

PART 1 - GENERAL**1.1 RELATED REQUIREMENTS**

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 35 29.06 - Health and Safety Requirements.
- .3 Section 01 45 00 - Quality Control.
- .4 Section 01 61 00 - Common Product Requirements.
- .5 Section 26 05 32 - Outlet Boxes, Conduit Boxes and Fittings.
- .6 Section 28 31 00.01 - Multiplex Fire Alarm System.

1.2 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CSA C22.1-15, Canadian Electrical Code, Part 1 (23rd Edition), Safety for Standard Electrical Installations.
 - .2 CAN/CSA C22.3 No. 1-15, Overhead Systems.
 - .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.

1.3 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.

1.4 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 and labels for control items in English and French.
- .4 Use one nameplate or label for each language.

1.5 ACTION AND
INFORMATIONAL
SUBMITTALS

- .1 Submittals: 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 Ontario, 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 copies of 600 x 600 mm minimum size drawings and product data to authority having jurisdiction.
 - .6 If changes are required, notify Departmental Representative of these changes before they are made.
- .3 Quality Control: in accordance with Section 01 45 00 - Quality Control.
 - .1 Provide CSA certified equipment and material.
 - .2 Where CSA certified equipment and material is not available, submit such equipment and material to authority having jurisdiction for special 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.

1.6 QUALITY
ASSURANCE

- .1 Quality Assurance: in accordance with Section 01 45 00 - Quality Control.
- .2 Qualifications: electrical Work to be carried out by qualified, licensed electricians who hold valid Master Electrical Contractor license or apprentices in accordance with authorities having jurisdiction as per the conditions of Provincial Act respecting manpower vocational training and qualification.
 - .1 Employees registered in provincial apprentices program: permitted, under direct supervision of qualified licensed electrician, to perform specific tasks.
 - .2 Permitted activities: determined based on training level attained and demonstration of ability to perform specific duties.
- .3 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

1.7 DELIVERY,
STORAGE AND
HANDLING

- .1 Material Delivery Schedule: provide Departmental Representative with schedule within 2 weeks after award of Contract.
- .2 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling.

1.8 SYSTEM STARTUP

- .1 Instruct Departmental Representative and operating personnel in operation, care and maintenance of systems, system equipment and components.
- .2 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.

PART 2 - PRODUCTS2.1 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 authority having jurisdiction before delivery to site and submit such approval as described in PART 1 - SUBMITTALS.
- .3 Factory assemble control panels and component assemblies.

2.2 ELECTRIC MOTORS, EQUIPMENT AND CONTROLS

- .1 Verify installation and co-ordination responsibilities related to motors, equipment and controls, as indicated.

2.3 WIRING TERMINATIONS

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

2.4 EQUIPMENT IDENTIFICATION

- .1 Identify electrical equipment with nameplates and labels as follows:
 - .1 Nameplates: lamiconid 3 mm thick plastic engraving sheet, black face, white core, lettering accurately aligned and engraved into core.
 - .2 Nameplates for emergency power and life safety systems shall be red with white lettering.
 - .3 All labels and nameplates shall be bilingual (English and French).
 - .4 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.

2.4 EQUIPMENT
IDENTIFICATION
(Cont'd)

- .3 Wording on nameplates and labels to be approved by Departmental Representative prior to manufacture.
- .4 Allow for minimum of twenty-five (25) letters per nameplate and label.
- .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.
- .9 Transformers: indicate capacity, primary and secondary voltages.

2.5 WIRING
IDENTIFICATION

- .1 Identify wiring with permanent indelible identifying markings, numbered coloured plastic tapes, 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.

2.6 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, 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
Telephone	Green	
Other	Green	Blue
Communication Systems		
Fire Alarm	Red	
Other	Red	Yellow
Security Systems		

2.7 FINISHES

- .1 Shop finish metal enclosure surfaces by application of rust resistant primer inside and outside, and at least two coats of finish enamel.
 - .1 Paint outdoor electrical equipment "equipment green" finish.

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| 2.7 FINISHES
(Cont'd) | .1 | (Cont'd) |
| | .2 | Paint indoor switchgear and distribution enclosures light gray. |

PART 3 - EXECUTION

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| 3.1 INSTALLATION | .1 | Do complete installation in accordance with CSA C22.1 except where specified otherwise. |
| 3.2 NAMEPLATES AND LABELS | .1 | Ensure manufacturer's nameplates, CSA labels and identification nameplates are visible and legible after equipment is installed. |
| 3.3 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. |
| 3.4 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: 1100 mm. |
| | .2 | Wall receptacles: |
| | .1 | General: 400 mm. |
| | .2 | Above top of counters or counter splash backs: 175 mm. |
| | .3 | Panelboards: as required by Code or as indicated. |
| | .4 | Telephone and interphone outlets: 400 mm. |
| | .5 | Wall mounted telephone and interphone outlets: 1100 mm. |
| | .6 | Fire alarm stations: 1200 mm. |
| | .7 | Fire alarm bells: 2300 mm. |
| 3.5 CO-ORDINATION OF PROTECTIVE DEVICES | .1 | Ensure circuit protective devices such as overcurrent trips, relays and fuses are installed to required values and settings. |

3.6 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 - 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 generation and 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 system.
 - .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.

3.7 CLEANING

- .1 Clean and touch up surfaces of shop-painted equipment scratched or marred during shipment or installation, to match original paint.
- .2 Clean and prime exposed non-galvanized hangers, racks and fastenings to prevent rusting.

3.8 DEMOLITION

- .1 For communications outlets to be removed, coil existing cables in the ceiling space for removal by the Departmental Representative.
- .2 Maintain existing remaining circuits, systems, etc. which pass through the area of construction and in close proximity. Provide necessary components to maintain systems. Ensure components will be concealed when construction is complete.

END OF SECTION

PART 1 - GENERAL

<u>1.1 RELATED REQUIREMENTS</u>	.1	Section 01 33 00 - Submittal Procedures.
	.2	Section 01 61 00 - Common Product Requirements.
	.3	Section 01 74 11 - Cleaning.
	.4	Section 01 78 00 - Closeout Submittals.
<u>1.2 REFERENCES</u>	.1	Canadian Standards Association (CSA International) .1 CAN/CSA C22.2 No. 65-13, Wire Connectors (Tri-National Standard with UL 486A-486B and NMX-J-543-ANCE).
	.2	National Electrical Manufacturers Association (NEMA)
<u>1.3 ACTION AND INFORMATIONAL SUBMITTALS</u>	.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 wire and box connectors and include product characteristics, performance criteria, physical size, finish and limitations.
<u>1.4 CLOSEOUT SUBMITTALS</u>	.1	Submit in accordance with Section 01 78 00 - Closeout Submittals.
	.2	Operation and Maintenance Data: submit operation and maintenance data for wire and box connectors for incorporation into manual.
<u>1.5 DELIVERY, STORAGE AND HANDLING</u>	.1	Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
	.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 in dry location 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.
	.4	Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, and packaging materials as specified in Construction Waste Management Plan.

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 Bushing stud connectors: to NEMA to consist of:
 - .1 Connector body and stud clamp for copper conductors.
 - .2 Clamp for copper conductors.
 - .3 Stud clamp bolts.
 - .4 Bolts for copper conductors.
 - .5 Sized for conductors as indicated.

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 wire and box connectors 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 and after receipt of written approval to proceed from Departmental Representative.
- 3.2 INSTALLATION**
- .1 Remove insulation carefully from ends of conductors and cables and:
 - .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.
 - .4 Install bushing stud connectors in accordance with NEMA.
- 3.3 CLEANING**
- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - 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 00 - Cleaning.

3.3 CLEANING
(Cont'd)

- .3 Waste Management: separate waste materials for reuse and recycling.
- .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

PART 1 - GENERAL

<u>1.1 RELATED REQUIREMENTS</u>	.1	Section 01 33 00 - Submittal Procedures.
	.2	Section 26 05 00 - Common Work Results for Electrical.
	.3	Section 26 05 20 - Wire and Box Connectors - (0-1000 V).
	.4	Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.
<u>1.2 PRODUCT DATA</u>	.1	Provide product data in accordance with Section 01 33 00 - Submittal Procedures.
<u>1.3 DELIVERY, STORAGE AND HANDLING</u>	.1	Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding and packaging materials.

PART 2 - PRODUCTS

<u>2.1 BUILDING WIRES</u>	.1	Conductors: stranded for 10 AWG and larger. Minimum size: 12 AWG.
	.2	Copper conductors: size as indicated, with 1000 V insulation of cross-linked thermosetting polyethylene material rated RW90 XLPE.
<u>2.2 ARMOURED CABLES</u>	.1	Conductors: insulated, copper, size as indicated.
	.2	Type: AC 90.
	.3	Armour: interlocking type fabricated from aluminum strips.
	.4	Connectors: anti short connectors.
	.5	AC 90 (BX) may be used in removable ceilings and metal partition walls, maximum length 3 metres.

PART 3 - EXECUTION

<u>3.1 FIELD QUALITY CONTROL</u>	.1	Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.
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<u>3.1 FIELD QUALITY CONTROL</u> (Cont'd)	.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.
<u>3.2 GENERAL CABLE INSTALLATION</u>	.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 shall 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.
<u>3.3 INSTALLATION OF BUILDING WIRES</u>	.1	Install wiring as follows:
	.1	In conduit systems in accordance with Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.

END OF SECTION

PART 1 - GENERAL

<u>1.1 RELATED REQUIREMENTS</u>	.1	Section 01 33 00 - Submittal Procedures.
	.2	Section 01 61 00 - Common Product Requirements
	.3	Section 01 74 00 - Cleaning.
	.4	Section 01 78 00 - Closeout Submittals.
	.5	Section 26 05 00 - Common Work Results for Electrical.
<u>1.2 ACTION AND INFORMATIONAL SUBMITTALS</u>	.1	Submit in accordance with Section 01 33 00 - Submittal Procedures.
	.2	Product Data: <ul style="list-style-type: none">.1 Submit manufacturer's instructions, printed product literature and data sheets for grounding equipment and include product characteristics, performance criteria, physical size, finish and limitations.
<u>1.3 CLOSEOUT SUBMITTALS</u>	.1	Submit in accordance with Section 01 78 00 - Closeout Submittals.
	.2	Operation and Maintenance Data: submit operation and maintenance data for grounding equipment for incorporation into manual.
<u>1.4 DELIVERY, STORAGE AND HANDLING</u>	.1	Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
	.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: <ul style="list-style-type: none">.1 Store materials in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area..2 Store and protect grounding equipment from nicks, scratches, and blemishes..3 Replace defective or damaged materials with new.
	.4	Develop Construction Waste Management Plan related to Work of this Section.
	.5	Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, and packaging materials as specified in Construction Waste Management Plan.

PART 2 - PRODUCTS

- 2.1 EQUIPMENT**
- .1 Grounding conductors: bare stranded copper, tinned, soft annealed, size as required.
 - .2 Insulated grounding conductors: green, copper conductors, size as required.
 - .3 Ground bus: copper, size as indicated, complete with insulated supports, fastenings, connectors.
 - .4 Non-corroding accessories necessary for grounding system, type, size, material as indicated, including but not necessarily limited to:
 - .1 Grounding and bonding bushings.
 - .2 Bolted type conductor connectors.
 - .3 Bonding jumpers, straps.
 - .4 Pressure wire 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 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 and after receipt of written approval to proceed from Departmental Representative.
- 3.2 INSTALLATION GENERAL**
- .1 Install permanent, continuous grounding system including, conductors, connectors, accessories. Where EMT is used, run ground wire in conduit.
 - .2 Install connectors in accordance with manufacturer's instructions.
 - .3 Protect exposed grounding conductors from mechanical injury.
 - .4 Use mechanical connectors for grounding connections to equipment provided with lugs.
 - .5 Soldered joints not permitted.
 - .6 Make grounding connections in radial configuration only, with connections terminating at single grounding point. Avoid loop connections.

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| <u>3.3 EQUIPMENT
GROUNDING</u> | .1 | Install grounding connections to typical equipment included in, but not necessarily limited to following list. Service equipment, transformers, frames of motors, starters, control panels, distribution panels. |
| <u>3.4 GROUNDING BUS</u> | .1 | Install copper grounding bus mounted on insulated supports on wall of room. |
| | .2 | Ground items of electrical equipment to ground bus with individual bare stranded copper connections size #6 AWG. |
| <u>3.5 FIELD QUALITY
CONTROL</u> | .1 | Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical. |
| <u>3.6 CLEANING</u> | .1 | Progress Cleaning: clean in accordance with Section 01 74 00 - 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 00 - Cleaning. |
| | .3 | Waste Management: separate waste materials for reuse and recycling.
.1 Remove recycling containers and bins from site and dispose of materials at appropriate facility. |

END OF SECTION

PART 1 - GENERAL

<u>1.1 RELATED REQUIREMENTS</u>	.1	Section 01 33 00 - Submittal Procedures.
	.2	Section 01 61 00 - Common Product Requirements.
<u>1.2 REFERENCES</u>	.1	Canadian Standards Association (CSA International)
	.1	CSA C22.1-15, Canadian Electrical Code, Part 1, 23rd Edition.
<u>1.3 ACTION AND INFORMATIONAL SUBMITTALS</u>	.1	Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
<u>1.4 DELIVERY, STORAGE AND HANDLING</u>	.1	Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.
	.2	Waste Management and Disposal:
	.1	Separate waste materials for reuse and recycling.

PART 2 - PRODUCTS

<u>2.1 OUTLET AND CONDUIT BOXES GENERAL</u>	.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.
<u>2.2 GALVANIZED STEEL OUTLET BOXES</u>	.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.

<u>2.2 GALVANIZED STEEL OUTLET BOXES (Cont'd)</u>	.5	Extension and plaster rings for flush mounting devices in finished plaster, tile walls.
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<u>2.3 CONDUIT BOXES</u>	.1	Cast FS boxes with factory-threaded hubs and mounting feet for surface wiring of devices.
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<u>2.4 FITTINGS - GENERAL</u>	.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 35 mm and pull boxes for larger conduits.
	.4	Double locknuts and insulated bushings on sheet metal boxes.

PART 3 - EXECUTION

<u>3.1 INSTALLATION</u>	.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

<u>1.1 RELATED REQUIREMENTS</u>	.1	Section 01 33 00 - Submittal Procedures.
	.2	Section 01 74 00 - Cleaning.
<u>1.2 REFERENCES</u>	.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. 56-13, Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit.
	.3	CSA C22.2 No. 83-M1985 (R2008), Electrical Metallic Tubing.
<u>1.3 ACTION AND INFORMATIONAL SUBMITTALS</u>	.1	Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
	.2	Product data: submit manufacturer's printed product literature, specifications and datasheets.
	.1	Submit cable manufacturing data.
	.3	Quality assurance submittals:
	.1	Test reports: submit certified test reports.
	.2	Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
	.3	Instructions: submit manufacturer's installation instructions.
<u>1.4 WASTE MANAGEMENT AND DISPOSAL</u>	.1	Separate waste materials for reuse and recycling.
	.2	Place materials defined as hazardous or toxic waste in designated containers.
	.3	Ensure emptied containers are sealed and stored safely for disposal away from children.

PART 2 - PRODUCTS

<u>2.1 CONDUITS</u>	.1	Electrical metallic tubing (EMT): to CSA C22.2 No. 83, with couplings.
	.2	Flexible metal conduit: to CSA C22.2 No. 56, steel.
<u>2.2 CONDUIT FASTENINGS</u>	.1	One hole steel straps to secure surface conduits 50 mm and smaller.
	.1	Two hole steel straps for conduits larger than 50 mm.

2.2 CONDUIT FASTENINGS (Cont'd)

- .2 Beam clamps to secure conduits to exposed steel work.
- .3 Channel type supports for two or more conduits at 1.5 m 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 Steel set-screw couplings and connectors for EMT. All couplings associated with fire alarm conduits shall be red. All couplings associated with Public Address System shall be green.

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 and in unfinished areas.
- .3 Use electrical metallic tubing (EMT) except in cast concrete.
- .4 Use liquid tight flexible metal conduit for connection to motors or vibrating equipment in damp, wet or corrosive locations.
- .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 and provide nylon bushings at both ends.

3.2 INSTALLATION
(Cont'd)

- .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 surface 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.

3.5 CLEANING

- .1 Proceed in accordance with Section 01 74 00 - 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

<u>1.1 RELATED REQUIREMENTS</u>	.1	Section 01 33 00 - Submittal Procedures.
	.2	Section 01 61 00 - Common Product Requirements.
	.3	Section 01 74 00 - Cleaning.
	.4	Section 01 78 00 - Closeout Submittals.
	.5	Section 26 05 00 - Common Work Results for Electrical.
	.6	Section 26 28 16.02 - Moulded Case Circuit Breakers.
<u>1.2 REFERENCES</u>	.1	Canadian Standards Association (CSA International)
	.1	CSA C22.2 No. 29-2015, Panelboards and Enclosed Panelboards.
<u>1.3 ACTION AND INFORMATIONAL SUBMITTALS</u>	.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 panelboards and include product characteristics, performance criteria, physical size, finish and limitations.
	.3	Shop Drawings:
	.1	Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.
<u>1.4 CLOSEOUT SUBMITTALS</u>	.2	Include on drawings:
	.1	Electrical detail of panel, branch breaker type, quantity, ampacity and enclosure dimension.
	.1	Submit in accordance with Section 01 78 00 - Closeout Submittals.
<u>1.5 DELIVERY, STORAGE AND HANDLING</u>	.2	Operation and Maintenance Data: submit operation and maintenance data for panelboards for incorporation into manual.
	.1	Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
	.2	Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

1.5 DELIVERY,
STORAGE AND
HANDLING
(Cont'd)

- .3 Storage and Handling Requirements:
 - .1 Store materials in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect panelboards from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, and packaging materials as specified in Construction Waste Management Plan.

PART 2 - PRODUCTS2.1 PANELBOARDS

- .1 Panelboards: to CSA C22.2 No. 29 and product of one manufacturer.
 - .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.
- .2 250 V and 600 V panelboards: bus and breakers rated for 10 kA and 14 kA (symmetrical) interrupting capacity respectively.
- .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 and phase.
- .4 Panelboards: mains, number of circuits, and number and size of branch circuit breakers as indicated.
- .5 Minimum of 2 flush locks for each panel board.
- .6 Two keys for each panelboard and key panelboards alike.
- .7 Copper bus with neutral of same ampere rating of mains.
- .8 Mains: suitable for bolt-on breakers.
- .9 Trim with concealed front bolts and hinges.
- .10 Trim and door finish: baked enamel.
- .11 Include grounding busbar with 3 of terminals for bonding conductor equal to breaker capacity of the panel board.
- .12 Sprinklerproof drip shield.

2.2 BREAKERS

- .1 Breakers: to Section 26 28 16.02 - Moulded Case Circuit Breakers.
- .2 Breakers with thermal and magnetic tripping in panelboards except as indicated otherwise.

<u>2.2 BREAKERS (Cont'd)</u>	.3	Provide manufacturer's certificate of authenticity for all new breakers.
	.4	Circuit breakers to have minimum symmetrical rms interrupting capacity rating as per short circuit study.
<u>2.3 EQUIPMENT IDENTIFICATION</u>	.1	Provide equipment identification in accordance with Section 26 05 00 - Common Work Results for Electrical.
	.2	Nameplate for each panelboard size 4 engraved as indicated.
	.3	Nameplate for each circuit in distribution panelboards size 2 engraved as indicated.
	.4	Complete circuit directory with typewritten legend showing location and load of each circuit, mounted in plastic envelope at inside of panel door.

PART 3 - EXECUTION

<u>3.1 EXAMINATION</u>	.1	Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for panelboards 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 and after receipt of written approval to proceed from Departmental Representative.
<u>3.2 INSTALLATION</u>	.1	Locate panelboards as indicated and mount securely, plumb, true and square, to adjoining surfaces.
	.2	Install surface mounted panelboards on plywood backboards. Where practical, group panelboards on common backboard.
	.3	Mount panelboards to height specified in Section 26 05 00 - Common Work Results for Electrical or as indicated.
	.4	Connect loads to circuits.
	.5	Connect neutral conductors to common neutral bus with respective neutral identified.
<u>3.3 CLEANING</u>	.1	Progress Cleaning: clean in accordance with Section 01 74 00 - 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 00 - Cleaning.

3.3 CLEANING

(Cont'd)

- .3 Waste Management: separate waste materials for reuse and recycling.
- .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.4 PROTECTION

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

END OF SECTION

PART 1 - GENERAL

<u>1.1 RELATED REQUIREMENTS</u>	.1	Section 01 33 00 - Submittal Procedures.
	.2	Section 01 61 00 - Common Product Requirements.
	.3	Section 01 74 00 - Cleaning.
	.4	Section 01 78 00 - Closeout Submittals.
	.5	Section 26 05 00 - Common Work Results for Electrical
<u>1.2 REFERENCES</u>	.1	Canadian Standards Association (CSA International)
	.1	CSA C22.2 No. 42-10 (R2015), General Use Receptacles, Attachment Plugs and Similar Devices.
	.2	CAN/CSA C22.2 No. 42.1-13, Cover Plates for Flush-Mounted Wiring Devices (Bi-national standard, with UL 514D).
	.3	CSA C22.2 No. 55-15, Special Use Switches.
	.4	CSA C22.2 No. 111-10 (R2015), General-Use Snap Switches (Bi-national standard, with UL 20).
<u>1.3 ACTION AND INFORMATIONAL SUBMITTALS</u>	.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.
	.3	Shop Drawings:
	.1	Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.
<u>1.4 CLOSEOUT SUBMITTALS</u>	.1	Submit in accordance with Section 01 78 00 - Closeout Submittals.
	.2	Operation and Maintenance Data: submit operation and maintenance data for wiring devices for incorporation into manual.
<u>1.5 DELIVERY, STORAGE AND HANDLING</u>	.1	Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
	.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:

1.5 DELIVERY,
STORAGE AND
HANDLING
(Cont'd)

- .3 (Cont'd)
 - .1 Store materials in dry location 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.
- .4 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, and packaging materials as specified in Construction Waste Management Plan.

PART 2 - PRODUCTS2.1 SWITCHES

- .1 20 A, 120 V, single pole, switches to: CSA C22.2 No. 55 and ANSI/CSA C22.2 No. 111.
- .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 Toggle operated fully rated for tungsten filament and fluorescent lamps, and up to 80% of rated capacity of motor loads and or heating loads.
- .4 Switches of one manufacturer throughout project.

2.2 RECEPTACLES

- .1 Duplex receptacles, CSA type 5-15 R, CSA type 5-20RA, 125 V, 15 A, 10A,U ground, to: CSA C22.2 No. 42 with following features:
 - .1 White urea moulded housing.
 - .2 Suitable for No. 10 AWG for back and side wiring.
 - .3 Break-off links for use as split receptacles.
 - .4 Eight back wired entrances, four side wiring screws.
 - .5 Triple wipe contacts and riveted grounding contacts.
- .2 Single receptacles CSA type 6-15 R, 250 V, 15 A, U ground with following features:
 - .1 White urea moulded housing.
 - .2 Suitable for No. 10 AWG for back and side wiring.
 - .3 Four back wired entrances, 2 side wiring screws.
- .3 Other receptacles with ampacity and voltage as indicated.
- .4 Receptacles of one manufacturer throughout project.

2.3 COVER PLATES

- .1 Cover plates for wiring devices to: CSA C22.2 No. 42.1.

<u>2.3 COVER PLATES (Cont'd)</u>	.2	Sheet steel utility box cover for wiring devices installed in surface-mounted utility boxes.
	.3	Stainless steel, cover plates for wiring devices mounted in flush-mounted outlet box.
	.4	Cast cover plates for wiring devices mounted in surface-mounted FS type conduit boxes.
<u>2.4 GROUND FAULT PROTECTOR UNIT</u>	.1	Self-contained with 15 A, 120 V circuit interrupter and duplex receptacle complete with:
	.1	Solid state ground sensing device.
	.2	Facility for testing and reset.
	.3	CSA Enclosure with stainless steel face plate.
<u>2.5 SOURCE QUALITY CONTROL</u>	.1	Cover plates from one manufacturer throughout project.

PART 3 - EXECUTION

<u>3.1 EXAMINATION</u>	.1	Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for wiring devices 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 and after receipt of written approval to proceed from Departmental Representative.
<u>3.2 INSTALLATION</u>	.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 in accordance with Section 26 05 00 - Common Work Results for Electrical as indicated.
	.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 in accordance with Section 26 05 00 - Common Work Results for Electrical as indicated.
	.3	Install GFI type receptacles as indicated.
	.3	Cover plates:
	.1	Install suitable common cover plates where wiring devices are grouped.

3.2 INSTALLATION(Cont'd)

- .3 (Cont'd)
- .2 Do not use cover plates meant for flush outlet boxes on surface-mounted boxes.
- .3 Provide circuit label on each cover plate.

3.3 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - 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 00 - Cleaning.
- .3 Waste Management: separate waste materials for reuse and recycling.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.4 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

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| <u>1.1 RELATED REQUIREMENTS</u> | .1 | Section 01 33 00 - Submittal Procedures. |
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| <u>1.2 REFERENCES</u> | .1 | Canadian Standards Association (CSA International) |
| | .1 | CSA C22.2 No. 5-16, Moulded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures (Tri-national standard with UL 489, tenth edition, and the second edition of NMX-J-266-ANCE-2016). |
| | | |
| <u>1.3 ACTION AND INFORMATIONAL SUBMITTALS</u> | .1 | Submit product data in accordance with Section 01 33 00 - Submittal Procedures. |
| | | |
| <u>1.4 WASTE MANAGEMENT AND DISPOSAL</u> | .1 | Separate waste materials for reuse and recycling. |
| | .2 | Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan. |
| | .3 | Separate for reuse and recycling and place in designated containers Steel, Metal, Plastic waste in accordance with Waste Management Plan. |

PART 2 - PRODUCTS

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|-----------------------------|----|---|
| <u>2.1 BREAKERS GENERAL</u> | .1 | Moulded-case circuit breakers and Ground-fault circuit-interrupters: to CSA C22.2 No. 5. |
| | .2 | Bolt-on moulded case circuit breaker: quick- make, quick-break type, for manual and automatic operation with temperature compensation for 40 degrees C ambient. |
| | .3 | Common-trip breakers: with single handle for multi-pole applications. |
| | .4 | Magnetic instantaneous trip elements in circuit breakers to operate only when value of current reaches setting. |
| | .1 | Trip settings on breakers with adjustable trips to range from 3-8 times current rating. |
| | .5 | Interrupting Capacity: 10 kAIC for 120/208V breakers, 14 kAIC for 600V breakers. |

- 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 and instantaneous tripping for short circuit protection.

PART 3 - EXECUTION

- 3.1 INSTALLATION .1 Install circuit breakers as indicated.

END OF SECTION

PART 1 - GENERAL

<u>1.1 RELATED REQUIREMENTS</u>	.1	Section 01 33 00 - Submittal Procedures
	.2	Section 01 35 29.06 - Health and Safety Requirements.
	.3	Section 26 05 00 - Common Work Results for Electrical.
<u>1.2 REFERENCES</u>	.1	Canadian Standards Association (CSA International).
<u>1.3 ACTION AND INFORMATIONAL SUBMITTALS</u>	.1	Submit product data in accordance with Section 01 33 00 - Submittal Procedures.
<u>1.4 HEALTH AND SAFETY</u>	.1	Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.
<u>1.5 WASTE MANAGEMENT AND DISPOSAL</u>	.1	Separate waste materials for reuse and recycling.
	.2	Remove from site and dispose of packaging materials at appropriate recycling facilities.
	.3	Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.
	.4	Separate for reuse and recycling and place in designated containers Steel, Metal, Plastic waste in accordance with Waste Management Plan.
	.5	Fold up metal banding, flatten and place in designated area for recycling.

PART 2 - PRODUCTS

<u>2.1 DISCONNECT SWITCHES</u>	.1	Non-fusible, disconnect switch in CSA Enclosure,
	.2	Provision for padlocking in off switch position by three locks.
	.3	Mechanically interlocked door to prevent opening when handle in ON position.
	.4	Quick-make, quick-break action.

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|---|----|--|
| <u>2.1 DISCONNECT SWITCHES</u>
<u>(Cont'd)</u> | .5 | ON-OFF switch position indication on switch enclosure cover. |
| | .6 | Sprinkler proof drip shield. |

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|-------------------------------------|----|--|
| <u>2.2 EQUIPMENT IDENTIFICATION</u> | .1 | Provide equipment identification in accordance with Section 26 05 00 - Common Work Results for Electrical. |
| | .2 | Indicate name of load controlled on size 4 nameplate. |

PART 3 - EXECUTION

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|-------------------------|----|--|
| <u>3.1 INSTALLATION</u> | .1 | Install disconnect switches complete with fuses if applicable. |
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END OF SECTION

PART 1 - GENERAL

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|---|---|
| <u>1.1 RELATED REQUIREMENTS</u> | <ul style="list-style-type: none">.1 Section 01 33 00 - Submittal Procedures..2 Section 01 61 00 - Common Product Requirements..3 Section 01 74 00 - Cleaning..4 Section 01 78 00 - Closeout Submittals..5 Section 26 05 00 - Common Work Results for Electrical. |
| <u>1.2 REFERENCES</u> | <ul style="list-style-type: none">.1 International Electrotechnical Commission (IEC)<ul style="list-style-type: none">.1 IEC 947-4-1-2002, Part 4: Electromechanical contactors and motor-starters. |
| <u>1.3 ACTION AND INFORMATIONAL SUBMITTALS</u> | <ul style="list-style-type: none">.1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures..2 Product Data:<ul style="list-style-type: none">.1 Provide manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations..3 Shop Drawings:<ul style="list-style-type: none">.1 Provide shop drawings: in accordance with Section 01 33 00 - Submittal Procedures.<ul style="list-style-type: none">.1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada..2 Provide shop drawings for each type of starter to indicate:<ul style="list-style-type: none">.1 Mounting method and dimensions..2 Starter size and type..3 Layout and components..4 Enclosure types..5 Wiring diagram..6 Interconnection diagrams. |
| <u>1.4 CLOSEOUT SUBMITTALS</u> | <ul style="list-style-type: none">.1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals..2 Submit operation and maintenance data for each type and style of motor starter for incorporation into maintenance manual..3 Extra Materials:<ul style="list-style-type: none">.1 Provide listed spare parts for each different size and type of starter.<ul style="list-style-type: none">.1 3 contacts, stationary..2 3 contacts, movable..3 1 contacts, auxiliary. |

1.4 CLOSEOUT
SUBMITTALS
(Cont'd)

- .3 (Cont'd)
 - .1 (Cont'd)
 - .4 1 control transformers.
 - .5 1 operating coil.
 - .6 2 fuses.
 - .7 10% indicating lamp bulbs used.

1.5 DELIVERY,
STORAGE AND
HANDLING

- .1 Deliver, store and handle 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 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, and packaging materials.

PART 2 - PRODUCTS2.1 MATERIALS

- .1 Starters: to IEC 947-4 with AC4 utilization category.

2.2 MANUAL MOTOR
STARTERS

- .1 Single phase manual motor starters of size, type, rating, and enclosure type as indicated, 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 oil tight labelled as indicated.
 - .2 Indicating light: heavy duty oil tight type and colour red.
 - .3 Locking tab to permit padlocking in "ON" or "OFF" position.

2.3 FULL VOLTAGE
MAGNETIC STARTERS

- .1 Combination magnetic 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 each phase, manually reset from outside enclosure.
 - .3 Wiring and schematic diagram inside starter enclosure in visible location.
 - .4 Identify each wire and terminal for external connections, within starter, with permanent number marking identical to diagram.
- .2 Combination type starters to include circuit breaker with operating lever on outside of enclosure to control circuit breaker, and provision for:
 - .1 Locking in "OFF" position with up to 3 padlocks.
 - .2 Independent locking of enclosure door.
 - .3 Provision for preventing switching to "ON" position while enclosure door open.

<u>2.3 FULL VOLTAGE MAGNETIC STARTERS (Cont'd)</u>	.3	Accessories:
	.1	Pushbuttons Selector switches: heavy duty oil tight labelled "HAND-OFF-AUTO".
	.2	Indicating lights: heavy duty oil tight type and colour red.
	.3	1-N/O and 1-N/C spare auxiliary contacts unless otherwise indicated.
<u>2.4 FINISHES</u>	.1	Apply finishes to enclosure in accordance with Section 26 05 00 - Common Work Results for Electrical.
<u>2.5 EQUIPMENT IDENTIFICATION</u>	.1	Provide equipment identification in accordance with Section 26 05 00 - Common Work Results for Electrical.
	.2	Manual starter designation label, white plate, black letters, engraved as indicated.
	.3	Magnetic starter designation label, white plate, black letters, engraved as indicated.

PART 3 - EXECUTION

<u>3.1 INSTALLATION</u>	.1	Install starters and control devices in accordance with manufacturer's instructions.
	.2	Install and wire starters and controls as indicated.
	.3	Ensure correct fuses installed.
	.4	Confirm motor nameplate and adjust overload device to suit.
<u>3.2 FIELD QUALITY CONTROL</u>	.1	Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical and manufacturer's instructions.
	.2	Operate switches and contactors to verify correct functioning.
	.3	Perform starting and stopping sequences of contactors and relays.
	.4	Check that sequence controls, interlocking with other separate related starters, equipment, control devices, operate as indicated.
<u>3.3 CLEANING</u>	.1	Clean in accordance with Section 01 74 00 - Cleaning. .1 Remove surplus materials, excess materials, rubbish, tools and equipment.
	.2	Waste Management: separate waste materials for reuse and recycling.

END OF SECTION

PART 1 - GENERAL

<u>1.1 RELATED REQUIREMENTS</u>	.1	Section 01 33 00 - Submittal Procedures.
	.2	Section 01 61 00 - Common Product Requirements.
	.3	Section 01 74 00 - Cleaning.
<u>1.2 REFERENCES</u>	.1	Canadian Standards Association (CSA International).
	.2	Underwriters' Laboratories of Canada (ULC).
<u>1.3 ACTION AND INFORMATIONAL SUBMITTALS</u>	.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.
	.2	Provide complete photometric data prepared by independent testing laboratory for luminaires where specified, for review by Departmental Representative.
	.3	Photometric data to include: VCP Table where applicable spacing criterion.
	.3	Quality assurance submittals: provide following in accordance with Section 01 45 00 - Quality Control.
	.1	Manufacturer's instructions: provide manufacturer's written installation instructions and special handling criteria, installation sequence, cleaning procedures.
<u>1.4 DELIVERY, STORAGE AND HANDLING</u>	.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	Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, and packaging materials.
	.4	Divert unused metal materials from landfill to metal recycling facility.
	.5	Disposal and recycling of fluorescent lamps as per local regulations.
	.6	Disposal of old PCB filled ballasts.

PART 2 - PRODUCTS

- 2.1 LED FIXTURES**
- .1 Except as otherwise indicated, provide LED luminaires, of type and size indicated on fixture schedules.
 - .2 Including the following features unless otherwise indicated:
 - .1 Each luminaire shall consist of an assembly that utilizes LEDs as the light source. In addition, a complete luminaire shall consist of a housing, LED array, and electronic driver (power supply).
 - .2 Each luminaire shall be rated for a minimum operational life of 50,000 hours utilizing a maximum ambient temperature of (25°C).
 - .3 Light Emitting Diodes tested under LM-80 standards for a minimum 12,000 hours.
 - .4 Colour Rendering Index (CRI) of 80 at a minimum.
 - .5 Colour temperature as per fixture schedule.
 - .6 Rated lumen maintenance at 70% lumen output for 50,000 hours, unless otherwise indicated.
- 2.2 DRIVERS**
- .1 Electronic driver for LED fixtures: Comply with UL 1310 Class 2 requirements for dry and damp locations. Include the following features unless otherwise indicated:
 - .1 Rated for 50,000 hours of life or greater, unless otherwise noted.
 - .2 Sound rating: Class A.
 - .3 Total Harmonic Distortion Rating: 20 percent or less.
 - .4 Current Crest Factor: 1.5 or less.
 - .5 0-10V dimming standard, unless otherwise indicated.
- 2.3 LENSES**
- .1 Acrylic K-12 patter. Nominal thickness 3.2 mm.
- 2.4 FINISHES**
- .1 Light fixture finish and construction to meet ULC listings and CSA certifications related to intended installation.
- 2.5 EXTENDED WARRANTY**
- .1 For the work of Section 2.1, the 12 month warranty period is extended to 60 months.

PART 3 - EXECUTION

- 3.1 INSTALLATION**
- .1 Locate and install luminaires as indicated.
 - .2 Provide adequate support to suit ceiling system.

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|------------------------------------|----|---|
| <u>3.2 WIRING</u> | .1 | Connect luminaires to lighting circuits: |
| | .1 | Install flexible or rigid conduit for luminaires as indicated. |
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 | | |
| <u>3.3 LUMINAIRE
SUPPORTS</u> | .1 | For suspended ceiling installations support luminaires independently of ceiling in accordance with local inspection requirements. |
|
 | | |
| <u>3.4 LUMINAIRE
ALIGNMENT</u> | .1 | Align luminaires mounted in continuous rows to form straight uninterrupted line. |
| | .2 | Align luminaires mounted individually parallel or perpendicular to building grid lines. |
|
 | | |
| <u>3.5 CLEANING</u> | .1 | Clean in accordance with Section 01 74 00 - Cleaning. |
| | .1 | Remove surplus materials, excess materials, rubbish, tools and equipment. |
| | .2 | Waste Management: separate waste materials for reuse and recycling. |

END OF SECTION