
COMMON WORK RESULTS - ELECTRICAL

Part 1 General

1.1 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CSA C22.1-06, Canadian Electrical Code, Part 1 (20th Edition), Safety Standard for Electrical Installations.
 - .2 CSA C22.2.
 - .3 CAN/CSA-C22.3 No. 1, Overhead Systems.
 - .4 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-1-1958, Light Gray Colour for Indoor Switch Gear.
- .3 Institute of Electrical and Electronics (IEEE)/National Electrical Safety Code Product Line (NESC)
 - .1 IEEE SP1122-2000, The Authoritative Dictionary of IEEE Standards Terms, 7th Edition.

1.2 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.

1.3 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 and labels for control items in English.
- .4 The contractor shall be required to obtain a complete FAS VI report for the FAS including the FAS Sprinkler system. A copy of these reports shall be left on Site at the main FAS panel as well as a complete FAS device list (with addresses). Soft copies of these reports are required. As built drawings of a floor plan with all of the FAS devices, indicating approx. device location and addressable address shall be provided. The contractor shall supply as built drawings of all of the FAS network loops. The contractor shall supply as built drawings of sprinkler system showing approx. location of all sprinkler devices and zoning.

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1.4 SUBMITTALS

- .1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit for review single line electrical diagrams under plexiglass and locate at main service.
 - .1 Electrical distribution system in main electrical room.
- .3 Submit for review fire alarm riser diagram, plan and zoning of building under plexiglass at fire alarm control panel and annunciator.
- .4 Shop drawings:
 - .1 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.
 - .2 Identify on wiring diagrams circuit terminals and indicate internal wiring for each item of equipment and interconnection between each item of equipment.
 - .3 Indicate of drawings clearances for operation, maintenance, and replacement of operating equipment devices.
 - .4 Submit and product data to Contract Administrator. Quantities as required.
 - .5 If changes are required, notify Contract Administrator of these changes before they are made.

1.5 SYSTEM STARTUP

- .1 Instruct Operating Personnel in operation, care and maintenance of systems, system equipment and components.
- .2 Arrange and pay for services of manufacturer's factory service Contract Administrator 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.

1.6 OPERATING INSTRUCTIONS

- .1 Provide for each system and principal item of equipment as specified in technical sections for use by operation and maintenance personnel.
- .2 Operating instructions to include following:
 - .1 Wiring diagrams, control diagrams, and control sequence for each principal system and item of equipment.
 - .2 Start up, proper adjustment, operating, lubrication, and shutdown procedures.
 - .3 Safety precautions.

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- .4 Procedures to be followed in event of equipment failure.
- .5 Other items of instruction as recommended by manufacturer of each system or item of equipment.
- .3 Print or engrave operating instructions and frame under glass or in approved laminated plastic.
- .4 Post instructions where directed.
- .5 For operating instructions exposed to weather, provide weather-resistant materials or weatherproof enclosures.
- .6 Ensure operating instructions will not fade when exposed to sunlight and are secured to prevent easy removal or peeling.

1.7 SEPARATE PRICING

- .1 The contract shall require the electrical be broken into the following separate price items for electrical:
 - .1 SP-1 Fire Alarm System Upgrade
 - .2 SP-2 Upgrade to the Emergency Lighting System.
 - .3 SP-3 Upgrade to the Gym and Weight Room Lighting.
 - .4 SP-4 Electrical required for mechanical system upgrade including all upgrades in the mezzanine.

Part 2 Products

2.1 MATERIALS AND EQUIPMENT

- .1 Material and equipment to be CSA certified. Where CSA certified material and equipment is 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 authority having jurisdiction and Contract Administrator.
- .2 decal signs, minimum size 175 x 250 mm.

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2.4 WIRING TERMINATIONS

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

2.5 EQUIPMENT IDENTIFICATION

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

- .2 Sizes as follows:

NAMEPLATE SIZES

Size 1	10 x 50 mm	1 line	3 mm high letters
Size 2	12 x 70 mm	1 line	5 mm high letters
Size 3	12 x 70 mm	2 lines	3 mm high letters
Size 4	20 x 90 mm	1 line	8 mm high letters
Size 5	20 x 90 mm	2 lines	5 mm high letters
Size 6	25 x 100 mm	1 line	12 mm high letters
Size 7	25 x 100 mm	2 lines	6 mm high letters

- .2 Labels: embossed plastic labels with 6mm high letters unless specified otherwise.
 - .3 Wording on nameplates and labels to be approved by Contract Administrator 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 Disconnects, starters and contactors: indicate equipment being controlled and voltage.
 - .7 Terminal cabinets and pull boxes: indicate system and voltage.
 - .8 Transformers: indicate capacity, primary and secondary voltages.

2.6 WIRING IDENTIFICATION

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

2.7 CONDUIT AND CABLE IDENTIFICATION

- .1 Colour code conduits, boxes and metallic sheathed cables.

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.2 Code with plastic tape or paint at points where conduit or cable enters wall, ceiling, or floor, and at 5 m intervals.

.3 Colours: 25 mm wide prime colour and 15 mm wide auxiliary colour.

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

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 grey 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 plastic, sized for free passage of conduit, and protruding 50 mm.

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

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

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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 3000 mm, and information is given before installation.
- .4 Locate light switches on latch side of doors.
 - .1 Locate disconnect devices in mechanical and elevator machine rooms on latch side of floor.

3.5 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. Install electrical equipment at following heights unless indicated otherwise.
 - .1 Local switches: 1200 mm.
 - .2 Wall receptacles:
 - .1 General: 300 mm.
 - .2 Above top of continuous baseboard heater: 200 mm.
 - .3 Above top of counters or counter splash backs: 175 mm.
 - .4 In mechanical rooms: 1400 mm.
 - .3 Panelboards: as required by Code or as indicated.
 - .4 Fire alarm stations: 1200 mm.
 - .5 Fire alarm bells/strobes: 2100 mm.

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. Verify co-ordination with upstream devices.

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.

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- .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, Security System, PA system, communications.
 - .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.
- .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

WIRE BOX CONNECTORS – 0 - 1000 V

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.18-98, Outlet Boxes, Conduit Boxes, Fittings and Associated Hardware.
 - .2 CSA C22.2No.65-93(R1999), Wire Connectors.
- .2 Electrical and Electronic Manufacturers' Association of Canada (EEMAC)
 - .1 EEMAC 1Y-2, 1961 Bushing Stud Connectors and Aluminum Adapters (1200 Ampere Maximum Rating).
- .3 National Electrical Manufacturers Association (NEMA)

Part 2 Products

2.1 MATERIALS

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

2.2 INSTALLATION

- .1 Remove insulation carefully from ends of conductors 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 CSA C22.2No.65.
 - .3 Install fixture type connectors and tighten. Replace insulating cap.
 - .4 Install bushing stud connectors in accordance with NEMA.

END OF SECTION

WIRES AND CABLES (0-1000 V)

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 .0.3-96, Test Methods for Electrical Wires and Cables.
- .2 CAN/CSA-C22.2 No. 131-M89(R1994), Type TECK 90 Cable.

1.3 PRODUCT DATA

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

1.4 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials.
- .2 Collect and separate plastic, paper packaging and corrugated cardboard in accordance with Waste Management Plan.
- .3 Fold up metal banding, flatten and place in designated area for recycling.

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 1000 V insulation of chemically cross-linked thermosetting polyethylene material rated RW90.
- .3 Aluminum conductors made of NUAL may be used only where clearly indicated on drawings.

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 Aluminum conductors made of NUAL may be used only where clearly indicated on drawings.

WIRES AND CABLES (0-1000 V)

- .3 Insulation:
 - .1 Chemically cross-linked thermosetting polyethylene rated type RW90, 1000 V.
- .4 Inner jacket: polyvinyl chloride material.
- .5 Armour: interlocking galvanized steel or aluminum.
- .6 Overall covering: polyvinyl chloride material.
- .7 Fastenings:
 - .1 One hole steel straps to secure surface cables 50 mm and smaller. Two hole steel straps for cables larger than 50 mm.
 - .2 Channel type supports for two or more cables at 50 mm centers.
 - .3 Threaded rods: 6 mm dia. to support suspended channels.
- .8 Connectors:
 - .1 Watertight approved for TECK cable. Explosion proof connectors shall be used in rated areas.

2.3 ARMoured CABLES

- .1 Conductors: insulated, copper, size as indicated. Aluminum conductors made of NUAL may be used only where clearly indicated on drawings.
- .2 Type: AC90.
- .3 Armour: interlocking type fabricated from galvanized steel or aluminum strip.
- .4 Connectors: Teck90 Style.

2.4 ALUMINUM SHEATHED CABLE

- .1 Conductors: copper, size as indicated.
- .2 Insulation: type RA90 rated 1000 V.
- .3 Sheath: aluminum applied to form continuous sheath.
- .4 Fastenings for aluminum sheathed cable:
 - .1 One hole aluminum straps to secure surface cables 25 mm and smaller. Two hole steel straps for cables larger than 25 mm. Use aluminum strap only with single conductor cable.
 - .2 Channel type supports for two or more cables.
 - .3 Threaded rods: 6 mm dia. to support suspended channels.

WIRES AND CABLES (0-1000 V)

2.5 CONTROL CABLES

- .1 Low energy 300 V control cable: stranded annealed copper conductors sized as indicated. All cables shall be FT-4 rated and meet manufacturers requirements for the intended purpose. Cables shall be shielded as required. Cables for fire alarm systems shall be rated FA or FAS and meet the requirements of the fire alarm system manufacturer.
- .2 600 V type: as above but with 600V insulation where required.

Part 3 Execution

3.1 INSTALLATION - General

- .1 Install wiring as follows:
 - .1 In conduit systems in accordance with Section 26 05 34.
 - .2 In cabletroughs in accordance with Section 26 05 36.
 - .3 In trenches in accordance with Section 16 26 05 44.

3.2 INSTALLATION OF BUILDING WIRES

- .1 Install wiring as follows:
 - .1 In conduit systems in accordance with Section 26 05 34.

3.3 INSTALLATION OF TECK CABLE 0 -1000 V

- .1 Install cables.
 - .1 Group cables wherever possible on channels.
- .2 Terminate cables in accordance with Section 26 05 20- Wire and Box Connectors - 0 - 1000 V.

3.4 INSTALLATION OF ARMOURED CABLES

- .1 Group cables wherever possible.
- .2 Terminate cables in accordance with Section 26 05 20 - Wire and Box Connectors - 0 - 1000 V.

3.5 INSTALLATION OF ALUMINUM SHEATHED CABLE

- .1 Group cables wherever possible on channels.
- .2 Terminate cables in accordance with Section 26 05 20- Wire and Box Connectors - 0-1000 V.

WIRES AND CABLES (0-1000 V)

3.6 INSTALLATION OF CONTROL CABLES

- .1 Install control cables in conduit.
- .2 Ground control cable shield as required for application

3.7 INSTALLATION OF NON-METALLIC SHEATHED CABLE

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

END OF SECTION

SPLITTERS, JUNCTION, PULL BOXES AND CABINETS

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.

1.2 WASTE MANAGEMENT AND DISPOSAL

- .1 Collect and separate plastic, paper packaging and corrugated cardboard in accordance with Waste Management Plan.
- .2 Fold up metal banding, flatten and place in designated area for recycling.

Part 2 Products

2.1 SPLITTERS

- .1 Sheet metal enclosure, welded corners and formed hinged cover suitable for locking in closed position.
- .2 Connection bars 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 400 A or less.

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 or flush mounting as required.
- .3 All cabinets shall be sprinklerproof

Part 3 Execution

3.1 SPLITTER INSTALLATION

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

SPLITTERS, JUNCTION, PULL BOXES AND CABINETS

- .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 required in Type T cabinets.
- .4 Only main junction and pull boxes are indicated. Install pull boxes so as not to exceed 30m of conduit run between pull boxes.

3.3 IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 01 - Common Work Results - Electrical.
- .2 Install size 2 identification labels indicating system name, voltage and phase.

END OF SECTION

OUTLET BOXES, CONDUIT BOXES AND FITTINGS

Part 1 General

1.1 REFERENCES

- .1 CSA C22.1-2006, Canadian Electrical Code, Part 1.

1.2 WASTE MANAGEMENT AND DISPOSAL

- .1 Collect and separate plastic, paper packaging and corrugated cardboard in accordance with Waste Management Plan.

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 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.
- .4 102 mm square outlet boxes with extension and plaster rings for flush mounting devices in finished tile walls.

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.

OUTLET BOXES, CONDUIT BOXES AND FITTINGS

2.5 FLOOR BOXES

- .1 Concrete tight electro-galvanized sheet steel floor boxes with adjustable finishing rings to suit floor finish with brushed aluminum faceplates. Device mounting plate to accommodate short or long ear receptacles. Minimum depth: 28 mm for receptacles; 73 mm for communication equipment.
- .2 Adjustable, watertight, concrete tight, cast floor boxes with openings drilled and tapped for 19 mm conduit. Minimum size: 73 mm deep.

2.6 CONDUIT BOXES

- .1 Cast FS or FD boxes with factory-threaded hubs and mounting feet for surface wiring of switches and receptacle. This is only allowed in mechanical spaces.

2.7 OUTLET BOXES FOR NON-METALLIC SHEATHED CABLE

- .1 Electro-galvanized, sectional, screw ganging steel boxes, minimum size 76 x 50 x 63 mm with two double clamps to take non-metallic sheathed cables.

2.8 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

CONDUITS, CONDUIT FASTENINGS AND CONDUIT FITTINGS

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.

1.2 WASTE MANAGEMENT AND DISPOSAL

- .1 Place materials defined as hazardous or toxic waste in designated containers.
- .2 Ensure emptied containers are sealed and stored safely for disposal away from children.
- .3 Collect and separate plastic, paper packaging and corrugated cardboard in accordance with Waste Management Plan.

Part 2 Products

2.1 CONDUITS

- .1 Rigid metal conduit: to CSA C22.2 No. 45, galvanized steel threaded.
- .2 Electrical metallic tubing (EMT): to CSA C22.2 No. 83, with couplings.
- .3 Rigid pvc conduit: to CSA C22.2 No. 211.2.
- .4 Flexible metal conduit: to CSA C22.2 No. 56, liquid-tight flexible metal.

2.2 CONDUIT FASTENINGS

- .1 One hole steel straps to secure surface conduits 50 mm and smaller. Two hole steel straps for conduits larger than 50 mm.
- .2 Beam clamps to secure conduits to exposed steel work.
- .3 Channel type supports for two or more conduits at 2 m oc.
- .4 Threaded rods, 6 mm dia., to support suspended channels.

CONDUITS, CONDUIT FASTENINGS AND CONDUIT FITTINGS

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 200 mm 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 Conceal conduits except in mechanical and electrical service rooms.
- .3 Use RGS conduit in Industrial arts area where conduit is exposed.
- .4 Use electrical metallic tubing (EMT) except in cast concrete above 2.4 m not subject to mechanical injury.
- .5 Use rigid pvc conduit underground.
- .6 Use liquid tight flexible metal conduit for connection to motors or vibrating equipment.
- .7 Use explosion proof flexible connection for connection to explosion proof motors.
- .8 Install conduit sealing fittings in hazardous areas. Fill with compound.
- .9 Minimum conduit size for lighting and power circuits: 19 mm.
- .10 Bend conduit cold. Replace conduit if kinked or flattened more than 1/10th of its original diameter.

CONDUITS, CONDUIT FASTENINGS AND CONDUIT FITTINGS

- .11 Mechanically bend steel conduit over 19 mm dia.
- .12 Field threads on rigid conduit must be of sufficient length to draw conduits up tight.
- .13 Install fish cord in empty conduits.
- .14 Run 2-25 mm spare conduits up to ceiling space from each flush panel. Terminate these conduits in 152 x 152 x 102 mm junction boxes in ceiling space or in case of an exposed concrete slab, terminate each conduit in surface type box.
- .15 Remove and replace blocked conduit sections. Do not use liquids to clean out conduits.
- .16 Dry conduits out before installing wire.

3.2 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 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.
- .7 Surface conduits shall not be used where exposed.

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.

CONDUITS, CONDUIT FASTENINGS AND CONDUIT FITTINGS

- .5 Do not place conduits in 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 UNDERGROUND

- .1 Slope conduits to provide drainage.

END OF SECTION

SURFACE AND LIGHTING FIXTURE RACEWAYS

Part 1 General

1.1 REFERENCES

- .1 Canadian Standards Association (CSA)
 - .1 CAN/CSA-C22.2 No. 62-93/R1999, Surface Raceway Systems.

1.2 PRODUCT DATA

- .1 Submit product data in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Indicate types of raceways with terminology similar to that used in this Section.

1.3 WASTE MANAGEMENT AND DISPOSAL

- .1 Place materials defined as hazardous or toxic waste in designated containers.
- .2 Ensure emptied containers are sealed and stored safely for disposal away from children.
- .3 Collect and separate plastic, paper packaging and corrugated cardboard in accordance with Waste Management Plan.

Part 2 Products

2.1 SURFACE RACEWAY SYSTEM (WIRING PULLED IN)

- .1 Steel: to CSA C22.2 No. 62, one piece, free of sharp edges.
- .2 Corners, pull boxes, elbows, tees, two piece assembly to facilitate Site wiring.
- .3 Finish: enamel.
- .4 Necessary switch, receptacle, extension boxes, adapters and utility fittings required for complete installation.

2.2 SURFACE RACEWAY SYSTEM (WIRING LAID IN)

- .1 Steel: to CSA C22.2 No. 62, two piece.
 - .1 Finish: buff enamel.
- .2 Necessary switch, receptacle, extension boxes, adapters and utility fittings required for complete installation.

2.3 CHANNEL RACEWAY

- .1 Channel type raceway: to CSA C22.2 No. 62, aluminum, solid.

SURFACE AND LIGHTING FIXTURE RACEWAYS

2.4 PLASTIC RACEWAY

- .1 Plastic raceway: to CSA C22.2 No. 62, rigid extruded polyvinyl chloride with slots on either side of raceway for exit of wiring.
- .2 Channel: with solid snap-on cover throughout entire length.

2.5 LIGHTING FIXTURE RACEWAY

- .1 Fluorescent fixture support system using channel type raceway with snap-on cover.
- .2 Channel: minimum 1.6 mm thick.
- .3 Clamp hangers with threaded rod.

2.6 FITTINGS

- .1 Elbows, tees, couplings and hanger fittings: to CSA C22.2 No. 62, manufactured as accessories to raceway supplied.

Part 3 Execution

3.1 INSTALLATION

- .1 Install raceways before installation of wiring. Install covers for raceways and fittings after installation or wiring.
- .2 Install supports, elbows, tees, connectors, fittings, bushings, adaptors as required.
- .3 Keep number of elbows, offsets, connections to minimum.
- .4 Use wiring with mechanical protection in channel raceways.
- .5 Install barriers in raceways where different voltage systems are indicated.

END OF SECTION

FRACTIONAL HORSEPOWER MOTORS

Part 1 General

1.1 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CSA C22.2 No. 100-04, Motors and Generators.
 - .2 CSA C22.2 No. 145-M1986(R2004), Motors and Generators for Use in Hazardous Locations.
- .2 Electrical and Electronic Manufacturers' Association of Canada (EEMAC)
 - .1 EEMAC M1-7-[1992], Standard for Motors and Generators.

1.2 SUBMITTALS

- .1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data: include: product characteristics, performance criteria, physical size, horsepower, watt rating, limitations and finish.
- .3 Shop drawings:
 - .1 Indicate dimensions, recommended installation procedure, wiring diagrams, sizes and location of mounting bolt holes and recommended support method.
- .4 Quality Assurance Submittals:
 - .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
 - .2 Manufacturer's Instructions: submit manufacturer's installation instructions.
- .5 Closeout Submittals:
 - .1 Provide maintenance data for fractional horsepower motors for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

Part 2 Products

2.1 FRACTIONAL HORSEPOWER MOTOR

- .1 Non-hazardous locations: to CSA C22.2 No. 100 and EEMAC M1-7.
- .2 Hazardous locations: to CSA C22.2 No. 145.
 - .1 Rating: As indicated.
 - .2 Type: As indicated.
 - .3 Bearings: As indicated.
 - .4 Frame size: As indicated.

FRACTIONAL HORSEPOWER MOTORS

- .5 Enclosure: As indicated.
- .6 Mounting: As indicated.
- .3 Motor with inherent overheating protectors.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

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

3.3 CLEANING

- .1 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

MOTORS: 1 TO 200 HPKW TO 149KW, TO 600 V

Part 1 General

1.1 REFERENCES

- .1 Electrical and Electronic Manufacturer's Association of Canada (EEMAC)
 - .1 EEMAC M1-7, 1992 , Motors and Generators.

1.2 PRODUCT DATA

- .1 Submit product data in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit product data sheets for motors. Include product characteristics, performance criteria, physical size, horsepower, watt rating, limitations and finish.
- .3 Manufacturer's Instructions: Provide to indicate special handling criteria, installation sequence, cleaning procedures.

1.3 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Indicate:
 - .1 Overall dimensions of motor.
 - .2 Shaft centreline to base dimension.
 - .3 Shaft extension diameter and keyway, coupling dimensions and details.
 - .4 Fixing support dimensions.
 - .5 Dimensioned position of ventilation openings. Details of ventilation duct attachments.
 - .6 Terminal box location and size of terminals.
 - .7 Arrangement and dimensions of accessories.
 - .8 Diagram of connections.
 - .9 Starting current and relative data necessary for use in design of motor starting equipment.
 - .10 Speed/torque characteristic.
 - .11 Weight.
 - .12 Installation data.

1.4 CLOSEOUT SUBMITTALS

- .1 Provide maintenance data for motors for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.
- .2 Data necessary for maintenance of motors.
- .3 Manufacturer's recommended list of spare parts.

MOTORS: 1 TO 200 HPKW TO 149KW, TO 600 V

1.5 QUALITY ASSURANCE

- .1 Contract Administrator reserves the right to witness standard factory testing of motors 50 hp and above.

1.6 WASTE MANAGEMENT AND DISPOSAL

- .1 Place materials defined as hazardous or toxic waste in designated containers.
- .2 Ensure emptied containers are sealed and stored safely for disposal away from children.
- .3 Collect and separate plastic, paper packaging and corrugated cardboard in accordance with Waste Management Plan.
- .4 Fold up metal banding, flatten and place in designated area for recycling.
- .5 Collect, package and store expired motors for either recycling or rebuilding and return to recycler or rebuilder.

1.7 EXTRA MATERIALS

- .1 Provide maintenance materials and spare parts in accordance with Section 01 78 00 - Closeout Submittals.

Part 2 Products

2.1 MATERIALS

- .1 Motors: to EEMAC M1-7.
- .2 Lead markings: to EEMAC M2-1.

2.2 RATING

- .1 Motor:
 - .1 As indicated

2.3 MOTOR TYPE

- .1 As Indicated.

2.4 DESIGN LETTERS

- .1 Polyphase squirrel cage induction motors design As Indicated.

2.5 ENCLOSURE

- .1 Totally enclosed fan cooled.
- .2 Totally enclosed explosion proof for use in: Class as Indicated.

MOTORS: 1 TO 200 HPKW TO 149KW, TO 600 V

2.6 SERVICE CONDITIONS

- .1 Service Factor: 1.15.

2.7 INSULATION

- .1 Class: B or As Indicated..
- .2 Ambient temperature: 40 °C or As indicated.

2.8 BEARINGS

- .1 Antifriction type bearings, fitted with readily accessible facilities for lubrication while motor running or stationary.

2.9 STARTING METHOD

- .1 All motors shall be Inverter Duty rated.
- .2 Include anchor devices and setting templates.

Part 3 Execution

3.1 INSTALLATION

- .1 Dry out motor if dampness present in accordance with manufacturer's instructions.
- .2 Install motor.
- .3 Make wiring connections. Use liquid tight pvc jacketed flexible conduit between rigid conduit and motor.
- .4 Make flexible conduit long enough to permit movement of motor over entire length of slide rails.
- .5 Check for correct direction of rotation, with motor uncoupled from driven equipment.
- .6 Align and couple motor to driven machinery to manufacturer's instructions, using only correct parts such as couplings, belts, sheaves, as provided by manufacturer.

3.2 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 01 - Common Work Results – Electrical.

END OF SECTION

PANELBOARDS BREAKER TYPE

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 01 - Common Work Results - Electrical.

1.3 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CSA C22.2 No.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 C22.2 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 250V panelboards: bus and breakers rated for 25 kA (symmetrical) interrupting capacity or as indicated.
- .3 600V panelboards: bus and breakers rated for 35 kA (symmetrical) interrupting capacity or as indicated.
- .4 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.
- .5 Panelboards: mains, number of circuits, and number and size of branch circuit breakers as indicated.
- .6 Two keys for each panelboard and key panelboards alike.

PANELBOARDS BREAKER TYPE

- .7 Copper bus with neutral of same ampere rating as mains and 200% neutral where indicated.
- .8 Mains: suitable for bolt-on breakers or as required for replacement.
- .9 Trim with concealed front bolts and hinges.
- .10 Trim and door finish: baked grey enamel.

2.2 CUSTOM BUILT PANELBOARD ASSEMBLIES

- .1 Double stack panels as indicated.
- .2 Contactors in mains as indicated.
- .3 Feed through lugs as indicated.
- .4 Isolated ground bus.

2.3 BREAKERS

- .1 Breakers with thermal and magnetic tripping in panelboards except as indicated otherwise.
- .2 Main breaker: separately mounted on top or bottom of panel to suit cable entry. When mounted vertically, down position should open breaker.
- .3 Lock-on devices for 10% of 15 to 30A breakers installed as indicated. Turn over unused lock-on devices to Departmental Representative.
- .4 Lock-on devices for fire alarm, emergency, door supervisory, Security, exit and night light circuits.

2.4 TVSS

- .1 Provide TVSS unit with digital indication and 100kA rating where indicated.

2.5 EQUIPMENT IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 01 - 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.

PANELBOARDS BREAKER TYPE

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 plywood backboards. Where practical, group panelboards on common backboard.
- .3 Mount panelboards to height specified in Section 26 05 01 - Common Work Results - Electrical or as indicated.
- .4 Connect loads to circuits.
- .5 Connect neutral conductors to common neutral bus with respective neutral identified.

END OF SECTION

MOTOR CONTROL CENTRES

Part 1 **General**

1.1 RELATED SECTIONS

1.2 SUBMITTALS

- .1 Provide submittals 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 Manufacturer's Instructions: provide to indicate special handling criteria, installation sequence, cleaning procedures..
- .4 Submit shop drawings and 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.
- .5 Closeout Submittals: provide operation and maintenance data for motor control centre for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.
 - .1 Include data for each type and style of starter.

1.3 WASTE MANAGEMENT AND DISPOSAL

- .1 Collect, package and store existing busbars, wireways, sills, copper ground straps and other associated components for recycling and reuse.

1.4 EXTRA MATERIALS

- .1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.

Part 2 **Products**

2.1 SUPPLY CHARACTERISTICS

- .1 347/600 V, 60Hz, 3 phase, 4 wire, grounded neutral.

2.2 GENERAL DESCRIPTION

- .1 Compartmentalized vertical sections with common power busbars.
- .2 Floor mounting, free standing, enclosed dead front.

MOTOR CONTROL CENTRES

- .3 Indoor CSA sprinklerproof enclosure, front mounting.

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 165 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 cover plates, 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 BUSBARS

- .1 Main horizontal and branch vertical, three phase and neutral tin plated copper busbars in separate compartment bare 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 or as indicated.
- .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 35 kA rms symmetrical.

MOTOR CONTROL CENTRES

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

2.5 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.

2.6 MOTOR STARTERS AND DEVICES

- .1 As Specified. All units complete with HOA selector switch, LED indicator lights for run power and fault, electronic programmable overloads and local disconnect.

2.7 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.
- .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.

2.8 WIRING IDENTIFICATION

- .1 Provide wiring identification in accordance with Section 26 05 01 - Common Work Results - For Electrical.

MOTOR CONTROL CENTRES

2.9 EQUIPMENT IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 01 - Common Work Results - For Electrical.
 - .1 Motor control centre main nameplate: size No. 7, engraved.
 - .2 Individual compartment nameplates: size No. 5, engraved as indicated.

2.10 FINISHES

- .1 Apply finishes in accordance with Section 26 05 01 - Common Work Results - For Electrical.
- .2 Paint motor control centre exterior light gray and interiors white.

2.11 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.

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.

3.2 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results - For 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 hour period.

END OF SECTION

ELECTRICAL CABINETS AND ENCLOSURES

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures.

1.2 REFERENCES

- .1 The Munsell System of Colour Notation.

1.3 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 MATERIALS

- .1 Enclosure constructed with 2.7 mm thick minimum steel, with weather and corrosion resistant finish, Munsell Notation 7.5GY3.5/1.5, size as indicated.
- .2 Entire enclosure capable of withstanding maximum impact force of 86 MN/m² area without rupture of material.
- .3 Removable enclosure panels with formed edges, galvanized steel external fasteners removable only from inside enclosure.
- .4 Enclosure equipped with hot dipped galvanized mounting rails 1 m adjustable horizontally and vertically to enable mounting of equipment at any location within housing.
 - .1 Rails: 14 mm holes and 50 x 14 mm slots on 100 mm centres for horizontal adjustment.
 - .2 Holes in side panel flanges in 60 mm increments for vertical adjustment.
- .5 Cover: tamperproof, bolt-on, domed to shed water.
- .6 Door: minimum 1 m wide, hinged, 3 point latching, with padlocking means.
- .7 Ventilation panel constructed to allow air circulation yet preventing entry of foreign objects, wild life, vermin.
- .8 Door interlocks: as required.
- .9 Enclosure construction such as to allow any configuration of single or ganged enclosures.
- .10 Enclosure capable of being shipped in knocked-down condition.

ELECTRICAL CABINETS AND ENCLOSURES

Part 3 Execution

3.1 INSTALLATION

- .1 Assemble enclosure in accordance with manufacturer's instructions and mount on concrete pad.

- .2 Mount equipment in enclosure.

END OF SECTION

WIRING DEVICES

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.42-99(R2002), General Use Receptacles, Attachment Plugs and Similar Devices.
 - .2 CSA-C22.2 No.42.1-00, Cover Plates for Flush-Mounted Wiring Devices (Bi-national standard, with UL 514D).
 - .3 CSA-C22.2 No.55-M1986(July 2001), Special Use Switches.
 - .4 CSA-C22.2 No.111-00, 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 15 or 20 A, 120 V, single pole, three-way, or 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 White toggle.
- .3 Toggle operated 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: Specification Grade Commercial switches.

WIRING DEVICES

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 White urea moulded housing for normal switches. Co-ordinate with owner for all unique coloured switches. (Red- UPS, Orange – IG Wiring Type)
 - .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 Other receptacles with ampacity and voltage as indicated.
- .3 Receptacles of one manufacturer throughout project.
- .4 Acceptable materials: Specification Grade Commercial switches.

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 steel utility box cover for wiring devices installed in surface-mounted utility boxes.
- .4 Stainless steel, vertically brushed, 1 mm thick cover plates for wiring devices mounted in flush-mounted outlet box.
- .5 Sheet metal 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.

WIRING DEVICES

- .3 Mount toggle switches at height in accordance with Section 26 05 01 - 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 01 - 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

DISCONNECT SWITCHES - FUSED AND NON-FUSED

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-M89 (R2000), Enclosed Switches.
 - .2 CSA C22.2 No.39-M89 (R2003), 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 Non-fusible, horsepower rated disconnect switch in CSA Enclosure, to CAN/CSA C22.2 No.4 sized as per drawings.
- .2 Provision for padlocking in off switch position by three locks.
- .3 Mechanically interlocked door to prevent opening when handle in ON position.
- .4 Sprinkler-proof indoors, weatherproof outdoors.
- .5 Quick-make, quick-break action.
- .6 ON-OFF switch position indication on switch enclosure cover.
- .7 Where required (For VFDs) provide an auxilliary contact to break prior to main contacts and interlock with the VFD emergency stop.

2.2 EQUIPMENT IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 01 - Common Work Results - Electrical.
- .2 Indicate name of load controlled on size 4 nameplate.

DISCONNECT SWITCHES - FUSED AND NON-FUSED

Part 3 Execution

3.1 INSTALLATION

- .1 Install disconnect switches.

END OF SECTION

CONTACTORS

Part 1 **General**

1.1 **SECTION INCLUDES**

- .1 Materials and installation for contactors for system voltages up to 600 V

1.2 **RELATED SECTIONS**

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 26 05 01 - Common Work Results - Electrical.
- .3 Section 26 29 03 - Control Devices.

1.3 **REFERENCES**

- .1 Canadian Standards Association (CSA International)
 - .1 CSA C22.2 No.14-95 (R2001), Industrial Control Equipment.

1.4 **PRODUCT DATA**

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

Part 2 **Products**

2.1 **CONTACTORS**

- .1 Contactors: to CSA C22.2 No.14.
- .2 Electrically held controlled by pilot devices as indicated and rated for type of load controlled.
- .3 Fused switch combination contactor as indicated.
- .4 Complete with 2 normally open and 2 normally closed auxiliary contacts unless indicated otherwise.
- .5 Mount in CSA Enclosure unless otherwise indicated.
- .6 Include following options in cover:
 - .1 Red LED indicating lamp.
 - .2 Hand-Off-Auto selector switch.
- .7 Control transformer: in accordance with Section 26 29 03 - Control Devices, in contactor enclosure.

CONTACTORS

2.2 EQUIPMENT IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 01 - Common Work Results - Electrical.

- .2 Size 4 nameplate indicating name of load controlled.

Part 3 Execution

3.1 INSTALLATION

- .1 Install contactors and connect auxiliary control devices.

END OF SECTION

CONTROL DEVICES

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 01 - Common Work Results - Electrical.

1.3 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CSA C22.2 No.14-95(R2001), Industrial Control Equipment.
- .2 National Electrical Manufacturers Association (NEMA)
 - .1 NEMA ICS 1-2001, 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 one copy of test results.

Part 2 Products

2.1 AC CONTROL RELAYS

- .1 Control Relays: to CSA C22.2 No.14 and NEMA ICS 1.
- .2 Convertible contact type: contacts field convertible from NO to NC, electrically held solid state. Contact rating: as required.

2.2 RELAY ACCESSORIES

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

CONTROL DEVICES

2.3 OPERATOR CONTROL STATIONS

- .1 Enclosure: CSA Type 4, flush mounting:

2.4 PUSHBUTTONS

- .1 Illuminated, Heavy duty Oil tight. Operator flush type, as indicated. With 1-NO and 1-NC contacts rated at as required.

2.5 SELECTOR SWITCHES

- .1 Maintained 3 position labelled as indicated heavy duty oil tight, operators standard, contact arrangement as indicated.

2.6 INDICATING LIGHTS

- .1 Heavy duty Oil tight, full voltage, LED type, as indicated.

2.7 CONTROL AND RELAY PANELS

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

2.8 CONTROL CIRCUIT TRANSFORMERS

- .1 Single phase, dry type.
- .2 Primary: 208 V, 60 Hz ac.
- .3 Secondary: 24 or 120 V, AC. As required
- .4 Rating: VA rating as shown.
- .5 Secondary fuse: rated as required.
- .6 Close voltage regulation as required by magnet coils and solenoid valves.

2.9 THERMOSTAT (LINE VOLTAGE)

- .1 Wall mounted.
- .2 Full load rating: 15A at 120V.
- .3 Temperature setting range: 5 degrees C to 40 degrees C.
- .4 Thermometer Range: 5 degrees C to 50 degrees C.
- .5 Markings in 5 degrees increments.

CONTROL DEVICES

Part 3 Execution

3.1 INSTALLATION

- .1 Install as required.

3.2 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 01 - 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

MOTOR STARTERS TO 600 V

Part 1 General

1.1 RELATED SECTIONS

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

1.2 REFERENCES

- .1 National Electrical Manufacturer's Association (NEMA)
 - .1 NEMA Standards Publication ICS 2-2000: Industrial Control and Systems Controllers, Contactors and Overload Relays Rated 600 Volts.
- .2 International Electrotechnical Commission (IEC)
 - .1 IEC 947-4-1-1990, Part 4: 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 specified in Section 01 78 00 - Closeout Submittals.
- .2 Include operation and maintenance data for each type and style of starter.

1.5 EXTRA MATERIALS

- .1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.
- .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.
 - .5 1 operating coil.
 - .6 2 fuses.
 - .7 10% indicating lamp bulbs used.

MOTOR STARTERS TO 600 V

Part 2 Products

2.1 MATERIALS

- .1 Starters: to NEMA ICS 2-2000.

2.2 MANUAL MOTOR STARTERS

- .1 Single and Three 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 Three overload heater's, manual reset, trip indicating handle.
- .2 Accessories:
 - .1 pushbutton: heavy duty oil tight labelled as indicated.
 - .2 Indicating light: heavy duty oil tight type and colour as indicated.
 - .3 Locking tab to permit padlocking in "ON" or "OFF" position.

2.3 FULL VOLTAGE MAGNETIC STARTERS

- .1 Magnetic and 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 disconnect 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.
- .3 Accessories:
 - .1 Selector switches: heavy duty oil tight labelled as indicated.
 - .2 Indicating lights: heavy duty oil tight type and color as indicated.
 - .3 1-N/O and 1-N/C spare auxiliary contacts unless otherwise indicated.

2.4 VARIABLE FREQUENCY DRIVE STARTERS

- .1 VFD starters of size, type, rating and enclosure type as indicated with components as follows:
 - .1 Heavy Duty Industrial drives with all required accessories and line and load filters. Drive manufacturers as specified or approved equivalent.
 - .2 Drives shall be Toshiba, Cutler Hammer, or Allen Bradley.

MOTOR STARTERS TO 600 V

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 01 - Common Work Results - Electrical.

2.7 EQUIPMENT IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 01 - Common Work Results - Electrical.
- .2 Manual starter designation label, white plate, black letters, size 1, engraved as indicated.
- .3 Magnetic starter designation label, white plate, black letters, size 3 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.

3.2 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 01 - Common Work Results - Electrical and manufacturer's instructions.
- .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

UNIT EQUIPMENT FOR EMERGENCY LIGHTING

Part 1 General

1.1 SECTION INCLUDES

- .1 Materials and installation for emergency lighting systems.

1.2 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 26 05 21 - Wires and Cables (0-1000 V).
- .3 Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.

1.3 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CSA C22.2 No.141-M1985(R1999), Unit Equipment for Emergency Lighting.

1.4 SUBMITTALS

- .1 Submit product data in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Data to indicate system components, mounting method, source of power and special attachments.

1.5 WARRANTY

- .1 For batteries, the 12 months warranty period extended to 120 months, with no-charge replacement during the first 5 years and pro-rate charge on the second 5 years.

Part 2 Products

2.1 EQUIPMENT

- .1 Emergency lighting equipment: to CSA C22.2 No.141.
- .2 Supply voltage: 120 V, ac.
- .3 Output voltage: 12 V dc.
- .4 Operating time: 60 min.
- .5 Battery: sealed, maintenance free.
- .6 Charger: solid state, multi-rate, voltage/current regulated, inverse temperature compensated, short circuit protected with regulated output of plus or minus 0.01V for plus or minus 10% input variations.
- .7 Solid state transfer circuit.

UNIT EQUIPMENT FOR EMERGENCY LIGHTING

- .8 Low voltage disconnect: solid state, modular, operates at 80% battery output voltage.
- .9 Signal lights: solid state, for 'AC Power ON' and 'High Charge'.
- .10 Lamp heads: integral on unit and remote, 345 degrees horizontal and 180 degrees vertical adjustment. Lamp type: MR-16 20W, minimum.
- .11 Cabinet: suitable for direct or shelf mounting to wall and c/w knockouts for conduit. Removable or hinged front panel for easy access to batteries.
- .12 Finish: White.
- .13 Auxiliary equipment:
 - .1 Ammeter.
 - .2 Voltmeter.
 - .3 Test switch.
 - .4 Time delay relay.
 - .5 Battery disconnect device.
 - .6 AC input and DC output terminal blocks inside cabinet.
 - .7 Cord and single twist-lock plug connection for AC.
 - .8 RFI suppressors.
 - .9 Remote Circuit sensing unit for a minimum of 6 circuits.

2.2 WIRING OF REMOTE HEADS

- .1 Conduit: in accordance with Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.
- .2 Conductors: in accordance with Section 26 05 21 - Wires and Cables 0-1000 V, sized in accordance with manufacturer's recommendations to minimize voltage drop.

Part 3 Execution

3.1 INSTALLATION

- .1 Install unit equipment and remote mounted fixtures.
- .2 Direct heads.
- .3 Connect the remote sensing circuits to the lighting circuits for the areas covered by the emergency lights.
- .4 Connect exit lights to unit equipment.

END OF SECTION

FIRE ALARM SYSTEMS

Part 1 General

1.1 SUMMARY

- .1 Section Includes:
 - .1 Materials and installation for fire alarm systems.
 - .2 Control panel to carry out fire alarm and protection functions including receiving alarm signals, initiating general alarm, supervising system continuously, actuating zone annunciators, and initiating trouble signals.
 - .3 Trouble signal devices.
 - .4 Power supply facilities.
 - .5 Manual alarm stations.
 - .6 Automatic alarm initiating devices.
 - .7 Audible signal devices.
 - .8 End-of-line devices.
 - .9 Annunciators.
 - .10 Visual alarm signal devices.
 - .11 Ancillary devices.
 - .12 Sustainable requirements for construction and verification.

1.2 REFERENCES

- .1 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
- .2 Underwriter's Laboratories of Canada (ULC)
 - .1 CAN/ULC-S524-2001, Standard for the Installation of Fire Alarm Systems.
 - .2 CAN/ULC-S525-1999, Audible Signal Device for Fire Alarm Systems.
 - .3 CAN/ULC-S526-2002, Visual Signal Devices for Fire Alarm Systems.
 - .4 CAN/ULC-S527-1999, Control Units.
 - .5 CAN/ULC-S528-1991, Manual Pull Stations for Fire Alarm Systems.CAN/ULC-S529-2002, Smoke Detectors for Fire Alarm Systems.
 - .6 CAN/ULC-S530-M1991, Heat Actuated Fire Detectors for Fire Alarm Systems.
 - .7 CAN/ULC-S531-2002, Standard for Smoke Alarms.
 - .8 CAN/ULC-S536-S537-2004, Burglar and Fire Alarm Systems and Components.
- .3 National Fire Protection Agency
 - .1 NFPA 72-2002, National Fire Alarm Code.
 - .2 NFPA 90A-2002, Installation of Air Conditioning and Ventilating Systems.

FIRE ALARM SYSTEMS

1.3 SUBMITTALS

- .1 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures.
 - .1 Submit Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Shop Drawings:
 - .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
 - .2 Include:
 - .1 Layout of equipment.
 - .2 Zoning.
 - .3 Complete wiring diagram, including schematics of modules.
- .3 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.
 - .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
 - .2 Instructions: submit manufacturer's installation instructions.
 - .3 Manufacturer's Field Reports: manufacturer's field reports specified.
- .4 Closeout Submittals:
 - .1 Submit maintenance and engineering data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals in accordance with ANSI/NFPA 20.
 - .2 Authority of Jurisdiction will delegate authority for review and approval of submittals required by this Section.
 - .3 Submit to Authority of Jurisdiction 2 sets of approved submittals and drawings immediately after approval but no later than 15 working days to prior to final inspection.
 - .4 Submit following:
 - .1 Manufacturer's Data for:
 - .1 Control panel and modules.
 - .2 Storage batteries.
 - .3 Battery charger.
 - .4 Manual pull stations.
 - .5 Heat detectors.
 - .6 Open-area smoke detectors.
 - .7 Duct smoke detectors.
 - .8 Alarm bells.

FIRE ALARM SYSTEMS

- .9 Alarm horns.
- .10 Visible appliances.
- .11 Main annunciator.
- .12 Remote annunciator panel.
- .13 Electro-magnetic door holder-releases.
- .14 Valve tamper switches.
- .15 Wiring.
- .16 Conduit.
- .17 Outlet boxes.
- .18 Fittings for conduit and outlet boxes.
- .19 Trouble buzzer.
- .20 Surge suppression devices.
- .21 Mark data which describe more than one type of item to indicate which type will be provided.
- .22 Submit 1 original for each item and clear, legible, first-generation photocopies for remainder of specified copies.
- .2 System wiring diagrams:
 - .1 Submit complete wiring diagrams of system showing points of connection and terminals used for electrical connections in the system.
 - .2 Show modules, relays, switches and lamps in control panel.
- .3 Design data: Power Calculations:
 - .1 Submit design calculations new work specified to substantiate that battery capacity exceeds supervisory and alarm power requirements.
 - .2 Show comparison of detector power requirements per zone versus control panel smoke detector power output per zone in both standby and alarm modes.
 - .3 Show comparison of notification appliance circuit alarm power requirements with rated circuit power output.
- .4 Schedules:
 - .1 Conductor wire marker schedule.
- .5 Test Reports:
 - .1 Open-area 2-wire smoke detectors.
 - .2 Preliminary testing:
 - .1 Final acceptance testing.
 - .2 Submit for inspections and tests specified under Field Quality Control.

FIRE ALARM SYSTEMS

1.4 QUALITY ASSURANCE

- .1 Qualifications:
 - .1 Installer: company or person specializing in fire alarm system installations with 10-years documented experience approved by manufacturer.
- .2 Provide services of representative or technician from manufacturer of system, experienced in installation and operation of type of system being provided, to supervise installation, adjustment, preliminary testing, and final testing of system and to provide instruction to project personnel.
- .3 Extra Materials:
 - .1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.
- .4 Maintenance Service:
 - .1 Provide one year's free maintenance with two inspections by manufacturer during warranty period. Inspection tests to conform to CAN/ULC-S536. Submit inspection report to Contract Administrator.

Part 2 Products

2.1 MATERIALS

- .1 Equipment and devices: ULC listed and labelled and supplied by single manufacturer.
- .2 Power supply: to CAN/ULC-S524.
- .3 Audible signal devices: to CAN/ULC-S525.
- .4 Visual signal devices: to CAN/ULC-S526.
- .5 Control unit: to CAN/ULC-S527.
- .6 Manual pull stations: to CAN/ULC-S528.
- .7 Thermal detectors: to CAN/ULC-S530.
- .8 Smoke detectors: to CAN/ULC-S529.
- .9 Smoke alarms: to CAN/ULC-S531.
- .10 **Spare Devices:** Provide 2 spares of each FAS device to be stored in a new red enclosure mounted beside the main FAS panel and utilizing same lock/key mechanism. Storage enclosure to be labeled as 'spare parts cabinet'.

FIRE ALARM SYSTEMS

2.2 SYSTEM OPERATION

- .1 Provide complete, electrically supervised and automatic Fully Addressable, fire alarm system.
- .2 Provide separate isolated class A circuits from control panel to each zone of initiating devices. Transmission of signals from more than one zone over common circuit to control panel is prohibited.
- .3 System shall be a Simplex 4100U addressable system or approved equivalent.
- .4 Single stage operation. Operation to actuation following:
 - .1 Manual station.
 - .2 Heat detector.
 - .3 Smoke detector.
 - .4 Automatic fire sprinkler system.
 - .5 Fire extinguishing system.
- .5 Actuation of single operation device to initiate following:
 - .1 Building evacuation alarm devices to operate continuously.
 - .2 Transmit signal to fire department via monitoring station.
 - .3 Zone of alarm device to be indicated on control panel and remote annunciator.
 - .4 Fire doors, smoke control doors and smoke dampers if normally held open, to close automatically.
 - .5 Electro-magnetic door holders to de-energize.
 - .6 Operations to remain in alarm mode (except alarm notification appliances if manually silenced) until system is manually restored to normal.
- .6 Capability to program smoke detector status change confirmation on any or zones in accordance with CAN/ULC-S527, Appendix C.

2.3 CONTROL PANEL

- .1 Class A.
- .2 Single stage operation.
- .3 Zoned.
- .4 Coded.
- .5 Fully Digital addressable
- .6 Minimum six bell circuits and six strobe circuits.
- .7 Enclosure:

FIRE ALARM SYSTEMS

- .1 CSA Enclosure Sprinklerproof, c/w lockable concealed hinged door, full viewing window, flush lock and 2 keys.
- .2 Provide modular type panel installed in surface mounted steel cabinet with hinged door and cylinder lock.
- .3 Mount with panel centerline 1.5 m above finished floor elevation.
- .4 Switches and other controls: not accessible without use of key. 8 event LCD display c/w individual zone LEDs & bypass switches. Secondary CPU to ensure constant system operation during programming or software downloading.
- .5 Design of control panel: neat, compact assembly containing parts and equipment required to provide specified operating and supervisory functions of system.
- .6 Control panel components: CSA approved and approved by control panel manufacturer for use in control panel.
- .7 Panel cabinet: finished on inside and outside with factory-applied enamel finish.
- .8 Provide main annunciator located on exterior of cabinet door or visible through cabinet door.
- .9 Provide audible trouble signal.
- .10 Provide permanent engraved
- .11 Provide 8 spare sets of Form C dry alarm contacts and common system Form C dry alarm contact, and common system Form C dry trouble contact and a Supervisory Form C dry Contact. Provide auxiliary contacts for the above and connect to the Building Metasys system
- .12 Permanently label switches.
- .13 Provide panel with following switches:
 - .1 Trouble silencing switch which silences audible trouble signals without extinguishing trouble indicating lamp(s).
 - .1 For silencing switch of momentary action self-resetting type: trouble signal circuit automatically restored to normal upon correction of trouble condition.
 - .2 Evacuation alarm silencing switch which when activated will silence alarm notification appliances without resetting panel, and cause operation of system trouble signals. Subsequent alarm(s) from additional zone(s) not originally in alarm to cause activation of notification appliances even with alarm silencing switch in "silenced" position.
 - .3 Individual zone disconnect switches which when operated will disable only their respective initiating circuit and cause operation of system and zone trouble signals.
 - .4 Reset switch which when activated will restore the system to normal standby status after cause of alarm has been corrected, and activated initiating devices reset.
 - .1 Operation of reset switch to restore activated smoke detectors to normal standby status.
 - .5 Lamp test switch.

FIRE ALARM SYSTEMS

- .6 Drill switch which will enable test of notification appliances and restoration to normal without tripping master box. Master box disconnect switch which when activated will disconnect coded device and cause operation of system trouble signal.
- .7 HVAC shutdown bypass switch. Operation of the switch to allow HVAC system to operate with detectors in alarm and cause operation of system trouble signals.
- .8 Supervised, modular design with plug-in modules:
 - .1 Alarm receiver with trouble and alarm indications, for class A and B initiating circuits.
 - .2 Spare zones: compatible with smoke detectors and open circuit devices.
 - .3 Space for future modules.
 - .4 Latching type supervisory receiver circuits. Discrete indication for both off-normal and trouble.
- .9 Components:
 - .1 Coded alarm receiver panel with trouble and alarm indications for class A initiating circuit.
 - .2 Single stage alarm pulse rate panels:
 - .1 Single stroke control type for output to signal control panel continuously.
 - .3 Single stage alarm to NBC 2005 Standards.
 - .4 Audible signal control panel with 10 control circuits complete with terminals for wiring and 10 plug-in modules for dc signals up to 2.0 A load with trouble indication with class A connections.
 - .5 Common control and power units:
 - .1 Control panel containing following indications and controls:
 - .1 "Power on" LED (green) to monitor primary source of power to system.
 - .2 "Power trouble" indication.
 - .3 "Ground trouble" indication.
 - .4 "Remote annunciator trouble" indication.
 - .5 "System trouble" indication.
 - .6 "System trouble" buzzer and silence switch c/w trouble resound feature.
 - .7 System reset switch.
 - .8 "LED test" switch if applicable.
 - .9 "Alarm silence" switch to silence signals manually. If new alarm occurs after signals have been silenced, signals to resound.
 - .10 "Signals silenced" indication.
 - .2 Master power supply panel to provide 24 V dc to system from 120 V ac, 60 Hz input.
 - .3 Fire department connections:

FIRE ALARM SYSTEMS

- .1 Plug-in module for tripper or shunt type municipal box.
- .2 Fire department bypass switch c/w indicator for trouble at panel.
- .6 Auxiliary relays: plug-in type, dust cover, supervised against unauthorized removal by common trouble circuit.
 - .1 Contacts: 2.0 A, 120 V ac, for functions such as release of door holders or initiation of fan shut down.
 - .2 Contact terminal size: capable of accepting 22-12 AWG wire.

2.4 POWER SUPPLY

- .1 120 V, ac, 60 Hz input, 24 V dc output from rectifier to operate alarm and signal circuits, with standby power of gel cell batteries minimum expected life of 4 years, sized in accordance with NBC-2005.

2.5 MANUAL ALARM STATIONS

- .1 Addressing to be included on the base of the unit by a label identifier (marker not acceptable).
- .2 Provide addressable single action type with mechanical reset features.
- .3 Stations: semi-flush mounted and type as indicated.
 - .1 For surface mounting provide station manufacturer's approved back box.
 - .2 Back box finish to match station finish.
- .4 Equip each station with terminal strip with contacts of proper number and type to perform functions required.
- .5 Station colour: red.-Fire,
- .6 Provide station with visible indication of operation.
- .7 Restoration to require use of key.
 - .1 Keys: identical throughout system for stations and control panel(s).
- .8 Mount stations with operating lever not more than 1.2 m above finished floor.
- .9 Supply with clear, tamperproof polycarbonate shield and frame with integral horn that fits over manual pullstation. When lifted to gain access to the actual alarm a minimum 105dB warning horn is sounded. c/w Lifetime guarantee against breakage and battery.

2.6 AUTOMATIC ALARM INITIATING DEVICES

- .1 'FAS device addressing to be included on the base of the unit by a label identifier (marker not acceptable).'
- .2 Heat detectors: provide heat detectors designed for detection of fire by combination fixed temperature rate-of-rise principle.

FIRE ALARM SYSTEMS

- .3 Combination Fixed Temperature Rate-Of-Rise Detectors (Spot Type): designed for semi-flush outlet box mounting and supported independently of conduit, tubing or wiring connections.
 - .1 Contacts: self-resetting after response to rate-of-rise actuation
 - .2 Operation under fixed temperature actuation to result in external indication.
 - .3 Detector units located in boiler rooms, showers, or other areas subject to abnormal temperature changes to operate on fixed temperature principle only.
- .4 Rate Compensating Detector (Spot Type): designed for flush and surface outlet box mounting and supported independently of conduit, tubing or wiring connections.
 - .1 Detectors: hermetically sealed and automatically resetting type which will operate when ambient air temperature reaches detector setting regardless of rate of temperature rise.
 - .2 Detector operation: not be subject to thermal time lag
 - .3 CF135 detector to be connected to system via sealed addressable monitor module.
- .5 Open-Area Smoke Detectors: provide detectors designed for detection of abnormal smoke densities by photoelectric principle.
 - .1 Photoelectric and FAS device addressing to be included on the base of the unit by a label identifier (marker not acceptable).
 - .2 Detectors: addressable type.
 - .3 Provide necessary control and power modules required for operation integral with control panel.
 - .4 Detectors and associated modules: compatible with control panel and suitable for use in supervised circuit.
 - .5 Malfunction of electrical circuits to detector or its control or power units to result in operation of system trouble signals.
 - .6 Equip each detector with visible indicator lamp that will flash when detector is in normal standby mode and glow continuously when detector is activated.
 - .7 Provide remote indicator lamps for each detector that is located beneath raised floors.
 - .8 Each detector: plug-in type with tab-lock or twist-lock, quick disconnect head and separate base in which detector base contains screw terminals for making wiring connections.
 - .9 Detector head: removable from its base without disconnecting wires. Removal of detector head from its base to cause activation of system trouble signals.
 - .10 Screen each detector to prevent entrance of insects into detection chamber(s).

FIRE ALARM SYSTEMS

- .6 Photoelectric Detectors: operate on light scattering principle using LED light source.
 - .1 Detector: respond to both flaming and smouldering fires.
- .7 Locate detectors in accordance with their listing by ULC and the requirements of NFPA 72 and CAN/ULC s524, except provide at least 2 detectors in rooms of 54 square meters or larger in area where detectors are required.
- .8 Mount detectors at underside of ceiling or deck above unless otherwise indicated.
 - .1 For mounting heights greater than 3 m above floor level, reduce actual detector linear spacing from listed spacing as required by NFPA 72 and CAN/ULC s524.
- .9 Temperature rating of detectors: in accordance with NFPA 72.
- .10 Locate detectors minimum 300 mm to lighting fixtures and not closer than 600 mm to air supply or return diffuser.
- .11 Ensure detectors, located in areas subject to moisture or exterior atmospheric conditions or hazardous locations as defined by NFPA 70, are approved for such locations.
- .12 Provide detectors with terminal screw type connections.
- .13 Removal of detector head from its base to cause activation of system trouble signals if detectors are provided with separable heads and bases.

2.7 AUDIBLE SIGNAL DEVICES

- .1 Provide remote system trouble buzzer arranged to operate in conjunction with panel's integral trouble signal.
- .2 Audible device(s):
 - .1 multi-candela, synchronized bell/strobe units. Bells shall be 12" diameter. Alternately, strobes shall be multi-candela synchronized strobe units. Bell/strobes shall be capable of silencing bells while maintaining strobe function.

2.8 END-OF-LINE DEVICES

- .1 End-of-line devices to control supervisory current in alarm circuits and signalling circuits, sized to ensure correct supervisory current for each circuit. Open, short or ground fault in any circuit will alter supervisory current in that circuit, producing audible and visible alarm at main control panel and remotely as indicated. All end of line devices shall be clearly marked on Site and on the as-built drawings (Marker on the device is not acceptable).

2.9 REMOTE ANNUNCIATOR PANELS

- .1 Provide panels where indicated mounted 1.5 m above finished floor elevation.

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- .2 Panels: duplicate requirements for control panel annunciator, with exception of individual trouble lamps are not required.
- .3 Provide 2 remote annunciator panels, one panel to be located @ the east main entrance and the other @ the south entrance. Each panel to included plexi glass covering to protect the panel circuit boards.
- .4 LED type with designation cards to indicate zone.
- .5 LCD based text annunciation and eight event display.
- .6 LEDs to annunciate alarm zone.
- .7 Wired in multiple with main control panel.
- .8 Supervised, including trouble signal for open circuit.
- .9 LED test button.

2.10 VISUAL ALARM SIGNAL DEVICES

- .1 Flush-mounted assembly of stroboscopic type suitable for use in electrically supervised circuit and powered from notification appliance circuits.
- .2 Appliances: minimum of 110 candela measured as approved by ULC.
- .3 Protect lamps with thermoplastic lens and labelled "FIRE" in letters at least 12 mm high.
- .4 Provide visible appliances within 300 mm of each audible appliance as indicated.
- .5 Visible appliances may be part of audio-visual assembly, where more than two appliances are located in same room or corridor.

2.11 VALVE TAMPER AND FLOW SWITCHES

- .1 Provide switches to monitor open position of valves controlling water supply to sprinkler systems. And monitors for the Flow of the system.
- .2 Switch contacts to transfer from normal position to off-normal position during first two revolutions of hand wheel or when stem of valve has moved not more than one-fifth of distance from its normal position.
- .3 Provide switch with tamper resistant cover.
- .4 Removal of the cover to cause switch to operate into off-normal position.
- .5 All Monitoring for the sprinkler shall be in accordance with NFPA and CAN/ULC codes as well as the NBC 2005.

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2.12 WIRING

- .1 14 AWG min.for power & 18 AWG twisted shielded for data & addressable loop wiring Wire to remote annunciators: No. 18 AWG minimum solid copper conductor.
- .2 Wire for connection to base telegraphic alarm loop: No. 12 AWG minimum solid copper conductor.
- .3 Insulation 75 degrees C minimum with nylon jacket.
- .4 Colour code wiring.

2.13 SURGE SUPPRESSION

- .1 Provide line voltage surge suppression devices to suppress voltage transients which might damage control panel components.

2.14 LINE VOLTAGE SURGE SUPPRESSOR

- .1 Suppressor : ULC approved with maximum 330 volt clamping level and maximum response time of 5 nanoseconds.
- .2 Suppressor: multi-stage construction which includes inductors and silicon avalanche zener diodes.
- .3 Equip suppressor with light emitting diode which extinguishes upon failure of protection components.
- .4 Fuses: externally accessible.
- .5 Wire in series with incoming power source to protected equipment using screw terminations.
- .6 Provide surge suppression for circuits which leave building shell.
- .7 When circuits interconnect 2 or more buildings, provide arrestor at circuit entrance to each building.
- .8 Suppressor: UL 497B listed with maximum 30 volt clamping level and maximum response time of 5 nanoseconds.
- .9 Suppressor: multi-stage construction and both differential and common mode protection.

2.15 AS-BUILT RISER DIAGRAM

- .1 Fire alarm system riser diagram: in glazed frame, minimum size 600 x 600 mm.

FIRE ALARM SYSTEMS

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 datasheet.

3.2 INSTALLATION

- .1 Install systems in accordance with CAN/ULC-S524
- .2 Install main control panel and connect to ac power supply.
- .3 Panel to be able to connect to the two new remote annunciator panels. A fully working FAS system for the building must be maintained at all times while installing and commissioning the new system. Any disruption in building FAS protection must be coordinated min. 2 working days in advance with the project officer and approved by same.
- .4 Locate and install manual alarm stations and connect to alarm circuit wiring.
- .5 Locate and install detectors and connect to alarm circuit wiring. Do not mount detectors within 1 m of air outlets. Maintain at least 600 mm radius clear space on ceiling, below and around detectors. Locate duct type detectors in straight portions of ducts.
- .6 Connect alarm circuits to main control panel.
- .7 Locate and install horn/strobes and connect to signalling circuits.
- .8 Connect signalling circuits to main control panel.
- .9 Install end-of-line devices at end of alarm and signalling circuits.
- .10 Install remote annunciator panels and connect to annunciator circuit wiring.
- .11 Locate and install door releasing devices.
- .12 Locate and install remote relay units to control fan shut down. Sprinkler system: wire alarm and supervisory switches and connect to control panel.
- .13 Connect fire suppression systems to control panel.

3.3 FIELD QUALITY CONTROL

- .1 Site Tests:
 - .1 Perform tests in accordance with Section 26 05 00 - Common Work Results - for Electrical and CAN/ULC-S537.
 - .2 Fire alarm system:

FIRE ALARM SYSTEMS

- .1 Test each device and alarm circuit to ensure manual stations, thermal and smoke detectors and sprinkler systems transmit alarm to control panel and general alarm.
 - .2 Check annunciator panels to ensure zones are shown correctly.
 - .3 Simulate grounds and breaks on alarm and signalling circuits to ensure proper operation of system.
 - .4 Class A circuits.
 - .1 Test each conductor on circuits for capability of providing alarm signal on line side of single open-circuit fault condition imposed at electrically most remote device on circuit. Reset control unit after each alarm function and correct imposed fault after completion of each test.
 - .2 Test each conductor on circuits for capability of providing alarm signal during ground-fault condition imposed at electrically most remote device on circuit. Reset control unit after each alarm function and correct imposed fault after completion of each test.
 - .5 Audibility levels of alarm system to be confirmed post occupancy. A proper audiometric report shall be prepared with a calibrated instrument.
- .2 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.

3.4 TRAINING

- .1 Arrange and pay for on-Site lectures and demonstrations by fire alarm equipment manufacturer to train operational personnel in use and maintenance of fire alarm system.

END OF SECTION