

1 CODES AND STANDARDS

- .1 Complete installation in accordance with the latest edition of the Canadian Electrical Code Part I (CSA C22.1) and the Saskatchewan Supplement, as well as Municipal and Provincial Codes and Regulations and the local authorities having jurisdiction. Where this specification is at variance with applicable Codes and Standards, the more stringent shall apply.
- .2 Comply with CSA Electrical Bulletins and Certification Standards in force at time of bid submission. While not identified and specified by number in this Division, these Bulletins and Standards are to be considered as forming part of related CSA Part II Standard.
- .3 All references to Codes and Standards refer to the latest edition in force at the time of bid unless specified otherwise.
- .4 Under no circumstances shall the Codes and Standards referred to above and herein, be interpreted to allow a lower standard than specified elsewhere herein.
- .5 Abbreviations for electrical terms: to CSA Z85.
- .6 Complete all work in a neat manner performed by qualified tradesmen. All work shall be completed under the on-site direction of a journeyman electrician.

2 QUALIFICATIONS

- .1 Designate a foreman / superintendent holding a journeyman's certificate to assume complete responsibility for the electrical construction work. Minimum experience requirement for this position is five (5) years experience as a journeyman foreman / superintendent. Submit the name, qualifications, and experience to the electrical consultant for approval.
- .2 Furnish qualified personnel to continuously direct and monitor electrical construction work.
- .3 Attend site meetings.

3 PERMITS, FEES

- .1 The electrical consultant will submit to the Electrical Inspection Department and Supply Authority the necessary number of drawings and specifications for examination and approval prior to commencement of work. The electrical contractor shall pay all fees associated with this examination and approval.
- .2 Obtain and pay fees associated with all electrical inspections.

APPROVED EQUIVALENTS/ALTERNATES

- .1 The listing of a manufacturer and his respective type or catalogue number as the basis of design, is to establish the construction features, sizes, quality, and accessories of an item of equipment in addition to the characteristics specified.
- .2 Approval of equivalent products will be granted on the basis of the manufacturer, and general

design only. Such approval does not relieve the electrical contractor and/or supplier from providing all necessary components and finishes as called for on the drawings or in the specifications.

- .3 Request for equals must be received in the electrical consultant's office not less than seven working days prior to subcontractor bid closing date.
- .4 A detailed line-by-line compliance comparison of any product submitted for approval, must be submitted. Exceptions and non-compliance shall be clearly identified. Requests for equals must include the following:
 - .1 A detailed bill of materials correlating each item of equipment to those specified.
 - .2 Catalogue product data sheet for each proposed item of equipment. If more than one model is shown on the data sheet, indicate exactly which model is proposed.
 - .3 Copy of the specification section with each paragraph marked to show where on the product data sheet the specification requirement is satisfied (use specification cross reference numbers on the product data sheet).
 - .4 If compliance with any specification requirement cannot be substantiated by reference to published data provide a typewritten compliance statement signed by an executive officer of the manufacturer. Stating that the executive proposed products comply with all specified requirements.
- .5 A contractor quoting on materials or equipment not thus approved, does so at his own risk and will be required to install those products which are approved.
- .6 The Contractor shall make allowances in his bid for the cost of any associated changes in this division made necessary by the selection of an approved product other than that named as the basis of designs. Additional costs to this division due to the departure from equipment named shall be borne by the contractor.

5 SHOP DRAWINGS, PRODUCT DATA AND SAMPLES

- .1 Submit shop drawings, product data and samples in accordance with the requirements of General Conditions.
- .2 Indicate details of construction, dimensions, capacities, weights and electrical performance characteristics of equipment or material. All shop drawings shall be identified with the project name.
- .3 Where applicable, include wiring, single line and schematic diagrams.
- .4 Include wiring drawings or diagrams showing interconnection with work of other Sections.
- .5 Submit a copy of each shop drawing in electronic PDF format to the electrical consultant for review. PDF documents must be generated by manufacturer's software, or from electronically published documentation. PDF documents generated by scanning technology are not acceptable. Consultant will return shop drawing submittals via email for distribution. It is the responsibility of the Contractor to ensure adequate copies of the shop drawings are distributed to required parties, including a copy at the construction site.
- .6 If hard copies are submitted, submit three (3) copies of each shop drawing to the electrical consultant for review. Two copies will be returned to the architect who will subsequently

return one copy to the Contractor (to produce required copies at his expense).

- .7 All electrical shop drawings for the project shall be submitted at one time and within 30 days of contract signing.

6 DRAWINGS AND SPECIFICATIONS

- .1 Examine also the architectural, structural, and mechanical drawings and specifications.
- .2 Drawings do not indicate all construction details. Any installation involving accurate measurements of the building shall be coordinated with construction drawings and/or actual on-site measurements.
- .3 Drawings and specifications are intended to supplement each other, and any information indicated on one and omitted on the other shall be assumed as included on both.
- .4 Refer to architectural reflected ceiling plan for exact location of lighting fixtures in t-bar ceiling grids.
- .5 The electrical sub-contractor shall peruse the mechanical drawings and specifications to confirm size and location of all motors, controls, and other equipment in order to determine exact electrical requirements of all mechanical equipment. Ensure that all electrical work noted on mechanical drawings and specifications are included in the electrical contract bid price.
- .6 In order to provide sufficient detail and clarity, the symbols used for various electrical devices, occupy more space on the drawing, than the device actually occupies when installed. The electrical sub-contractor shall use common sense when actually placing these devices, ensuring that devices are grouped wherever possible. Do not space devices along wall to coincide with the scale location of the electrical device symbol.
- .7 Bidders finding discrepancies or omissions in the specifications or drawings, or having doubt as to the meaning or intent thereof, shall at once notify the Consultant who will, if necessary, send written instructions or explanation to all bidders. Oral interpretations made to any bidder shall not effect a modification of any provision of the bid documents.

7 EXAMINATION OF THE SITE

- .1 Prior to submitting bid, visit the site and thoroughly investigate the location, connection points, and details of all services and systems which, in any way, may affect or tie-in with the work covered in these specifications and accompanying drawings. No extra will be considered for work resulting from conditions that would have been evident upon thorough examination of the site.
- .2 Any discrepancies, points of doubt, or contention shall be made known to the electrical consultant in writing not later than seven (7) days prior to closing date of tender; otherwise, allow for the most expensive alternative.

8 VOLTAGE RATINGS

- .1 Operating Voltages: to CAN3 C235.

- .2 Motors, electrical heating, control and distribution devices and equipment to operate satisfactorily at 60 Hz within normal operating limits established by above standard.

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

9 MATERIALS AND EQUIPMENT

- .1 Provide materials and equipment in accordance with the requirements of General Conditions.
- .2 Equipment and material to be CSA certified, and manufactured to standard quoted.
- .3 Where there is no alternative to supplying equipment which is not CSA certified, obtain special approval from Inspection Department.
- .4 Factory assemble control panels and component assemblies.
- .5 Uniformity of manufacturer shall be maintained for any particular item or type of equipment throughout the building.

10 ELECTRICAL MOTORS, EQUIPMENT AND CONTROLS

- .1 Supplier and Installer responsibility is indicated in Motor Control and Equipment Schedule on electrical drawings and related Mechanical responsibility is indicated on Mechanical Equipment Schedule on mechanical drawings.
- .2 Control wiring and conduit is specified in Division 26 except for conduit, wiring, and connections below 50V which are related to control systems specified in Division 25 and shown on mechanical drawings.

11 FINISHES

- .1 Shop finish metal enclosures by removal of rust and scale, cleaning, application of rust resistant primer inside and outside, and at least two coats of finished enamel.
 - .1 Paint outdoor electrical equipment "equipment green" finish to EEMAC Y1-1.
 - .2 Paint indoor switchgear and distribution enclosures light grey to EEMAC 2Y-1.
- .2 Clean and touch up surfaces to shop-painted equipment scratched or marred during shipment or installation, to match original paint.
- .3 Clean, prime, and paint exposed hangers, racks, fastenings to prevent rusting.
- .4 All electrical fittings, supports, hanger rods, pull boxes, channel fittings, conduit racks, outlet boxes, brackets, clamps, etc. shall either have a galvanized finish, or have a painted finish over corrosion resistant primer.
- .5 Where indicated herein and on drawings, provide finishes to match samples as provided by the architectural consultant.

12 EQUIPMENT IDENTIFICATION

- .1 Identify electrical equipment with nameplates as follows:

Nameplates:

- .1 Plastic laminate engraving sheet, 3 mm thick, black face, white core, self-adhesive. Nameplates identifying emergency power system circuits shall be red face with white core.
- .2 Nameplate sizes:

Size 1	7 X 25 mm	1 line	3 mm high lettering
Size 2	7 x 40 mm	1 line	5 mm high lettering
Size 3	12 x 70 mm	2 lines	3 mm high lettering
Size 4	20 x 90 mm	1 line	8 mm high lettering
Size 5	20 x 90 mm	2 lines	5 mm high lettering
Size 6	25 x 100 mm	1 line	12 mm high lettering
Size 7	25 x 100 mm	2 lines	6 mm high lettering
- .3 Wordings on nameplates to be approved prior to manufacture.
- .4 Allow for average of twenty-five (25) letters per nameplate.
- .5 Identification to be English.
- .6 Nameplates for terminal cabinets and junction boxes to indicate system and/or voltage characteristics.
- .7 Nameplates for disconnects, starters, contactors and control stations shall indicate equipment being controlled, and voltage.
- .8 Nameplates for transformers shall indicate capacity, primary, and secondary voltages.
- .9 All nameplates shall be mechanically attached with a minimum of two chrome self tapping screws as well as the self adhesive.

13 WIRING IDENTIFICATION

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

14 CONDUIT AND CABLE IDENTIFICATION

- .1 Colour code conduits, and metallic sheathed cables.
- .2 Code with 305 mm band of coloured spray paint at points where conduit or cable enters wall, ceiling, or floor, and at 15 m intervals in accessible ceiling spaces and service spaces:

Emergency Power

Orange

15 JUNCTION BOX IDENTIFICATION

- .1 Identify all system junction boxes with enamel spray paint on entire cover. Colour shall match those specified for conduit and cable identification.

- .2 Identify all junction boxes, containing branch circuit conductors, with neat hand lettering using black felt marker indicating panel and breaker number (i.e. "B-24). Provide corresponding identification on surface adjacent to junction box as well.

16 WIRING TERMINATIONS

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

17 MANUFACTURER'S AND CSA LABELS

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

18 WARNING SIGNS

- .1 Provide warning signs, as specified or to meet requirements of Inspection Department.
- .2 Use decal signs, minimum 175 x 250 mm size.

19 LOCATIONS OF OUTLETS

- .1 Do not install outlets back-to-back in wall; allow minimum 150 mm horizontal clearance between boxes.
- .2 Change location of outlets at no extra cost or credit, providing distance does not exceed 3 meters, and information is given before installation.
- .3 Locate light switches on latch side of doors (determine direction of door swings from architectural drawings). Locate disconnect devices in mechanical and elevator machine rooms on latch side of door.
- .4 Coordinate the rough-in location of all outlets with architectural, structural, and mechanical drawings. Ensure compatibility with finishes, accessories, and devices by others.

20 MOUNTING HEIGHTS

- .1 Mounting heights of equipment are from finished floor to centerline of equipment unless specified or indicated otherwise.
- .2 If mounting height of equipment is not indicated, verify before proceeding with installation.
- .3 Install electrical equipment at the following heights unless indicated otherwise (assuming a minimum ceiling height of 2400 mm).
 - .1 Local switches: 1200 mm (1300 mm in concrete block)
 - .2 Wall receptacles: General: 450 mm (500 mm in concrete block)
 - .3 Disconnect switches: 1800 mm to top

21 PROTECTION

- .1 Protect exposed live equipment during construction for personnel safety.
- .2 Shield and mark live parts "LIVE 120 VOLTS" or with appropriate voltage in English.

22 OWNER'S EQUIPMENT

- .1 This Contractor is responsible for electrical service connections to all Owner's equipment being supplied and installed in the building and that are shown in the contract documents. All Owner's equipment will be supplied complete with starters and disconnects as required.

23 WORK PROVIDED FOR OTHER DIVISIONS

- .1 Provide information as to the exact size and location of all required concrete foundations and curbs for equipment.
- .2 All bus ducts, cable tray, and conduit openings through floor, walls, and ceilings shall be sleeved 25 mm larger all around the duct, tray, or conduit. Fill the opening with 3# density acoustic media under 50% compression and seal both ends with the appropriate caulking compound. Refer to "Firestopping" specific requirements.
- .3 Supply and installation of control wiring for all line voltage thermostats, for unit heaters, force flow, and cabinet heaters.
- .4 Supply and installation of all electric heaters.

24 WORK NOT INCLUDED IN THIS DIVISION

- .1 Low voltage and control wiring for the mechanical equipment associated with the heating and cooling of the building will not be included in this Division.

25 CONDUIT AND CABLE INSTALLATION

- .1 Install conduit, and sleeves, prior to pouring of concrete. Sleeves through concrete: schedule 40 steel pipe, sized for free passage of conduit, and protruding 50 mm.
- .2 Install cables, conduits, and fittings neatly and close to building structure so furring can be kept to minimum.
- .3 Conduit shall be laid out to avoid interference with other trades, and to maintain maximum headroom. Arrange conduit to conserve space, allow maintenance, and avoid crossovers where possible.
- .4 Holes through exterior walls and roof shall be flashed and made completely weatherproof.

26 FIRESTOPPING

- .1 Provide firestopping in accordance with the requirements of General Conditions.
- .2 Provide fire stopping and smoke seal system materials in accordance with CAN4-S115. Materials shall be asbestos free and systems shall be capable of maintaining an effective barrier against gases, flame and smoke in compliance with CAN4-S115, not exceeding opening sizes stated and conforming to all requirements of the Standard. Fire-resistance

rating of fire stopping material assembly shall meet or exceed the fire-resistance rating of the floor, wall or partition being penetrated. Acceptable manufacturers include: Fyre Shield manufactured by Tremco Ltd., Fyre-Sil manufactured by Tremco Ltd., Mineral Wool and FSI Silicone Sealant manufactured by FSI Engineering.

Damming and backup materials, supports and anchoring devices to manufacturer's recommendations and in strict accordance with tested assembly being installed, and as acceptable to the Authority Having Jurisdiction.

27 ACCESS

- .1 Provide access doors for installation in walls and ceiling to service electrical equipment. Supply to appropriate trade for installation. Doors shall be ULC labelled when installed in fire separations. Wherever finish and construction allow, access doors shall be installed flush with the finished surface. Access doors shall have 16 gauge frames, 14 gauge door panels, piano hinge, screw driver latch, and mounting channels as required for installation. Minimum size shall be 300 mm x 300 mm.

28 INSULATION RESISTANCE TESTING

- .1 Megger circuits, feeders, and equipment up to 350V with a 500V instrument.
- .2 Megger 350 - 600V circuits, feeders, and equipment with 1000V instrument.
- .3 Check resistance to ground before energizing.

29 COORDINATION OF PROTECTIVE DEVICES

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

30 EXCAVATION AND BACKFILL

- .1 Route of underground electrical and communication services shall be as indicated on drawings. Depth shall be minimum 1000 mm below grade unless otherwise noted.
- .2 Backfill shall be machine tamped in 150 mm layers to prevent future settling.
- .3 Replace existing pavement, lawn turf, concrete, etc. where damaged, or removed in connection with the installation of these underground services.
- .4 Investigate location of all existing underground services which may exist in the vicinity of the new services. This contractor shall be responsible for all damage to existing services caused during excavation and backfill.
- .5 Level the bottom of all trenches with a 75 mm (minimum) layer of sand. Underground cables shall be covered by a 75 mm (minimum) layer of sand prior to backfill.
- .6 Install 150 mm wide green or yellow 6 mil poly ribbon approximately 300 mm above buried conductors, to serve as a warning flag.

31 CLEANING

- .1 Complete final cleaning in accordance with the requirements of General Conditions.
- .2 Protect all equipment and material from weather and the work of other trades. Remove waste periodically. Clean all materials and equipment prior to acceptance of the Work.
- .3 At time of final cleaning, clean lighting reflectors, lenses, and other lighting surfaces that have been exposed to construction dust and dirt. The electrical installation shall be left in a clean and finished condition, to the satisfaction of the electrical consultant.

32 TESTS

- .1 Conduct and pay for tests of the following:
 - .1 Power distribution system including phasing, voltage, grounding, and load balancing.
 - .2 Circuits originating from branch distribution panels.
 - .3 Lighting and its control.
 - .4 Motors, heaters, and associated control equipment including sequenced operation of systems where applicable. Take clip on ammeter readings on all phases of motor feeders, with motor operating under full load conditions. Submit test readings to electrical consultant.
 - .5 Systems: heat trace cables
- .2 Furnish Manufacturer's certificate or letter confirming that entire installation as it pertains to each system has been installed to Manufacturer's instructions.
- .3 Notify electrical consultant a minimum of 48 hours prior to test.
- .4 Provide instruments, meters, equipment, and personnel required to conduct tests during and at conclusion of project.
- .5 Submit test results for electrical consultant's review.

33 LOAD BALANCE

- .1 Measure phase current to panelboards and distribution centres with all possible loads operating. Adjust branch circuit connections as required to obtain best balance of current between phases and record final measurements after adjustments have been completed. Load unbalance shall not exceed fifteen percent (15%).
- .2 Measure phase voltages at loads and adjust transformer taps to within 2% of rated voltage of equipment.
- .3 Submit, on completion of work, a report listing phase and neutral currents on panelboards, dry type transformers, and motor control centres operating under normal load. State hour and date on which each load was measured, and voltage at time of test.

34 RECORD DRAWINGS

- .1 Submit record drawings in accordance with requirements of General Conditions.

- .2 Obtain one set of solid white prints to be used for record work as actually installed. Record on this set, all changes associated with the work.
- .3 Obtain one set of electrical drawing prints, and upon completion of the work, transcribe all information from the on-site record prints to the as-builts. Include all changes to the electrical contract including addenda, site instructions, change orders, and site conditions. Contractor shall retain the services of a qualified CAD draftsman to transfer the as-built information from the as-built prints to an electronic digital format using the CAD software application used to produce the original drawings. Identify CAD electronic drawing files with "AS BUILT" status. Contractor shall pay all costs associated with transfer of as-built information to electronic digital format.

35 WARRANTY

- .1 Submit a written warranty stating that all materials and workmanship will be free from defects for a period of one (1) year from date of Substantial Performance of Work. The warranty period shall not begin until:
 - Electrical Operating and Maintenance Manuals are submitted and approved.
 - Systems Demonstration and Training is completed and Systems Demonstration certificate is submitted.

The electrical sub-contractor shall remain responsible for all electrical equipment and systems until the Electrical Operating and Maintenance Manuals are submitted and approved, and the Systems Demonstration and Training has been completed.

36 OPERATION AND MAINTENANCE DATA

- .1 Provide operation and maintenance data for incorporation into an architectural operation and maintenance manual. The following are minimum requirements.
- .2 Include in operations and maintenance data:
 - .1 Cover page including project name, year, name of owner, electrical consultant, and electrical contractor. Cover page shall be enclosed in a clear plastic cover.
 - .2 Index.
 - .3 Electrical Contractor's Guarantee.
 - .4 List of manufacturer and supplier for all items.
 - .5 Name, address and phone number of local suppliers for items included in Maintenance Manual.
 - .6 A copy of all panelboard directories (revised directories for existing panels).
 - .7 Details of design elements, construction features, component function and maintenance requirements, to permit effective start-up operation, maintenance, repair, modification, extension and expansion of any portion or feature of installation.
 - .8 Technical data, product data, supplemented by bulletins, component illustrations, exploded views, technical descriptions of items and parts lists. Advertising or sales literature not acceptable.
 - .9 Operating Instructions for All Systems.
- .4 The following index tabs and associated product information shall be contained within the binder:

- Index
- Contractor Guarantee
- Manufacturer and Supplier List
- Supplier Addresses and Phone Numbers
- Systems Demonstration Certificate
- Panelboard Directories
- Disconnect Switches
- Enclosed Breakers

Divider tab pages shall be laminated mylar plastic with reinforced holes. Plastic tabs with typed insertions will not be accepted.

37 CARE, OPERATION AND START-UP

- .1 Instruct owner's maintenance and operating personnel in the operation, care, and maintenance of equipment. A minimum of four (4) hours of instruction shall be provided. Provide documentation in maintenance manual confirming that instruction has been provided including description of system, owner representatives in attendance, date, and signatures.
- .2 Arrange and pay for services of Manufacturer's factory service representative to supervise start-up of installation, check, adjust, balance, and calibrate components.
- .3 Provide these services for such period, and for as many visits as necessary to put equipment in operation, and ensure that operating personnel are conversant with aspects of its care and operation.

38 REVIEW OF WORK

- .1 When the contractor is satisfied that the work is completed, and after making his own inspection of work to verify completion, the electrical contractor shall submit a written request to the electrical consultant requesting a review of work.
- .2 Any deficiencies noted by the electrical consultant during the review of work, will be listed by the electrical consultant, and issued to the contractor.
- .3 Such deficiencies shall be corrected within three (3) weeks of the issuance of the deficiency list, or by a mutually agreed upon date. Once complete, the contractor shall submit a written request to the electrical consultant requesting a final deficiency review.
- .4 If subsequent site visits are required by the electrical consultant because the deficiencies listed were not complete, all time and expense costs incurred by the electrical consultant will be the responsibility of the electrical contractor.
- .5 During construction, the electrical contractor shall make any equipment or wiring accessible for review purposes, as requested by the electrical consultant.

39 DEMOLITION

- .1 Remove all redundant conduit and conductors to the source of supply. Where conduit is embedded in concrete or other inaccessible locations, it shall be abandoned.

- .2 Boxes, fittings, equipment and accessories which become redundant shall be completely removed. All such material shall become the property of the Contractor and he shall remove it from the site. Re-useable items of electrical equipment shall be re-installed where indicated on the drawings.
- .3 Remove all redundant light fixtures, speakers, starters, safety switches, contactors, enclosed breakers, panelboards, transformers, and other re-useable items of electrical equipment. These items shall be reinstalled where indicated on the drawings or shall be turned over to the Owner.
- .4 Where existing equipment is shown to be reinstalled, only the best quality items shall be selected for re-use.
- .5 The Contractor shall visit the site prior to submitting a bid to determine the amount of demolition work involved. No extras will be considered for work resulting from conditions that would have been evident upon thorough examination of the site.

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BREAKDOWN AND PRICES

- .1 During the course of construction, when the Contractor is requested to submit a price for the performance of additional work, the price shall be broken down as requested by the electrical consultant to show quantity, material, and labour charges for each item.
- .2 Submit the following Contract Price Breakdown to the electrical consultant within 30 days of award of the contract, and with each monthly progress claim during construction. Alternate formats for Contract Price Breakdown are not acceptable. Submit invoices to support claims for material on site, when requested.

END OF SECTION 26 05 00

CONTRACT PRICE BREAKDOWN

PROJECT: _____

PROGRESS CLAIM #: _____ DATE: _____

	Contract Amount				Amount Complete to Date			
	Material	Labour	Total	% of Contract	Material	Labour	Total	% Complete
General								
Site Services								
Conduit, Outlet Boxes								
Conductors								
Heat Tracing Cable								
Sub Total								
Change Orders								
TOTAL								

Part 1 General

1.1 RELATED WORK SPECIFIED ELSEWHERE

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

Part 2 Products

2.1 MATERIALS

- .1 All fixture and branch wiring joints in junction and outlet boxes shall be made with a CSA certified pressure type connector rated at 600 volts maximum. Connector body shall consist of a cone shaped coil spring insert, insulated with a colour coded flame retardant, thermoplastic shell, which shall be knurled for easy grip.
- .2 Lugs, terminals, and screws used for termination of conductors, shall be suitable for type of conductor used.
- .3 Wire connectors to CSA C22.2 No. 65-93.
- .4 Acceptable manufacturers: Buchanan

Part 3 Execution

3.1 INSTALLATION

- .1 Remove insulation carefully from ends of conductors and:
 - .1 Install mechanical pressure type connectors and tighten as recommended by Manufacturer as specified in CSA C22.2 No. 65-93. Installation shall meet secureness tests.

END OF SECTION 26 05 20

Part 1 General

Part 2 Products

2.1 MATERIALS

- .1 Conductors: copper, sized as indicated, with 600 volt insulation rated at 90°C. The conductor shall have PVC insulation with an overall nylon jacket (T90 or THHN), or cross-linked polyethylene insulation (R90 XLPE or RW90 XLPE).
- .2 Conductor shall be stranded for sizes #10 AWG and larger.
- .3 Conductors: to CSA C22.2 38.
- .4 Armoured cable: Copper conductors, interlocking armour fabricated galvanized steel strip.

Part 3 Execution

3.1 INSTALLATION - GENERAL

- .1 In conduit systems in accordance with Section 26 05 34.
- .2 #12 AWG shall be the minimum wire size used for branch circuits. All building conductors shall be sized to allow for a maximum of 2% voltage drop.
- .3 Conductor phasing for three phase electrical distribution equipment shall be made phase A, B, C, from left to right when facing equipment. The A, B, C, phasing shall be continuous from the incoming utility supply, throughout the electrical system, including panels, motor control centres, transformers, etc. and shall continue through to all the branch circuitry to the final connection of the outlet or device. Phase colour coding shall be red, black and blue for phases A, B and C respectively (X, Y, Z sequence). Continuous colour coding of insulation is required for conductors sized #2 AWG and smaller. Colour code phase taping for conductors sized #2 AWG and smaller will not be allowed.
- .4 Neutral conductors shall be white, ground conductors green, and isolated ground conductors green with yellow striped identification.
- .5 Conductors drawn into conduit shall not be pulled more than 30 metres nor more than three 90° bends without pullboxes.
- .6 Lubricant for pulling conductors shall be wax base insoluble in water and non-hardening.
- .7 Conductor length for parallel feeders shall be identical.
- .8 Identify all conductors (including neutral) with "Brady" marker to describe circuit number, wherever they are terminated in a junction box or panelboard.

- .9 Neutral conductors shall not be derated.
- .10 When changing the rotation of three phase motors, the change shall be made at the motor splice box.
- .11 Switch leg conductors shall be orange in colour (including low voltage relays). Traveller conductors for three-way and four-way switching of lighting circuits shall be yellow in colour. It is acceptable to use armoured cable between the switch outlet box and the junction box in the ceiling space above the switch outlet box (no orange conductor).
- .12 Low voltage wiring shall be red, blue, and orange in colour, minimum #16 AWG, THHN.
- .13 Control wiring conductors shall be red in colour (except associated building neutral conductor shall be white in colour).
- .14 Ground conductors shall be green in colour **A separate insulated (green) ground conductor shall be installed in each conduit system.** The conduit system will not constitute an adequate ground.
- .15 Install a separate insulated (green) ground conductor for each motor circuit.
- .16 Insulation for all conductors installed exterior to the building shall be rated at minus 40 degrees Celsius.
- .17 Circuits sharing a neutral shall be consecutive breakers in the panel (i.e. 1, 3, 5 or 8, 10, 12). Circuits energizing receptacles in computer labs, or dimming circuits shall not share neutrals.
- .18 Panelboard feeders shall be continuous and free of splices between the overcurrent protection device for the panelboards, and the panelboard.
- .19 Refer to Section 26 05 34 regarding installation of armoured cable.
- .20 Branch wiring for emergency power supply branch circuits shall be banded with yellow identification.

END OF SECTION 26 05 21

Part 1 General

Part 2 Products

2.1 MATERIALS

- .1 Grounding equipment to: CSA C22.2 No. 41.
- .2 Copper grounding conductors to: ASA G7.1.

2.2 EQUIPMENT

- .1 Non-corroding accessories necessary for grounding system, type, size, material as indicated, including but not necessarily limited to:
 - .1 Grounding and bonding bushings.
 - .2 Protective type clamps.
 - .3 Bolted type conductor connectors.
 - .4 Compression connectors – Burndy Type #YGHC-C (cable to cable).
 - .5 Bonding jumpers, straps.
 - .6 Pressure wire connectors.

Part 3 Execution

3.1 INSTALLATION - GENERAL

- .1 Install a complete permanent continuous grounding system including onductors, connectors, accessories, as indicated, to conform to requirements of electrical consultant and local authority having jurisdiction over installation.
- .2 Install connectors to Manufacturer's instructions.
- .3 Protect exposed grounding conductors from mechanical injury.
- .4 Use mechanical connectors for grounding connections to equipment provided with lugs.
- .5 Soldered joints not permitted.
- .6 Install bonding wire for flexible conduit, connected at both ends to grounding bushing, solderless lug, clamp of cup washer and screw. Neatly cleat bonding wire to exterior or flexible conduit.
- .7 Install separate insulated green ground conductor in each conduit system. The conduit system will not be considered as providing an adequate ground.
- .8 Each motor shall be provided with a separate insulated (green) ground conductor originating at the panel or Motor Control Centre from which the motor is energized.

3.2 TESTS

- .1 Perform tests in accordance with Section 26 05 01.
- .2 Perform ground continuity and resistance tests using method appropriate to site conditions and to approval of the Electrical Consultant and local authority having jurisdiction over installation. Ground resistance to be maximum five (5) ohms prior to connections being completed at the ground grid.
- .3 Perform tests before energizing electrical system.

END OF SECTION 26 05 28

Part 1 General

1.1 RELATED WORK SPECIFIED ELSEWHERE

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

Part 2 Products

2.1 SUPPORT CHANNELS

- .1 Support channels, length as indicated, U-shape, size 41 mm x 41 mm, 2.5 mm thick, surface mounted or suspended.

2.2 FASTENERS

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

2.3 MANUFACTURERS

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

Part 3 Execution

3.1 INSTALLATION

- .1 Lead anchors and plastic anchors will not be permitted.
- .2 Secure equipment to poured concrete with expandable inserts.
- .3 Secure equipment to hollow masonry walls or suspended ceilings with toggle bolts.
- .4 Secure surface mounted equipment with twist clip fasteners to inverted "T" bar ceilings. Ensure that "T" bars are adequately supported to carry weight of equipment specified before installation of same.
- .5 Support equipment, conduit or cables using clips, spring-loaded bolts, cable clamps designed as accessories to basic channel members.
- .6 Fasten conduit or cables to building construction or support system using straps.
 - .1 One-hole steel straps to secure surface conduits and cables 50 mm and smaller.
 - .2 Two-hole steel straps for conduits and cables larger than 50 mm.
 - .3 Beam clamps to secure conduit to exposed steel work.

- .7 Suspended support systems:
 - .1 Support individual cable or conduit runs with 6 mm diameter threaded rods and spring clips.
 - .2 Support 2 or more cables or conduits on channels supported by 6 mm diameter threaded rod hangers where direct fastening to building construction is impractical.
- .8 Provide metal brackets, frames, hangers, clamps and related types of support structures where indicated or as required to support conduit and cable runs.
- .9 Provide adequate support for raceways and cables dropped vertically to equipment where there is no wall support.
- .10 Do not use wire lashing, tie wraps, or perforated strap to support or secure raceways or cables.
- .11 Do not use supports or equipment installed for other trades for conduit or cable support except with permission of other trade and approval of the electrical consultant.
- .12 Install fastenings and supports as required for each type of equipment cables and conduits, and to Manufacturer's installation recommendations.
- .13 Do not install screws through upper flute portion of metal roof deck when roof membrane is located directly on top of metal roof deck. Confirm with general contractor.

END OF SECTION 26 05 29

Part 1 General

1.1 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings and product data for cabinets in accordance with Section 26 05 01.

1.2 OPERATING AND MAINTENANCE DATA

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

Part 2 Products

2.1 JUNCTION AND PULL BOXES

- .1 Junction and pull boxes: to CSA C22.2 No. 40, welded steel construction with screw-on flat covers for surface mounting.
- .2 Covers with 25 mm minimum extension all around, for flush-mounted pull and junction boxes.

2.2 CABINETS

- .1 Type T: sheet steel cabinet with hinged door, latch, lock (2 keys), containing 19mm G1S painted plywood backboard, suitable for flush or surface mounting as noted.

Part 3 Execution

3.1 JUNCTION AND PULL BOXES

- .1 Install junction and pull boxes in accessible locations.
- .2 Support boxes independently of connecting conduits. Secure boxes to building structure.
- .3 Mount cabinets with top not greater than 2 m above finished floor.
- .4 Extension rings will not be allowed on junction or pullboxes.
- .5 Only main junction and pull boxes are indicated. Provide pull boxes so as not to exceed 30 meters of conduit run between pull boxes.

3.2 IDENTIFICATION

- .1 Junction, pull boxes, and splitters with size 2 identification labels indicating system name, ampacity, voltage and phase in accordance with Section 26 05 01.
- .2 Identify all 100 mm square or 100 mm octagon junction boxes, containing branch circuit conductors, with black felt marker indicating panel and breaker number (i.e. "B-24").

END OF SECTION 26 05 31

Part 1 General

1.1 RELATED WORK SPECIFIED ELSEWHERE

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

Part 2 Products

2.1 SHEET METAL BOXES

- .1 All octagon boxes shall be hot dipped galvanized steel, minimum 100 mm in diameter #54151. All 100 mm square boxes shall be minimum 40 mm deep #52151. Deep boxes #52171 shall be installed where specified and where six or more conductors enter the box.
- .2 Device boxes shall be minimum 64 mm deep (#1104).

2.2 CAST BOXES

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

Part 3 Execution

3.1 INSTALLATION

- .1 Support boxes independently of connecting conduits. Secure outlet boxes to building structure.
- .2 Fill boxes with paper to prevent entry of construction material.
- .3 Provide correct size of openings in boxes for conduit, mineral insulated and armoured cable connections. Reducing washers not allowed.
- .4 Extension rings shall **not** be utilized to accommodate conductor fill requirements.
- .5 Where 25 mm conduit is utilized, outlet boxes must be minimum 119 mm (4 11/16") square.

END OF SECTION 26 05 32

Part 1 General

1.1 RELATED WORK

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

Part 2 Products

2.1 CONDUITS

- .1 Rigid metal conduit: to CSA C22.2 No. 45.
- .2 Electrical metallic tubing (EMT): to CSA C22.2 No. 83. EMT shall be thin-walled electroplated steel.
- .3 Flexible metal conduit and liquid-tight flexible metal conduit: to CSA C22.2 No. 56.
- .4 Type DB2 PVC duct for ductbanks and direct burial: sized as indicated on drawings, to CSA C22.2 No. 211.1.
- .5 Rigid PVC conduit: sized as indicated on drawings to CSA C22.2 No. 211.2.

2.2 CONDUIT FASTENINGS

- .1 One hole galvanized steel straps to secure surface conduits 50 mm and smaller. Use two hole galvanized steel straps for conduits larger than 50 mm.
- .2 Beam clamps to secure conduits to exposed steel work.
- .3 Channel type supports for two or more conduits at the following maximum spacings:
 - 1500 mm for 13 mm and 19 mm conduits
 - 2000 mm for 25 mm and 32 mm conduits
 - 3000 mm for 40 mm and larger conduits
- .4 6 mm diameter threaded rods to support suspended channels.
- .5 Conduit clamps for conduits on channels.

2.3 CONDUIT FITTINGS

- .1 Fittings for raceways: to CSA C22.2 No. 18-97.
- .2 Fittings manufactured for use with conduit specified.
- .3 Factory "ells" where 90 degree bends are required for 19 mm and larger conduits.

Part 3 Execution

3.1 INSTALLATION

- .1 Drawings do not show all conduits. Those shown are in diagrammatic form. Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass.
- .2 Conceal conduits except in unfinished areas and concealed ceiling spaces.
- .3 Use rigid conduit where noted, and in any location which, in the opinion of the electrical consultant is subjected to mechanical damage.
- .4 Use rigid P.V.C. underground or in concrete slabs only. PVC conduit is not acceptable above floor slab.
- .5 Use liquid-tight flexible metal conduit and liquid-tight connectors for connection to all motors.
- .6 Bend conduits cold, so that conduit at any point is not flattened more than 1/10th of its original diameter. Consider conduits bent more than this or kinked as defective and replace.
- .7 Mechanically bend steel conduit over 19 mm diameter.
- .8 Field threads on rigid conduit shall be sufficient length to draw conduits up tight.
- .9 Provide polypropylene pull cord in empty conduits to facilitate pulling wiring in future.
- .10 Where conduits become blocked, use of corrosive agents is prohibited. Remove and replace blocked section.
- .11 Dry conduits out thoroughly before installing wire.
- .12 Conduits shall not pass through structural members without the knowledge and consent of the structural consultant.
- .13 Locate conduits not less than 75 mm parallel to steam or hot water lines with a minimum of 25 mm at crossovers.
- .14 All conduit connectors shall be complete with a nylon insulated throat wherever conduit terminates in an outlet or junction box.
- .15 Conduit shall be secured to building structure. Do not fasten conduit to suspended ceiling or its support.
- .16 Run conduit parallel or perpendicular to building lines, when installed exposed or in ceiling spaces.
- .17 Locate conduits a minimum of 1.5 metres from infrared or gas fired heaters.

- .18 Conduits to be run in flanged portion of structural steel.
- .19 Group conduits wherever possible on surface channels.
- .20 Install CSA approved expansion fittings complete with grounding jumpers where conduits cross building expansion joints. Provide offsets in conduit adjacent to building expansion joints, where conduit is installed above suspended ceilings.
- .21 Conduits installed between heated and unheated spaces shall be sealed internally with a silicone sealant at the wall between the two spaces.

3.2 CONDUITS UNDERGROUND

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

3.3 IDENTIFICATION

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

END OF SECTION 26 05 34

Part 1 General

1.1 WORK INCLUDED

- .1 General inspection of all electrical equipment.
- .2 Specific equipment testing as specified herein or in other sections of the specifications.
- .3 Power Distribution System testing including insulation resistance testing, load balance, and voltage testing.
- .4 Building Systems testing.
- .5 Submittal of test reports.
- .6 Instruction for the Owner's staff in the cleaning, maintenance and operation of the building systems, equipment, and finishes.

Part 2 Products

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

Part 3 Execution

3.1 GENERAL EQUIPMENT INSPECTION

- .1 Visually inspect all equipment delivered to the site, to identify damage due to transportation, handling, or placing into position. Verify the content of the equipment with the bill of material and note any missing items. Document all defects or damage noted and submit to the Electrical Consultant.
- .2 Check all bus connections, wiring, and other joints that are made at equipment shipping splits and ensure that the equipment sections are properly bolted together.
- .3 Ensure that the equipment is clean and free of debris before proceeding with testing or energization of the equipment.
- .4 Verify the phasing connections of the incoming and / or outgoing connections to the equipment.
- .5 Visually check air gap and surface clearances, phase to phase and phase to ground. Document any clearances that appear to be below the CSA standard for the equipment.
- .6 Ensure that ground connections are provided to C.E.C. requirements and as specified.

3.2 DISTRIBUTION SYSTEM ELECTRICAL TESTING

- .1 Take voltage readings at all power distribution points including service switchgear motor control centres, distribution panels, transformer primary and secondary terminals, and lighting panelboards.
- .2 Insulation Resistance Testing
 - .1 Megger test all branch circuits, feeders, and equipment buswork prior to energization. Insulation resistance shall conform to the requirements of the Canadian Electrical Code, the local inspection authority, and the Electrical Consultant.
 - .1 Test circuits and equipment rated up to 350 volt with a 500 volt instrument.
 - .2 Test 350 to 600 volt circuits and equipment with a 1000 volt instrument.
 - .2 Insulation resistance less than 1.0 Megohm on any circuit, feeder, or equipment shall be considered unacceptable. Clean, dry out, or replace equipment until acceptable resistance is achieved.
 - .3 Load Balance
 - .1 Measure phase current to panelboards and distribution centres with all possible loads operating. Adjust branch circuit connections as required to obtain best balance of current between phases and record final measurements after adjustments have been completed. Load unbalance shall not exceed fifteen percent (15%).
 - .2 Measure phase voltages at loads and adjust transformer taps to within 2% of rated voltage of equipment.
 - .3 Submit, on completion of work, a report listing phase and neutral currents on panelboards, operating under normal load. State hour and date on which each load was measured, and voltage at time of test.

3.3 BUILDING SYSTEMS TESTING

- .1 Functionally test all building systems components including disconnect switches, heat tracing cables, thermostats, transformers, gate control pushbutton stations, etc.

3.4 TEST REPORTING

- .1 Submit general equipment inspection report to confirm that equipment has been tested and noting any damage or defects.
- .2 Submit distribution system electrical test reports including:
 - insulation resistance test results for all feeders and equipment except for 120/208 volt branch circuit wiring.
 - power distribution system voltage readings
 - load balance readings.

END OF SECTION 26 08 00

Part 1 General

1.1 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings and product data in accordance with Section 26 05 01.
- .2 Shop drawings shall include type, insulation, BIL, sound level, impedance, KVA rating, and enclosure dimensions.

1.2 OPERATION AND MAINTENANCE DATA

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

Part 2 Products

2.1 TRANSFORMERS

- .1 Dry type transformers: to CSA 22.2 No. 47, and CAN/CSA C802.2-00.
- .2 Use transformers of one manufacturer throughout project.
- .3 Design 1.
 - .1 Type: ANN.
 - .2 Insulation: Class H, 150 degrees Celsius temperature rise.
 - .3 Basic Impulse Level (BIL): 10kV.
 - .4 Hipot: standard.
 - .5 Average sound level: 45dB up to 45kVA, 50dB from 75kVA to 150kVA, and 55dB from 150kVA to 300kVA measured in any third octave band between 60 Hz and 1000 Hz.
 - .6 Impedance at 170 degrees Celsius: six percent maximum.
 - .7 Enclosure: EEMAC 1, removable metal front panel.
 - .8 Mounting: floor.
 - .9 Finish: ASA 61 grey.
 - .10 Windings: copper
 - .11 Taps: 2.5% of full capacity.
 - .12 Anti vibration pads between core and the enclosure.
- .4 Transformers located in areas where fire protection sprinklers are located must be complete with a non-combustible hood or shield to prevent spray from fire protection sprinklers from entering the transformer.

2.2 MANUFACTURERS

- .1 Acceptable manufacturers: Hammond, Polygon, Square D, Rex Manufacturing, Delta, Eaton Cutler-Hammer, GE Industrial Systems, or approved equivalent.

Part 3 Execution

3.1 MOUNTING

- .1 Mount floor mounted dry type transformers on 100 mm concrete housekeeping pad.
- .2 Ensure adequate clearance around transformer for ventilation.
- .3 Install transformers in level upright position.
- .4 Remove shipping supports only after transformer is installed and just before putting into service.
- .5 Loosen isolation pad bolts until no compression is visible.
- .6 Use flexible conduit to make connections to transformer.

3.2 CONNECTIONS

- .1 Make primary and secondary connections shown on wiring diagram.
- .2 Energize transformers immediately after installation is completed, where practicable.
- .3 Adjust primary taps as necessary to produce rated secondary voltage at no-load.

3.3 NOISE / VIBRATION ISOLATION

- .1 Isolate transformer noise and vibration from occupied areas of the building. Provide neoprene isolation for support of the transformer, and utilize flexible wiring connections. Advise other trades not to locate services in the area adjacent to the transformer, that may hinder the isolation of the transformer noise and vibration.
- .2 Utilize Vibro-Acoustics type NSN resilient elements below transformers.

3.4 EQUIPMENT IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 01.
- .2 Nameplate for each transformer Size 7 engraved in accordance with Section 16010. Indicate transformer designation, capacity, primary and secondary voltages, phase, and name of load the transformer energizes (i.e., "T-2, 300 kVA, 600/120/208V, three phase, feeds Sub-Distribution SD-1"). Mount on front face of transformer.

END OF SECTION 26 12 17

Part 1 General

1.1 SHOP DRAWINGS AND PRODUCT DATA

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

1.2 OPERATION AND MAINTENANCE DATA

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

Part 2 Products

2.1 BREAKERS - GENERAL

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

2.2 THERMAL MAGNETIC BREAKERS

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

2.3 BREAKER ENCLOSURES

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

2.4 MANUFACTURERS

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

Part 3 Execution

3.1 INSTALLATION

- .1 Install circuit breakers as indicated.

END OF SECTION 26 28 21

Part 1 General

1.1 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings and product data in accordance with Section 26 05 01
- .2 Drawings shall include rating and enclosure dimensions.

1.2 OPERATIONS AND MAINTENANCE DATA

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

1.3 RELATED WORK SPECIFIED ELSEWHERE

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

Part 2 Products

2.1 EQUIPMENT

- .1 Enclosed manual air break switches in non-hazardous locations: to CSA C22.2 No. 4-M1985.
- .2 Fuseholder assemblies: to CSA C22.2 No. 39-M1987.
- .3 Fusible and non-fusible disconnect switch in CSA Enclosure 1 as indicated.
- .4 Provision for padlocking in "OFF" switch position.
- .5 Mechanically interlocked door to prevent opening when handle in 'ON' position.
- .6 Fuseholders in each switch suitable without adaptors, for type of fuse as indicated.
- .7 Quick-make, quick-break action.
- .8 ON-OFF switch position indication on switch enclosure cover.
- .9 Fusible and non-fusible disconnect switch shall be complete with solid neutral lug assembly.

2.2 MANUFACTURERS

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

Part 3 Execution

3.1 INSTALLATION

- .1 Install disconnect switches complete with fuses as indicated.

- .2 Mount securely at 1800 mm above finished floor to top of switch. Provide a minimum of 1000 mm clear floor space in front of the switch.

3.2 EQUIPMENT IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 01.
- .2 Nameplate for each disconnect switch Size 5 engraved in accordance with Section 26 05 01. Indicate disconnect load, amperage, voltage, and phase (i.e., rooftop unit, 60 amp, 120/208V, 3 phase).
- .3 Identify circuit number on disconnect switch (i.e. “B-36”).

END OF SECTION 26 28 23

Part 1 General

1.1 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings and product data in accordance with Section 26 05 01.
- .2 Indicate:
 - .1 Mounting method and dimensions.
 - .2 Starter size and type.
 - .3 Layout of identified internal and front panel components.
 - .4 Enclosure types.
 - .5 Wiring diagram for each type of starter.
 - .6 Interconnection diagrams.
 - .7 Identify motor that starter energizes.

1.2 OPERATION AND MAINTENANCE DATA

- .1 Provide data for incorporation into Maintenance Manual specified in Section 26 05 01.
- .2 Include operation and maintenance data for each type of starter.

1.3 MAINTENANCE MATERIALS

- .1 Provide listed spare parts for each different size and type of starter.
 - .1 1 contact, auxiliary.
 - .2 2 fuses.

Part 2 Products

2.1 MATERIALS

- .1 Starters to CSA C22.2 No. 14-M91, EEMAC E14-1.
 - .1 Half size starters not acceptable.
- .2 Control transformers - to CSA C22.2 No. 66-1988.
- .3 Resistors - to EEMAC 13E-1-1965.
- .4 Auto transformers - to CSA C22.2 No. 47-M90.

2.2 MANUAL STARTING SWITCHES

- .1 Single phase manual motor starters of size, type, rating, and enclosure type as required, with components as follows:
 - .1 Switching mechanism, quick-make and break.
 - .2 One overload heater, manual reset, trip indicating handle.

.2 Accessories

- .1 Toggle switch heavy duty labelled as indicated.
- .2 Indicating light: heavy duty LED type, red colour.
- .3 Locking tab to permit padlocking in "ON" or "OFF" position.

2.3 FULL VOLTAGE MAGNETIC STARTER

- .1 Magnetic and combination starters of size, type, rating and enclosure type as indicated with components as follows:
 - .1 Contactor solenoid operated, rapid action type.
 - .2 Motor overload protective device in phase, manually reset from outside enclosure.
 - .3 Power and control terminals.
 - .4 Wiring and schematic diagram inside starter enclosure in visible location.
 - .5 Identify each wire and terminal for external connections, within starter, with permanent number marking identical to diagram.
- .2 Combination type starters to be circuit breaker with operating handle on outside of enclosure to control circuit breaker, and provision for:
 - .1 Locking in "OFF" position with up to 3 padlocks.
 - .2 Locking in "ON" position.
 - .3 Independent locking of enclosure door.
 - .4 Provision for preventing switching to "ON" position while enclosure door open.
- .3 Accessories:
 - .1 Selector switches: heavy duty H.O.A. unless otherwise indicated.
 - .2 Indicating lights: heavy duty neon type, red color.
 - .3 1-N/O and 1-N/C spare auxiliary contacts unless otherwise indicated.

2.4 CONTROL TRANSFORMER

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

2.5 FINISHES

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

2.6 MANUFACTURERS

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

Part 3 Execution

3.1 INSTALLATION

- .1 Install starters, connect power and control as indicated.
- .2 Ensure correct fuses and overcurrent devices are sized to accommodate actual motor loads prior to ordering electrical equipment. Actual motor electrical loads may vary depending upon manufacturer of the mechanical equipment. Refer to mechanical shop drawings and manufacturer specifications.
- .3 Provide the necessary conduit for mechanical heating and ventilation control to the starters as required under the mechanical contract. Confirm with the Mechanical Contractor the conduit requirements prior to installation.
- .4 The Electrical Contractor shall complete all control wiring required which is not specifically related to the controls systems as outlined in the mechanical specifications. All control wiring outlined in the mechanical specifications as part of the controls systems shall be completed by the Controls Contractor. The Electrical Contractor shall supply all control equipment specifically noted on plans or specifications. All other equipment required shall be supplied by Mechanical or other trades. The Electrical Contractor shall co-operate with the Mechanical trades to ensure that all control sequences and equipment are correct. The Electrical Contractor shall be supplied with all electrical equipment from other trades and shall verify that its characteristics are correct. It will be the responsibility of the Electrical Contractor to obtain from the Mechanical Contractor, and all other trades, complete detailed wiring diagrams for all equipment supplied by these trades requiring electrical wiring by the Electrical Contractor's work and the work of other trades. It is the Electrical Contractor's responsibility to point out immediately any discrepancies in these diagrams or any reason they cannot be adhered to. All control equipment such as immersion type thermostats, coil freeze protection, pneumatic control devices, etc. shall be installed by the trade responsible for its supply and operation.
- .5 It is the responsibility of the electrical contractor to provide a dedicated line voltage power source where required for control systems. Coordinate locations of power source for controls systems with mechanical contractor.
- .6 It is the responsibility of the electrical contractor to provide all control devices such as pushbutton stations, when they do not form part of a control panel.

3.2 TESTS

- .1 Perform tests in accordance with Section 26 05 01.
- .2 Perform tests in accordance with Manufacturer's instructions.
- .3 Operate switches, contactors to verify correct functioning, related starters, equipment, control devices, operate as indicated.
- .4 Perform starting and stopping sequences of contactors and relays.

- .5 Check that sequence controls, interlocking with other separate related starters, equipment, control devices, operate as indicated.

3.3 EQUIPMENT IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 01.
- .2 Provide a size 1 plastic laminate identifying both name of motor as well as motor designation (ie "EXHAUST FAN EF-1").

END OF SECTION 26 29 10