## Part 1 General

### 1.1 SUMMARY

.1 Section Includes:

.1 General requirements that are common to NMS sections found in Division 26 - Electrical

### 1.2 REFERENCES

.1 Canadian Standards Association (CSA International)

.1 CSA C22.1, Canadian Electrical Code, Part 1, Safety Standard for Electrical Installations.

.2 CAN3-C235-[83(R2000)], Preferred Voltage Levels for AC Systems, 0 to 50,000 V.

.2 Electrical and Electronic Manufacturer's Association of Canada (EEMAC)

.1 EEMAC 2Y-1, Light Gray Colour for Indoor Switch Gear.

.3 Health Canada / Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS).

### 1.3 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.

### 1.4 SUBMITTALS

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

.2 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 Contract Administrator.

.3 Manufacturer's Field Reports: submit to Contract Administrator manufacturer's written report, within 3 days of review, verifying compliance of Work and electrical system and instrumentation testing, as described in PART 3 - FIELD QUALITY CONTROL.

**1.5 QUALITY ASSURANCE**

.1 Quality Assurance:

.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.

**1.6 SYSTEM STARTUP**

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

.2 Arrange and pay for services of manufacturer's factory service engineer to supervise start-up of installation, check, adjust, balance and calibrate components and instruct operating personnel.

.3 Provide these services for such period, and for as many visits as necessary to put equipment in operation, and ensure that operating personnel are conversant will aspects of its care and operation.

**Part 2 Products**

**2.1 MATERIALS AND EQUIPMENT**

.1 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.

.2 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 Control wiring and conduit: in accordance with Section 26 29 03 - Control Devices except for conduit, wiring and connections below 50 V which are related to control systems specified in mechanical sections and as shown on mechanical drawings.

## 2.3 WARNING SIGNS

.1 Warning Signs: in accordance with requirements of inspection authorities.

.2 Lamacoid signs, minimum size [175 x 250 mm] [___].

## 2.4 WIRING TERMINATIONS

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

## 2.5 EQUIPMENT IDENTIFICATION

.1 Identify electrical equipment with nameplates as follows:

.1 Nameplates: lamicoid 3 mm thick plastic engraving sheet, black with 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 Wording on nameplates to be approved Contract Administrator prior to manufacture.

.3 Allow for minimum of twenty-five (25) letters per nameplate.

.4 Nameplates for terminal cabinets and junction boxes to indicate system and/or voltage characteristics.

.5 Disconnects, starters and contactors: indicate equipment being controlled and voltage.

.6 Terminal cabinets and pull boxes: indicate system and voltage.

.7 Transformers: indicate capacity, primary and secondary voltages.

## 2.6 WIRING IDENTIFICATION

.1 Identify wiring with permanent indelible identifying markings, 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.

**2.7 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 15m intervals.

.3 Colours: 25mm wide prime colour and 20mm 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 |

**2.8 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.

.2 Paint indoor switchgear and distribution enclosures light gray to EEMAC 2Y-1.

**Part 3 Execution**

**3.1 INSTALLATION**

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

.2 Do overhead and underground systems in accordance with CSA C22.3 No.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 CONDUIT AND CABLE INSTALLATION**

.1 Install conduit and sleeves prior to pouring of concrete.

.1 Sleeves through concrete: schedule 40 steel pipe or plastic, sized for free passage of conduit, and protruding 50mm.

.2 If plastic sleeves are used in fire rated walls or floors, remove before conduit installation.

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

## 3.4 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 3000mm, 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.

## 3.5 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: 1400mm.

.2 Wall receptacles:

.1 General:300 mm.

.2 Above top of continuous baseboard heater: 200mm.

.3 Above top of counters or counter splash backs: 175mm.

.4 In mechanical rooms: 1400mm.

.3 Panelboards: as required by Code or as indicated.

.4 Fire alarm stations: 1500mm.

.5 Fire alarm bells: 2100mm.

## 3.6 CO-ORDINATION OF PROTECTIVE DEVICES

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

## 3.7 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 :

.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 system, building alarms.

.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 Contract Administrator.

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

.5 Manufacturer's Field Services:

.1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - SUBMITTALS.

.2 Provide manufacturer's field services consisting of product use recommendations and periodic Site visits for inspection of product installation in accordance with manufacturer's instructions.

.3 Schedule Site visits, to review Work, as directed in PART 1 - QUALITY ASSURANCE.

## 3.8 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.

**END OF SECTION**

## Part 1 General

### 1.1 SECTION INCLUDES

.1 Materials and installation for wire and box connectors.

### 1.2 REFERENCES

.1 Canadian Standards Association (CSA International)

.1 CAN/CSA-C22.2No.18, Outlet Boxes, Conduit Boxes, Fittings and Associated Hardware.

.2 CSA C22.2No.65, Wire Connectors.

.2 Electrical and Electronic Manufacturers' Association of Canada (EEMAC)

.1 EEMAC 1Y-2, Bushing Stud Connectors and Aluminum Adapters (1200 Ampere Maximum Rating).

.3 National Electrical Manufacturers Association (NEMA)

## Part 2 Products

### 2.1 MATERIALS

.1 Pressure type wire connectors to: CSA C22.2No.65, with current carrying parts of copper] sized to fit copper conductors as required.

.2 Fixture type splicing connectors to: CSA C22.2No.65, with current carrying parts of copper sized to fit copper conductors 10 AWG or less.

.3 Bushing stud connectors: to EEMAC 1Y-2 to consist of:

.1 Connector body and stud clamp for stranded copper conductors.

.2 Clamp for stranded copper conductors.

.3 Stud clamp bolts.

.4 Bolts for copper conductors.

.5 Sized for conductorsas indicated.

.4 Clamps or connectors for armoured cable, flexible conduit, non-metallic sheathed cable as required to: CAN/CSA-C22.2No.18.

## Part 3 Execution

### 3.1 INSTALLATION

.1 Remove insulation carefully from ends of conductors and:

.1 Install mechanical pressure type connectors and tighten screws with appropriate compression tool recommended by manufacturer. Installation shall meet secureness tests in accordance with CSA C22.2No.65.

.2 Install fixture type connectors and tighten. Replace insulating cap.

.3 Install bushing stud connectors in accordance with EEMAC 1Y-2.

**END OF SECTION**

## Part 1 General

### 1.1 RELATED SECTIONS

.1 Section 26 05 20 - Wire and Box Connectors - 0 - 1000 V.

### 1.2 REFERENCES

.1 CSA C22.2 No .0.3, Test Methods for Electrical Wires and Cables.

.2 CAN/CSA-C22.2 No. 131, Type TECK 90 Cable.

### 1.3 PRODUCT DATA

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

## 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 TWU or TWH rated at 600 V.

### 2.2 TECK CABLE

.1 Cable: to CAN/CSA-C22.2 No. 131.

.2 Conductors:

.1 Grounding conductor: copper.

.2 Circuit conductors: copper, size as indicated.

.3 Insulation:

.1 Chemically cross-linked thermosetting polyethylene rated type RW90, 1000 V.

.4 Inner jacket: polyvinyl chloride material.

.5 Armour: interlocking aluminum.

.6 Overall covering: thermoplastic polyvinyl chloride material.

.7 Fastenings:

.1 One hole aluminum straps to secure surface cables 50 mm and smaller. Two hole aluminum straps for cables larger than 50 mm.

.2 Channel type supports for two or more cables at 900 mm centers.

.3 Stainless steel threaded rods: 6 mm dia. to support suspended channels.

.8 Connectors:

.1 Watertight approved for TECK cable.

**2.3 VFD DRIVE CABLE**

.1 Cable: to CAN/CSA-C22.2 No. 131.

.2 Conductors:

.1 Sectored Grounding conductors: three (3) bare copper.

.2 Circuit conductors: copper, size as indicated.

.3 Insulation:

.1 Type: ethylene propylene rubber.

.2 Chemically cross-linked thermosetting polyethylene rated 1000 V.

.4 Inner jacket: polyvinyl chloride material.

.5 Armour: heavy wall, continuously corrugated aluminum.

.6 Overall covering: thermoplastic polyvinyl chloride material.

.7 Fastenings:

.1 One hole aluminum straps to secure surface cables 50 mm and smaller. Two hole aluminum straps for cables larger than 50 mm.

.2 Channel type supports for two or more cables at 1000 mm centers.

.3 Stainless steel threaded rods: 9 mm dia. to support suspended channels.

.8 Connectors:

.1 Watertight, approved for TECK cable.

**2.4 CONTROL CABLES**

.1 Type LVT: soft annealed copper conductors, sized as indicated, with thermoplastic insulation, outer covering of thermoplastic jacket

.2 600 V type: stranded annealed copper conductors, sizes as indicated with PVC insulation type TW, or cross-linked polyethylene type RW90 (x-link with shielding ofmetallized tapes over each pair of conductors and overall covering of thermoplastic jacket interlocked armour and jacket over sheath of PVC.

## Part 3 Execution

### 3.1 INSTALLATION OF BUILDING WIRES

.1 Install wiring as follows:

.1 In conduit systems in accordance with Section 260534

### 3.2 INSTALLATION OF TECK CABLE 0 -1000 V

.1 Install cables.

.1 Group cables wherever possible on channels.

.2 Install cable in trenches in accordance with Section 260544.

.3 Lay cable in cabletroughs/cable tray in accordance with Section 260536.

.4 Terminate cables in accordance with Section 26 05 20- Wire and Box Connectors - 0 - 1000 V.

### 3.3 INSTALLATION OF CONTROL CABLES

.1 Install control cables [in [conduit] [under floor raceways] [cable troughs] [underground ducts]] [by direct burial].

.2 Ground control cable shield.

### 3.4 INSTALLATION OF VFD DRIVE CABLE

.1 Install drive cable between VFD output and motor load.

.2 Install cables.

.1 Group cables wherever possible on channels.

.3 Lay cable in cabletroughs in accordance with **Section 26 05 34**.

.4 Use approved connectors

.5 Terminate cables in accordance with Section 26 05 20 - Wire and Box Connectors - 0-1000 V.

### 3.5 NSTALLATION OF NON-METALLIC SHEATHED CABLE

.1 Install cables.

.2 Install straps and box connectors to cables as required.

**END OF SECTION**

## Part 1 General

### 1.1 SECTION INCLUDES

.1 Materials and installation for connectors and terminations.

### 1.2 REFERENCES

.1 Canadian Standards Association (CSA International)

.1 CSA C22.2 No.2012 (22nd Edition)

.2 CSA C22.2 No.41-M1987(R1999), Grounding and Bonding Equipment.

### 1.3 PRODUCT DATA

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

## Part 2 Products

### 2.1 CONNECTORS AND TERMINATIONS

.1 Copper long barrel compression connectors to CSA C22.2No.2 as required sized for conductors.

## Part 3 Execution

### 3.1 INSTALLATION

.1 Install terminations, and splices in accordance with manufacturer's instructions.

.2 Bond and ground as required to CSA C22.2No.41.

**END OF SECTION**

## Part 1 General

### 1.1 RELATED SECTIONS

.1 Section 26 05 00 - Common Work Results - Electrical.

### 1.2 REFERENCES

.1 American National Standards Institute (ANSI)/Institute of Electrical and Electronics Engineers (IEEE)

.1 ANSI/IEEE 837, Qualifying Permanent Connections Used in Substation Grounding.

.2 Canadian Standards Association, (CSA International)

## Part 2 Products

### 2.1 EQUIPMENT

.1 Clamps for grounding of conductor: size as required to electrically conductive underground water pipe.

.2 Copper conductor: minimum 6 m long for each concrete encased electrode, bare, stranded, soft annealed, size as indicated.

.3 Rod electrodes: copper clad steel 19 mm dia by 3 m long.

.4 Grounding conductors: bare stranded copper, soft annealed, size as indicated.

.5 Insulated grounding conductors: green, type RW90.

.6 Ground bus: copper, size as required, complete with insulated supports, fastenings, connectors.

.7 Non-corroding accessories necessary for grounding system, type, size, material as indicated, including but not necessarily limited to:

.1 Grounding and bonding bushings.
.2 Protective type clamps.
.3 Bolted type conductor connectors.
.4 Thermit welded type conductor connectors.
.5 Bonding jumpers, straps.
.6 Pressure wire connectors.

□

## Part 3 Execution

### 3.1 INSTALLATION GENERAL

.1 Install complete permanent, continuous grounding system including, electrodes, 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 Make buried connections, and connections to conductive water main, electrodes, using copper welding by thermit process.

.5 Use mechanical connectors for grounding connections to equipment provided with lugs.

.6 Soldered joints not permitted.

.7 Install bonding wire for flexible conduit, connected at both ends to grounding bushing, solderless lug, clamp or cup washer and screw. Neatly cleat bonding wire to exterior of flexible conduit.

.8 Install flexible ground straps for bus duct enclosure joints, where such bonding is not inherently provided with equipment.

.9 Bond single conductor, metallic armoured cables to cabinet at supply end, and provide non-metallic entry plate at load end.

.10 Ground secondary service pedestals.

### 3.2 ELECTRODES

.1 Install rod electrodes and make grounding connections.

.2 Bond separate, multiple electrodes together.

.3 Use size 2/0AWG copper conductors for connections to electrodes.

### 3.3 SYSTEM AND CIRCUIT GROUNDING

.1 Install system and circuit grounding connections to neutral of primary 600 V system, secondary 208 V system.

### 3.4 EQUIPMENT GROUNDING

.1 Install grounding connections to typical equipment included in, but not necessarily limited to following list. Service equipment, transformers, switchgear, duct systems, frames of motors, motor control centres, starters, control panels, building steel work, generators, elevators and escalators, distribution panels, outdoor lighting.

□

## 3.5 GROUNDING BUS

.1 Install copper grounding bus mounted on insulated supports on wall of electrical room.

.2 Ground items of electrical equipment in electrical room to ground bus with individual bare stranded copper connections size 2/0AWG.

## 3.6 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 00 - Common Work Results - Electrical.

.2 Perform ground continuity and resistance tests using method appropriate to Site conditions and to approval of Contract Administrator.

.3 Perform tests before energizing electrical system.

.4 Disconnect ground fault indicator during tests.

**END OF SECTION**

## Part 1 General

### 1.1 RELATED SECTIONS

.1 Not Used

## Part 2 Products

### 2.1 SUPPORT CHANNELS

.1 U shape aluminum, size 41 x 41 mm, 2.5 mm thick, surface mounted or suspended.

## Part 3 Execution

### 3.1 INSTALLATION

.1 Secure equipment to hollow or 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 Support equipment, conduit or cables using clips, spring loaded bolts, cable clamps designed as accessories to basic channel members.

.5 Fasten exposed conduit or cables to building construction or support system using straps.

- .1 One-hole aluminum or stainless steel straps to secure surface conduits and cables 50 mm and smaller.
- .2 Two-hole aluminum or stainless steel straps for conduits and cables larger than 50 mm.
- .3 Beam clamps to secure conduit to exposed steel work.

.6 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.

.7 For surface mounting of two or more conduits use channels at 1 m on centre spacing.

.8 Provide metal brackets, frames, hangers, clamps and related types of support structures where indicated or as required to support conduit and cable runs.

.9 Ensure adequate support for raceways and cables dropped vertically to equipment where there is no wall support.

.10 Do not use wire lashing or perforated strap to support or secure raceways or cables.

.11 Do not use supports or equipment installed for other trades for conduit or cable support except with permission of other trade and approval of Contract Administrator.

.12 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 SHOP DRAWINGS AND PRODUCT DATA

.1 Submit shop drawings and product data for cabinets in accordance with Section 01 33 00 - Submittal Procedures.

## Part 2 Products

### 2.1 SPLITTERS

.1 Sheet metal enclosure, welded corners and formed hinged cover suitable for locking in closed position.

.2 Main and branch lugs to match required size and number of incoming and outgoing conductors as indicated.

.3 At least three spare terminals on each set of lugs in splitters less than 400 A.

### 2.2 JUNCTION AND PULL BOXES

.1 Welded steel construction with screw-on flat covers for surface mounting.

.2 Covers with 25 mm minimum extension all around, for flush-mounted pull and junction boxes.

### 2.3 CABINETS

.1 Type E: sheet steel, hinged door and return flange overlapping sides, handle, lock and catch, for surface mounting.

.2 Type T: sheet steel cabinet, with hinged door, latch, lock, 2 keys, containing sheet steel backboard for surface mounting.

## Part 3 Execution

### 3.1 SPLITTER INSTALLATION

.1 Install splitters and mount plumb, true and square to the building lines.

.2 Extend splitters full length of equipment arrangement except where indicated otherwise.

### 3.2 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.

.3 Install terminal block as indicated in Type T cabinets.

.4 Only main junction and pull boxes are indicated. Install pull boxes so as not to exceed 30 m of conduit run between pull boxes.

## 3.3 IDENTIFICATION

.1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results - Electrical.

.2 Install size 2 identification labels indicating system name, voltage and phase.

**END OF SECTION**

## Part 1 General

### 1.1 REFERENCES

.1 CSA C22.1, Canadian Electrical Code, Part 1.

## 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 for special devices.

.3 Gang boxes where wiring devices are grouped.

.4 Blank cover plates for boxes without wiring devices.

.5 347 V outlet boxes for 347 V switching devices.

.6 Combination boxes with barriers where outlets for more than one system are grouped.

### 2.2 SHEET STEEL OUTLET BOXES

.1 Electro-galvanized steel 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.

.2 Electro-galvanized steel utility boxes for outlets connected to surface-mounted EMT conduit, minimum size 102 x 54 x 48 mm.

.3 102 mm square or octagonal outlet boxes for lighting fixture outlets.

### 2.3 MASONRY BOXES

.1 Electro-galvanized steel masonry single and multi gang boxes for devices flush mounted in exposed block walls.

### 2.4 CONCRETE BOXES

.1 Electro-glavanized sheet steel concrete type boxes for flush mount in concrete with matching extension and plaster rings as required.

### 2.5 CONDUIT BOXES

.1 Cast FS or FD aluminum boxes with factory-threaded hubs and mounting feet for surface wiring of switches and receptacle.

**2.6 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 32 mm 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. Reducing washers are not allowed.

**END OF SECTION**

## Part 1 General

### 1.1 REFERENCES

.1 Canadian Standards Association (CSA)

- .1 CAN/CSA C22.2 No. 18-98, Outlet Boxes, Conduit Boxes, and Fittings and Associated Hardware.
- .2 CSA C22.2 No. 45-M1981(R1992), Rigid Metal Conduit.
- .3 CSA C22.2 No. 56-1977(R1999), Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit.
- .4 CSA C22.2 No. 83-M1985(R1999), Electrical Metallic Tubing.
- .5 CSA C22.2 No. 211.2-M1984(R1999), Rigid PVC (Unplasticized) Conduit.
- .6 CAN/CSA C22.2 No. 227.3-M91(R1999), Flexible Nonmetallic Tubing.

## Part 2 Products

### 2.1 CONDUITS

.1 Rigid metal conduit: to CSA C22.2 No. 45, aluminum threaded.

.2 Epoxy coated conduit: to CSA C22.2 No. 45, with zinc coating and corrosion resistant epoxy finish inside and outside.

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

.4 Flexible metal conduit: to CSA C22.2 No. 56, liquid-tight flexible metal.

### 2.2 CONDUIT FASTENINGS

.1 One hole aluminum or stainless steel straps to secure surface conduits 50 mm and smaller. Two hole aluminum or stainless 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 1 m oc.

.4 Stainless steel threaded rods, 6 mm dia., to support suspended channels.

### 2.3 CONDUIT FITTINGS

.1 Fittings: manufactured for use with conduit specified. Coating: same as conduit.

.2 Factory "ells" where 90° bends are required for 25 mm and larger conduits.

.3 Watertight connectors and couplings for EMT. Set-screws are not acceptable.

**2.4 EXPANSION FITTINGS FOR RIGID CONDUIT**

.1 Weatherproof expansion fittings with internal bonding assembly suitable for 100mm linear expansion.

.2 Watertight expansion fittings with integral bonding jumper suitable for linear expansion and 19 mm deflection in all directions.

.3 Weatherproof expansion fittings for linear expansion at entry to panel.

**2.5 FISH CORD**

.1 Polypropylene.

**Part 3 Execution**

**3.1 INSTALLATION**

.1 Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass.

.2 X-ray cast walls and floors before coring to confirm location of embedded items.

.3 Existing structure contains asbestos. Confirm materials are free of asbestos before drilling or coring.

.4 Use rigid aluminum threaded conduit in areas subject to mechanical injury.

.5 Use epoxy coated conduit underground and in cast concrete.

.6 Use electrical metallic tubing (EMT) except in cast concrete above 2.4 m not subject to mechanical injury.

.7 Use liquid tight flexible metal conduit for connection to motors or vibrating equipment.

.8 Minimum conduit size for lighting and power circuits: 19 mm.

.9 Bend conduit cold. Replace conduit if kinked or flattened more than 1/10th of its original diameter.

.10 Mechanically bend steel conduit over 19 mm dia.

.11 Field threads on rigid conduit must be of sufficient length to draw conduits up tight.

.12 Install fish cord in empty conduits.

.13 Remove and replace blocked conduit sections. Do not use liquids to clean out conduits.

.14 Dry conduits out before installing wire.

**3.2 SURFACE CONDUITS**

.1 Paint walls before installation of electrical equipment including conduits.

.2 Run parallel or perpendicular to building lines.

.3 Locate conduits behind infrared or gas fired heaters with 1.5 m clearance.

.4 Run conduits in flanged portion of structural steel.

.5 Group conduits wherever possible on suspended or surface channels.

.6 Do not pass conduits through structural members except as indicated.

.7 Do not locate conduits less than 75 mm parallel to steam or hot water lines with minimum of 25 mm at crossovers.

**3.3 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.

**3.4 CONDUITS IN CAST-IN-PLACE CONCRETE**

.1 Locate to suit reinforcing steel. Install in centre one third of slab.

.2 Protect conduits from damage where they stub out of concrete.

.3 Install sleeves where conduits pass through slab or wall.

.4 Provide oversized sleeve for conduits passing through waterproof membrane, before membrane is installed. Use cold mastic between sleeve and conduit.

.5 Do not place conduits is slabs in which slab thickness is less than 4 times conduit diameter.

.6 Encase conduits completely in concrete with minimum 25 mm concrete cover.

.7 Organize conduits in slab to minimize cross-overs.

**3.5 CONDUITS IN CAST-IN-PLACE SLABS ON GRADE**

.1 Run conduits 25 mm and larger below slab and encased in 75 mm concrete envelope. Provide 50 mm of sand over concrete envelope below floor slab.

**3.6 CONDUITS UNDERGROUND**

.1 Slope conduits to provide drainage.

.2 Waterproof joints (pvc excepted) with heavy coat of bituminous paint.

**END OF SECTION**

## Part 1 General

### 1.1 RELATED SECTIONS

.1 Section 01 33 00 - Submittal Procedures.

### 1.2 REFERENCES

.1 Canadian Standards Association (CSA International)

.1 CAN/CSA C22.2No.126, Cable Tray Systems.

.2 National Electrical Manufacturers Association (NEMA) standards

.1 NEMA FG 1, Fibreglass and Cable Tray Systems.

.2 NEMA VE 1, Metal Cable Tray Systems.

### 1.3 SHOP DRAWINGS AND PRODUCT DATA

.1 Submit shop drawings and product data in accordance with section 01 33 00 - Submittal Procedures.

.2 Identify types of cabletroughs used.

.3 Show actual cabletrough installation details and suspension system.

## Part 2 Products

### 2.1 CABLETROUGH

.1 Cabletroughs and fittings: to NEMA VE 1.

.2 Ladder type, Class D1 to CAN/CSA C22.2No.126.

.3 Trays: extruded aluminum, 750 mm wide with depth of 100 mm.

.4 Fittings: horizontal elbows, end plates, drop outs, vertical risers and drops, tees, wyes, expansion joints and reducers where required, manufactured accessories for cabletrough supplied.

.1 Radii on fittings: 600 mm minimum.

.5 Barriers where different voltage systems are in same cabletrough.

### 2.2 SUPPORTS

.1 Provide supports as required.

## Part 3 Execution

### 3.1 INSTALLATION

.1 Install complete cabletrough system.

.2 Support cabletrough on both side.

.3 Install green insulated 1/0 copper bonding conductor to run full length of cabletroughs.

.4 Bonding conductors to be fastened with electrically conducting metal clamps at 6 m centres and at each end of terminated cabletrough.

.5 Remove sharp burrs or projections to prevent damage to cables or injury to personnel.

### 3.2 CABLES IN CABLETROUGH

.1 Install cables individually.

.2 Lay cables into cabletrough. Use rollers when necessary to pull cables.

.3 Secure cables in cabletrough at 3 m centres, with nylon ties.

.4 Identify cables every 30 m with size 2 nameplates .

**END OF SECTION**

## Part 1 General

### 1.1 RELATED SECTIONS

.1 Section 31 23 33 – Excavating and Backfilling.

.2 Section 26 05 00 - Common Work Results - Electrical.

### 1.2 REFERENCES

.1 Canadian Standards Association, (CSA International)

.2 Insulated Cable Engineers Association, Inc. (ICEA)

## Part 2 Products

### 2.1 CABLE PROTECTION

.1 38 x 140 mm planks pressure treated with copper napthenate or 5% pentachlorophenol solution, water repellent preservative.

## Part 3 Execution

### 3.1 DIRECT BURIAL OF CABLES

.1 After 75 mm sand bed, is in place, lay cables maintaining 75 mm clearance from each side of trench to nearest cable. Do not pull cable into trench.

.2 Provide offsets for thermal action and minor earth movements. Offset cables 150 mm for each 60 m run, maintaining minimum cable separation and bending radius requirements.

.3 Make termination and splice only as indicated leaving 0.6 m of surplus cable in each direction.

.1 Make splices and terminations in accordance with manufacturer's instructions using approved splicing kits.

.4 Underground cable splices not acceptable.

.5 Minimum permitted radius at cable bends for rubber, plastic or lead covered cables, 8 times diameter of cable; for metallic armoured cables, 12 times diameter of cables or in accordance with manufacturer's instructions.

.6 Cable separation:

.1 Maintain 75 mm minimum separation between cables of different circuits.

.2 Maintain 300 mm horizontal separation between low and high voltage cables.

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.3 When low voltage cables cross high voltage cables maintain 300 mm vertical separation with low voltage cables in upper position.

.4 At crossover, maintain 75 mm minimum vertical separation between low voltage cables and 150 mm between high voltage cables.

.5 Maintain 300 mm minimum lateral and vertical separation for fire alarm and control cables when crossing other cables, with fire alarm and control cables in upper position.

.6 Install treated planks on lower cables 0.6 m in each direction at crossings.

.7 After 75 mm sand protective cover spec is in place, install continuous row of overlapping 38 x 140 mm pressure treated planks as indicated to cover length of run.

## 3.2 CABLE INSTALLATION IN DUCTS

.1 Install cables as indicated in ducts.

.1 Do not pull spliced cables inside ducts.

.2 Install multiple cables in duct simultaneously.

.3 Use CSA approved lubricants of type compatible with cable jacket to reduce pulling tension.

.4 To facilitate matching of colour coded multiconductor control cables reel off in same direction during installation.

.5 Before pulling cable into ducts and until cables are properly terminated, seal ends of lead covered cables with wiping solder; seal ends of non-leaded cables with moisture seal tape.

.6 After installation of cables, seal duct ends with duct sealing compound.

## 3.3 MARKERS

.1 Mark cable every 150 m along cable and duct runs and changes in direction.

.2 Mark underground splices.

.3 Where markers are removed to permit installation of additional cables, reinstall existing markers.

.4 Install concrete cable markers within 180 m from each side of runway centreline; 45 m from each side of taxi way centreline; 50 m from edge of taxi ramps or aprons.

.5 Install cedar post type markers.

.6 Lay concrete markers flat and centred over cable with top flush with finish grade.

## 3.4 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 00 - Common Work Results - Electrical.

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.2 Perform tests using qualified personnel. Provide necessary instruments and equipment.

.3 Check phase rotation and identify each phase conductor of each feeder.

.4 Check each feeder for continuity, short circuits and grounds. Ensure resistance to ground of circuits is not less than 50 megohms.

.5 Pre-acceptance tests.

.1 After installing cable but before splicing and terminating, perform insulation resistance test with 1000 V megger on each phase conductor.

.2 Check insulation resistance after each splice and/or termination to ensure that cable system is ready for acceptance testing.

.6 Acceptance Tests

.1 Ensure that terminations and accessory equipment are disconnected.

.2 Ground shields, ground wires, metallic armour and conductors not under test.

.7 Provide Contract Administrator with list of test results showing location at which each test was made, circuit tested and result of each test.

.8 Remove and replace entire length of cable if cable fails to meet any of test criteria.

**END OF SECTION**

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## 1. GENERAL

### 1.1 References

.1 CAN3-C17, Alternating - Current Electricity Metering

.2 ANSI/IEEE C37.90A surge withstand and fast transient tests

### 1.2 Product Data

.1 Submit product data in accordance with **Section 26 05 00 – Common Work Results - For Electrical**.

.2 Indicate meter, instrument, outline dimensions, panel drilling dimensions and include cutout template.

## 2. PRODUCTS

### 2.1 Digital Metering Instrument

.1 Microprocessor-based data collection and storage meter to monitor power conditions on transformer secondaries as shown on the plans.

.2 Meter to display true RMS value of:

| | | |
|---|---|---|
| .1 | Amps | 3-phase current |
| .2 | Volts | Line-to-line or line-to-neutral 3-phase voltage |
| .3 | kW | kilowatts |
| .4 | kVA | kilovoltamperes |
| .5 | Pf | power factor |
| .6 | F | frequency |
| .7 | kWd | kilowatt demand |
| .8 | Ad | amperes demand |
| .9 | kWh | kilowatt hours |

.10 Total kWH as an accumulating total, providing bi-directional (import/export) indication.

.11 Total kVARH as an accumulating total, providing bi-directional (import/export) indication.

.12 kW Demand, user-programmable length of each demand period and the number of periods averaged to match local utility billing method.

.13 Amps Demand

.14 kVA Demand, user-programmable length of each demand period and the number of periods averaged to match local utility billing method.

.15 Total harmonic current and voltage

.16 Individual harmonic true rms current and voltage to the 63rd harmonic

.3 Each power meter to have:

.1 True RMS measurement.

.2 Direct connection to 600 V, 3 phase, 4 wire system.

.3 Fourth current input for measurement of ground or neutral current.

.4 Eight (8) digital inputs for status/counter inputs, self excited dry contact sensing, to remotely monitor breaker status, ground fault relay status, or any other dry contact input.

.5 Storage in non-volatile memory for the following:

.1 A time-stamped alarm and event log of up to 800 events which records event date, time (to 0.001 sec), event type, and value for all over/under limit conditions, all status input activity, and all relay operations.

.2 A time-stamped minimum/maximum log, which records the value of any parameter exceeding the previous highest or lowest value recorded. Log to be read from the front panel display or via the communications port.

.3 All setup data.

.6 Waveform capture capability allowing any of the eight voltage and current input channels to be digitally sampled at 256 samples/60 Hz cycle. Waveform capture to be initiated using commands made via the communications port or event triggered. Waveform capture data is to be made accessible via the communications port.

.7 Liquid crystal display, 320 x 240 pixels resolution, backlight.

.8 Serial communications ports:

.1 One (1) RS-232C/RS-485, and one (1) RS-485

.2 Protocols: ION, Modbus RTU

.3 Baud rate: RS-232, 300 bps to 115,200 bps.

.4 Baud rate: RS-485, 300 bps to 57,600 bps.

.9 Ethernet port:

.1 Protocols: ION, Modbus TCP

.2 10BaseT

.3 Simultaneous communications using ION and Modbus TCP protocols

.10 Field programmability as follows:

.1 Volts scale, volts mode (wye, delta, single phase), amps scale, Vaux scale, baud rate, TCP/IP address and the relay operation are programmable from the front panel.

.2 All parameters in 10.1 above, plus additional alarm/event parameters may be programmed via the communications port using a portable terminal or a computer.

.3 Ensure programming is password protected.

.11 Compliance with the following standards:

.1 ULC certified

.2 CSA approved

.3 Voltage, current, status, relay and power inputs pass the ANSI/IEEE C37.90A surge withstand and fast transient tests.

.4 Certified to comply with FCC Part 15 Subpart J for Class A computing devices.

.12 300 amps for one (1) second surge protection on all four (4) current inputs.

.13 The following accuracy, resolution, range, and power supply ratings specifications:

| Parameter | Accuracy | Resolution | Range |
|---|---|---|---|
| Volts (V1, V2, V3) | 0.1% | 0.1% | 0 - 1,000,000[1] |
| Amps (I1, I2, I3) | 0.1% | 0.1% | 0 - 30,000 |
| Neutral Current (I4) | 0.4% | 0.1% | 0 - 9,999 |
| kW | class 0.2 | 0.1% | 0 - 1,000,000[2] |
| kVAR | class 0.2 | 0.1% | 0 - 1,000,000[2] |
| kVA | class 0.2 | 0.1% | 0 - 1,000,000[2] |
| Power Factor | 0.2% | 1.0% | 1.0 to ±0.6 |
| Frequency | 0.005 Hz | 0.1 Hz[3] | 40 to 450 Hz |
| kW Demand | class 0.2 | 0.1% | 0 - 1,000,000 |
| Amps Demand | class 0.2 | 0.1% | 0 - 30,000 |
| kWH (-F, -R) | class 0.2 | 1 kWH | 0 - 1,000,000,000 |
| kVARH (-F, -R) | class 0.2 | 1 kVARH | 0 - 1,000,000,000 |

.1 Reads in kV for voltages over 9,999

.2 Reads in MVA, MW, MVAR for readings over 9,999 K

.3 1 Hz resolution at 400 Hz range

.4 Power Supply

.1 85 to 250 VAC or 110 to 300 VDC

.2 Burden: 15 VA typical, 35 VA maximum

.3 Record and store the following information in meter memory. Recall and reset stored data via meter controls and meter indicator.

| | | |
|---|---|---|
| .1 | Volts | max/min at 1 second interval |
| .2 | Amps | max/min at 1 second interval |
| .3 | F | max/min at 1 second interval |
| .4 | kW | max/min at 1 second interval |
| .5 | Pf | max/min (or kVA max/min) at 1 second interval |
| .6 | kWd | at field programmable intervals of 1 minute to 30 minutes; set at 1 minute |
| .7 | Ad | per kWd |

.5 10-Base-T communications port for future addition of remote data acquisition.

.6 Field programmable for set-up and system variables.

.7 Test terminal blocks as required.

.8 Relay output signalling loss of phase. Relay to open on phase loss.

.9 CSA approved

.10 Approved Product: ION 7550 manufactured by Power Measurement Ltd

**2.2 Current Transformers**

.1 Provide shorting switches or test blocks for all meter CT inputs

**2.3 Equipment Identification**

.1 Provide equipment identification.

**3. EXECUTION**

**3.1 Metering Installation**

.1 Install meters in panels as indicated

.2 Make connections in accordance with diagrams

.3 Connect phase loss relay to Metasys Building Management control system.

## 3.2 Field Quality Control

.1 Perform simulated operation tests with metering, instruments disconnected from permanent signal and other electrical sources.

.2 Verify correctness of connections, polarities of meters, instruments, potential and current transformers, transducers, signal sources and electrical supplies.

**END OF SECTION**

## Part 1 General

### 1.1 SYSTEM DESCRIPTION

.1 Factory assembled networked switching panels, interfaces, modules and software

.2 Low voltage wall stations and control interfaces.

.3 Lighting Controls shall meet "The Public Health Act (C.C.S.M c. P210) Swimming Pools and Other Water Recreational Facilities Regulation"

.4 Minimum lighting levels around pool shall be maintained at all times.

### 1.2 SHOP DRAWINGS

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

.2 Indicate:

- .1 Complete assembly.
- .2 Contact surfaces.
- .3 Construction features.
- .4 Wiring diagrams.
- .5 Catalogue information.

## Part 2 Products

### 2.1 COMPONENTS

.1 Designed for lighting control up to and including 208 V 20 amp.

.2 Control up to 48 relays per panel

.3 Layout and connections as per plans.

.4 RS485 network between panels and computer system.

.5 Programming as per plans.

.6 Low Voltage Switch Kit.

.7 Keeper Enterprise software, VisionTouch and Event Manager Software installed on City’s computer hardware.

.8 Approved Manufacture: Cooper Controls, ControlKeeper.

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## Part 3 Execution

### 3.1 INSTALLATION

.1 Install system and components in accordance with manufacturer's instructions.

.2 Install low voltage switch kits and low voltage cables as shown on drawings and connect to control ports of controlled circuits.

.3 Install software on City supplied computer hardware. Program system to operate as per plans.

.4 Provide training of City personnel on operation of the system. Provide two(2) training sessions to accommodate City staff.

### 3.2 FIELD QUALITY CONTROL

.1 On completion of installation, manufacturer representative shall be notified to carry out Site inspection and report any inconsistencies to the Contract Administrator. Corrections are to be implemented to comply with manufacturer's report.

**END OF SECTION**

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## Part 1 General

### 1.1 SECTION INCLUDES

.1 Materials and components for dry type transformers up to 600 V primary, equipment identification and transformer installation.

### 1.2 RELATED SECTIONS

.1 Section 01 33 00 - Submittal Procedures.

.2 Section 26 05 00 - Common Work Results - Electrical.

### 1.3 REFERENCES

.1 Canadian Standards Association (CSA International)

- .1 CAN/CSA-C22.2 No.47, Air-Cooled Transformers (Dry Type).
- .2 CSA C9, Dry-Type Transformers.

.2 National Electrical Manufacturers Association (NEMA)

### 1.4 PRODUCT DATA

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

## Part 2 Products

### 2.1 TRANSFORMERS

.1 Use transformers of one manufacturer throughout project and in accordance with CAN/CSA-C22.2No.47.

.2 Design.

- .1 Type: ANN.
- .2 Rating as specified.
- .3 Voltage taps: standard.
- .4 Insulation: 180 degrees C temperature rise.
- .5 Basic Impulse Level (BIL): standard.
- .6 Hipot :standard.
- .7 Average sound level: standard
- .8 Impedance at 17 degrees C: standard
- .9 Enclosure: CSA 1, removable metal front panel c/w sprinkler sheild.
- .10 Finish: in accordance with Section 26 05 01 - Common Work Results - Electrical.
- .11 Acceptable manufactures: Schneider Electric, Eaton, Rex Manufacturing.

**2.2 EQUIPMENT IDENTIFICATION**

.1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results - Electrical.

.2 Label size: 7.

.3 Nameplate wording:

T-2
15kVA
600V – 120/208V

**Part 3 Execution**

**3.1 INSTALLATION**

.1 Mount dry type transformers up to 75 kVA as indicated.

.2 Mount dry type transformers above 75 kVA on floor.

.3 Ensure adequate clearance around transformer for ventilation.

.4 Install transformers in level upright position.

.5 Remove shipping supports only after transformer is installed and just before putting into service.

.6 Loosen isolation pad bolts until no compression is visible.

.7 Make primary and secondary connections in accordance with wiring diagram.

.8 Energize transformers after installation is complete.

**END OF SECTION**

## Part 1 General

### 1.1 SECTION INCLUDES

.1 Materials and installation for dead front type, low voltage service entrance panel, main breaker, customer metering, transient voltage surge suppression, and distribution feeder section in a single enclosure. The panel must be completely factory assembled and CSA listed.

### 1.2 RELATED SECTIONS

.1 Section 01 33 00 - Submittal Procedures.

### 1.3 SHOP DRAWINGS PRODUCT DATA

.1 Submit shop drawings and product data in accordance with Section 01 33 00 - Submittal Procedures.

.2 Indicate on shop drawings:

.1 Floor anchoring method and foundation template.
.2 Dimensioned cable entry and exit locations.
.3 Dimensioned position and size of bus.
.4 Overall length, height and depth of complete switchboard.
.5 Overall weight of switchboard
.6 Dimensioned layout of internal and front panel mounted components.
.7 Assembly ratings including: short circuit, voltage class, continuous current rating.
.8 Major component ratings including: short circuit, voltage class, continuous current.
.9 Cable lug termination sizes,

### 1.4 REFERENCES

.1 Canadian Standards Association (CSA International)

.1 CAN/CSA-C22.2 No.31, Switchgear Assemblies.

## Part 2 Products

### 2.1 MATERIALS

.1 Switchboard assembly: to CAN/CSA-C22.2No.31.

### 2.2 RATING

.1 Switchboard: indoor, 347/600 V, 2000 A, 3 phase, 4 wire, 60 Hz, minimum short circuit capacity 50 kA (rms symmetrical).

## 2.3 ENCLOSURE

.1 Main incoming section to contain:

.1 Moulded case circuit breaker with solid state trip unit (LSIG), sized as indicated.

.2 Customer digital power meter.

.3 Transient voltage surge suppression.

.2 Distribution sections to contain:

.1 Moulded case circuit breaker with solid state trip unit, sized as indicated.

.2 Silver flashed copper bus, from main section to distribution sections including vertical bussing.

.3 Blanked off spaces for future units.

.4 Metal enclosed, free standing, floor mounted, dead front, indoor, CSA Enclosure 2, sprinkler proof cubicle unit.

.5 Ventilating louvres: vermin, insect, sprinkler proof with easily replaceable fibre glass filters.

.6 Access from front only.

.7 Steel channel sills for base mounting in single length common to multi-cubicle switchboard.

.8 Provision for future extension on left side.

## 2.4 BUSBARS

.1 Three phase and full capacity neutral silver flashed copper busbars, continuous current rating 2000A self-cooled, extending full width of multi-cubicle switch board], suitably supported on insulators.

.2 Main connections between bus and major switching components to have continuous current rating to match major switching components.

.3 Busbars and main connections: 99.30% conductivity copper.

.4 Provision for extension of bus on left side of unit without need for further drilling or preparation in field.

.5 Silver surfaced joints, secured with non-corrosive bolts and Belleville washers.

.6 Identify phases of busbars by suitable marking.

.7 Busbar connectors, when switchboard shipped in more than one section.

## 2.5 GROUNDING

.1 Copper ground bus not smaller than 50 x 6 mm extending full width of multi-cubicle switchboard and situated at bottom.

.2 Lugs at each end for size 2/0 AWG grounding cable.

**2.6 CIRCUIT BREAKERS**

.1 Molded case circuit breaker, bolt-on, solid state trip unit.

.2 Connected and programmed for zone selective interlocking.

.3 Breaker interrupting capacity: 50 kAIC RMS symmetrical.

.4 Breaker tripping devices, solid state as indicated.

.1 Instantaneous overcurrent relas.
.2 Overvoltage relay.
.3 Undervoltage relay.
.4 Time overcurrent relay.
.5 Time-delay relay.
.6 Ground fault relay.

.5 Trip setting devices: dials.

.6 Auxiliary contacts: 2 - N.O., 2 - N.C.

.7 Provide spare parts as recommended by the manufacturer for a maintenance period of at least 2 years.

**Part 3 Execution**

**3.1 INSTALLATION**

.1 As indicated.

**END OF SECTION**

## Part 1 General

### 1.1 SECTION INCLUDES

.1 Materials and installation for standard and custom breaker type panelboards.

### 1.2 RELATED SECTIONS

.1 Section 01 33 00 - Submittal Procedures.

.2 Section 26 05 00 - Common Work Results - Electrical.

.3 Section 26 28 21 - Moulded Case Circuit Breakers.

### 1.3 REFERENCES

.1 Canadian Standards Association (CSA International)

.1 CSA C22.2No.29-[M1989(R2000)], Panelboards and enclosed Panelboards.

### 1.4 SHOP DRAWINGS

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

.2 Drawings to include electrical detail of panel, branch breaker type, quantity, ampacity and enclosure dimension.

## Part 2 Products

### 2.1 PANELBOARDS

.1 Panelboards: to CSA C22.2No.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 panelboards: bus and breakers rated for 18kA (symmetrical) interrupting capacity or as indicated.

.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 Two keys for each panelboard and key panelboards alike.

.6 Copper bus with neutral of same ampere rating as mains.

.7 Mains: suitable for bolt-on breakers.

.8 Trim with concealed front bolts and hinges.

.9 Trim and door finish: baked grey enamel.

.10 Approved manufacture: Schneider Electric, Eaton

**2.2 BREAKERS**

.1 Breakers: to Section 26 28 21 - Moulded Case Circuit Breakers.

.2 Breakers with thermal and magnetic tripping in panelboards except as indicated otherwise.

.3 Lock-on devices for fire alarm clock outlet, emergency, door supervisory, intercom, stairway, exit and night light circuits.

**2.3 EQUIPMENT IDENTIFICATION**

.1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results – 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.

**Part 3 Execution**

**3.1 INSTALLATION**

.1 Locate panelboards as indicated and mount securely, plumb, true and square, to adjoining surfaces.

.2 Install surface mounted panelboards on U-channel. Where practical, group panelboards on common supports.

.3 Mount panelboards to height specified in Section 26 05 00 - Common Work Results - Electrical.

.4 Connect loads to circuits.

.5 Connect neutral conductors to common neutral bus with respective neutral identified.

.6 Measure load current on each phase and adjust phase loading for a balanced system.

**END OF SECTION**

## Part 1 General

### 1.1 RELATED WORK

.1 Section 26 05 00 - Common Work Results - Electrical.

### 1.2 REFERENCES

.1 Canadian Standards Association (CSA)

.1 CAN/CSA-Q9000, Quality Management and Quality Assurance Standards - Guidelines for Selection and Use.

### 1.3 PRODUCT DATA

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

.2 Submit product data sheets for sills, busbars and compartments. Include product characteristics, physical size and finish.

.3 Manufacturers Instructions: Provide to indicate special handling criteria, installation sequence, cleaning procedures.

### 1.4 SHOP DRAWINGS

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

.2 Indicate:

.1 Outline dimensions
.2 Configuration of identified compartments.
.3 Floor anchoring method and dimensioned foundation template.
.4 Cable entry and exit locations.
.5 Dimensioned position and size of busbars and details of provision for future extension.
.6 Schematic and wiring diagrams.

### 1.5 CLOSEOUT SUBMITTALS

.1 Provide operation and maintenance data for motor control centre for incorporation into manual.

.2 Include data for each type and style of starter.

### 1.6 EXTRA MATERIALS

.1 Provide maintenance materials.

.2 Include: 5 control fuses, control transformer, H-O-A selector switch and contact blocks, 5 lamps

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## Part 2 Products

### 2.1 SUPPLY CHARACTERISTICS

.1 600 V, 60Hz, wye connected, 3 phase, 3 wire, grounded neutral.

### 2.2 GENERAL DESCRIPTION

.1 Compartmentalized vertical sections with common power busbars.

.2 Floor mounting, free standing, enclosed dead front.

.3 Indoor CSA 1 gasketted enclosure, back to back mounting.

.4 Class I Type B.

### 2.3 VERTICAL SECTION CONSTRUCTION

.1 Independent vertical sections fabricated from rolled flat steel sheets bolted together to form rigid, completely enclosed assembly.

.2 Each vertical section divided into compartment units, minimum 305 mm high, as indicated.

.3 Each unit to have complete top and bottom steel plate for isolation between units.

.4 Horizontal wireways, equipped with cable supports, across top and bottom, extending full width of motor control centre, isolated from busbars by steel barriers.

.5 Vertical wireways c/w doors for load and control conductors extending full height of vertical sections, and equipped with cable tie supports. Installation wiring to units accessible with doors open and units in place.

.6 Openings, with removable coverplates, in side of vertical sections for horizontal wiring between sections.

.7 Incoming cables to enter at top with terminals.

.8 Provision for outgoing cables to exit via top or bottom with terminals.

.9 Removable lifting means.

.10 Provision for future extension of both ends of motor control centre including busbars without need for further drilling, cutting or preparation in field.

.11 Divide assembly for shipment to Site, complete with hardware and instructions for re-assembly.

**2.4 SILLS**

.1 Continuous channel iron floor sills for mounting bases with 19 mm diameter holes for bolts.

**2.5 BUSBARS**

.1 Main horizontal and branch vertical, three phase high conductivity tin plated copper busbars in separate compartment self-cooled, extending entire width and height of motor control centre, supported on insulators and rated:

.1 Main horizontal busbars: 600 A.

.2 Branch vertical busbars: 300 A.

.2 Branch vertical busbars for distribution of power to units in vertical sections.

.3 No other cables, wires, equipment in main and branch busbar compartments.

.4 Brace buswork to withstand effects of short-circuit current of 42kA rms symmetrical.

.5 Bus supports: with high dielectric strength, low moisture absorption, high impact material and long creepage surface designed to discourage collection of dust.

**2.6 GROUND BUS**

.1 Copper ground bus extending entire width of motor control centre.

.2 Vertical ground bus strap, full height of section, tied to horizontal ground bus, engaged by plug-in unit ground stab.

**2.7 MOTOR STARTERS AND DEVICES**

.1 Provide motor starters with required controls to interface with existing Metasys Control System. This includes start signals, running signals, and current CTs.

**2.8 STARTER UNIT COMPARTMENTS**

.1 Units EEMAC size 5 and smaller, circuit breaker units 225A and smaller, plug-in type with self-disconnect. Guide rail supports for units to ensure that stabs make positive contact with vertical bus. Provision for units to be installed or removed, off load, while buses energized.

.2 Unit mounting:

.1 Engaged position - unit stabbed into vertical bus.

.2 Withdrawn position - unit isolated from vertical bus but supported by structure. Terminal block accessible for electrical testing of starter.

.3 Provision for positive latching in either engaged or withdrawn position and padlocking in withdrawn position.

.4 Stab-on connectors free floating tin plated clips, self-aligning, backed up with steel springs.

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.3 External operating handle of circuit switch interlocked with door to prevent door opening with switch in "on" position. Provision for 3 padlocks to lock operating handle in "off" position and lock door closed.

.4 Hinge unit doors on same side.

.5 Overload relays manually reset from front with door closed.

.6 Pushbuttons and indicating lights mounted on door front.

.7 Devices and components by one manufacturer to facilitate maintenance.

.8 Pull-apart terminal blocks for power and control to allow removal of starter units without removal of field wiring.

## 2.9 WIRING IDENTIFICATION

.1 Provide wiring identification in accordance with Section 26 05 00 - Common Work Results - Electrical.

## 2.10 EQUIPMENT IDENTIFICATION

.1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results - Electrical.

.1 Motor control centre main nameplate: size No. 7

.2 Individual compartment nameplates: size No. 5.

## 2.11 FINISHES

.1 Apply finishes in accordance with Section 26 05 00 - Common Work Results - Electrical.

.2 Paint motor control centre exterior light gray and interiors white.

## 2.12 SOURCE QUALITY CONTROL

.1 Provide manufacturer's type test certificates including short circuit fault damage certification up to short circuit values specified under bus bracing.

.2 Contract Administrator to witness standard factory testing of complete motor control centre including operation of switches, circuit breakers, starters and controls.

.3 Manufacturer to provide proof of quality control program in accordance with [CAN/CSA-Q9000].

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## Part 3 Execution

### 3.1 INSTALLATION

.1 Set and secure motor control centre in place on channel bases, rigid, plumb and square to building floor and wall.

.2 Make field power and control connections as indicated.

.3 Ensure correct overload heater elements are installed.

.4 Make connections to Metasys Control System

### 3.2 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 00 - Common Work Results - Electrical.

.2 Ensure moving and working parts are lubricated where required.

.3 Operate starters in sequence to prove satisfactory performance of motor control centre during 8 hours period.

**END OF SECTION**

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## Part 1 General

### 1.1 SECTION INCLUDES

.1 Switches, receptacles, wiring devices, cover plates and their installation.

### 1.2 RELATED SECTIONS

.1 Section 01 33 00 - Submittal Procedures.

.2 Section 26 05 01 - Common Work Results - Electrical.

### 1.3 REFERENCES

.1 Canadian Standards Association (CSA International)

.1 CSA-C22.2 No.42, General Use Receptacles, Attachment Plugs and Similar Devices.

.2 CSA-C22.2 No.42.1, Cover Plates for Flush-Mounted Wiring Devices (Bi-national standard, with UL 514D).

.3 CSA-C22.2 No.55, Special Use Switches.

.4 CSA-C22.2 No.111, General-Use Snap Switches (Bi-national standard, with UL 20, twelfth edition).

### 1.4 SHOP DRAWINGS AND PRODUCT DATA

.1 Submit shop drawings and product data in accordance with Section 01 33 00 - Submittal Procedures.

## Part 2 Products

### 2.1 SWITCHES

.1 20 A, 120 V, single pole, double pole, three-way, four-way switches to: CSA-C22.2 No.55 and 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 Ivory toggle.

.3 Toggle operated locking fully rated for tungsten filament and fluorescent lamps, and up to 80% of rated capacity of motor loads.

.4 Switches of one manufacturer throughout project.

.5 Acceptable materials: Leviton specification grade, Hubbell specification grade.

**2.2 RECEPTACLES**

.1 Duplex receptacles, CSA type 5-15 R, 125 V, 15 A, U ground, to: CSA-C22.2 No.42 with following features:

.1 Ivory 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 rivetted grounding contacts.

.2 Single receptacles CSA type 5-15 R, 125 V, 15 A, U ground with following features:

.1 Ivory 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.

.5 Acceptable materials: Leviton specification grade, Hubbell specification grade.

**2.3 COVER PLATES**

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

.2 Cover plates from one manufacturer throughout project.

.3 Sheet stainless steel utility box cover for wiring devices installed in surface-mounted utility boxes.

.4 Stainless steel, 1 mm thick cover plates for wiring devices mounted in flush-mounted outlet box.

.5 Stainless steel or cast aluminum cover plates for wiring devices mounted in surface-mounted FS or FD type conduit boxes.

.6 Weatherproof double lift spring-loaded cast aluminum cover plates, complete with gaskets for duplex receptacles as indicated.

.7 Weatherproof spring-loaded cast aluminum cover plates complete with gaskets for single receptacles or switches.

**Part 3 Execution**

**3.1 INSTALLATION**

.1 Switches:

.1 Install single throw switches with handle in "UP" position when switch closed.

.2 Install switches in gang type outlet box when more than one switch is required in one location.

.3 Mount toggle switches at height in accordance with Section 26 05 00 - Common Work Results - Electrical.

.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 - Electrical.

.3 Where split receptacle has one portion switched, mount vertically and switch upper portion.

.3 Cover plates:

.1 Protect stainless steel cover plate finish with paper or plastic film until painting and other work is finished.

.2 Install suitable common cover plates where wiring devices are grouped.

.3 Do not use cover plates meant for flush outlet boxes on surface-mounted boxes.

**END OF SECTION**

## Part 1 General

### 1.1 SECTION INCLUDES

.1 Materials for moulded-case circuit breakers.

### 1.2 RELATED SECTIONS

.1 Section 01 33 00 - Submittal Procedures.

### 1.3 REFERENCES

.1 Canadian Standards Association (CSA International).

.1 CSA-C22.2 No. 5, 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).

### 1.4 SUBMITTALS

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

.2 Include time-current characteristic curves for breakers with ampacity of 90 A and over or with interrupting capacity of 22,000 A symmetrical (rms) and over at system voltage.

## Part 2 Products

### 2.1 BREAKERS GENERAL

.1 Moulded-case circuit breakers: 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 Circuit breakers to have minimum symmetrical rms interrupting capacity rating matching panel board or switchboard containing breaker.

### 2.2 THERMAL MAGNETIC BREAKERS [DESIGN A]

.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.

**2.3 MAGNETIC BREAKERS [DESIGN B]**

.1 Moulded case circuit breaker to operate automatically by means of magnetic tripping devices to provide instantaneous tripping for short circuit protection.

**2.4 SOLID STATE TRIP BREAKERS [DESIGN D]**

.1 Moulded case circuit breaker to operate by means of solid-state trip unit with associated current monitors and self-powered shunt trip to provide inverse time current trip under overload condition, and long time, short time, instantaneous tripping for phase and ground fault short circuit protection.

## Part 3 Execution

**3.1 INSTALLATION**

.1 Install circuit breakers as indicated.

.2 Set adjustable trip settings according to coordination study.

**END OF SECTION**

## Part 1 General

### 1.1 SECTION INCLUDES

.1 Materials and installation for fused and non-fused disconnect switches.

### 1.2 RELATED SECTIONS

.1 Section 01 33 00 - Submittal Procedures.

.2 Section 26 05 01 - Common Work Results - Electrical.

### 1.3 REFERENCES

.1 Canadian Standards Association (CSA International).

.1 CAN/CSA C22.2 No.4, Enclosed Switches.

.2 CSA C22.2 No.39, Fuseholder Assemblies.

### 1.4 SUBMITTALS

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

## Part 2 Products

### 2.1 DISCONNECT SWITCHES

.1 Fusible, non-fusible, horsepower rated disconnect switch in CSA Enclosure 12, to CAN/CSA C22.2 No.4size as indicated.

.2 Provision for padlocking in on-off switch position by three locks.

.3 Mechanically interlocked door to prevent opening when handle in ON position.

.4 Fuses: size as indicated

.5 Fuseholders: to CSA C22.2 No.39 relocatable and suitable without adaptors, for type and size of fuse indicated.

.6 Quick-make, quick-break action.

.7 ON-OFF switch position indication on switch enclosure cover.

### 2.2 EQUIPMENT IDENTIFICATION

.1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results - Electrical.

.2 Indicate name of load controlled on size 4 nameplate.

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## Part 3 Execution

### 3.1 INSTALLATION

.1 Install disconnect switches complete with fuses if applicable.

**END OF SECTION**

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## Part 1 General

### 1.1 SECTION INCLUDES

.1 Materials and installation for industrial control devices including pushbutton stations, control and relay panels.

### 1.2 RELATED SECTIONS

.1 Section 01 33 00 - Submittal Procedures.

.2 Section 26 05 00 - Common Work Results - Electrical.

### 1.3 REFERENCES

.1 Canadian Standards Association (CSA International)

.1 CSA C22.2 No.14, Industrial Control Equipment.

.2 National Electrical Manufacturers Association (NEMA)

.1 NEMA ICS 1, Industrial Control and Systems: General Requirements.

### 1.4 SHOP DRAWINGS

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

.2 Include schematic, wiring, interconnection diagrams.

### 1.5 QUALITY ASSURANCE

.1 Submit to Contract Administrator copy of test results.

## Part 2 Products

### 2.1 AC CONTROL RELAYS

.1 Control Relays: to CSA C22.2 No.14.

.2 Fixed contact plug-in type: general purpose heavy duty with 2 poles. Coil rating: 120 V. Contact rating: 240V, 2 A.

### 2.2 RELAY ACCESSORIES

.1 Standard contact cartridges: normally-open - convertible to normally-closed in field.

### 2.3 OILTIGHT LIMIT SWITCHES

.1 Snap action type: roller, rod, fork], lever, top, side, push, wobble stick actuator, CSA type 4 enclosure. Contact rating 240VAC, 2A

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**2.4 SOLID STATE TIMING RELAYS**

.1 Construction: AC operated electronic timing relay with solid-state timing circuit to operate output contact.

.2 Operation: on-delay or off-delay.

.3 Potentiometer: self contained to provide time interval adjustment.

.4 Supply voltage: 120 V, AC, 60 Hz.

.5 Temperature range: minus 20 degrees C to 60 degrees C.

.6 Output contact rating: maximum voltage 300 V AC or DC. Current: 2A

.7 Timing ranges: field adjustable, minimum 0.1s, maximum 60 hr.

**2.5 OPERATOR CONTROL STATIONS**

.1 Enclosure: CSA Type 4, surface mounting:

**2.6 PUSHBUTTONS**

.1 Illuminated], Heavy duty Oil tight. Operator extend type, as indicated. Black, with 2-NO and 2-NC contacts rated at 10 A, AC, labels as indicated. Stop pushbuttons coloured red. Start pushbuttons coloured green

**2.7 SELECTOR SWITCHES**

.1 Maintained 3 position labelled as indicated heavy duty oil tight, operators wing lever contact arrangement as indicated, rated 120 V, 10A, AC.

**2.8 INDICATING LIGHTS**

.1 Heavy duty Oil tight, full voltage, LED type, push-to-test, lens colour: as indicated, supply voltage: 120 V, lamp voltage: 120 V, labels as indicated.

**2.9 CONTROL AND RELAY PANELS**

.1 CSA Type 12 sheet steel enclosure with hinged padlockable access door, accommodating relays timers, labels, as indicated, factory installed and wired to identified terminals.

**2.10 CONTROL CIRCUIT TRANSFORMERS**

.1 Single phase, dry type.

.2 Primary: 600 V, 60 Hz ac.

.3 Secondary: 120 V, AC.

.4 Rating: 150 VA, or larger as required.

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.5 Secondary fuse: ampacity as required.

.6 Close voltage regulation as required by magnet coils and solenoid valves.

**2.11 THERMOSTAT LINE VOLTAGE**

.1 Wall mounted, for exhaust fan control.

.2 Full load rating: 8A at 120 V.

.3 Temperature setting range: 0 degrees C to 30 degrees C.

.4 Thermometer Range: 0 degrees C to 30 degrees C.

.5 Markings in 5 degrees increments.

.6 Differential temperature fixed at 1 degrees C.

## Part 3 Execution

**3.1 INSTALLATION**

.1 Install pushbutton stations, control and relay panels, control devices and interconnect.

**3.2 FIELD QUALITY CONTROL**

.1 Perform tests in accordance with Section 26 05 00 - Common Work Results - Electrical.

.2 Depending upon magnitude and complexity, divide control system into convenient sections, energize one section at time and check out operation of section.

.3 Upon completion of sectional test, undertake group testing.

.4 Check out complete system for operational sequencing.

**END OF SECTION**

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## Part 1 General

### 1.1 RELATED SECTIONS

.1 Section 26 05 00 - Common Work Results - Electrical.

### 1.2 REFERENCES

.1 NEMA contactors and motor starters

### 1.3 SHOP DRAWINGS AND PRODUCT DATA

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

.2 Indicate:

.1 Mounting method and dimensions.
.2 Starter size and type.
.3 Layout of identified internal and front panel components.
.4 Enclosure types.
.5 Wiring diagram for each type of starter.
.6 Interconnection diagrams.

### 1.4 CLOSEOUT SUBMITTALS

.1 Provide operation and maintenance data for motor starters for incorporation into manual.

.2 Include operation and maintenance data for each type and style of starter.

### 1.5 EXTRA MATERIALS

.1 Provide maintenance materials.

.2 Provide listed spare parts for each different size and type of starter:

.1 3 contacts, stationary.
.2 3 contacts, movable.
.3 1 contacts, auxiliary.
.4 1 control transformer[s].
.5 1 operating coil.
.6 2 fuses.
.7 10% indicating lamp bulbs used.

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## Part 2 Products

### 2.1 MATERIALS

.1 Starters: NEMA standards, IEC rated equipment not allowed.

### 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 tigh] labelled as indicated.

.2 Indicating light: heavy duty oil tight, LED type and colour as indicated.

.3 Locking tab to permit padlocking in "ON" or "OFF" position.

### 2.3 FULL VOLTAGE MAGNETIC STARTERS

.1 Provide control signal interface to existing Metasys Control system.

.2 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.

.5 Hand-Off-Auto selector switch mounted on starter door

.3 Combination type starters to include motor circuit interrupter with operating lever on outside of enclosure to control disconnect motor circuit interrupter, 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.

.4 Accessories:

.1 Pushbuttons and selector switches: heavy duty, oil tight labelled as indicated.

.2 Indicating lights: heavy duty, oil tight, LED type and color as indicated.

.3 1-N/O and 1-N/C spare auxiliary contacts unless otherwise indicated.

### 2.4 FULL VOLTAGE REVERSING MAGNETIC STARTERS

.1 Provide control signal interface to existing Metasys Control system.

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.2 Full voltage reversing magnetic starters of size, type, rating and enclosure type as indicated with components as follows:

.1 Two - 3 pole magnetic contactors mounted on common base.

.2 Mechanical and electrical interlocks to prevent both contactors from operating at same time.

.3 Three overload relays with heater elements, manual reset.

.3 Accessories:

.1 Pushbuttons and selector switches: heavy duty, oil tight labelled as indicated.

.2 Indicating lights: heavy duty, oil tight, LED type and color as indicated.

.3 Auxiliary control devices as indicated.

**2.5 CONTROL TRANSFORMER**

.1 Single phase, dry type, control transformer with primary voltage as indicated and 120 V secondary, complete with secondary fuse, installed in with starter as indicated.

.2 Size control transformer for control circuit load plus 20% spare capacity.

**2.6 FINISHES**

.1 Apply finishes to enclosure in accordance with Section 26 05 00 - Common Work Results - Electrical.

**2.7 EQUIPMENT IDENTIFICATION**

.1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results - Electrical.

.2 Manual starter designation label, black plate, white letters, size 1, engraved as indicated.

.3 Magnetic starter designation label, black plate, white letters, size 4 engraved as indicated.

## Part 3 Execution

**3.1 INSTALLATION**

.1 Install starters, connect power and control as indicated.

.2 Ensure correct fuses and overload devices elements installed.

.3 Confirm operation of motor starters from Metasys Control System.

**3.2 FIELD QUALITY CONTROL**

.1 Perform tests in accordance with Section 26 05 00 - Common Work Results - Electrical and manufacturer's instructions.

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.2 Operate switches, 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.

**END OF SECTION**

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## Part 1 General

### 1.1 REFERENCES

.1 Canadian Standards Association (CSA)

.1 C22.2 No.190, Capacitors for Power Factor Correction.

### 1.2 PRODUCT DATA

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

## Part 2 Products

### 2.1 CAPACITORS

.1 Capacitor unit assembly for power factor correction: to C22.2 No.190.

.2 Capacitor characteristics:

.1 100 kVAR, 1 kV insulation class.
.2 600 V, 3 phase, 60 Hz, 4 wire, wye connected , grounded neutral .
.3 Enclosure: indoor enclosed, dustproof .
.4 Non propogating liquid insulated .
.5 Protective fuses: with blown fuse indicators .
.6 Discharge device to 50 V in 1 min .
.7 Lug terminal.
.8 50kA short circuit capacity.

### 2.2 FINISH

.1 Apply finishes in accordance with Section 26 05 00 - Common Work Results - Electrical.

## Part 3 Execution

### 3.1 INSTALLATION

.1 Install and connect capacitors.

### 3.2 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 00 - Common Work Results - Electrical.

.2 Following tests to be carried out by manufacturer within 24 h of energizing equipment:

.1 Voltage and current are balanced and within capacity rating.
.2 Operating kVAR.

.3 Terminal to case resistance is greater than 1000 megohm for two bushing capacitors. For one bushing capacitor check by measuring discharge time constant. This should be less than 60 s and residual capacitor voltage should be reduced from crest value of nominal rated voltage to less than 50 V.

.3 Submit certified test results to Contract Administrator .

**END OF SECTION**