/or photocell sensors turn lights off when vacancy or sufficient daylight is detected.
 - .3 Pressing a switch will turn lights off. The lights will remain off regardless of occupancy until switch is pressed again, restoring the sensor to Automatic On functionality.
 - .2 Manual-On / Auto-Off (also called Semi-Automatic)
 - .1 Pushing a switch will turn lights on.
 - .2 Zones with occupancy and/or photocell sensors turn lights off when vacancy or sufficient daylight is detected.
 - .3 Manual-On to Auto-On/Auto-Off
 - .1 Pushing a switch will turn lights on.
 - .2 After initial lights on, zones with occupancy and/or photocell sensors turn lights on/off according to occupancy/vacancy and/or daylight conditions.
 - .3 Sequence can be reset via scheduled (ex. daily each morning) events
 - .4 Auto-to-Override On
 - .1 Zones with occupancy sensors automatically turn lights on when occupant is detected.

- .2 Zone lighting then goes into an override on state for a set amount of time or until the next time event returns the lighting to an auto-off style of control.
 - .3 Sequence can be reset via scheduled (ex. daily each morning) events
- .5 Manual-to-Override On
 - .1 Pushing a switch will turn lights on.
 - .2 Zone lighting then goes into an override on state for a set amount of time or until the next time event returns the lighting to an auto-off style of control.
 - .3 Sequence can be reset via scheduled (ex. daily each morning) events
- .6 Auto On / Predictive Off
 - .1 Zones with occupancy sensors automatically turn lights on when occupant is detected.
 - .2 Zones with occupancy and/or photocell sensors turn lights off when vacancy or sufficient daylight is detected.
 - .3 If switch is pressed, lights turn off and a short "exit timer" begins. After timer expires, sensor scans the room to detect whether occupant is still present. If no occupancy is detected, zone returns to auto-on. If occupancy is detected, lights must be turned on via the switch.
- .17 Control software shall enable logging of system performance data and presenting useful information in a web-based graphical format and downloadable to .CSV files.
- .18 Control software shall enable integration with a BMS via BACnet IP.
- .19 System shall provide the option of having pre-terminated plenum rated CAT-5e cabling supplied with hardware.

2.2 INDIVIDUAL DEVICE SPECIFICATIONS

- .1 Networked System Occupancy Sensors
 - .1 Occupancy sensors system shall sense the presence of human activity within the desired space and fully control the on/off function of the lights.
 - .2 Sensors shall utilize passive infrared (PIR) technology, which detects occupant motion, to initially turn lights on from an off state; thus preventing false on conditions. Ultrasonic or Microwave based sensing technologies shall not be accepted.
 - .3 For applications where a second method of sensing is necessary to adequately detect maintained occupancy (such as in rooms with obstructions), a sensor with an additional "dual" technology shall be used.
 - .4 Dual technology sensors shall have one of its two technologies not require motion to detect occupancy. Acceptable dual technology includes PIR/Microphonics (also known as Passive Dual Technology or PDT) which both looks for occupant motion and listens for sounds indicating occupants. Sensors where both technologies detect motion (PIR/Ultrasonic) shall not be acceptable.
 - .5 All sensing technologies shall be acoustically passive meaning they do not transmit sounds waves of any frequency (for example in the Ultrasonic range), as these technologies have the potential for interference with other electronic

devices within the space (such as electronic white board readers). Acceptable detection technologies include Passive Infrared (PIR), and/or Microphonics technology. Ultrasonic or Microwave based sensing technologies shall not be accepted.

- .6 Sensors shall be available with zero, one, or two integrated Class 1 switching relays, and up to one 0-10 VDC dimming output. Sensors shall be capable of switching 120 / 277 / 347 VAC. Load ratings shall be 800 W @ 120 VAC, 1200 W @ 277 VAC, 1500 W @ 347 VAC, and ¼ HP motor. Relays shall be dry contacts.
- .7 Sensors shall be available with one or two occupancy “poles”, each of which provides a programmable time delay.
- .8 Sensors shall be available in multiple lens options which are customized for specific applications.
- .9 Communication and Class 2 low voltage power shall be delivered to each device via standard CAT-5e low voltage cabling with RJ-45 connectors.
- .10 All sensors shall have two RJ-45 ports or capable of utilizing a splitter.
- .11 All sensors shall have the ability to detect when it is not receiving valid communication (via CAT-5e connections) and blink its LED in a pattern to visually indicate of a potential wiring issue
- .12 Every sensor parameter shall be available and configurable remotely from the software and locally via the device push-button.
- .13 Sensors shall be able to function together with other sensors in order to provide expanded coverage areas by simply daisy-chain wiring together the units with CAT-5e cabling.
- .14 Sensors shall be equipped with an automatic override for 100 hour burn-in of lamps. This feature must be available at any time for lamp replacements.
- .15 Wall switch sensors shall recess into single-gang switch box and fit a standard GFI opening.
- .16 Wall switch sensors must meet NEC grounding requirements by providing a dedicated ground connection and grounding to mounting strap. Line and load wire connections shall be interchangeable. Sensor shall not allow current to pass to the load when sensor is in the unoccupied (Off) condition.
- .17 Wall switch sensors shall have optional features for photocell/daylight override, vandal resistant lens, and low temperature/high humidity operation.
- .18 Wall switch sensors shall be available in four standard colors (Ivory, White, Light Almond, Gray)
- .19 Wall switch sensors shall be available with optional raise/lower dimming adjustment controls
- .20 Network system shall have sensors that can be embedded into luminaire such that only the lens shows on luminaire face.
- .21 Embedded sensors shall be capable of both PIR and Dual Technology occupancy detection
- .22 Embedded sensors shall have an optional photocell
- .23 Network system shall also have ceiling, fixture, recessed, & corner mounted sensors available.

- .24 Fixture mount sensors shall be capable of powering themselves via a line power feed.
 - .25 Sensors shall have optional features for photocell/daylight override, dimming control, and low temperature/high humidity operation.
 - .26 Sensors with dimming can control 0 to 10 VDC dimmable ballasts by sinking up to 20 mA of Class 2 current (typically 40 or more ballasts).
 - .27 Embedded sensors shall have an optional photocell and 0-10 VDC dimming output
- .2 Networked System Daylight (Photocell and or Dimming) Sensors
- .1 Photocell shall provide for an on/off set-point, and a deadband to prevent the artificial light from cycling. Delay shall be incorporated into the photocell to prevent rapid response to passing clouds.
 - .2 Photocell and dimming sensor's set-point and deadband shall be automatically calibrated through the sensor's microprocessor by initiating an "Automatic Set-point Programming" procedure. Min and max dim settings as well as set-point may be manually entered.
 - .3 Deadband setting shall be verified and modified by the sensor automatically every time the lights cycle to accommodate physical changes in the space (i.e., furniture layouts, lamp depreciation, or lamp outages).
 - .4 Dimming sensors shall control 0 to 10 VDC dimmable ballasts by sinking up to 20 mA of class 2 current (typically 40 or more ballasts).
 - .5 Photocell and dimming sensors shall be equipped with an automatic override for 100 hour burn-in of lamps. This feature must be available at any time for lamp replacements. (Note: This function should be performed prior to any dimming of the lamps including the "auto set-point" setting.)
 - .6 Combination units that have all features of on/off photocell and dimming sensors shall also be available.
 - .7 A dual zone option shall be available for On/Off Photocell, Automatic Dimming Control Photocell, or Combination units. The second zone shall be capable of being controlled as an "offset" from the primary zone.
 - .8 Line voltage versions of the above described photocell and combination photocell/dimming sensors shall be capable of switching both 120 VAC, 277 VAC, and 347 VAC. Load ratings shall be 800 W @ 120 VAC, 1200 W @ 277 VAC, 1500 W @ 347 VAC, and ¼ HP motor load. Relays shall be dry contacts.
 - .9 Network system shall have dimming photocells that can be embedded into luminaire such that only the lens shows on luminaire face.
- .3 Networked System Power (Relay) Packs
- .1 Power Pack shall incorporate one or more Class 1 relays and contribute low voltage power to the rest of the system. Secondary Packs shall incorporate the relay(s), shall have an optional 2nd relay, 0-10 VDC dimming output, or line voltage dimming output, but shall not be required to contribute system power. Power Supplies shall provide system power only, but are not required to switch line voltage circuit. Auxiliary Relay Packs shall switch low voltage circuits only.

- .2 Power Packs shall accept 347 VAC, be plenum rated, and provide Class 2 power to the system.
- .3 All devices shall have two RJ-45 ports.
- .4 Every Power Pack parameter shall be available and configurable remotely from the software and locally via the device push-button.
- .5 Power Pack shall securely mount to junction location through a threaded ½ inch chase nipple or be capable of being secured within a luminaire ballast channel. Plastic clips into junction box shall not be accepted. All Class 1 wiring shall pass through chase nipple into adjacent junction box without any exposure of wire leads. Note: UL Listing under Energy Management or Industrial Control Equipment automatically meets this requirement, whereas Appliance Control Listing does not meet this safety requirement.
- .6 When required by local code, Power Pack must install inside standard electrical enclosure and provide UL recognized support to junction box. All Class 1 wiring is to pass through chase nipple into adjacent junction box without any exposure of wire leads.
- .7 Power Packs and Power Supplies shall be available that are WiFi enabled.
- .8 Power (Secondary) Packs shall be available that provide up to 16 Amp switching of all lighting load types.
- .9 Power (Secondary) Packs shall be available that provide up to 5 Amps switching of all lighting load types as well as 0-10 VDC dimming or fluorescent ballasts/LED drivers.
- .10 Specific Secondary Packs shall be available that provide up to 5 Amps of switching as well as 0-10 VDC dimming of fluorescent ballasts/LED drivers.
- .11 Specific Secondary Packs shall be available that provide up to 5 Amps of switching and can dim 120 VAC incandescent lighting loads or 120/277 VAC line voltage dimmable fluorescent ballasts (2-wire and 3-wire versions).
- .12 Specific Secondary Packs shall be available that provide up to 5 Amps of switching and can dim 120/277 VAC magnetic low voltage transformers.
- .13 Specific Secondary Packs shall be available that provide up to 4 Amps of switching and can dim 120 VAC electronic low voltage transformers.
- .14 Specific Secondary Packs shall be available that provide up to 5 Amps of switching of dual phase (208/240/480 VAC) lighting loads.
- .15 Specific Secondary Packs shall be available that require a manual switch signal (via a networked Wall Station) in order to close its relay.
- .16 Specific Power/Secondary Packs shall be available that are UL924 listed for switching of Emergency Power circuits.
- .17 Specific Secondary Packs shall be available that control louver/damper motors for skylights.
- .18 Specific Secondary Packs shall be available that provide a pulse on/pulse off signal for purposes of controlling shade systems via relay inputs.
- .4 Networked LED Luminaires
 - .1 Networked LED luminaire shall have a mechanically integrated control device
 - .2 Networked LED luminaire shall have two RJ-45 ports

- .3 Networked LED luminaire shall be able to digitally network directly to other network control devices (sensors, photocells, switches, dimmers)
- .4 Networked LED luminaire shall provide low voltage power to other networked control devices
- .5 System shall be able to turn on/off LED luminaire without using a relay
- .6 System shall be able to maintain constant lumen output over the specified life of the LED luminarie (also called lumen compensation) by varying the input control power (and thus saving up to 20% power usage).
- .7 System shall indicate (via a blink warning) when the LED luminaire has reached its expected life (in hrs).
- .5 Networked System Wall Switches & Dimmers
 - .1 Devices shall recess into single-gang switch box and fit a standard GFI opening.
 - .2 Devices shall be available with zero or one integrated Class 1 switching relay.
 - .3 Communication and low voltage power shall be delivered to each device via standard CAT-5e low voltage cabling with RJ-45 connectors.
 - .4 All sensors shall have two RJ-45 ports.
 - .5 All devices shall provide toggle switch control. Dimming control and low temperature/high humidity operation are available options.
 - .6 Devices shall be available in four colors (Ivory, White, Light Almond, Gray).
 - .7 Devices with dimming control outputs can control 0-10 VDC dimmable ballasts by sinking up to 20 mA of current (typically 40 or more ballasts).
 - .8 Devices with capacitive touch buttons shall provide audible user feedback with different sounds for on/off, raise/lower, start-up, and communication offline.
 - .9 Devices with mechanical push-buttons shall provide tactile and LED user feedback.
 - .10 Devices with mechanical push-buttons shall be made available with custom button labeling
 - .11 Devices with a single on button shall be capable of selecting all possible lighting combinations for a bi-level lighting zone such that the user confusion as to which of two buttons (as is present in multi-button scenarios) controls which load is eliminated.

2.3 LIGHTING CONTROL PROFILES

- .1 Changes to the operation of the system shall be capable of being made in real-time or scheduled via lighting control profiles. These profiles are outlines of settings that direct how a collection of devices function for a defined time period.
- .2 Lighting control profiles shall be capable of being created and applied to a single device, zone of devices, or customized group of zones.
- .3 All relays and dimming outputs shall be capable of being scheduled to track or ignore information regarding occupancy, daylight, and local user switches via lighting control profiles.
- .4 Every device parameter (e.g. sensor time delay and photocell set-point) shall be configurable via a lighting control profile.

- .5 All lighting control profiles shall be stored on the network control gateway device and on the software's host server.
- .6 Lighting control profiles shall be capable of being scheduled to run according to the following calendar options: start date/hour/minute, end date/hour/minute, and sunrise/sunset +/- timed offsets.
- .7 Sunrise/sunset times shall be automatically derived from location information using an astronomical clock.
- .8 Daylight savings time adjustments shall be capable of being performed automatically, if desired.
- .9 Lighting control profile schedules shall be capable of being given the following recurrence settings: daily, weekday, weekend, weekly, monthly, and yearly.

2.4 START-UP & SUPPORT FEATURES

- .1 To facilitate start-up, all devices daisy-chained together (using CAT-5e) shall automatically be grouped together into a functional lighting control zone.
- .2 All lighting control zones shall be able to function according to default settings once adequate power is applied and before any system software is installed.
- .3 Once software is installed, system shall be able to auto-discover all system devices without requiring any commissioning.
- .4 All system devices shall be capable of being given user defined names.
- .5 All devices within the network shall be able to have their firmware reprogrammed remotely and without being physically uninstalled for purposes of upgrading functionality at a later date.
- .6 All sensor devices shall have the ability to detect improper communication wiring and blink its LED in a specific cadence as to alert installation/startup personnel.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 ASTM International
 - .1 ASTM B317/B317M-07, Standard Specification for Aluminum-Alloy Extruded Bar, Rod, Tube, Pipe, Structural Profiles and Profiles for Electrical Purposes (Bus Conductor).

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for indoor service poles and include product characteristics, performance criteria, physical size, finish and limitations.

1.3 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for indoor service poles for incorporation into manual.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect indoor service poles from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

Part 2 Products

2.1 INDOOR SERVICE POLES

- .1 Indoor service poles: extruded aluminum sections to ASTM B317/B317M.
- .2 Nominal length of poles: 2.765 m from floor to ceiling, with plus or minus 50 mm adjustment. Total adjustment: 100mm.
- .3 Service poles approximately 50mm square with snap-on covers to provide access to wiring without removing unit. Barrier to isolate power from communication systems.

- .4 Include fastening accessories at top of pole to secure to inverted T-Bar ceiling using set screws to permit relocation.
 - .1 Flange at ceiling to conceal wiring.
- .5 Metal sleeve at bottom of pole to conceal vertical adjustment.
 - .1 Include removable grip-tight devices for carpet and tile floors to prevent movement of poles.
- .6 Service poles with two prewired duplex receptacles, two knockout holes for communication.
 - .1 3TW No.12 AWG leads terminating in utility box with cover, mounted at top of pole.

Part 3 Execution

3.1 INSTALLATION

- .1 Install service poles as indicated.
- .2 Install service poles in accordance with manufacturer's recommendations. Secure to ceiling and to finished floor.
 - .1 Adjust length as required.
 - .2 Make power connections in utility box at top of pole.
- .3 Re-adjust service poles as required after telephone cables are installed.

3.2 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

3.3 PROTECTION

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by indoor service poles installation.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 CSA International
 - .1 CSA C22.2 No.42-10, General Use Receptacles, Attachment Plugs and Similar Devices.
 - .2 CAN/CSA C22.2 No.42.1-00(R2009), Cover Plates for Flush-Mounted Wiring Devices (Bi-national standard, with UL 514D).
 - .3 CSA C22.2 No.55-M1986(R2008), Special Use Switches.
 - .4 CSA C22.2 No.111-10, General-Use Snap Switches (Bi-national standard, with UL 20).

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for wiring devices and include product characteristics, performance criteria, physical size, finish and limitations.

1.3 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect wiring devices from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

Part 2 Products

2.1 SWITCHES

- .1 15 A, 120 V, single pole, double pole, three-way, four-way switches to: CSA C22.2 No.55
- .2 Manually-operated general purpose AC switches with following features:
 - .1 Terminal holes approved for No. 10 AWG wire.
 - .2 Silver alloy contacts.
 - .3 Urea or melamine moulding for parts subject to carbon tracking.

- .4 Suitable for back and side wiring.
- .5 White toggle.
- .3 Switches of one manufacturer throughout project.

2.2 OCCUPANCY SENSORS

- .1 15 A, 120 V, single pole
- .2 Mount: Ceiling or wall as noted on drawings.
- .3 Sensing technologies: Dual technology, equipped with both
 - .1 Passive infrared sensing
 - .2 Ultrasonic sensing
- .4 Sensitivity: adjustable
- .5 Automatic off: Adjustable from 5-30 minutes.
- .6 Occupancy Sensors of one manufacturer throughout project.

2.3 RECEPTACLES

- .1 Duplex receptacles with following features:
 - .1 Configuration: Type as specified and indicated.
 - .1 General: CSA type 5-15 R, 125 V, 15 A, U ground, to: CSA C22.2 No.42
 - .2 20A: CSA type 5-20R, 125V, 20 A, U ground to CSA C22.2 No. 42.
 - .3 GFCI: Duplex receptacle with integral ground fault circuit interrupter to meet regulatory requirements complete with steady-on “Green-Power-On” and steady-on “Red-Power-Tripped Off” LED indicator lights.
 - .2 Specification grade.
 - .3 White urea moulded housing.
 - .4 Suitable for No. 10 AWG for back and side wiring.
 - .5 Break-off links for use as split receptacles.
 - .6 Eight back wired entrances, four side wiring screws.
 - .7 Triple wipe contacts and rivetted grounding contacts.
- .2 Other receptacles with ampacity and voltage as indicated.
- .3 Receptacles of one manufacturer throughout project.

2.4 COVER PLATES

- .1 Cover plates for wiring devices to: CSA C22.2 No.42.1.
- .2 Sheet steel utility box cover for wiring devices installed in surface-mounted utility boxes.
- .3 Stainless steel, 1 mm thick cover plates for wiring devices mounted in flush-mounted outlet box.

2.5 SOURCE QUALITY CONTROL

- .1 Cover plates from one manufacturer throughout project.

Part 3 Execution

3.1 INSTALLATION

- .1 Receptacles:
 - .1 Install receptacles in gang type outlet box when more than one receptacle is required in one location.
 - .2 Mount receptacles at height in accordance with Section 26 05 00 - Common Work Results for Electrical.
 - .3 Install GFI type receptacles as indicated.
 - .4 Do not install devices back-to-back in wall.
- .2 Cover plates:
 - .1 Install suitable common cover plates where wiring devices are grouped.
 - .2 Do not use cover plates meant for flush outlet boxes on surface-mounted boxes.
- .3 Label:
 - .1 Label all electrical devices with its circuit number.

3.2 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

3.3 PROTECTION

- .1 Protect installed products and components from damage during construction.
- .2 Protect stainless steel cover plate finish with paper or plastic film until painting and other work is finished.
- .3 Repair damage to adjacent materials caused by wiring device installation.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 American National Standards Institute (ANSI)
 - .1 ANSI C82.1-04, Lamp Ballasts-Line Frequency Fluorescent Lamp Ballast.
 - .2 ANSI C82.4-02(R2007), Ballasts for High-Intensity-Discharge and Low-Pressure Sodium Lamps Multi Supply Type.
- .2 American National Standards Institute/Institute of Electrical and Electronics Engineers (ANSI/IEEE)
 - .1 ANSI/IEEE C62.41-1991, Recommended Practice for Surge Voltages in Low-Voltage AC Power Circuits.
- .3 ASTM International Inc.
 - .1 ASTM F1137-00(2006), Standard Specification for Phosphate/Oil and Phosphate/Organic Corrosion Protective Coatings for Fasteners.
- .4 Canadian Standards Association (CSA International)
- .5 Underwriters' Laboratories of Canada (ULC)

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Provide manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.

1.3 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .3 Divert unused metal materials from landfill to metal recycling facility.
- .4 Disposal and recycling of fluorescent lamps as per local regulations.
- .5 Disposal of old PCB filled ballasts.

Part 2 Products

2.1 LED LUMINAIRES AND DRIVERS

- .1 All Luminaires

- .1 Comply with IES LM-79-08 Approved Method for measuring lumen maintenance of LED light sources.
- .2 Comply with IES LM-80-08 Approved Method for electrical and photometric measurement of SSL product.
- .3 LED's shall be Restriction of Hazardous Substances Directive (RoHS) compliant.
- .4 LED arrays shall be sealed, high performance, long life type; minimum 70% rated output at 50,000 hours.
- .5 LED luminaires shall deliver a minimum of 60 lumens per watt.
 - .1 LED's shall be "Bin No. 1" quality.
- .6 Drivers shall be solid state and accept 347VAC at 60 Hz input.
- .7 The LED light source shall be fully dimmable with use of compatible dimmers switch designated for low voltage loads.
- .8 LED color temperatures: CRI 85, 3500K as noted +/- 275K.
- .9 Luminaires shall have internal thermal protection.
- .10 Luminaires shall not draw power in the off state. Luminaires with integral occupancy, motion, photo-controls, or individually addressable luminaires with external control and intelligence are exempt from this requirement. The power draw for such luminaires shall not exceed 0.5 watts when in the off state.
- .11 Color spatial uniformity shall be within .004 of CIE 1976 diagram.
- .12 Color maintenance over rated life shall be within .007 of CIE 1976.
- .13 Indoor luminaires shall have a minimum CRI of 85.
- .14 Luminaire manufacturers shall adhere to device manufacturer guidelines, certification programs, and test procedures for thermal management
- .15 LED package(s)/module(s)/array(s) used in qualified luminaires shall deliver a minimum 70% of initial lumens, when installed in-situ, for a minimum of 50,000 hours.
- .16 Luminaires shall be fully accessible from below ceiling plane for changing drivers, power supplies and arrays.
- .2 Power Supplies and Drivers
 - .1 MB Hydro Powersmart approved.
 - .2 Power Factor: 0.90 or higher
 - .3 Maximum driver case temperature not to exceed driver manufacturer recommended in-situ operation.
 - .4 Output operating frequency: 60Hz.
 - .5 Interference: EMI and RFI compliant with FCC 47 CFR Part 15.
 - .6 Total Harmonic Distortion Rating: 20% Maximum.
 - .7 Meet electrical and thermal conditions as described in LM-80 Section 5.0.
 - .8 Primary Current: Confirm primary current with Drawings.
 - .9 Secondary Current: Confirm secondary current specified by individual luminaire manufacturers.
 - .10 Compatibility: Certified by manufacturer for use with individually specified luminaire and individually specified control components.

- .11 Solid-state control components to be integral or external per each specified luminaire. Remote control gear to be enclosed in Class 1, Class 2, or NEMA 3R enclosures as required.
 - .3 Controller and Control System
 - .1 System electronics driver / controller to use coordinated communication protocols: DMX512, 0-10V, DALI, or proprietary as required.
 - .2 The Contractor to ensure that external control equipment is compatible with LED control requirements
 - .3 Provide connector types and wiring as appropriate for un-interrupted communication between devices, considering distance maximums, field obstructions, and accessibility. Ensure that connection points are optically isolated for system noise reduction.
 - .4 Compatibility: Certified by manufacturer for use with individually specified luminaire and individually specified power supplies and/or drivers.
 - .4 Refer to section 26 09 23 for details regarding networked lighting control system and networked luminaires.
- 2.2 FINISHES**
 - .1 Light fixture finish and construction to meet ULC listings and CSA certifications related to intended installation.
- 2.3 LUMINAIRES**
 - .1 As indicated in drawing schedules.
- Part 3 Execution**
 - 3.1 INSTALLATION**
 - .1 Locate, relocate, and install luminaires as indicated.
 - .2 Provide adequate support to suit ceiling system.
 - 3.2 WIRING**
 - .1 Connect luminaires to lighting circuits:
 - .1 Install flexible or rigid conduit for luminaires as indicated.
 - 3.3 LUMINAIRE SUPPORTS**
 - .1 For suspended ceiling installations support luminaires from ceiling grid in accordance with local inspection requirements.
 - 3.4 LUMINAIRE ALIGNMENT**
 - .1 Align luminaires mounted in continuous rows to form straight uninterrupted line.
 - .2 Align luminaires mounted individually parallel or perpendicular to building grid lines.

3.5 CLEANING

- .1 Clean in accordance with Section 01 74 11 - Cleaning.
- .1 Remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION