

PART 1 – GENERAL

1.1 GENERAL

- .1 This section covers items common to all sections of Divisions 02, 26, 27 and 28.

1.2 ELECTRICAL WORK INCLUDED

- .1 The specification complements the drawings in describing the supply and installation of a complete electrical system. This system shall include but not necessarily be limited to the following:
 - .1 New electrical service including power feeds from the central services building and a new switchboard.
 - .2 A power distribution system including 600/347 and 120/208 volt 3 phase 4 wire panel boards,
 - .3 Small power system including wiring devices;
 - .4 Lighting system including luminaires, including wiring;
 - .5 Exit and emergency lighting including wiring;
 - .6 Telephone and data system;
 - .7 Fire Alarm System;
 - .8 Security and access control systems;
 - .9 Demolition of existing as noted.
 - .9 Public address system

1.3 CONTRACT DRAWINGS

- .1 The specification together with the drawings are intended to provide a description of a complete electrical system and therefore there shall be no omission of the items necessary or required to make a finished, workmanlike, first class installation, even though each and every item of labour and material may not be mentioned in the specification or shown on the drawings.
- .2 Items indicated on floor plans and not on riser diagrams, or vice versa, shall be considered fully covered by both.
- .3 Runs of conduit and outlet locations indicated on the drawings are diagrammatic and exact locations must be determined by this contract as the work proceeds, with due regard to the structure and the work of other trades. This contract shall make any changes dictated by structural requirements, or conflicts with other trades, without charge.
- .4 Apparent errors or omissions shall be referred to the Architect/Engineer whose decision shall be final.
- .5 Building dimensions shall not be scaled from the electrical drawings but shall be obtained from the architectural and/or structural drawings. Any discrepancy between the drawings and building shall be questioned before proceeding with the installation.

1.4 CODES AND STANDARDS

- .1 As a minimum standard perform all work in accordance with the requirements of the Provincial Department of Labour, Shared Services Canada Structured Cabling Guideline,

Canadian Electrical Code C22.1-2012 Part 1, CSA Standards CAN Z32.4 and CAN Z32.2, National Building Code, and ULC-S524-2010. These standards together with all local or municipal rules, regulations, and ordinances shall be considered as the latest approved editions at the time of tender closing. In no instance, shall the standard established in these contract documents, be reduced by any codes.

- .2 Do underground systems in accordance with CSA CAN-C22.3 No. 7-10.
- .3 Abbreviations for electrical terms: to CSA Z85-1983.
- .4 Comply with CAN/CSA C860-11 standard for exit signs.
- .5 Comply with efficiency values as indicated in the latest version of CSA C802.2 Minimum Efficiency Values for Dry Type Transformers. Transformers to bear label of verification agency logo near nameplate.
- .6 Comply with CSA Certification Standards and Electrical Bulletins in force at the time of tender submission.

1.5 INSPECTIONS, PERMITS AND FEES

- .1 Obtain all inspections and permits required by all laws, ordinances, rules and regulations by the public authority having jurisdiction at the place of this building for work of this Contract, and obtain certificates of such inspections and submit same and pay all charges in connection therewith. The final certificate of inspection shall be obtained before final payment for work shall be considered due.
- .2 Electrical Permit
 - .1 Submit to the Electrical Inspection Department and Supply Authority necessary number of drawings and specifications for examination and approval prior to commencement of work.
 - .2 Pay associated fees.
 - .3 Furnish certificates of Acceptance from Inspection Department and AHJ on completion of work.

1.6 SHOP DRAWINGS, PRODUCT DATA AND SAMPLES

- .1 Submit shop drawings, product data and samples in accordance with Division 1. Provide all shop drawings within 30 days after contract has been awarded. Failure to do so will delay progress payments.
- .2 Indicate details of construction, dimensions, capacities, weights and electrical performance characteristics of equipment or material.
- .3 Where applicable, include wiring, single line and schematic diagrams.
- .4 Include wiring drawings or diagrams showing interconnection with work of other Sections.

- .5 Keep one copy of shop drawings and product data on site, available for reference at all times.

1.7 OPERATION AND MAINTENANCE DATA

- .1 Provide operation and maintenance data for incorporation into Operation and Maintenance Manuals as specified in Division 1.
- .2 Include in the operation and maintenance data:
 - .1 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.
 - .2 Technical data, product data, supplemented by bulletins, component illustrations, exploded views, technical description of items and parts lists. Advertising or sales literature not acceptable.
 - .3 Wiring and schematic diagrams and performance curves.
 - .4 Names and addresses of local suppliers for items included in maintenance manuals.
 - .5 Copy of reviewed shop drawings.
 - .6 Signed receipt for all spare parts.
- .3 Approvals:
 - .1 Submit one draft of Operating and Maintenance Manual to Engineer for approval one month prior to estimated substantial completion date. Submission of individual data will not be accepted unless so directed by Engineer.
 - .2 Make any changes in submission as may be required and re-submit as directed.
 - .3 Failure to do so will result in delay of progress payment.
 - .4 Provide two (2) final bound copies of Operation and Maintenance Manuals to Departmental Representative and one (1) bound copy to Engineer.

1.8 PROJECT RECORD DOCUMENTS

- .1 Provide Project Record Documents in accordance with Division 1.
- .2 Submit record drawings to Architect/Engineer showing changes of wire sizes, circuit numbering and location of raceways, fittings, fixtures, panels and equipment, and their sizes, the location of which has changed or deviated during the work.
- .3 Submit sepia or reproducible of record drawings after record drawings have been approved by the Engineer. Originals shall be made available by the Engineer for the making of sepia or reproducible of the contract drawings. All changes reflected on record drawings are to be indicated on these sepia or reproducible.

1.9 MAINTENANCE MATERIAL

- .1 Provide maintenance materials in accordance with Division 1.

1.10 CARE, OPERATION AND START UP

- .1 Instruct operating personnel in the operation, care and maintenance of the equipment.

- .2 Arrange and pay for services of the manufacturer's service engineer to supervise start-up and to 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.

1.11 VOLTAGE RATINGS

- .1 Operating voltages to meet requirements of CAN3-C235.
- .2 Motors, control and distribution equipment to operate satisfactorily at 60 Hz within normal operating limits established by the above standard. Equipment to operate in extreme operating conditions established in the above standard without damage to the equipment.

1.12 MATERIAL AND EQUIPMENT

- .1 Provide materials and equipment in accordance with Division 1.
- .2 Equipment and materials to be C.S.A. certified, and manufactured to standard quoted.
- .3 Where there is no alternative to supplying equipment which is not C.S.A. certified, obtain special approval from C.S.A.
- .4 Factory assemble control panels and component assemblies.
- .5 For the purposes of uniformity similar materials shall be of one manufacturer (i.e. all panels; all motor control equipment; all fixtures in as much as is possible, etc.).
- .6 To avoid the possibility of the work being delayed, order all materials as soon as the shop drawings are reviewed, and report at once to the Architect/Engineer any delays in the delivery of materials which would hold up the completion of the job.

1.13 GROUNDING

- .1 All equipment and exposed non-current carrying metal, conduits and parts shall be permanently and effectively *bonded to ground* to meet minimum requirements of the C.E.C. Section 10, and as indicated on the drawings and further specified. Standards set either by drawings or specifications which are above those covered by C.E.C. Section 10, shall not be reduced under any circumstances.

1.14 ELECTRIC MOTOR, EQUIPMENT AND CONTROLS

- .1 Provide final connections to all motors, equipment, controls, etc., indicated on the drawings. These motors, equipment, controls, etc., shall include those supplied under other sections of this specification, as well as Departmental Representative supplied items. Ensure that equipment will operate properly (e.g. proper rotation) and report any instance of defective equipment to the Architect/Engineer.

- .2 Supplier and installer responsibility is indicated on electrical drawings, and in this specification and related mechanical responsibility is indicated on mechanical drawings, and in the mechanical specifications.
- .3 All electrical equipment, which is supplied and installed by this Contract or other contracts, that requires wiring at or above 50V, shall be wired by this Contract in accordance with terms and regulations established by this Specification.
- .4 All electrical wiring and connections below 50V related to systems specified under other sections or contracts shall be done by their contractor in accordance with terms and regulations established by this Specification.
- .5 All electrical wiring and connections below 50V related to systems specified by Division 26 shall be done by the Division 26 Contractor.

1.15 FINISHES

- .1 Shop finish metal enclosure surfaces by removal of rust and scale, cleaning, application of rust resistant primer inside and outside, and at least two coats of finish enamel.
 - .1 Paint outdoor electrical equipment, "Equipment Green" finish to EEMAC Y1-1-1955.
 - .2 Paint indoor switchgear and distribution enclosures light grey to EEMAC 2Y-1-1958.
- .2 Clean and touch up surfaces of shop-painted equipment scratched or marred during shipment or installation, to match original paint.
- .3 Clean, prime and paint exposed hangers, racks, and fastenings to prevent rusting.
- .4 Where wire guards are specified in other sections, they are to be constructed of stainless steel. Painted steel is not acceptable.

1.16 EQUIPMENT IDENTIFICATION

- .1 All switchboards, motor control centres, starters, disconnect switches, receptacles, voice/data/CATV/multimedia outlets, dry-type transformers, control transformers, pushbuttons, timeclocks, panels, control panels, etc., shall have "Lamacoid" nameplates mounted on or adjacent for identification which shall include the panel designation, voltage, phase, wires overcurrent protection, H.P., KW and amperage as applicable. The nameplates shall be affixed to metal equipment with metal type pop rivets, and to all other equipment with contact type cement applied to the entire nameplate backing. Contact type cement shall be applied (buttered) to complete rear side of plate, as opposed to several points or locations on same.
- .2 Install directories on the back of each door of panel boards, neatly arranged and mounted in frame under transparent cover. Directories shall be typed and shall show system voltage, which outlets are on each circuit and any special information, such as sizes of fuses, etc., necessary for the proper operation and maintenance of the system.
- .3 All sectionalising panels shall have lamacoid plates affixed adjacent to each breaker.

- .4 Size of identification shall be suitable for equipment and importance of information.
- .5 All fused disconnect switches shall have lamacoid plates identifying the equipment they feed and a separate plate indicating maximum fuse size and type.
- .6 Lettering shall be of sufficient size to be readable from normal viewing distance and the information required on the nameplates shall dictate the physical size of plates.
- .7 Nameplates shall have white lettering on black background except for equipment connected to emergency power source, which shall have white lettering on red background.
- .8 All transformers to have lamacoid plates identifying source of primary feeder and secondary equipment which it feeds plus distribution designation lettering and/or numbers.
- .9 All "D" and "E" boxes 200mm x 200mm x 100mm or larger and "C" and "T" cabinets shall have lamacoid plates affixed indicating voltages and/or systems housed within.
- .10 Nameplates:
 - .1 Lamacoid 3mm thick plastic engraving sheet on metal surfaces, 1.5mm where not applied to metals.

NAMEPLATE SIZES

Size 1	10mm x 50mm	1 line	5mm high letters
Size 2	13mm x 75mm	1 line	6mm high letters
Size 3	16mm x 75mm	2 lines	5mm high letters
Size 4	19mm x 91mm	1 line	10mm high letters
Size 5	38mm x 91mm	2 lines	12mm high letters
Size 6	25mm x 100mm	1 line	12mm high letters
Size 7	25mm x 100mm	2 lines	6mm high letters
Size 8	50mm x 150mm	2 lines	12mm high letters

- .11 Labels:
 - .1 Embossed plastic labels with 6.5mm high letters unless specified otherwise.
- .12 Wording on nameplates and labels to be approved by the Engineer prior to manufacture.
- .13 Allow for average of forty (40) letters per nameplate and label.
- .14 Identification to be English.

1.17 WIRING IDENTIFICATION

- .1 Conductor insulation shall be colour coded as follows:
 - Phase A - Red
 - Phase B - Black
 - Phase C - Blue
 - Neutral - White/Grey

- Ground /Bond - Green
- Isolated Ground - Green w/Yellow stripe

This shall apply to all phase conductors up to and including #2AWG and all sizes of neutral, bond and ground conductors up to and including #3/0AWG.

- .2 For conductors exceeding sizes as described above, identification of wiring with approved coloured plastic tapes shall be acceptable. Attach to both ends of all conductor runs a minimum of 12” from terminations, and in all junction and/or pull boxes.
- .3 Maintain phase sequence and colour coding throughout.
- .4 Colour code shall be as per Section 26 05 21 2.1.1.
- .5 Use color coded wires in branch circuit wiring, systems wiring and communication cables.

1.18 CONDUIT, CABLE AND JUNCTION/PULLBOX IDENTIFICATION

- .1 Identify all conduit fittings and junction/pull boxes along with their covers with colours as described below. Boxes shall be coloured both inside and out where one colour is required, and inside only where two are required. Metal coverplates shall be completely painted where one colour is required, and shall have both colours applied diagonally where two colours are required. All junction boxes shall be colour identified prior to installation.

<u>System</u>	<u>Colour</u>
120/208V Lighting & Power	Yellow
Telephone (voice only)	Black
Grounding/bond	Green
Fire Alarm	Red
Security	Brown
0 to 50V	Violet
CATV	Yellow/White
Data only	Black/White
Voice & Data	Blue/White
Energy Management	Red/White

1.19 WIRING TERMINATION

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

1.20 MANUFACTURERS’ AND CSA LABELS

- .1 Manufacturers’ and CSA labels shall be visible and legible after equipment is installed.

1.21 WARNING SIGNS

- .1 Provide warning signs, as specified and/or to meet the requirements of the Department of Labour Inspection Department.

- .2 Use decal signs, minimum 175mm x 250mm size.

1.22 SINGLE LINE DIAGRAMS

- .1 Provide a framed single line diagram under Plexiglas as follows:
 - .1 Fire Alarm System Riser;
 - .2 Security System Riser including CCTV;
 - .3 Access Control System Riser;
 - .4 Power distribution system riser;
 - .5 Structured Cabling System Riser.

1.23 LOCATION OF OUTLETS

- .1 Locate outlets in accordance with Division 1.
- .2 Do not install outlets back-to-back in wall; allow minimum 150mm horizontal clearance between boxes.
- .3 Change location of outlets at no extra cost or credit providing distance does not exceed 3 metres and information is given before installation.
- .4 Locate light switches on latch side of doors and safety switches in mechanical rooms on latch side of door where possible.
- .5 Coordinate on site the location of outlets with respect to counters, heating cabinets, etc., before work is to start.
- .6 All outlets to have brushed stainless steel coverplates regardless of the system involved, includes light switches, receptacles, communication outlets and etc.

1.24 MOUNTING HEIGHTS

- .1 Mounting heights of equipment is from finished floor to centre line 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.
 - .1 Local switches, to switch: 1200mm
 - .2 Wall receptacles:
 - .1 General: 400mm
 - .2 Above top of continuous baseboard heater: 200mm
 - .3 Above top of counters or splash back: 375mm
 - .4 In mechanical rooms: 1200mm
 - .3 Panelboards: as required by code or as indicated
 - .4 Data/Telephone outlets: 400mm
 - .5 Pay phone: 1500mm
 - .6 End of line resistor: 2100mm
 - .7 Motor starters, disconnect, etc.: 1500mm

.8	Luminaires:	as indicated on drawings
.9	Fire alarm pull stations:	1200mm
.10	Fire alarm bells:	2100mm
.11	Unit emergency lighting equipment:	2100mm

1.25 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.
- .3 Arrange for installation of temporary doors for rooms containing electrical distribution equipment. Keep these doors locked except when under direct supervision of electrician.

1.26 LOAD BALANCE

- .1 Balance all phase currents of transformers, main switchboard, distribution Panel boards, etc., and where applicable, adjust transformer taps to obtain within 2% of the rated voltage of the load being supplied. Make adjustments and/or increase conductor size so as to limit voltage drops to 3% and make such adjustments under average load conditions in presence of Engineer.
- .2 Submit to Engineer, at completion of work, a report listing the voltage, phase and neutral currents on the switchboard, Panel boards and dry-type transformers, operating under normal load. On the report also state hour and date on which each load was measured

1.27 CONDUIT AND CABLE INSTALLATION

- .1 Install conduit, and sleeves, prior to pouring of concrete. Sleeves through concrete shall be constructed of sheet metal, sized for free passage of conduit, and protruding 50mm.
- .2 Install cables, conduits, and fittings to be embedded neatly and close to building structure so furring can be kept to minimum.

1.28 FIRESTOPPING AND SMOKE SEALS

- .1 All fire stopping and smoke seals required to properly accommodate the work of this Division shall be the financial responsibility of Division 26, and carried out by trades to the applicable ULC approved system of one of the approved Manufacturers provided in this document. Trades personnel must be trained by the manufacturer and provide documentation stating same.
- .2 Refer to architectural drawings for locations of assemblies and refer to Division 1 for firestopping details and procedures.

1.29 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 controls.
 - .4 Motors and associated control equipment including sequenced operation of systems where applicable.
 - .5 Polarity check on receptacles.
 - .6 Structured cabling system.
 - .7 Fire Alarm system.
 - .8 Security System
 - .9 Emergency Lighting System
 - .10 Exit Signage
 - .11 Access Control System
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- .2 Furnish manufacturer's certificate or letter confirming that entire installation as it pertains to each system has been installed to manufacturers' instructions.
 - .3 Carry out tests in presence of Architect and/or Engineer. Notify Architect and/or Engineer seven (7) days in advance of time testing will take place.
 - .4 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.
 - .5 The Architect and/or Engineer reserves the right to use any piece of electrical equipment, device, or material installed under this contract for such reasonable lengths of time and at such times as he may require in order to make a complete and thorough test of the same, before the final completion and acceptance of the work.
 - .6 Such tests shall not be construed as acceptance of any part of the work.
 - .7 Submit test results for Architect's and/or Engineer's review.

1.30 INSULATION RESISTANCE TESTING

- .1 Test all wiring, included in the work to ensure that there are no shorts and/or grounds are present on phase conductors for feeders or branch circuits and that insulation values are as required by the Canadian Electrical Code.
- .2 All testing of conductors to be done prior to energization of conductors with 600 volt and 1000 volt meggers as required by the Canadian Electrical Code.
- .3 Capacitive leakage testing of all phases and neutral feeder conductors at various system originating points, are to be recorded for each individual feeder with test results to be submitted to Architect and/or Engineer for approval.
- .4 Systems to be tested for capacitive leakage are as follows: 120/208V/3PH/4W.
- .5 Check resistance to ground before energizing. Ensure resistance to ground is not less than 50 megohms.
- .6 Submit test results for Architect's and/or Engineer's review. Test results shall include time of test, feeder tested, and instrument readings.

1.31 COORDINATION OF PROTECTIVE DEVICES

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

1.32 CLEANING

- .1 Do final cleaning in accordance with Division 1.
- .2 At time of final cleaning, clean lighting reflectors, lenses and other lighting surfaces that have been exposed to construction dust and dirt.
- .3 On completion of work, remove debris resulting from work of this Division and leave the site neat and tidy. Equipment shall be checked for proper fitting and alignment, adjusted, cleaned, repainted where necessary, and left in first class condition.
- .4 This section shall be responsible for the removal of spatters, droppings, soil, labels, and debris from finished surfaces and from surfaces to receive finishes, before the set up. Work and adjacent finished work shall be left in new condition.
- .5 Only cleaning materials which are recommended for the purpose by both the manufacturer of the surface to be cleaned and of the cleaning material shall be used.
- .6 Immediately before and during finishing work shall be made "broom clean". Interior areas shall be "vacuum cleaned" immediately before finish painting commences.
- .7 Material at site cannot be burned or buried except where approved by Architect and/or Engineer. Removal shall be as often as required to avoid accumulation in order to ensure site is maintained clean.
- .8 Volatile fluid wastes cannot be disposed of in storm or sanitary sewers or in open drain courses.
- .9 Lowering of materials shall be controlled and shall not be dropped or thrown from stories above grade.

1.33 COORDINATION

- .1 Cooperate and investigate with other trades to make maximum use of the spaces. Avoid conflicts with pipes, ducts, etc. Prepare shop drawings indicating the route of main conduits and ducts for submission to the Architect and/or Engineer for approval.
- .2 Cooperate with other trades on the site and carry out the work, in such a way, as not to hinder or hold up the work of other trades.
- .3 Consult with other trades, where their respective installations conflict and re-route conduits, ducts, outlets, equipment, etc., as required, subject to the approval of the Architect and/or Engineer.

- .4 Obtain from the mechanical and other trades complete detailed wiring diagrams of equipment requiring connections and be responsible for pointing out any discrepancies or the reason why they cannot be adhered to.
- .5 Locate all light fixtures, speakers, smoke detectors, etc. using Architect's reflected ceiling plan as a guide.

1.34 SUPERVISION

- .1 Provide supervision and sufficiently qualified foreman for work of this Contract to ensure that the work proceeds in proper and efficient manner to its completion. If in the opinion of the Architect and or Engineer, such personnel are not competent to carry out the work, replace these men immediately upon written request of the Architect and/or Engineer.

1.35 ELECTRICAL ROOM LAYOUTS

- .1 Refer to drawings for layout of electrical rooms; these drawings indicate the suggested arrangement of equipment in the various electrical rooms. After ordering equipment, the Electrical Contractor should verify dimensions of equipment on shop drawings or equipment brochures and discuss the arrangement of his equipment in all electrical rooms before roughing in. If changes are to be made in the arrangement of equipment they should be noted on these drawings and submitted to the Architect and/or Engineer for approval and composite drawings should be prepared by the Contractor wherever major changes are necessary.

1.36 ACCESS DOORS

- .1 This section to supply access doors for furred ceilings or spaces for servicing equipment and accessories or for inspection of safety, operating or fire devices for installation under Contractor responsible for erecting walls or ceilings. Provide ULC rated doors in fire rated construction.
- .2 Access doors shall be flush mounted size 300 x 300mm for hand entry or 600 x 600mm for body entry as required. Doors shall open 180 degrees and have rounded safety corners, concealed hinges, screwdriver latches anchor straps and steel shall be prime coated.
- .3 Provide stainless steel access doors for tiled, marble or terrazzo surfaces or special surfaces.
- .4 Provide cam type locking devices with hand or key lock when located in public corridors and washrooms complete with master keys.
- .5 Acceptable Product: Zurn, Enpoco, Williams WB.

1.37 UTILITY SERVICES

- .1 Division 26 Contractor is financially responsible to provide complete electrical, telephone and computer systems as specified including all necessary equipment and connections to the selected power Utility and telecommunication Utility infrastructures.

Payment of permits and other charges as may be levied by the Utilities shall be included in tender price.

1.38 SPRAY FIRE PROOFING

- .1 Spray fireproofing will be installed on the underside of roof deck, joists, beams and columns above the finished ceilings or on the open penthouse steel. This Contractor is to install all conduits, boxes, etc., as required prior to spray application. Any conduits, etc., installed after spray is applied will be the financial responsibility of Division 26 Contractor to have the fireproofing repaired where any damage may have occurred.

1.39 SPRINKLER PROOF HOODS

- .1 All distribution equipment with ventilated enclosures (Switchboards, MCC's, transformers, panel boards, relay panels and etc.) located in the building shall be protected from the direct spray from sprinkler heads to the satisfaction of the Inspection Authority by the use of non-combustible hoods.
- .2 Distribution conduits entering or exiting the equipment enclosures equipped with sprinkler hoods shall be installed with rain tight EMT connectors equipped with O-rings.

1.40 CONCRETE HOUSE KEEPING PADS

- .1 Not Applicable..

END OF SECTION

PART 1 – GENERAL

1.1 REFERENCE STANDARDS

- .1 In accordance with Section 26 05 00.

1.2 DEFINITIONS

- .1 Firestopping: Material or combination of materials used to retain integrity of fire-rated construction by maintaining an effective barrier against the spread of flame, smoke, and hot gases through penetrations in fire rated wall and floor assemblies.

1.3 GENERAL DESCRIPTION OF THE WORK OF THIS SECTION

- .1 Only tested firestop systems shall be used for penetrations for the passage of cables, conduit and other electrical equipment through the following:
 - .1 Fire-rated vertical barriers (walls and partitions)
 - .2 Horizontal barriers (floor/ceiling assemblies)
 - .3 Vertical service shaft walls and partitions.
- .2 Refer to Architectural drawings for location of rated assemblies.

1.4 RELATED WORK BY OTHERS

- .1 Coordinate work of this section with work of others as required to properly execute the work and as necessary to maintain satisfactory progress of the work of other sections, including:
 - .1 Concrete
 - .2 Masonry
 - .3 Finishes
 - .4 Special Construction
 - .5 Other sections of Division 13 and Division 26.

1.5 REFERENCES

- .1 Test Requirements: ULC-S115-M or CAN4-S115-M, "Standard Method of Fire Tests of Through Penetration Fire Stops".
- .2 Underwriters Laboratories of Canada (ULC) of Scarborough runs CAN4-S115-M under their designation of ULC-S115-M and publishes the results in their "FIRE RESISTANCE RATINGS DIRECTORY" that is updated annually.
- .3 Underwriters Laboratories (UL) of Northbrook, IL runs ASTM E-814 under their designation of UL 1479 and publishes the results in their "FIRE RESISTANCE DIRECTORY" that is updated annually. UL tests that meet the requirements of ULC-S115-M are given a cUL listing and are published by UL in their "Products Certified for Canada (cUL) Directory
- .4 International Firestop Council Guidelines for Evaluating Firestop Systems Engineering Judgments

- .5 CAN/ULC-S102-M, Standard Test Method for Surface Burning Characteristics of Building Materials.
- .6 National Building Code of Canada.
- .7 CSA C22.1-12, Canadian Electrical Code, Part 1 Safety Standard for Electrical Installations.

1.6 QUALITY ASSURANCE

- .1 A manufacturer's direct representative (not distributor or agent) to be on-site during initial installation of firestop systems to train appropriate contractor personnel in proper selection and installation procedures. This will be done per manufacturer's written recommendations published in their literature and drawing details.
- .2 Firestop System installation must meet requirements of CAN4-S115-M or ULC S-115-M tested assemblies that provide a fire rating as shown in Section 2. "Penetrations through a Fire Separation Wall" and "Penetrations through a Fire Wall or Horizontal Fire Separation" below.
- .3 Proposed firestop materials and methods shall conform to applicable governing codes having local jurisdiction.
- .4 Firestop Systems do not reestablish the structural integrity of load bearing partitions/assemblies, or support live loads and traffic. Installer shall consult the structural engineer prior to penetrating any load bearing assembly.
- .5 For those firestop applications that exist for which no ULC or cUL tested system is available through a manufacturer, a manufacturer's engineering judgment derived from similar ULC or cUL system designs or other tests will be submitted to local authorities having jurisdiction for their review and approval prior to installation. Engineer judgment drawings must follow requirements set forth by the International Firestop Council (September 7, 1994).

1.7 SUBMITTALS

- .1 Submit Product Data: Manufacturer's specifications and technical data for each material including the composition and limitations, documentation of ULC or cUL firestop systems to be used and manufacturer's installation instructions to comply with Division
 - .1 Manufacturer's engineering judgment identification number and drawing details when no ULC or cUL system is available for an application. Engineer judgment must include both project name and contractor's name who will install firestop system as described in drawing.
 - .2 Submit material safety data sheets provided with product delivered to job-site.

1.8 INSTALLER QUALIFICATIONS

- .1 Engage an experienced Installer who is certified, licensed, or otherwise qualified by the firestopping manufacturer as having been provided the necessary training to install manufacturer's products per specified requirements. A manufacturer's willingness to sell its firestopping products to the Contractor or to an Installer engaged by the Contractor does not in itself confer qualification on the buyer.

1.9 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver materials undamaged in manufacturer's clearly labeled, unopened containers, identified with brand, type, and ULC or cUL label where applicable.
- .2 Coordinate delivery of materials with scheduled installation date to allow minimum storage time at job-site.
- .3 Store materials under cover and protect from weather and damage in compliance with manufacturer's requirements.
- .4 Comply with recommended procedures, precautions or remedies described in material safety data sheets as applicable.
- .5 Do not use damaged or expired materials.

1.10 PROJECT CONDITIONS

- .1 Do not use materials that contain flammable solvents.
- .2 Scheduling
 - .1 Schedule installation of CAST IN PLACE firestop devices after completion of floor formwork, metal form deck, or composite deck but before placement of concrete.
 - .2 Schedule installation of other firestopping materials after completion of penetrating item installation but prior to covering or concealing of openings.
- .3 Verify existing conditions and substrates before starting work. Correct unsatisfactory conditions before proceeding.
- .4 Weather conditions: Do not proceed with installation of firestop materials when temperatures exceed the manufacturer's recommended limitations for installation printed on product label and product data sheet.
- .5 During installation, provide masking and drop cloths to prevent firestopping materials from contaminating any adjacent surfaces.

PART 2 - PRODUCTS

2.1 FIRESTOPPING, GENERAL

- .1 Provide firestopping composed of components that are compatible with each other, the substrates forming openings, and the items, if any, penetrating the firestopping under conditions of service and application, as demonstrated by the firestopping manufacturer based on testing and field experience.
- .2 Provide components for each firestopping system that are needed to install fill material. Use only components specified by the firestopping manufacturer and approved by the qualified testing agency for the designated fire-resistance-rated systems.

- .3 Fire stopping and smoke seals at openings intended for ease of re-entry such as cables: elastomeric seal.
- .4 Primers: to manufacturer's recommendation for specific material, substrate, and end use.
- .5 Damming and backup materials, supports and anchoring devices: to manufacturer's recommendations, and in accordance with tested assembly being installed as acceptable to authorities having jurisdiction.

2.2 ACCEPTABLE MANUFACTURERS

- .1 Subject to compliance with through penetration firestop systems listed in U.L.C Fire Resistance Directory – Volume III or UL Products Certified for Canada (cUL) Directory, provide products of the following manufacturers as identified below:
 - .1 Hilti (Canada) Limited, Mississauga, Ontario 1-800-363-4458
 - .2 Other manufacturers listed in the U.L.C Fire Resistance Directory – Volume III or UL Products Certified for Canada (cUL) Directory.

2.3 MATERIALS

- .1 Use only firestop products that have been ULC or cUL tested for specific fire-rated construction conditions conforming to construction assembly type, penetrating item type, annular space requirements, and fire-rating involved for each separate instance.
- .2 Cast-in place firestop devices are installed prior to concrete placement for use with non-combustible and combustible plastic pipe (closed and open piping systems), or electrical cable bundles, penetrating concrete floors, the following products are acceptable:
 - .1 Hilti CP 680 Cast-In Place Firestop Device
 - .2 Equivalent products listed in the U.L.C Fire Resistance Directory – Volume III or UL Products Certified for Canada (cUL) Directory.
- .3 Sealants or caulking materials for use with non-combustible items including rigid steel conduit and electrical metallic tubing (EMT), the following products are acceptable:
 - .1 Hilti FS-ONE Intumescent Firestop Sealant
 - .2 Hilti CP 620 Fire Foam
 - .3 Equivalent products listed in the U.L.C Fire Resistance Directory – Volume III or UL Products Certified for Canada (cUL) Directory.
- .4 Intumescent sealants or caulking materials for use with combustible items (penetrants consumed by high heat and flame) including PVC jacketed, flexible cable or cable bundles and plastic pipe, the following products are acceptable:
 - .1 Hilti FS-ONE Intumescent Firestop Sealant
 - .2 Hilti CP 620 Fire Foam
 - .3 Equivalent products listed in the U.L.C Fire Resistance Directory – Volume III or UL Products Certified for Canada (cUL) Directory
- .5 Intumescent sealants, caulking or putty materials for use with flexible cable or cable bundles, the following products are acceptable:
 - .1 Hilti FS-ONE Intumescent Firestop Sealant
 - .2 Hilti CP 618 Firestop Putty Stick

- .3 Hilti CP 620 Fire Foam
- .4 Equivalent products listed in the U.L.C Fire Resistance Directory – Volume III or UL Products Certified for Canada (cUL) Directory
- .6 Non curing, re-penetrable intumescent sealants, caulking or putty materials for use with flexible cable or cable bundles, the following products are acceptable:
 - .1 Hilti CP 618 Firestop Putty Stick
 - .2 Equivalent products listed in the U.L.C Fire Resistance Directory – Volume III or UL Products Certified for Canada (cUL) Directory
- .7 Wall opening protective materials for use with U.L.C. listed metallic and specified nonmetallic outlet boxes, the following products are acceptable:
 - .1 Hilti CP 617 Firestop Putty Pad
 - .2 Equivalent products listed in the U.L.C Fire Resistance Directory – Volume III or UL Products Certified for Canada (cUL) Directory
- .8 Materials used for large size/complex penetrations made to accommodate cable trays, multiple steel and copper pipes, electrical busways in raceways, the following products are acceptable:
 - .1 Hilti FS 635 Trowelable Firestop Compound
 - .2 Hilti FS 657 FIRE BLOCK
 - .3 Hilti CP 620 Fire Foam
 - .4 Equivalent products listed in the U.L.C Fire Resistance Directory – Volume III or UL Products Certified for Canada (cUL) Directory .
- .9 Non curing, re-penetrable materials used for large size/complex penetrations made to accommodate cable trough, multiple steel and copper pipes, electrical busways in raceways, the following products are acceptable:
 - .1 Hilti FS 657 FIRE BLOCK
 - .2 Equivalent products listed in the U.L.C Fire Resistance Directory – Volume III or UL Products Certified for Canada (cUL) Directory.

2.4 PENETRATIONS THROUGH A FIRE SEPARATION WALL

- .1 For penetrations through a Fire Separation wall provide a firestop system with a "F" Rating as determined by ULC or cUL as indicated below:

Fire Resistance Rating of Separation	Required ULC or cUL "F" Rating of Firestopping Assembly
30 minutes	20 minutes
45 minutes	45 minutes
1 hour	45 minutes
1.5 hours	1 hour
2 hours	1.5 hours
3 hours	2 hours
4 hours	3 hours

- .2 For combustible pipe penetrations through a Fire Separation provide a firestop system with a "F" Rating as determined by ULC or cUL which is equal to the fire resistance rating of the construction being penetrated.

2.5 PENETRATIONS THROUGH A FIRE WALL OR HORIZONTAL FIRE SEPARATION

- .1 For penetrations through a Fire Wall or horizontal Fire Separation provide a firestop system with a “FT” Rating as determined by ULC or cUL which is equal to the fire resistance rating of the construction being penetrated.

PART 3 - EXECUTION

3.1 PREPARATION

- .1 Verification of Conditions: Examine areas and conditions under which work is to be performed and identify conditions detrimental to proper or timely completion.
 - .1 Verify penetrations are properly sized and in suitable condition for application of materials.
 - .2 Surfaces to which firestop materials will be applied shall be free of dirt, grease, oil, rust, laitance, release agents, water repellents, and any other substances that may affect proper adhesion.
 - .3 Provide masking and temporary covering to prevent soiling of adjacent surfaces by firestopping materials.
 - .4 Comply with manufacturer's recommendations for temperature and humidity conditions before, during and after installation of firestopping.
 - .5 Do not proceed until unsatisfactory conditions have been corrected.

3.2 COORDINATION

- .1 Coordinate location and proper selection of cast-in-place Firestop Devices. Ensure device is installed before placement of concrete.
- .2 Provide adequate spacing of field run pipes to allow for installation of cast-in-place firestop devices without interferences.

3.3 INSTALLATION

- .1 Regulatory Requirements: Install firestop materials in accordance with ULC Fire Resistance Directory or UL Products Certified for Canada (cUL) Directory.
- .2 Manufacturer's Instructions: Comply with manufacturer's instructions for installation of through-penetration joint materials.
 - .1 Seal all holes or voids made by penetrations to ensure an air and water resistant seal.
 - .2 Protect materials from damage on surfaces subjected to traffic.

3.4 FIELD QUALITY CONTROL

- .1 Examine sealed penetration areas to ensure proper installation before concealing or enclosing areas.
- .2 Keep areas of work accessible until inspection by applicable code authorities.

- .3 Perform under this section patching and repairing of firestopping caused by cutting or penetrating of existing firestop systems already installed by other trades.
- .4 Install a warning card that is clearly visible adjacent to all large and medium openings that may be re-penetrated. This card should contain the following information:
 - .1 Warning that the opening has being fire stop protected
 - .2 Indicate the fire stop system used (ULC or cUL)
 - .3 F rating or FT rating
 - .4 Fire stop product(s) used
 - .5 Person to contact and phone number in case of modification or new penetration of fire stop system

3.5 ADJUSTING AND CLEANING

- .1 Remove equipment, materials and debris, leaving area in undamaged, clean condition.
- .2 Remove temporary dams after initial set of fire stopping and smoke seal materials.
- .3 Clean all surfaces adjacent to sealed holes and joints to be free of excess firestop materials and soiling as work progresses.

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCE STANDARDS

- .1 CSA C22.2 No. 18 - Clamps and connectors.
- .2 CSA C22.2 No. 65 Wire Connectors.

1.2 RELATED WORK

- .1 Not Applicable

1.3 SHOP DRAWINGS AND PRODUCT DATA

- .1 Not Applicable

1.4 OPERATION AND MAINTENANCE DATA

- .1 Not Applicable

PART 2 - PRODUCTS

2.1 MATERIALS

- .1 All connections shall be made electrically and mechanically secure. Sizes of connectors shall be according to manufacturer's recommendations for each size and combination of wires.
- .2 Joints required in branch wiring #10 AWG and smaller shall be made using fixture twist-on type connectors with current carrying parts made of copper.
 - .1 Standard of Acceptance: Marrette #31, #33 or #35 as required.
- .3 Joints for wiring #8 AWG and larger shall be made using pressure type colour keyed compression connectors with current carrying parts made of copper using compression tools. A first layer of tape shall be compound type followed by a layer of Scotch #3 vinyl type.
 - .1 Standard of Acceptance: 54000 series.
- .4 Bushing stud connectors are not acceptable.
- .5 Clamps or connectors for armoured cable and flexible conduit as required.

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Remove insulation carefully from ends of conductors and:
 - .1 Install mechanical pressure type connectors and tighten screws with appropriate compression tool recommended by manufacturer. Installation shall meet secureness tests in accordance with CSA C22.2 No. 65.
 - .2 Install fixture type connectors and tighten with pliers or appropriate tool. Finger-tightening alone is not acceptable. Replace insulating cap.
- .2 All connections shall be made electrically and mechanically secure. Sizes of connectors shall be according to manufacturer's recommendations for each wire size and combination of wires. Twist wires together before installing connectors. All stranded conductors shall be twisted together prior to connection around terminal.

END OF SECTION

PART 1- GENERAL

1.1 REFERENCE STANDARDS

- .1 CSA C22.2 No. 38 - Thermoset insulated Wires and Cables.
- .2 CSA C22.2 No. 51 - Armoured cables.
- .3 Wire and cable shall conform to the latest specification of the Canadian Standards Association (CSA), Electrical and Electronic Manufacturers Association of Canada (EEMAC), the Insulated Power Cable Engineers Association (IPCEA), and the American Society of Testing Materials (ASTM).

1.2 RELATED WORK

- .1 Not Applicable

1.3 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit product data in accordance with Division 1.

1.4 OPERATION AND MAINTENANCE DATA

- .1 Not Applicable

PART 2 - PRODUCTS

2.1 BUILDING WIRES

- .1 Conductors: Copper, soft drawn stranded, at least 98% conductivity for #12 AWG and larger. Insulation shall be chemically cross-linked thermosetting polyethylene rated 600 volts on all RW90 conductors and 1000 volts for RWU-90 for incoming service. Size as indicated on drawings and schedules. Conductor insulation shall be colour coded as follows:

Phase A	-	Red
Phase B	-	Black
Phase C	-	Blue
Neutral	-	White/Grey
Ground/Bond	-	Green
Isolated Ground	-	Green w/Yellow stripe
Isolated Power	-	as indicated hereinafter.

Where extra colours are required for three-way switches, etc., they shall be yellow. Approved color coded tape is acceptable for color coding phase conductors #1 AWG and larger and for neutral and ground conductors #4/0 and larger. Neutral conductors for feeders to branch panels feeding computerized equipment shall be sized at 200%.

2.2 CONTROL CABLES

- .1 600 V Type: 2 stranded copper conductors, 95% conductivity, full size AWG gauge, sizes as indicated with PVC insulation Type TW with shielding of magnetic tape wire braid over each pair of conductors and overall covering of thermoplastic jacket. Colour code shall be yellow.

2.3 ARMOURED CABLES

- .1 Conductors: insulated, copper, size as indicated.
- .2 Type: AC90.
- .3 Armour: interlocking type fabricated from aluminum strip.
- .4 Connectors: to manufacturer's recommendations.

2.4 SYSTEM WIRING

- .1 Wiring for auxiliary systems will be as indicated in specification or on drawings and/or as recommended by Manufacturer of the system.

2.5 MANUFACTURERS

- .1 Standard of Acceptance: Nexans or approved equal.

PART 3 - EXECUTION

3.1 INSTALLATION OF BUILDING WIRES

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

3.2 INSTALLATION OF CONTROL CABLES

- .1 Install control cables in EMT conduit complete with all associated steel connectors and couplings where run on surfaces of walls or open ceilings. Conduits shall be extended to within 760mm of all devices associated with the piece of equipment which they control. Final connection shall be made using liquid-tight flexible metal conduit and associated liquid-tight connectors.
- .2 EMT type conduit wall-stub c/w flush installed device box shall be located in all partitions to accommodate wiring between the device and the accessible ceiling space.
- .3 EMT connectors complete with nylon insulated throat or threaded type bushing shall be installed on end of EMT stubs where they protrude through the wall above, and within

finished accessible ceilings. CSA approved EMT plastic end cap bushings may also be used.

- .4 All EMT conduit stubs shall be bonded to ground as required by CEC.
- .5 Control cable shields, if applicable, shall be bonded to ground.

3.3 INSTALLATION OF ARMOURED CABLES

- .1 Group cables wherever possible.
- .2 Flexible type conduit c/w RW90 conductors sized as noted and/or flexible armoured cable AC90 (BX) complete with separate grounding conductor.
- .3 “Fixture drop” is defined as that portion of AC90 cable or flexible conduit being used to make the final connection between the accessible type junction or outlet box located in ceiling space and its respective luminaire.
- .4 Flexible type conduit c/w RW90 conductors sized as noted and/or flexible armoured cable AC90 (BX) complete with separate grounding conductor.
- .5 AC-90 cable or RW90 in flex is to be used for branch circuit wiring drops from ceiling junction boxes to light fixtures, receptacles and other equipment requiring power in the same room only unless otherwise noted on the drawings. AC 90 (BX) cable used for fixture drops with a minimum size of No. 12. Total length of any individual AC-90 cable or flex c/w RW90 not to exceed 4500mm in length unless specifically indicated otherwise.. The use of AC90 for home runs or wiring between rooms is not permitted.
- .6 All flex c/w RW90 or AC-90 cables used for fixture drops shall be secured within 300mm of the junction box.
- .7 Where application of AC-90 cables and/or other types of pliable cables are to be used, they shall be installed parallel or perpendicular to the building lines unless otherwise noted.
- .8 Support and securing of type AC-90 cables shall not be derived from either suspended ceiling support wires or directly laying atop of the ceiling grid system.
- .9 All AC-90 feeds shall originate from the sides of outlet boxes and not from the box cover. There shall not be more than 4 drop feeds permitted from any one box regardless of its size. Where 3 or more drop feeds extend from any one box, that box shall be sized no smaller than 119mm square.

3.4 INSTALLATION - GENERAL

- .1 Where pulling wires and cables, the use of an approved lubricant only will be permitted. No wires or cables shall be pulled in conduits until such conduits are free from moisture

and in no case shall wires be pulled until approval of the Architect and/or Engineer is obtained.

- .2 All stranded conductors prior to terminating under device bolts such as circuit breakers, light switches, receptacles, etc., to be twisted together to form a single conductor to ensure a reliable mechanical connection.
- .3 All branch circuits are to utilize conduit pathways for home runs to each room or area, including rooms in which the panel is located. Where the branch circuit has multiple splices and/ or drop offs to multiple rooms, the use of AC90 for the drop off is permitted, however, the home run conduit shall be continued until the final room destination splice or drop off is reached.
- .4 "Labelling" of all branch circuit wiring including phase conductors, neutrals, grounding and/or bonding conductors to be done on both ends of all circuit wires plus in any junction and/or pull boxes located in between using "Panduit" write-on, self laminating labels Nos. PDL-1 and PDL-2 as required.
- .5 The following wiring methods are designed to enhance the ability to perform capacitive leakage tests:
 - .1 All circuit conductors are to be individually tie wrapped to their corresponding labelled neutral conductor in all panelboards, pullboxes and junction boxes. Enough slack conductor length should be left to enable the ability to clamp the ground detector around the individually tie-wrapped circuit conductor and its corresponding labelled neutral. This wiring method is to be neat and of good workmanship quality.
 - .2 The tie wrapping of the neutral with its respective phase conductors is to be made at the closest point of entry into panelboards, pullboxes and junction boxes.
 - .3 The main switchboard, CDP's, panelboards, MCC's etc, are to have their respective feeder phase and neutral conductors tie-wrapped together and enough slack conductor length to enable the ability to clamp the ground detector around each set of feeders. This wiring method is to be neat and of good workmanship quality.
 - .4 After all electrical wiring has been completed by the Electrical Sub-Contractor, he is to test the grounded electrical distribution system to ensure there are not ground shorts and capacitive leakage in the system.
 - .5 All feeders or branch circuits which do not have neutral conductors are to have their respective phase conductors tie-wrapped together in accordance to the methods described previously.
 - .6 Run all circuits so that the voltage drop in no case exceeds 3% of the line volts. The neutral wire, wherever it is run, shall be continuous with no fuses, switches, or breaks of any kind.
 - .7 For 15 amp, 120 volt circuits the following table shall be used to determine the minimum conductor sizes required to compensate for voltage drop. In no case does this table allow a reduction in conductor size from that shown on the drawings or as specified elsewhere in the specifications.
 - .8 Find below the branch circuit maximum lengths (120 volt one way length from panelboard to load including vertical drops. Voltage drop shall not exceed 3% in any instance.
 - .1 From 0.3m to 24m #12 Wire
 - .2 From 24m to 37m #10 Wire

- .3 From 37m to 55m #8 Wire
- .9 Increased wire sizes where required shall not be decreased in size in any portion of length of run between panelboard and the wiring device itself.
- .10 All wiring shall be color coded as per Code requirements and/or as specified herein.

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCE STANDARDS

- .1 CSA C22.2 No. 41 - Grounding and Bonding Equipment.

1.2 RELATED WORK

- .1 Electrical General Instructions: Section 26 05 00
- .2 Wires and Cables, 0 to 1000V: Section 26 05 21

1.3 SHOP DRAWINGS AND PRODUCT DATA

- .1 Not Applicable

1.4 OPERATION AND MAINTENANCE DATA

- .1 Not Applicable

PART 2 - PRODUCTS

2.1 EQUIPMENT

- .1 Clamps for grounding of conductor, size as required to electrically conductive ground rods.
- .2 System and circuit, equipment, grounding conductors, bare stranded copper, un-tinned, soft annealed, un-armoured, size as indicated.
- .3 Insulated grounding conductors to Section 26 05 21.
- .4 Non-corroding accessories necessary for grounding system, type, size, material as indicated, including but not necessarily limited to:
 - .1 Grounding and bonding bushings.
 - .2 Protective type clamps.
 - .3 Bolted type conductor connectors.
 - .4 Thermit welded type conductor connectors.
 - .5 Bonding jumpers, straps.
 - .6 Pressure wire connectors.

2.2 MANUFACTURERS

- .1 Standard of Acceptance: Thomas & Betts.
- .2 Other approved manufacturers: Burndy, McGraw Edison.

PART 3 - EXECUTION

3.1 INSTALLATION GENERAL

- .1 Install complete permanent, continuous, system and circuit, equipment, grounding systems including, electrodes, conductors, connectors, busbars, accessories, as indicated, to conform to requirements of Engineer, and local authority having jurisdiction over installation. Where EMT is used for panelboard or motor control board feeders, run a separate green ground wire in conduit.
- .2 The main incoming ground conductor shall run unbroken to the main electrical service entrance overcurrent device ground bus and then to the wall mounted ground bus.
- .3 All conduits for all electrical systems shall contain a minimum # 14 AWG copper bond wire. Wire size shall be increased as required by Table 16 of the CEC or as otherwise noted.
- .4 Bonding jumpers are permitted for conduit stubbed into a T-bar ceiling. All metallic conduit stubs shall be bonded regardless of length.
- .5 Install connectors in accordance with manufacturer's instructions.
- .6 Protect exposed grounding conductors from mechanical injury.
- .7 Make buried connections, and connections to electrodes, using compression type connectors.
- .8 Use mechanical connectors for grounding connections to equipment provided with lugs as follows:
 - .1 Copper, one hole, short barrel (single crimp) type lugs shall be used for all wire sizes up to and including #6AWG;
 - .2 Copper, two hole, long barrel (dual crimp) type lugs shall be used for all wire sizes #4AWG and larger;
 - .3 Lugs shall be bolted to bus bars with concave or combination of flat and locking type washers c/w accompanying hardware as required.
- .9 Soldered joints are not permitted.
- .10 Install bonding wire for flexible conduit, connected at both ends to grounding bushing, solderless lug, clamp or cup washer and screw. Neatly cleat bonding wire to exterior of flexible conduit.
- .11 Make grounding connections in radial configuration only, with connections terminating at single grounding point. Avoid loop connections.
- .12 Bond single conductor, metallic armoured cables to cabinet at supply end, and provide non-metallic entry plate at load end.
- .13 Connect building structural steel to ground by welding copper to the steel near service entrance.

3.2 SYSTEM AND CIRCUIT GROUNDING

- .1 Install system and circuit grounding connections to the neutral of the 347/600V systems as required.
- .2 All cables, feeders and branch circuit conductors installed in conduit shall be complete with a separate minimum size #14AWG solid copper bond/ground wire as follows:
 - .1 Where bond wire sizes larger than #14AWG are required, they shall be increased as required by the Canadian Electrical Code Table 16 or as noted otherwise;
 - .2 #14AWG and larger size bond or ground conductors shall be of soft drawn stranded copper of 98% conductivity, and of full size and AWG gauge;
 - .3 Size of ground/bond conductors shall be based upon Table 16 of the Canadian Electrical Code;
 - .4 Minimum size #14AWG solid green insulated conductors are acceptable for bonding purposes associated with various other systems rated at 50 volts or less.

3.3 EQUIPMENT BONDING

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

3.4 COMMUNICATION SYSTEMS

- .1 Install *bonding* connections for telephone, fire alarm, intercommunication systems as follows and as shown on drawings:
 - .1 Telephone system: make telephone grounding system in accordance with telephone company's requirements.
 - .2 Fire alarm, intercommunication systems as required.

3.5 TESTS

- .1 Perform tests in accordance with Section 26 05 00.
- .2 Perform ground continuity and resistance tests using method appropriate to site conditions and to approval of Engineer and local authority having jurisdiction over installation.
- .3 Perform tests before energizing electrical system.
- .4 Submit test results for Engineer's review.

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCE STANDARDS

- .1 Not Applicable

1.2 RELATED WORK

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

1.3 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings and product data in accordance with Division 1.

1.4 OPERATION AND MAINTENANCE DATA

- .1 Not Applicable

PART 2 - PRODUCTS

2.1 SUPPORT DEVICES

- .1 U shape, size 41mm x 41mm, 2.5mm thick, surface mounted or suspended as required.
- .2 Supply and install all necessary inserts, rods, channels, brackets, etc., to form a support system capable of carrying at least twice the weight of the equipment supported.
- .3 In concrete, use cast-in threaded inserts wherever possible. Should additional inserts be required use a "red head" type of insert capable of carrying at least 45 kgs.
- .4 All hanger rods shall be 10mm diameter continuous threaded rod cut to required lengths. Cut off excess to within 13mm of bottom of channel.
- .5 All conduits not installed on Unistrut or approved equal type support channels to be supported as follows:
 - .1 13mm up to and including 35mm conduits - one hole steel straps.
 - .2 41mm and larger sizes - two hole steel straps.
- .6 All suspended conduit runs containing horizontal or vertical elbows shall have one additional support rod installed at not more than 300mm from midpoint of all 90 degree bends.
- .7 Beam clamps to secure conduit to exposed steel work.
- .8 In no case will the use of tye-wraps for supporting purposes be acceptable unless explicitly approved for the purpose, such as for securing wiring in-place.

- .9 All trays, wireways, and multiple conduits, shall be supported by a steel channel support system with all components, hangers, wall supports, cable clamps, etc., specifically manufactured and approved for their application.
- .10 Fastening devices for cabinets, boxes, supports, etc., shall be nut and bolt, ramset, expansion shields, wedge anchors, or toggle bolts, size and number to suit the application or as detailed on the drawings. Toggle bolts shall not be used in gypsum wallboard construction.
- .11 Fastening devices for outlet boxes shall be nut and bolt, ramset, expansion shields, wedge anchors or caddy clips, size and number to suit the application or as detailed on the drawings.
- .12 Suspended outlet, pull and junction boxes shall be supported with minimum 10mm threaded rod, nuts and flat washers. Threaded rods shall be secured to boxes with one flat washer and nut installed on both sides of box. Threaded rods shall be installed as follows:
 - .1 One rod required for all types of boxes sized 150mmx150mm and smaller;
 - .2 Two rods required for all types of boxes sized larger than 150mmx150mm up to and including 300mmx300mm;
 - .3 Minimum of four rods required for all boxes larger than 300mmx300mm.

2.2 MANUFACTURERS

- .1 Standard of Acceptance: Burndy.
- .2 Other approved manufacturers: Erico, Electrovert, Pursley, Unistrut.

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Secure equipment to hollow or solid masonry tile and plaster surfaces with lead anchors.
- .2 Secure equipment to poured concrete with expandable inserts.
- .3 Secure equipment to hollow masonry wall, or suspended ceilings with toggle bolts.
- .4 Secure surface mounted equipment with twist clip fasteners to inverted T bar ceilings. Ensure that T-bars are adequately supported to carry weight of equipment specified before installation.
- .5 Support equipment, conduit or cables using clips, spring loaded bolts, cable clamps designed as accessories to basic channel members.
- .6 Suspended support systems.
 - .1 Support individual cable or conduit runs with 10mm dia threaded rods and spring clips.

- .2 Support 2 or more cables or conduits on channels supported by 10mm dia threaded rod hangers where direct fastening to building construction is impractical.
- .7 For surface mounting of two or more conduits use channels at 1.5m on center spacing.
- .8 Provide metal brackets, frames, hangers, clamps and related types of support structures where indicated or as required to support conduit and cable runs.
- .9 Ensure adequate support for raceways and cables dropped vertically to equipment where there is no wall support.
- .10 Do not use wire lashing or perforated strap to support or secure raceways or cables.
- .11 Do not use supports or equipment installed for other trades for conduit or cable support except with permission of other trade and approval of Engineer.
- .12 Install fastenings and supports as required for each type of equipment cables and conduits, and in accordance with manufacturer's installation recommendations.
- .13 Coordinate the location of any insert to miss concrete reinforcement and obtain approval of Architect and/or Engineer prior to installing.
- .14 Secure all equipment in a manner so as not to distort or cause undue stress on any components.
- .15 Support of any equipment shall not rely on the strength of plaster or gypsum board construction.

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCE STANDARDS

- .1 CSA C22.2 No. 40 - Junction and pull boxes.

1.2 RELATED WORK

- .1 Not Applicable

1.3 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings and products data for splitters and cabinets in accordance with Division 1.

1.4 OPERATION AND MAINTENANCE DATA

- .1 Not Applicable

PART 2 - PRODUCTS

2.1 JUNCTION AND PULL BOXES

- .1 Pull and junction boxes, where larger than standard switch boxes, shall be sized according to C.E.C. Section 12-3038.
- .2 Welded steel construction with screw-on flat covers for surface mounting.
- .3 Covers with 25mm minimum extension all around, for flush-mounted pull and junction boxes.
- .4 Junction boxes 150mm x 150mm and larger used in branch circuit wiring shall be complete with bonding terminal strips.

2.2 CABINETS

- .1 Cabinets shall be steel fabricated to CSA and EEMAC Standards with baked enamel finish. Cabinets shall be EEMAC Standard Types "E" or "T" as indicated on the drawings.
 - .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 19mm plywood backboard for surface or flush mounting as indicated.

2.3 MANUFACTURERS

- .1 Standard of Acceptance: Bel

- .2 Other approved manufactures: Hammond, Hoffman.

PART 3 - EXECUTION

3.1 JUNCTION, PULL BOXES AND CABINETS

- .1 Install pull boxes in inconspicuous but accessible locations.
- .2 Mount cabinets with top not higher than 2000mm above finished floor.
- .3 Install terminal block as indicated in Type "T" cabinets.
- .4 Only main junction and pull boxes are indicated. Install pull boxes so as not to exceed 1000 ft. of conduit run between pull boxes.
- .5 In no case shall a pull or junction box be installed in a ceiling space that is not considered accessible unless provision is made for access to the box as approved by Architect and/or Engineer. Boxes and plates exposed to view and in suspended ceilings shall be colour coded with self-adhesive discs (diameters shown) as specified below:

<u>System</u>	<u>Colour</u>
Low voltage (>50V)	19mm Violet
120/208V Lighting and Power	19mm Yellow
Voice only	19mm Black
Fire Alarm	19mm Red
Security	19mm Brown
Grounding	19mm Green
Energy management	6mm White inside 19mm Red
Data only	6mm White inside 19mm Black
Voice and Data	6mm White inside 19mm Blue

Colour codes will be permitted to change only upon permission from Architect and/or Engineer

A wood framed plexiglass picture is to be supplied and mounted in the main electrical room. It shall be type written with the system colour and also a sample of paint adjacent.

- .6 Tiles or access hatches or doors for locating boxes shall be identified with approved type locating indicators and not tacks.
- .7 Coverplates for junction and/or pull boxes located above concealed accessible ceilings housing branch circuits for 208/120V/4 wire systems to have branch circuit breaker numbers neatly identified on plate, felt marker will suffice, boxes housing 5 circuits or less.
- .8 All branch conductors to be identified in all junction and/or pull boxes with "Panduit" write-on, self-laminating label Nos. PLD-1 and PLD-2 as required or approved equal by Thomas & Betts.

- .9 All junction boxes containing six or more branch circuits shall be installed in type "E" box c/w terminal strip. Minimum size of box to be 300mm x 300mm x 100mm.
- .10 Terminal strip(s) to be large enough to terminate all phase, neutral and bonding conductors as required plus size spare terminals.
- .11 All "E" box coverplates to have "Lamicoid" nameplates identifying designated panel letter and/or number affixed via pop rivet method.
- .12 All pull and junction boxes 150mm x 150mm and larger having auxiliary systems housed within shall be identified with "Lamicoid" nameplates permanently affixed.

3.2 IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 00.
- .2 Install size 2 identification labels indicating system name, voltage, and phase.

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCE STANDARDS

- .1 CSA C22.2 No. 18 - Outlet boxes, conduit boxes and fittings.

1.2 RELATED WORK

- .1 Not Applicable

1.3 SHOP DRAWINGS AND PRODUCT DATA

- .1 Not Applicable

1.4 OPERATION AND MAINTENANCE MANUAL

- .1 Not Applicable

PART 2 - PRODUCTS

2.1 OUTLET AND CONDUIT BOXES GENERAL

- .1 Size boxes in accordance with Canadian Electrical Code, Part 1.
- .2 100mm 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 CSA approved barriers where outlets for more than one system are grouped.
- .6 Outlet boxes for concealed use in frame construction shall be sectional, galvanized, pressed steel; these shall be restricted for use with flexible conduit AC-90 cable (where indicated) or other pliable type cable. The installation of any type of rigid type conduit in sectional boxes is prohibited. Where wire fill dictates larger boxes for outlets, use suitably sized square boxes with raised, square, welded tile ring style extensions. Tile rings shall not be used in surface mounted installations. Plaster type rings are not acceptable.
- .7 All outlet boxes connected to AC90 cabling shall be specifically designed for the purpose. Dual rated boxes are not acceptable.
- .8 Where multiple flush boxes are installed grouped together in metal drywall partitions, they shall be supported between the studs with a box mounting bracket (Caddy RBS or SGB series).

2.2 SHEET STEEL OUTLET BOXES

- .1 Electro-galvanized steel single and multi-gang flush device boxes for flush installation, minimum size 75 x 50 x 63mm or as indicated with a minimum volume of 262,192 cu. Mm (similar to Iberville # BC-3104-LSSAX). 100mm (4 inch) square outlet boxes when more than one conduit enters one side, with extension and tile rings (square, welded type) as required. For use in masonry construction, style MB (S or D) shall be used.
- .2 100 mm square or octagonal outlet boxes for lighting fixtures.
- .3 100mm square outlet boxes with extension and plaster rings for flush mounting special devices in finished plaster or tile walls.

2.3 MASONRY BOXES

- .1 Electro-galvanized steel masonry boxes single and multi gang for devices flush mounted in exposed block walls and where indicated.
- .2 Provide a 2-gang deep masonry outlet box for all multimedia outlets, c/w stainless steel cover plates. Minimum dimensions are as follows: 95mm X 96mm X 89mm deep. Install Caddy RBS Type mounting bracket.

2.4 CONCRETE BOXES

- .1 Electro-galvanized sheet steel concrete boxes for flush mounting in concrete with matching extension and plaster rings as required.
- .2 Where wire fill dictates larger boxes than single gang outlets, use suitable sized square boxes, with raised "tile ring" style extension.

2.5 CONDUIT BOXES

- .1 Cast FS Aluminum boxes with factory-threaded hubs and mounting feet for surface wiring of switches and receptacles.
- .2 Metal type "FS" device plates to be used on all type "FS" boxes unless noted otherwise.

2.6 RIGID CONDUIT BOXES

- .1 Cast FS or FD ferrous rigid conduit boxes with factory-threaded hubs and mounting feet for surface wiring where rigid conduit other than "EMT" is used.

2.7 MULTI-OUTLET BOXES

- .1 Electro-galvanized steel barrier pre-ganged multi-outlet boxes for devices with different sources of voltage in the same box.

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- .2 The barrier of sheet steel shall not be less than (No. 16 MSG) thick used to divide the space into separate compartments for the conductors of each system. The barrier shall be fastened rigidly to the box.

2.8 FITTINGS - GENERAL

- .1 Bushing and connectors with nylon insulated throats.
- .2 Knock-out fillers to prevent entry of foreign materials.
- .3 Conduit outlet bodies for conduit up to 32mm and pull boxes for larger conduits.
- .4 Double locknuts and insulated bushings on sheet metal boxes.

2.9 CONDUIT SUPPORTS

- .1 In steel stud framing construction provide for boxes a metal stud clip (Caddy MSF) and a far side support (Caddy 766) or a separate quick mount support (Caddy "H" Series).
- .2 Use adjustable screws gun brackets (caddy "TS" series) where box requires mounting between steel studs.
- .3 Other support systems will be accepted only after review by Engineer.

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 construction material. Remove filling material at completion of project.
- .3 For flush installations mount outlets flush with finished wall using plaster rings to permit wall finish to come within 65mm of opening.
- .4 Provide correct size of openings in boxes for conduit and armoured cable connections. Reducing washers not allowed.
- .5 At each local switch, receptacle, ceiling or wall fixture, continuous row of fixtures, or system unit (i.e. fire alarm, T.V., etc.) provide and install a standard or twin filler or barrier pressed steel outlet box, unless specifically noted otherwise. All outlet boxes shall be fabricated of galvanized sheet steel and set flush with finished surfaces. They shall be rigidly and securely set.
- .6 All flexible conduit fixture feeds shall originate from the side of the outlet box and not from the box cover, with the exception of the modular furniture connections, which shall be permitted to exit from the cover.

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- .7 In locating outlets, take care to allow for radiation, pipes, ducts, etc., and for the variation in arrangement and thickness of finishes, etc. Failure to comply with this will not relieve Electrical Contractor from the cost of necessary alterations.
 - .8 Allow for the relocation of an outlet up to a dimension of 3m from that indicated on drawings, provided notice is given before roughing-in has been completed.
 - .9 Install floor boxes in concrete formwork, prior to concrete pour, securely set to ensure finished collar is flush with the surface of the specified finish flooring.

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCE STANDARDS

- .1 Canadian Standards Association (CSA)
 - .1 CAN/CSA C22.2 No. 18, Outlet Boxes, Conduit Boxes, and Fittings and Associated Hardware.
 - .2 CSA C22.2 No. 45, Rigid Metal Conduit.
 - .3 CSA C22.2 No. 56, Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit.
 - .4 CSA C22.2 No. 83, Electrical Metallic Tubing.
 - .5 CSA C22.2 No. 211, Rigid PVC (Unplasticized) Conduit.
 - .6 CAN/CSA C22.2 No 227, Flexible Nonmetallic Tubing.

1.2 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with local requirements.
- .2 Place materials defined as hazardous or toxic waste in designated containers.
- .3 Ensure emptied containers are sealed and stored safely for disposal away from children.
- .4 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, size as indicated.
- .2 Thin wall type electrical metallic tubing "EMT" with steel set screw couplings, galvanized, size as indicated.
- .3 Rigid PVC conduit, size as indicated.
- .4 Flexible metal conduit.

2.2 EXPANSION FITTINGS FOR RIGID CONDUIT

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

2.3 FISHCORD

- .1 6.5 mm standard nylon pull rope with tensile strength of 5 kN.

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 and in unfinished areas.
- .3 Use epoxy coated conduit in underground or in corrosive areas.
- .4 Use electrical metallic tubing (EMT) except in cast concrete and above 2.4 m not subject to mechanical injury.
- .5 Use rain-tight connectors and couplings where vertical portion of EMT conduit runs terminate into the top of electrical equipment incorporating drip shields or hoods.
- .6 Use rigid PVC conduit underground and in corrosive areas. Thin-wall (DB2) rigid PVC shall be permitted only where encased in concrete.
- .7 Use flexible metal conduit for connection to recessed incandescent fixtures without a prewired outlet box, connection to surface or recessed fluorescent fixtures and work in movable metal partitions.
- .8 Use liquid tight flexible metal conduit (minimum 3/8" internal diameter) for connection to motors or vibrating equipment in all locations, including controls and related devices
- .9 Use explosion proof flexible connection for connection to explosion proof motors.
- .10 Install conduit sealing fittings in hazardous areas. Fill with compound.
- .11 Minimum conduit size for lighting and power circuits: 19 mm.
- .12 Install EMT conduit from branch circuit panel to outlet boxes located in sub floor.
- .13 Bend conduit cold. Replace conduit if kinked or flattened more than 1/10th of its original diameter.
- .14 Mechanically bend steel conduit over 19 mm diameter.

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- .10 Field threads on rigid conduit must be of sufficient length to draw conduits up tight.
 - .11 Install fish cord in empty conduits.
 - .12 Run 2 - 25 mm spare conduits up to ceiling space and 2 - 25 mm spare conduits down to ceiling space from each flush panel. Terminate these conduits in 152 x 152 x 102 mm junction boxes in ceiling space or in the case of an exposed concrete slab, terminate each conduit in surface type box.
 - .13 Remove and replace blocked conduit sections. Do not use liquids to clean out conduits.
 - .14 Dry conduits out before installing wire.
 - .15 Use electrical metallic tubing (EMT) for the following:
 - .1 Communication outlets between the device box and accessible ceiling space in all wall and partitions;
 - .2 All Fire alarm system wiring;
 - .3 All security system wiring;
 - .4 All wiring within electrical rooms and mechanical rooms;
 - .5 All panel feeders;
 - .6 Structured wiring for system copper backbone cable;
 - .7 All fiber;
 - .8 Home runs to panel boards from all branch circuit wiring;
 - .9 Where noted elsewhere.

3.2 SURFACE CONDUITS

- .1 Run parallel or perpendicular to building lines.
- .2 Locate conduits behind infrared or gas fired heaters with minimum 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.

3.3 CONCEALED CONDUITS

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

3.4 CONDUITS IN CAST-IN-PLACE CONCRETE

- .1 Locate to suit reinforcing steel. Install in centre one third of slab.
- .2 Protect conduits from damage where they stub out of concrete.
- .3 Install sleeves where conduits pass through slab or wall.
- .4 Provide oversized sleeve for conduits passing through waterproof membrane, before membrane is installed. Use cold mastic between sleeve and conduit.
- .5 Do not place conduits 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 IN CAST-IN-PLACE SLABS ON GRADE

- .1 Run conduits 25 mm and larger below slab and encased in 75 mm concrete envelope. Provide 50 mm of sand over concrete envelope below floor slab.
- .2 Transitions from rigid PVC conduit to rigid steel threaded conduit shall take place below floor slab.
- .3 Transitions from rigid steel threaded conduit to EMT conduit shall take place above concrete floor slab.

3.6 CONDUITS UNDERGROUND

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

END OF SECTION

PART 1 - GENERAL

1.1 LOCATION

- .1 Drawings indicating cable trays are in diagrammatic form only.

1.2 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with Division 1.
- .2 Submit complete information on the product, c/w all accessories, including:
 - .1 Cable Tray.
 - .2 Barrier, barrier splice strips, horizontal bends, barrier clips, etc.
 - .3 Connecting hardware, connecting assemblies, etc.
 - .4 Aluminum adjustable horizontal splice plates.
 - .5 Aluminum vertical adjustable splice plates.
 - .6 Ladder drop outs and water fall assemblies.
 - .7 Grounding clamps.
 - .8 Cable tray clamps.
 - .9 Blind End Sections.
 - .10 Bonding jumpers.

PART 2 - PRODUCTS

2.1 CABLE TRAY

- .1 General Distribution (Not inside Telecommunications Rooms)
 - .1 Cable Trays and fittings: to EEMAC F5-1-1977.
 - .2 Ladder type, Class D1 to CSA C22.2 No. 126-M91.
 - .3 NEMA loading depth to be 127 mm (five inches).
 - .4 Aluminum ladder tray, 460 mm (18 inch) wide with a depth of 156 mm (6 inch). Rung spacing to be 230 mm (9 inch). Minimum inside usable depth to be 127 mm (5 inches). Provide barrier strips to divide the tray into two distinct sections as follows: Television system (4 inch, 100 mm), structured wiring system (14 inch, 350 mm).
 - .5 Horizontal elbows, end plates, drop outs, vertical riser and drops, tees, wyes expansion joints and reducers where required. Fittings: manufactured accessories for the cable tray supplied. Radii on fittings to be a minimum of 600 mm (24 inch).
 - .6 Adjustable vertical and horizontal splice plates where changes in direction preclude the use of standard fittings. Always use manufactured fittings. Do not use field modified fittings.
 - .7 Dead ends of cable trays shall be closed by the use of manufacturer fabricated blind end sections.
- .2 Manufacturers
 - .1 Standard of Acceptance:
 - .1 B-Line # 26-A-09-18-240 c/w:

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- .1 Bonding jumpers, # 99-N1.
 - .2 Barrier strips, #75A-120.
 - .3 Horizontal Barrier Bend, #75A-90HBFL.
 - .4 Barrier Strip clip, #9ZN-9002.
 - .5 Barrier Strip Splice, #99-9982.
 - .6 Aluminum adjustable horizontal splice plates, #9A-103-6.
 - .7 Aluminum adjustable vertical adjustable splice plates, #9A-1026.
 - .8 Ladder drop outs # 9A-1104-18.
 - .9 Grounding clamps #9A-2130.
 - .10 Blind End Sections # 9A-1086-18.
 - .11 Cable Tray Clamps #9A-1205.
 - .12 Connecting hardware, connecting assemblies, etc.
- .2 Acceptable Manufacturers to the requirements above:
 - .1 CFRP Comtray.
 - .2 ElectroTray.
 - .3 Pilgrim.
 - .4 Canadian Electrical Raceways.
 - .5 Thomas and Betts.
 - .6 Legrand/Cablofil
- .3 Cable tray (within Telecommunications Rooms)
 - .1 Cable Trays and fittings: to EEMAC F5-1-1977.
 - .2 Wire basket of type and sizes indicated; with connector assemblies, clamp assemblies, connector plates, splice plates and splice bars. Construct units with rounded edges and smooth surfaces; in compliance with applicable standards; and with the following additional construction features.
 - .3 Straight sections and accessories shall be made from AISI Type 304 Stainless Steel.
 - .4 All straight section longitudinal wires shall be straight (with no bends).
 - .5 Wire basket dimension of 60mm (2.5 inch) side depth by 600mm (24 inch) wide, with a 50mm (2 inch) usable loading depth. Straight sections shall be 3000mm (10 feet) long. Tested load capacity of 30 kg (66 pound), with supports at 1500mm (5 feet) intervals.
 - .6 All fittings shall be field formed as needed.
 - .7 All splicing assemblies shall be the bolted type using serrated flange locknuts. Hardware shall be AISI Type 304 Stainless Steel.
 - .8 Wire basket supports shall be center support hangers, trapeze hangers or wall brackets.
 - .9 Special accessories shall be furnished as required to protect, support and install a wire basket support system.
- .4 Manufacturers:
 - .1 Standard of Acceptance:
 - .1 Cooper B-Line stainless steel basket tray, WB224-SS4, c/w
 - .1 WB4CA connector assemblies.
 - .2 WB4CP clamp assemblies.
 - .3 WB4SP splice plate.
 - .4 WB12SB splice bar.

- .5 WB TLC tab lock connector.
- .6 WB42GC grounding clamp.
- .7 WB224BE blind end.
- .8 WB2RSPL radius shield.
- .9 WB12DO drop out.
- .10 B719EB rubber end cap.

- .2 Acceptable Manufacturers, to the requirements above:
 - .1 CFRP Comtray.
 - .2 ElectroTray.
 - .3 Pilgrim.
 - .4 Canadian Electrical Raceways.
 - .5 Thomas and Betts.
 - .6 Legrand/Cablofil

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Prior to ordering cable tray the electrical contractor shall prepare a detailed sketch illustrating the following:
 - .1 Proposed method of installation.
 - .2 Proposed hanger type and dimensions.
 - .3 Proposed method of grounding cable tray.
 - .4 Proposed routing of cable tray.
- .2 Install complete cable tray system prior to pulling any cable.
- .3 Support cable tray on both sides, using trapeze support kits where installed from hangers.
- .4 Install cable tray clamps on each side of every support strut.
- .5 Wall mounted cable tray to be supported with angle brackets.
- .6 Remove sharp burrs or projections to prevent damage to cables or injury to personnel.

3.2 CONTINUITY OF CABLE TRAY

- .1 The entire run of cable tray is to be continuous. Include all required fittings, vertical splices, horizontal splices, offsets, etc., to allow for changes in elevation, direction, etc.
- .2 Always use manufactured fittings. Do not use field modified fittings. Where changes in direction preclude the use of standard fittings use adjustable vertical and horizontal splice plates.

3.3 COORDINATION WITH OTHER TRADES

- .1 Coordinate installation with mechanical services and equipment. Reroute cable tray as

necessary to avoid conflict with the work of other trades.

- .2 Minimum clearances for cable trays shall be in strict accordance with CEC Rule 12-2200.

3.4 INSTALLATION OF CABLES.

- .1 The cable tray shall be installed as a complete system before any cables are installed. This includes the following:
 - .1 All supports are complete;
 - .2 All hold down hardware complete;
 - .3 Installation of bonding conductor and associated components;
 - .4 Barrier strips are complete;
 - .5 Blind end sections;
- .2 Following the completion of the entire cable tray system and all related components, cables may be installed.
- .3 Lay cables into cable tray. Use rollers when necessary to pull cables.
- .4 Ensure adequate support for all cables both horizontally and vertically to comply with current standards.

3.5 FIRE BARRIERS

- .1 Arrange and make good fire rating of floors and walls after cables have been installed.
- .2 Where cable trays pass through fire separations, including, walls, membranes, etc., arrange and make good fire rating of floors and walls after cables have been installed.

3.6 BONDING

- .1 Install a continuous #6 bare bonding conductor in all runs of cable tray, terminating on ground bars in telecommunications rooms. Connect each section of cable tray to the bonding conductor.
- .2 Conduits containing horizontal distribution cables are to be bonded to the cable tray. Provide bonding bushing on the end of the conduit and connect to bonding conductor in tray using a mechanical type connector, similar to Burndy Tritap Servit Series KSA.

3.7 SUPPORTS

- .1 Provide trapeze and cantilever supports at 3 metre (10 foot) intervals.
- .2 Cut off excess rod within 13 mm (1/2 inch) of channel bottom.
- .3 Minimum sized threaded rods to be 9.5 mm (3/8 inch).
- .4 Sandwich channel between nuts and washers located on both upper and lower surfaces.

- .5 Provide hold down clips to secure tray to strut.

3.8 TERMINATION IN TELECOMMUNICATIONS ROOMS (TR).

- .1 Provide sufficient length of ladder tray to enter each telecommunications room and allow easy transition to basket tray.
- .2 Provide ladder drop out components with 100 mm (4 inch) radius to provide a rounded surface to protect cables as they exit from tray.
- .3 Ensure that the basket tray within each TR is positioned over each rack. Provide waterfall assemblies for transition from basket tray to equipment racks.
- .4 Provide vertical sections of tray as required to fully support cables transitioning from each type of tray.

3.9 ATTACHMENT OF CONDUIT AND BOXES

- .1 Attachment of conduit and electrical boxes to the strut supporting the cable tray is strictly prohibited.

END OF SECTION

PART 1 - GENERAL

- .1 Not Applicable.

PART 1 - PRODUCTS

- .1 Not Applicable

PART 2 - EXECUTION

2.1 CABLE INSTALLATION IN DUCTS

- .1 Install cables as indicated, in ducts.
- .2 Do not pull spliced cables inside ducts.
- .3 Install multiple cables in duct simultaneously.
- .4 Use CSA approved lubricants of type compatible with cable jacket to reduce pulling tension.
- .5 To facilitate matching of colour coded multi conductor control cables reel off in same direction during installation.
- .6 Before pulling cable into ducts and until cables are properly terminated seal ends of non-leaded cables with moisture seal tape.
- .7 After installation of cables, seal duct ends with duct sealing compound.

2.2 TESTING

- .1 Perform tests in accordance with Section 26 05 00.
- .2 Perform tests using qualified personnel. Provide necessary instruments and equipment.
- .3 Check phase rotation and identify each phase conductor of each feeder.
- .4 Check each feeder for continuity, short circuits and grounds. Ensure resistance to ground of circuits is not less than 50 megohms.
- .5 Pre-acceptance tests
 - .1 After installing cable but before splicing and terminating, perform insulation resistance test with 600 V megger on each phase conductor.
 - .2 Check insulation resistance after each splice and/or termination to ensure that cable system is ready for acceptance testing.

- .6 Acceptance Tests
 - .1 Ensure that terminations and accessory equipment are disconnected.
 - .2 Ground shields, ground wires, metallic armour and conductors not under test.

- .7 Provide Architect and/or Engineer with list of test results showing location at which each test was made, circuit tested and result of each test.

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

- .9 Failure to provide test results will delay progress billing.

END OF SECTION

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- .1 Extent of lighting control system work is indicated by drawings, and by the requirements of this section. It is defined to include low voltage lighting control panels, switch inputs, and wiring.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

- .1 The lighting control system shall consist of low voltage relay control panels with 64 programmable switch inputs and shall offer quantity of relays as indicated on the drawings.
- .2 Each low voltage lighting control panel shall be microprocessor controlled. Programming shall be accomplished through either the RS-232 port or through the network connection employing the Keeper Enterprise software or with an integral 4 x 16 – 64 character self-prompting LCD display and programming keypad.
- .3 Programmable intelligence shall include Time-Of-Day control, 32 holiday dates, warn occupants of an impending off, timed inputs, preset control, auto daylight savings, astronomical clock w/offsets, and local control, digital switches and network overrides.

TOD	64 Time-Of-Day/holiday schedules for 365 day programming
Holidays	32 holiday dates
Warn Off	Flash lights and provide an extra 1 second to 99 minutes of illumination
Preset	Pre-programmed switch patterns
Timed Inputs	Switch input timers 1-999 minutes
Timed Overrides	Timed override 1-999 minutes, resumes to normal schedule
Local Control	From keypad & LCD display or local switch
Astronomical Clock	Longitude and latitude input with sunset-sunrise offsets to customize outdoor lighting
Auto Daylight Savings Adjust.	Automatically adjusts the clock at the appropriate dates, selectable
Priorities	Establishes a hierarchy for inputs and network control commands
Masking	Provides permission orientation to switch inputs and network commands thereby ensuring building lighting control integrity.
Soft-Linking	Group linking for rapid programming

Global Linking Each panel shall provide 64 addressable groups for network linking of control commands

- .4 Relays may be designated as either normally open or normally closed from the software. Relay status shall not only disclose commanded relay status but next scheduled state to occur.
- .5 Each control panel shall provide a Warn Off (flash the lights) to inform the occupants of an impending Off command. The Warn Off command shall provide an adjustable time duration of 1 second to 99 extra minutes. The occupants may exit the premises with adequate lighting or cancel the Warn Off by overriding the lighting zone. This option occurs with all Off commands except local overrides.
- .6 The controller shall permit lighting to be overridden On for after hours use or cleaning. The controller shall provide optional switch timer assignments or timed overrides. The override choices for various relays shall provide special event occurrences and the controller shall return to the programmed state after the override event. Also, the controller shall provide priority and masking choices to customize the functions of switch inputs, thereby enabling switches to function differently at different times of the day to meet special facility operational requirements. These overrides shall be digital, or hard-wired inputs.
- .7 Programming the controller shall be through the RS-232 port or through the network connection. Communication to the panel can be accomplished via, RS-232, modem, or TCP/IP. Programming the controller shall also be accomplished through the integral keypad and LCD display. Descriptive information shall assist the user to employ the system with a programming manual. Lighting control systems that utilize removable programming keypads shall not be acceptable.
- .8 Priorities and/or Masking shall be assigned to inputs, telephone override, and global commands to insure building integrity. Priorities enable or disable the inputs based on user actuation of overrides. Masks shall permit: On only, Off only and On & Off control for intelligent after hours utilization of the controlled facility based on Time-Of-Day scheduling in the controller.
- .9 The lighting control system shall log all control events. The controller shall monitor all relay actuations, switch inputs and user intervention. Log reports shall be available for any duration of time the operator chooses through the Keeper Enterprise Software. Runtimes for each relay shall be available from the Keeper Enterprise Software.

2.3 OCCUPANCY SENSORS

- .1 Dual technology, ultrasonic and passive infrared occupancy sensor, ceiling mounted.
- .2 Standards of Acceptance: Green Gate #OAC-DT

2.4 TIMECLOCK/PHOTOCELL

- .1 24 hour electronic astronomical timeclock for control of lighting relay panels, supply one

per panel.

- .2 Panel RP12 controlling exterior lighting shall be wired to be controlled by timeclock and photocell, allowing timeclock to override the photocell control if desired.

2.5 LOW VOLTAGE RELAY

- .1 Electrically held 20amp, 120 VAC.
- .2 Relays to be rated for 10 million mechanical operations
- .3 Operating voltage: 24 VAC.
- .4 Heavy-duty load contact: 20 A, 120 VAC.
- .5 Screw terminals for line & load connections.
- .6 Acceptable manufacturer: Green Gate. Approved equal: Delta controls, *Cristal controls*.

2.6 CONTROL TRANSFORMER

- .1 Class 2, 120 V input 24 VAC, 75 VA output.

2.7 ACCEPTABLE MATERIAL

- .1 Standard of Acceptance
 - .1 LiteKeeper® lighting control unit manufactured by Cooper Controls
- .2 Acceptable Manufacturers:
 - .1 Leviton, Douglas Controls

PART 3 - EXECUTION

3.1 GENERAL

- .1 Do complete installation in accordance with requirements of:
 - .1 Electrical Contract, this specification.
 - .2 CSA 22.1 Canadian Electrical Code.
 - .3 Section 27 05 28 Pathways for Communications Systems.
- .2 The control system shall be installed and fully wired as shown on the plans by the installing contractor. The contractor shall complete all electrical connections to all control circuits, and override wiring.
- .3 The contractor shall provide accurate “as-built” drawings to the owner for correct programming and proper maintenance of the control system. The “as-builts” shall indicate the load controlled by each relay and the relay panel number.

- .4 All EMT conduit stubs are to be “bonded” to ground as required by Canadian Electrical Code.
- .5 The factory shall supply all operation and service manuals.
- .6 Factory telephone support shall be available at no cost to the owner. Factory assistance shall consist of solving programming or application questions concerning the control equipment.
- .7 Manufacturer shall supply a 3-year warranty on all hardware and software. A limited 10-year warranty shall be provided on all relay cards. These warranties will be in affect for all installations. Systems that provide special warranties based on installation shall not be acceptable.
- .8 Training: Provide 3 hours of on-site training to the owners representative.

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCE STANDARDS

- .1 Factory tests to CSA C9-M1981.

1.2 RELATED WORK

- .1 Not Applicable

1.3 SHOP DRAWINGS

- .1 Submit shop drawings and product data in accordance with Division 1.
- .2 Dimension drawing showing enclosure, mounting devices, terminals, taps, internal and external component layout.
 - .1 KVA rating
 - .2 Primary and secondary voltages
 - .3 Single or three phase
 - .4 BIL
 - .5 Insulation class and type

1.4 OPERATION AND MAINTENANCE DATA

- .1 Provide data for incorporation into operation and maintenance manual as specified in Division 1.
- .2 Operation and maintenance instructions to include:
 - .1 Tap changing
 - .2 Recommended environmental conditions
 - .3 Recommended periodic inspection and maintenance

1.5 STORAGE

- .1 Store transformers indoors in a dry location

PART 2 - PRODUCTS

2.1 TRANSFORMERS

- .1 Use transformers of one manufacturer throughout project and in accordance with CAN/CSA-C22.2, No. 47, CSA-C9, and CSA C802.2
- .2 All three phase transformers shall be constructed with 3 windings and a single coil, 2 winding transformers are not acceptable.
- .3 Design 1: General Purpose.
 - .1 Type: ANN.
 - .2 3 phase, 600 V input, 208/120 V output, 60 Hz.
 - .3 Copper Windings

-
- .4 Voltage taps: 4 – 2.5%, 2-FCBN, 2-FCAN.
 - .5 Insulation: Class H, 150 degrees C temperature rise.
 - .6 Basic Impulse Level (BIL): 1.2kv class.
 - .7 Hipot: 4kv
 - .8 Electrostatic Shielding.
 - .9 Impedance at 170 degrees C: 4-4.2%.
 - .10 Enclosure: EEMAC 3R, removable metal front panel, complete with sprinkler proof drip hood.
 - .11 Mounting: Floor or wall as indicated.
 - .12 Finish: ASA 61 Light Grey.
 - .13 K factor of 13.
 - .14 Sound level not to exceed 55dB. Anything that exceeds this limit will be replaced by Division 26 contractor.

2.2 TAP CHANGER

- .1 Bolted link type.

2.3 ACCESSORIES

- .1 Grounding terminal: outside of enclosure.
- .2 Transformers shall be mounted on vibration isolator and approved type pedestals to reduce noise transmission to a minimum.

2.4 MANUFACTURERS

- .1 Standard of Acceptance: Delta
- .2 Approved Manufacturers; Bemag, Eaton, Federal Pioneer, Hammond, Siemens, Square D, Rex.

2.5 EQUIPMENT IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 00.
- .2 Label size: 7.
- .3 Nameplate wording: Transformer No., Source, Equipment Feed.

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Locate, install transformers as indicated and in accordance with manufacturer's instructions.

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- .2 The neutral connection of all transformers, and transformer enclosures shall be adequately grounded.
 - .3 Set and secure transformers in place, rigid plumb and square.
 - .4 Connect primary terminals to conductors as indicated.
 - .5 Connect secondary terminals to conductors as indicated.
 - .6 Use Teck 90 or flexible conduit with RW90 conductors to make connections to transformers.
 - .7 Energize transformers and check secondary no load voltage.
 - .8 Adjust primary taps as necessary to produce rated secondary voltage at no load.
 - .9 Use Torque wrench to adjust internal connections in accordance with manufacturer's recommended values.
 - .10 Check transformer for dryness before putting it into service, and if it has not been energized for some considerable time.
 - .11 Provide mounting as required to match transformer dimensions and weight.
 - .12 Provide Lamacoid identification plate on Transformers as per Section 26 05 00.

3.2 TESTS

- .1 Perform tests in accordance with Section 26 05 00.
 - .1 Energize Transformers and apply incremental loads for the first 3 hours of operation. At each load change, check ambient temperature and enclosure temperature.

-- END OF SECTION --

PART 1 - GENERAL

- .1 Not Applicable.

1.2 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings and product data in accordance with Division 1.
- .2 Indicate on shop drawings.
 - .1 Floor anchoring method and foundation template.
 - .2 Dimensioned cable entry and exit locations.
 - .3 Dimensioned position and size of bus.
 - .4 Overall length, height and depth.
 - .5 Dimensional layout of internal and front panel mounted components.

1.3 MAINTENANCE DATA

- .1 Provide data for incorporation into maintenance manual specified in Division 1.
- .2 Three copies maintenance data for complete assembly including components.

1.4 SOURCE QUALITY CONTROL

- .1 Following manufacture but prior to shipping, the factory is to carry out a Switchboard Inspection and Test and produce a written report. This report will include as a minimum the following information:
 - .1 Date;
 - .2 Shop Order Number;
 - .3 Switchboard Identification Number;
 - .4 Bus Rating;
 - .5 Bus Bar Hardware Torqued;
 - .6 General Appearance;
 - .7 Hi Pot;
 - .8 Digital Meter Setup.
- .2 Submit three (3) copies of the Switchboard Inspection and Test Report to the Engineer.
- .3 Include a copy in the Maintenance Manuals.

PART 2 - PRODUCTS

2.1 POWER SUPPLY

- .1 Power Supply: 600V Volt, 3 phase, 4 wire, 60 Hz.

2.2 SERVICE ENTRANCE SWITCHBOARD

.1 General:

The service entrance switch board be standardized, CSA approved, and completely factory assembled. The design shall allow for bottom entry of service entrance cables. Factory supplied, suitably sized, NEMA two-hole crimp lugs shall be provided for all incoming conductor terminations on the bus bars. The switchboard manufacturer shall carry out a Secondary Distribution and Protection Coordination study prior to submission of shop drawings, and shall provide the results of this study with the shop drawings for review. *All breakers shall be set by the manufacturer at the factory.*

.2 Bus Material and Rating:

The service entrance board bus shall be rated @ 1200 Amps with a system voltage of 600 Volt, 3 phase, 4 wire, 60 Hz. for normal power. All phase bussing shall be silver flashed copper, 100% Fully Rated to carry 1200 amps and braced to withstand a system fault of 80kA RMSsymmetrical at 600VAC.

The service entrance board bus shall be rated @ 400 Amps with a system voltage of 600Volt, 3 phase, 4 wire, 60 Hz. for emergency power. All phase bussing shall be silver flashed copper, 100% Fully Rated to carry 600 amps and braced to withstand a system fault of 80kA RMSsymmetrical at 600VAC.

.3 Enclosure:

The switchboard shall be metal enclosed, fabricated from code gauge formed steel, finished with grey, polyester powder coat enamel and shall consist of the required number of vertical sections bolted together to form one rigid assembly. All sections are to be EEMAC-1 and equipped with sprinkler drip hoods. Insulated steel barriers are to be provided to isolate the main circuit breaker compartment and the utility metering compartment.

.4 Customer metering and Main Breaker Section—Normal power:

.1 One section containing main breaker compartment and utility metering compartment. Minimum dimensions: 90 inches (2286mm) high x 38 inches (965 mm) wide x 48 inches (1219 mm) deep.

.2 Main Breaker Compartment:

.1 The main breaker compartment shall come complete with provisions for pad-locking the main breaker and sealing screws on the front cover. Grounding is supplied with a link to ground the neutral, the service conduit, and the system ground.

.3 Customer Metering Transformer Compartment:

.1 The compartment shall be designed to meet local utility requirements. It shall be bussed and pre-drilled to accept standard bar type current transformers. The compartment shall have a concealed hinged door.

.5 Distribution Section:

.1 The distribution section shall be a minimum of 21 x space and accommodate the

-
- circuit breakers as shown on the drawings. Minimum dimensions: 90 inches (2286mm) high x 38 inches (965 mm) wide x 48 inches (1219 mm) deep.
 - .2 The distribution section shall be designed to accept the installation of circuit breakers. Any space not occupied by a circuit breaker shall have a filler plate allowing no access to parts when energized.
 - .3 Each circuit breaker shall be provided with a padlockable handle hasp to allow the breaker to be locked in the on or off position, mounted on the circuit breaker cover within the trimline.
 - .4 Distribution switch board bus shall be rated @ 1600 Amps with a system voltage of 120/208 Volt, 3 phase, 4 wire, 60 Hz. for normal power. All phase bussing shall be silver flashed copper, 100% Fully Rated to carry 1600 amps and braced to withstand a system fault of 50kA RMS symmetrical at 120/208VAC.
- .6 Surge Protective Device (SPD)
- .1 SPD unit mounted on wall near switchboard, complete with circuit breaker at switchboard.
 - .2 Surge current:
 - .1 Per Phase - 250 Ka.
 - .2 Line to Neutral - 125 Ka.
 - .3 Line to Ground - 125 Ka.
 - .4 Neutral to Ground - 125 Ka.
 - .3 Filter attenuation @ 100 KHz - 55dB.
 - .4 Surge withstand capabilities @ 10 Ka - > 3500.
 - .5 Complete with the following monitored items:
 - .1 Overcurrent protection.
 - .2 Infrared detection.
 - .3 Thermal detection.
 - .6 Complete with Premium Diagnostic Package.
 - .1 LED status indication on each phase.
 - .2 Transient surge counter.
 - .3 Audible alarm.
- .7 Customer Metering and Main Breaker Section—Emergency power:
- .1 One section containing main breaker compartment and utility metering compartment. Minimum dimensions: 90 inches (2286mm) high x 38 inches (965 mm) wide x 38 inches (965 mm) deep.
 - .2 Main Breaker Compartment:
 - .1 The main breaker compartment shall come complete with provisions for pad-locking the main breaker and sealing screws on the front cover. Grounding is supplied with a link to ground the neutral, the service conduit, and the system ground.
 - .3 Customer Metering Transformer Compartment:
 - .1 The compartment shall be designed to meet local utility requirements. It

shall be bussed and pre-drilled to accept standard bar type current transformers. The compartment shall have a concealed hinged door.

.8 Distribution Section:

- .1 The distribution section shall be a minimum of 21 x space and accommodate the circuit breakers as shown on the drawings. Minimum dimensions: 90 inches (2286mm) high x 38 inches (965 mm) wide x 48 inches (1219 mm) deep.
- .2 The distribution section shall be designed to accept the installation of circuit breakers. Any space not occupied by a circuit breaker shall have a filler plate allowing no access to parts when energized.
- .3 Each circuit breaker shall be provided with a padlockable handle hasp to allow the breaker to be locked in the on or off position, mounted on the circuit breaker cover within the trimline.
- .4 Distribution switch board bus shall be rated @ 400 Amps with a system voltage of 120/208 Volt, 3 phase, 4 wire, 60 Hz. for normal power. All phase bussing shall be silver flashed copper, 100% Fully Rated to carry 400 amps and braced to withstand a system fault of 50kA RMS symmetrical at 120/208VAC.

.9 Surge Protective Device (SPD)

- .1 SPD unit mounted on wall near switchboard, complete with circuit breaker at switchboard.
- .2 Surge current:
 - .1 Per Phase - 250 Ka.
 - .2 Line to Neutral - 125 Ka.
 - .3 Line to Ground - 125 Ka.
 - .4 Neutral to Ground - 125 Ka.
- .3 Filter attenuation @ 100 KHz - 55dB.
- .4 Surge withstand capabilities @ 10 Ka - > 3500.
- .5 Complete with the following monitored items:
 - .1 Overcurrent protection.
 - .2 Infrared detection.
 - .3 Thermal detection.
- .6 Complete with Premium Diagnostic Package.
 - .1 LED status indication on each phase.
 - .2 Transient surge counter.
 - .3 Audible alarm.

2.3 GROUNDING

- .1 Copper ground bus to be silver flashed copper, with a bussed connection to the neutral bus, extending full width of cubicles and located at bottom.

2.4 FINISHES

- .1 Exterior and interior metal surfaces shall be finished with baked enamel over an iron phosphate pre-treatment.
- .2 Supply 2 spray cans touch-up enamel.

2.5 PHYSICAL DIMENSIONS

- .1 The switchboard will be comprised of four sections, vertically mounted, total size : 90 inches (2286mm) high x 38 inches (965 mm) wide x 48 inches (1219 mm) deep (customer metering,main breaker section and Distribution section for normal power and emergency power).

2.6 MAIN OVERCURRENT DEVICE

- .1 Main Power Circuit Breaker
 - .1 Low voltage power circuit breaker.
 - .2 Fixed construction.
 - .3 100% rated.
 - .4 600 volt, 3 pole, MTD-700A adj(NGS 1200 frame) LSIG Circuit Breaker.—normal power
600 volt, 3 pole, MTD-300A adj(KD 400 frame) LSIG Circuit Breaker--- emergency power
 - .5 Frame size – 1200 A. for normal power 400A for emergency power
 - .6 Breaker trip set at 800A.
 - .7 Electronic Solid State Trip.
 - .8 System Voltage - 600V/3Ø.
 - .9 Frequency - 60 Hz.
 - .10 Operation: Manual
 - .11 Continuous current rating
 - .12 Interrupting rating - 80 KA RMS min. symmetrical @ 600 VAC.
 - .13 Minimum 30 cycle short time withstand rating. - 35 KA RMS min. symmetrical @ 600 VAC.
 - .14 Digitrip 520M Trip Unit (LSIG):
 1. True RMS sensing electronic trip unit c/w.
 - .1 Adjustable long delay setting.
 - .2 Adjustable long delay time.
 - .3 Adjustable short delay pickup.
 - .4 Adjustable short delay time.
 - .5 Adjustable ground fault pick-up.
 - .6 Adjustable ground fault delay.
 - .7 Fault indicating LEDs.
 - .8 Maintenance Mode Arc Flash Reduction Switch.
 - .9 Four character LCD display.

2.7 FEEDER CIRCUIT BREAKERS

- .1 200A to 400A:
 - .1 Frame designation: HFD.
 - .2 amp frame/trip rating as indicated.
 - .3 Breaker Type FDC.
 - .4 RMS symmetrical interrupting rating at 600 VAC: Minimum of 35KA.
 - .5 Thermal magnetic trip unit.
 - .6 250V, poles as indicated.
 - .7 Padlockable handle hasp.

- .2 500A to 600A:
 - .1 Frame designation: LD.
 - .2 amp frame/trip rating as indicated.
 - .3 Breaker type: JDB.
 - .4 RMS symmetrical interrupting rating at 600 VAC: Minimum of 35 KA.
 - .5 Thermal magnetic trip unit.
 - .6 250V, poles as indicated.
 - .7 Padlockable handle hasp.
 - .8 Extension handle for breakers rated at 225 amps and above.

2.8 STANDARD OF ACCEPTANCE

- .1 The service entrance switchboard shall be type Power R line C, as manufactured by EATON., c/w main 100 % rated MDS-620 circuit breaker, c/w Digitrip 520M Trip unit, SPD module, IQ6410 digital metering device and distribution sections with circuit breakers as indicated.

2.9 ACCEPTABLE MANUFACTURERS, TO THE REQUIREMENTS ABOVE

- .1 EATON.
- .2 Siemens.

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 This switchboard is designed for an indoor service application only. Switchboards supplied for indoor service which cannot be installed immediately must be stored in a clean, dry, heated and ventilated area.
- .2 Locate service entrance board in location as indicated.
- .3 Connect main secondary service conductors to busbars using factory supplied, NEMA two-hole crimp lugs.

- .4 Connect load side of distribution breakers to feeder conductors as indicated.
- .5 Check factory made connections for mechanical security and electrical continuity.
- .6 Run one grounding conductor, 2/0 AWG, copper, RW90, green insulated, in 35mm conduit from ground rods to water main, to neutral bar thru-lug, to switchboard ground bar thru-lug to ground bar on electrical room wall unbroken.
- .7 Field adjust all main breaker and feeder breaker trip units to match co-ordination values.
- .8 Provide an underslab conduit from the utility metering compartment to the meter base. Ensure this conduit does not pass through any other compartment or sections of the switchboard.
- .9 Provide two (2) underslab 63 mm spare conduits from the distribution section of the service entrance switchboard to the nearest available clear wall space. Terminate conduits in a common 450mm high X 305mm wide X 150 mm deep Type 'E' box.
- .10 Program Departmental Representative's digital meter as follows:
 - .1 Pulse output to indicate energy and demand.
 - .2 Undervoltage:
 - .1 Measure phase to neutral voltage under normal conditions.
 - .2 Set trigger threshold at 190 volts.
 - .3 Set delay at 300 cycles (5 seconds).
 - .3 Overvoltage:
 - .1 Measure phase to neutral voltage under normal conditions.
 - .2 Set trigger threshold at 265 volts.
 - .3 Set delay at 300 cycles (5 seconds).

3.2 SWITCHBOARD START-UP, VERIFICATION AND PERFORMANCE TESTING

- .1 Start-Up
 - .1 Perform start-up checks paying particular attention to:
 1. Name plate complete.
 2. Proper grounding.
 3. Drip hood in place.
 4. Clean equipment.
 5. Condition of insulation and insulators.
 6. No evidence of moisture damage.
 7. Cable lugs torqued to manufacturer's recommendation.
 8. Bus bolts torqued to manufacturer's recommendation.
 9. Doors and covers in place.
 10. Code required clearances around equipment.

11. Exterior and paint finish.
12. SPD installation.
13. Departmental Representative's metering installation.
14. Insulation Megger tests.

.2 Verification

- .1 Perform verification checks paying particular attention to:
 - .1 Departmental Representative's Metering
 - .2 Phase Rotation Test
 - .3 Main Breaker
 - .4 Feeder Breakers

.3 Performance

- .1 Carry out performance checks:
 - .1 Test Main Breaker and Solid State Trip Device
 - .2 Test Feeder Breakers and Trip Units.

3.3 COMMISSIONING

- .1 Carry out the commissioning in conformance with Section 26 91 13.

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCE STANDARDS

- .1 CSA C22.2 No. 29-M1983 - Panelboards and panelboard enclosures.

1.2 RELATED WORK

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

1.3 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings and product data in accordance with Division 1.
- .2 Drawings to include electrical detail of panel, branch breaker type, quantity, ampacity and enclosure dimension.

1.4 OPERATION AND MAINTENANCE MANUAL

- .1 Not Applicable

PART 2 - PRODUCTS

2.1 PANELBOARDS

- .1 Panelboards: product of one manufacturer.
- .2 Type: 250V LT and 600V, 3 phase, 4 wire, as indicated.
- .3 Panelboards shall have surface trim and doors finished for surface or flush mounted as shown on drawings, bolt-on circuit breaker type, sized and of types and electrical characteristics as indicated on drawings.
- .4 Cabinets for panelboards shall be minimum number 14 gauge galvanized steel, minimum of 508mm wide and 147mm deep, of dead front construction, and doors shall be single type, 120 degree door swing, with spring latch and lock. Two keys shall be supplied with each panelboard and all shall be keyed alike. Surface mounted panelboards shall be finished in ASA61 baked enamel. Panel bus bars shall be of aluminum with lugs suitable for copper conductor connections.
- .5 Drip Hoods: on all surface mounted panelboards factory installed.
- .6 All 3 phase, 4 wire panelboards rated at 225 amperes or less to have grounding terminal strip supplied and installed by manufacturer capable of terminating a minimum of two #2s, four #6s with balance of terminations to accept #12 conductors.

- .7 All panelboards rated at 225 amperes or less with voltages and phases as indicated on drawings requiring isolated grounding, to be capable of terminating quantities and sizes as indicated on electrical drawings.
- .8 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.
- .9 Ratings: mains, number of circuits, and number and size of main and branch circuit breakers as indicated in panel schedules.
- .10 Neutrals in panels A, B, C and D shall have 200% rated neutrals.

2.2 BREAKERS

- .1 Breakers: to Section 26 28 16.
- .2 Breakers with thermal magnetic tripping in panelboards except as indicated otherwise.
- .3 Main breaker: When indicated separately mounted on top or bottom of panel to suit cable entry. When mounted vertically, down position should open breaker. If main breaker is mounted on the bottom of panel, panel shall be approved for that purpose and shall be so marked.
- .4 Lock-on devices on handles of circuit breakers shall be installed for exit light circuits, fire alarm circuits, CCTV system, alarm monitoring and security, sump pumps to prevent accidental operation.

2.3 EQUIPMENT IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 00.
- .2 Nameplate for each panelboard size 4 engraved or as indicated.
- .3 Nameplate for each circuit in distribution panelboards size 2 engraved or as indicated.
- .4 Complete circuit directory with typewritten legend showing location and load of each circuit.

2.4 MANUFACTURERS

- .1 Standard of Acceptance: Cutler Hammer
- .2 Other approved manufacturers: Siemens, Square D.

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 00 or as indicated.
- .4 Connect loads to circuits as indicated.
- .5 Connect neutral conductors to common neutral bus with respective neutral identified.
- .6 Panels shall be installed in an upright position and the bottom of the panelboard shall be located not less than 1000mm above finished floor level where practicable.
- .7 Install a typed directory under transparent cover on the inside of each new panelboard showing the location and load connected to each circuit.
- .8 Wiring in panelboards shall be secured with tie wrap or equivalent means to present a neat workmanlike appearance. Branch circuitry wiring within panelboards shall have approximately 300mm of "slack" wire installed in 150mm loop adjacent to respective breakers where phase conductors terminate. All branch circuit neutral, ground and/or bond conductors to have approximately 300mm of slack wire neatly "looped" prior to terminations taking place. All feeder conductors to be installed in such a manner as to enable "clip on" type capacitive leakage tester to encompass neutral plus phase conductors together. Feeder conductors to be provided with additional slack wire adjacent to termination lugs.
- .9 Panels shall be flush or surface mounted as indicated in the schedule and shall be equipped with all breakers of the amperage and interrupting capacity noted on the drawings.
- .10 Run two 25mm spare conduits up to the ceiling space from each flush panel. Terminate these conduits in a 150 x 150 x 100mm junction box in the ceiling space. Box to have affixed nameplate indicating panel.
- .11 Circuit numbers on drawings do not necessarily correspond to the numbers on the lighting and power panels. Circuits sharing a common neutral shall not be connected to the same phase. Any changes in circuit numbering is to be included on "record drawings". Individual light fixtures fed with two branch circuits are to derive their source from two pole breakers.
- .12 The Lamacoid identification plate on panelboards shall include the voltage phase and wires and amperage (of breaker or fuse protecting it) in addition to the panel designation itself.
- .13 "Labelling" of all branch circuit phase conductors plus neutral and/or bond conductors shall be done with "Panduit" write-on, self laminating labels Nos. PDL-1 and PDL-2 as required or approved equal.

- .14 Maximum size conduits housing 15A or 20A branch circuits to be limited to 25mm in size exiting any panelboard.

3.1 TESTS

- .1 Perform tests in accordance with Section 26 05 00.

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCE STANDARDS

- .1 CSA C22.2 No. 111 – General Use Switches.
- .2 CSA C22.2 No. 42 – General Use Receptacles, Attachment Plugs and Similar Wiring Devices.

1.2 RELATED WORK

- .1 Not Applicable.

1.3 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings and product data in accordance with Division 1.

1.4 OPERATION AND MAINTENANCE DATA

- .1 Not Applicable.

PART 2 - PRODUCTS

2.1 SWITCHES

- .1 Provide switches as indicated on the drawings.
- .2 All switches shall be from one manufacturer throughout, specification grade, white in colour.

2.2 RECEPTACLES

- .1 Unless specified otherwise, all receptacles are duplex type.
- .2 All receptacles shall be from one manufacturer throughout, CSA Type, commercial specification grade and suitable for back wiring of #10AWG conductors.
- .3 Provide receptacles as indicated on the drawings.
- .4 Unless specified otherwise, all receptacles are duplex type.
- .5 5-15R receptacles: Hubbell BR15WH or approved equal by Leviton (BR15-W), Cooper (BR15W).
- .6 5-20R receptacles: Hubbell BR20WH or approved equal by Leviton (BR20-W), Cooper (BR20W).
- .7 All receptacles to be complete with stainless steel coverplate.

2.3 EXTERIOR RECEPTACLES:

- .1 Locate in flush weatherproof enclosure incorporating a recessed back box, cover plate as described in paragraph 2.4.5. Hubbell or approved equal by Leviton, Cooper.

2.4 COVER PLATES

- .1 Stainless steel, vertically brushed, 1mm thick for wiring devices mounted in flush mount boxes. Hubbell SS8 or approved equal by Leviton, Cooper.
- .2 Cover plates from one manufacturer throughout project and required for all devices.
- .3 Sheet steel utility box cover for wiring devices installed in surface-mounted utility boxes.
- .4 Cast cover plates for wiring devices mounted in surface-mounted outlet boxes.
- .5 Weatherproof cover plates *shall be heavy cast aluminium 'WHILE IN USE', lockable, complete with enclosure keys.*

2.5 INDUSTRIAL DUTY CABLE REEL

- .1 Not Applicable.

2.6 MANUFACTURERS

- .1 Standard of Acceptance: Hubbell, Leviton, Cooper.

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Switches:
 - .1 Mount toggle switches at height specified in Section 26 05 00 or as indicated.
 - .2 All switches and their wall plates shall be installed plumb, with switch handle in the "up" position when switch is closed.
 - .3 Group switches under one wall plate in gang type box where more than one switch is shown at one location and when more than three are grouped.
 - .4 Where light switches, thermostats, receptacles, etc., are located in close proximity with one another, they are to be located on the same vertical centerline at their respective heights.
- .2 Receptacles:
 - .1 Mount receptacles at height specified in Section 26 05 00 or as indicated. 120V 15A receptacle shall have their U-ground connection oriented to the upper or top side. Horizontally mounted 120V receptacles shall be installed with their neutral termination bolts located on the top side.

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- .2 Install a green insulated ground conductor, between the grounding terminal of the receptacle and the grounding screw and stud of the outlet box. Minimum size of ground and/or bonding cables are to be #12 AWG.
 - .3 Group receptacles under one wall plate in gang type box, where more than one outlet is shown at one location, except if on separate circuits. The use of sectional boxes whether single or multi-ganged shall be restricted for use with flexible conduits, cables or other types of pliable cables.
 - .5 Two or more receptacles in same location but on different circuits shall be grouped under one wall plate but in separate boxes wherever possible. If not possible, they shall be kept separate but in close proximity to each other.
 - .6 Receptacles above counters shall be installed above the splashback to a height as indicated on the drawings and coordinated on the site.
 - .7 Receptacles installed on raceways to be fitted with raceway cut outs and fittings.
 - .8 "Pig-tail" type leads shall be installed on conductors in all device or outlet boxes where feeding through to other receptacles. "Daisy-chaining" of receptacles is not acceptable. Provide separate pig-tail conductor leads for final termination to each receptacle for phase, neutral and bond conductors.
- .3 Coverplates:
- .1 Coverplates to be installed plumb and have stainless steel screws.
 - .2 Install suitable common cover plates where wiring devices are grouped.
 - .3 Do not use cover plates meant for flush outlet boxes on surface-mounted boxes.

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCE STANDARDS

- .1 Not Applicable

1.2 RELATED WORK

- .1 Not Applicable

1.3 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings and product data in accordance with Division 1.
- .2 Submit fuse time-current characteristics for each fuse type and size above 400 A. Time-current characteristics to include: average melting time-current, I/t (for fuse coordination), and peak let-through current.
- .3 Submit shop drawing on fuse storage cabinet.
- .4 Ship fuses in original containers.
- .5 Do not ship fuses installed in equipment.
- .6 Store fuses in original containers in storage cabinet, moisture free location.

1.4 OPERATION AND MAINTENANCE DATA

- .1 Provide maintenance materials in accordance with Division 1.
- .2 Supply three spare fuses of each type and size installed above 600A, and six spare fuses of each type and size installed up to and including 600A.

PART 2 - PRODUCTS

2.1 FUSES GENERAL

- .1 HRC fuses to have interrupting capability of 200,000 RMS AMPS symmetrical.
- .2 Fuses: product of one manufacturer.
- .3 Fuses shall be of silver element construction and rated for 250 volt.

2.2 FUSE TYPES

- .1 Form 1, HRC fuses, Class J:
 - .1 Time delay, Type AJT.

- .2 Fast acting, Type CJ.

2.3 MANUFACTURERS

- .1 Standard of Acceptance: FerrazShawmut.
- .2 Other approved manufacturers: Littelfuse and Bussman.

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Install fuses in mounting devices immediately before energizing circuit.
- .2 Ensure correct fuses fitted to physically matched mounting devices.
- .3 Ensure correct fuses fitted to assigned electrical circuit.
- .4 Use Type J fuses only except where specified otherwise.
- .5 Fuse sizes shall be as indicated on the drawings.

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCE STANDARDS

- .1 CSA C22.2 No. 5.1 - Moulded Case Circuit Breakers.

1.2 RELATED WORK

- .1 Not Applicable

1.3 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit product data in accordance with Division 1.
- .2 Include time-current characteristic curves for breakers with ampacity of 400A and over or with interrupting capacity of 22,000A symmetrical RMS and over at system voltage.

1.4 OPERATION AND MAINTENANCE DATA

- .1 Not Applicable.

PART 2 - PRODUCTS

2.1 BREAKERS GENERAL

- .1 Bolt-on moulded case circuit breaker, quick-make, quick-break type, de-ionizing arc chambers for manual and automatic operation with temperature compensation for 40 degree C ambient. Breakers to be trip-free of operating handles on overloads with a definite indication when tripping has taken place.
- .2 Mini type circuit breakers are not acceptable.
- .3 Multi-pole breakers shall have common trip mechanisms; tie handles are not acceptable.
- .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 from 10 to 12 times current rating.
- .5 Circuit breakers with interchangeable trips as indicated.
- .6 Minimum acceptable circuit breaker interrupting rating shall be 14,000 RMS symmetrical amperes or as indicated on the drawings.

2.2 BREAKER TYPE GROUND FAULT INTERRUPTER

- .1 Ground fault protection where required by circuit breakers in branch circuit panelboards shall be CSA listed as Class "A", Group "1", with a sensitivity of 5 milliamps or greater. Breakers shall be of the thermal magnetic type incorporating a solid state ground fault sensing circuit and push to test push button. Breakers shall be of the bolt on design, and

interchangeable with other panelboard breakers. Interrupting capacity shall be 22,000 RMS symmetrical amperes or as indicated.

2.3 MANUFACTURERS

- .1 Breaker manufacturer shall match that of panel in which they are installed.
- .2 Standard of Acceptance: Cutler-Hammer GBH series.
- .3 Other approved manufacturers: Square D, Siemens.

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Circuit breakers shall be securely mounted in switchboards, panelboards, or EEMAC one (1) enclosures as indicated on the drawings and as required by other sections of the specifications.

END OF SECTION

PART 1 - PRODUCTS

1.1 REFERENCE STANDARDS

- .1 Not Applicable

1.2 RELATED WORK RELATED WORK

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

1.3 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings and product data in accordance with Division 1.

1.4 OPERATION AND MAINTENANCE DATA

- .1 Not Applicable.

PART 2 - PRODUCTS

2.1 MATERIALS

- .1 Components comprising ground fault protective system to be of same manufacturer.

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Install ground fault circuit breakers as specified for panelboards.
- .2 Conduct supply and load wiring to equipment in accordance with manufacturer's recommendations.

3.2 TESTS

- .1 Perform tests in accordance with Section 26 05 00.
- .2 Arrange and pay for field-testing of ground fault equipment by ground fault equipment manufacturer before commissioning services.
- .3 Submit report of tests to Engineer and certificate that system as installed meets criteria specified herein.
- .4 Demonstrate simulated ground fault tests.

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCE STANDARDS

- .1 CSA C22.2 No. 39 - Fuseholder Assemblies.
- .2 CSA C22.2 No. 4 - Enclosed switches.

1.2 RELATED WORK

- .1 Common Work Results for Electrical: Section 26 05 00
- .2 Fuses Low Voltage: Section 26 28 13

1.3 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit Shop Drawings and Product Data in accordance with Division 1.

1.4 OPERATION AND MAINTENANCE DATA

- .1 Not applicable.

PART 2 - PRODUCTS

2.1 DISCONNECT SWITCHES

- .1 Fusible and non-fusible disconnect switches in CSA enclosures as indicated.
- .2 Provision for padlocking in either on or off positions.
- .3 Mechanically interlocked door to prevent opening when handle in ON position.
- .4 ON-OFF switch position indication on switch enclosure cover.
- .5 Fuseholders: suitable without adaptors, for type and size of fuse as indicated.
- .6 Type "A", quick-make, quick-break action.

2.2 EQUIPMENT IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 00.
- .2 Indicate name of load controlled on size 4 nameplate

2.3 MANUFACTURERS

- .1 Standard of Acceptance: Cutler Hammer 1HD321 (30A indoor), 3HD322 (60A outdoor)
- .2 Other approved manufacturers: Siemens HNFC321N (30A indoor) or HNFC322NR (60A outdoor), Square D CHU361N (30A indoor) or CHU362NRB (60A outdoor)

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Install disconnect switches as indicated.
- .2 Mount all disconnect switches in a secure manner, easily accessible, and at a height as specified in Section 26 05 00.
- .3 In finished areas mount disconnect switch on top of flush mounted junction box with conduit nipple on its coverplate into back of the switch.

END OF SECTION

PART 1 -GENERAL

1.1 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings and product data in accordance with Division 1.
- .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 Equipment being controlled, making reference to the Motor Starter and Control list.
- .3 Project Specific Wiring Diagrams:
 - .1 Refer to the MC drawings for individual motor starter control wiring diagrams and sequences of operation.
 - .2 Submit with each starter a project specific wiring diagram indicating all interconnections.
 - .3 Each starter shop drawing will indicate the equipment being controlled (For example- Supply fan #1).

1.2 OPERATION AND MAINTENANCE DATA

- .1 Provide data for incorporation into maintenance manual specified in Division 1.
- .2 Include operation and maintenance data for each type and style of starter.

1.3 SPARE PARTS

- .1 Provide spare parts as indicated in 26 05 00.

PART 2 - PRODUCTS

2.1 MATERIALS

- .1 All individual starters and motor control centre starters are to be from one manufacturer.
- .2 Starters: EEMAC E14-1.
 - .1 Half size starters are not acceptable.

2.2 MANUAL MOTOR STARTERS

- .1 Single phase manual motor starters of size, type, rating, and enclosure type as indicated, with components as follows:
 - .1 Switching mechanism, quick make and break.

.2 One overload heater, manual reset, trip indicating handle.

.2 Accessories:

- .1 Toggle switch: standard labeled as indicated.
- .2 Indicating light: LED type and colour as indicated.
- .3 Locking tab to permit padlocking in "ON" or "OFF" position.

2.3 FULL VOLTAGE MAGNETIC STARTERS

.1 Combination magnetic starters of size, type, rating and enclosure type as indicated with components as follows:

- .1 Contactor solenoid operated, rapid action type.
- .2 Motor solid state overload protective device in each phase ambient compensated, manually reset from outside enclosure, c/w
 - .1 One current sensor in each phase.
 - .2 Dial selectable overload protection.
 - .3 Phase loss protection.
- .3 Power and control terminals.
- .4 Project specific 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 include magnetic only circuit breaker, where indicated with operating lever on outside of enclosure to control circuit breaker, and provision for:

- .1 Locking in "OFF" position with up to 3 padlocks.
- .2 Locking in "ON" position.
- .3 Independent locking of enclosure door.
- .4 Provision for adjustable trip settings of 700 - 1300 % of motor FLA.

.3 Accessories:

- .1 Selector switches: labeled as indicated.
- .2 Indicating lights: LED type and colour as indicated.
- .3 1-N/O and 1-N/C spare auxiliary contacts unless otherwise indicated.
- .4 Manual overload reset button on enclosure exterior.
- .5 Control transformer, voltage as indicated, minimum 150 VA, factory installed.

.4 Wiring Diagrams:

- .1 Each starter will be supplied with a project specific wiring diagram located inside the cover in a plastic sleeve.

2.4 BUILDING AUTOMATION SYSTEM CONTROL COMPONENTS

1. Provide solid core AC current sensors in each and every starter enclosure. Wire all connections to a factory installed terminal strip.

- 1. Acceptable material: Greystone Model CS-450-1.

2. Provide mechanical relay and relay base in each and every starter enclosure. Unit to be

DPDT and have 12 VDC coil and 120 VAC, 6 Amp contacts to switch motor control circuit. Wire all connections to a factory installed terminal strip.

1. Acceptable material: Eaton Model # XRR2D12 and plug-in base.
3. All components and entire assembly to be CSA approved.

2.5 ENCLOSURE

- .1 Provide EEMAC 1 enclosures for all starters unless indicated otherwise.

2.6 COORDINATION

- .1 Coordinate with mechanical contractor.

2.7 STANDARD OF ACCEPTANCE

- .1 Cutler-Hammer MS Series manual motor starters.
- .2 Cutler-Hammer – Freedom NEMA c/w CEP7 solid state overload relay.

2.8 ACCEPTABLE MANUFACTURERS

- .1 Acceptable manufacturer: Furnas, Square D, Allen Bradley, Siemens.

PART 3 - EXECUTION

3.1 INSTALLATION OF STARTERS

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

3.2 MOTOR STARTER START-UP, VERIFICATION AND PERFORMANCE TESTING

- .1 Start-Up
 - .1 Perform start-up checks paying particular attention to:
 1. Name plate complete.
 2. Proper grounding.
 3. Clean equipment.
 4. Evidence of moisture damage.
 5. Cable lugs torqued to manufacturer's recommendation.
 6. Doors and covers in place.
 7. Code required clearances around equipment.
 8. Exterior and paint finish.
 - .2 Verification
 - .1 Perform verification checks paying particular attention to:
 1. Manufacturer
 2. Voltage
 3. Phase Rotation Test

- 4. Breakers (MCP and Thermal/magnetic type)
- .3 Performance
 - .1 Carry out performance checks:
 - 1. Test overcurrent devices.
 - 2. Test overload Trip Units.

3.3 MOTOR STARTER MANUFACTURER'S SITE VISIT

- .1 Engage the services of the Motor Starter manufacturer's representative to visit the site and commission the units. Commissioning to include the following:
 - 1. Verify circuit breakers trip unit set points match motor nameplate values.
 - 2. Verify overload trip unit set points match motor nameplate values.
 - 3. Verify all connections are torqued to manufacturer's recommended values.
 - 4. Verify proper operation of each over device and that starter connections are properly made, and torqued.
- 2. A written report shall be prepared detailing this portion of the work, and submitted to the engineer.

3.4 TESTS

- .1 Operate switches to verify correct functioning.
- .2 Perform starting and stopping.
- .3 Check that starters operate as indicated and to requirements of the mechanical contractor.

3.5 RECORDS

- .1 Obtain and record the following information for each motor.
 - .1 Motor horsepower.
 - .2 Motor voltage.
 - .3 Motor full load amps (both nameplate and site measured values).
 - .4 Installed solid state overload unit's set point.
 - .5 Installed over current protection.
 - .6 Motor circuit protector set point, where applicable.
- .2 Submit chart to Engineer for approval and make changes where instructed.
- .3 Incorporate in maintenance manuals.

3.6 COMMISSIONING

- .1 Carry out the commissioning in conformance with Section 26 91 13.

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCE STANDARDS

- .1 ANSI C82.-SSL1-20XX – Solid state lighting power, supplies and drivers
- .2 ANSI C78 series - Fluorescent lamps.
- .3 CSA C22.2 No. 74 – Ballasts. Equipment for use with Electric Discharge Lamps.
- .4 CSA C22.2 No. 8 - Radio interference suppressor. Electromagnetic Interference (EMI) Fitters.
- .9 CSA C22.2 No. 250.13-12 - Light emitting diode (LED) equipment for lighting applications

1.2 RELATED WORK

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

1.3 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings and product data in accordance with Division 1.
- .2 Submit complete photometric data prepared by independent testing laboratory for luminaires where specified or requested for approval by Engineer.
- .3 Submit shop drawings on all lamps, dimming & electronic ballasts.

1.4 OPERATION AND MAINTENANCE DATA

- .1 Not Applicable

1.5 GUARANTEE

- .1 Replace:
 - .1 LED drivers that fail within 12 months of takeover.

PART 2 - PRODUCTS

2.1 LUMINAIRE DETAILS

- .1 Provide fixtures as indicated in Paragraph 2.3 below and as shown on drawings.
- .2 Provide supporting devices, surface mounted junction boxes and outlet boxes where required.

- .3 LED light fixtures shall be Reduction of Hazardous Substances (RoHS)-compliant..
- .4 LED modules shall comply with IES LM-79 and LM-80 requirements.
- .5 Minimum CRI of 80 and color temperature of 3500k unless specified otherwise.
- .6 Minimum rated life of LED fixtures shall be 50,000 hours per IES L70.
- .7 Lenses or diffusers shall be of glass or acrylic material, as indicated.
- .8 Include finishes to Section 26 05 00 and as indicated.
- .9 Provide gasketing, stops and barriers to form light traps to prevent light leaks.

2.2 LUMINAIRE MANUFACTURERS

- .1 Supply luminaires as per the light fixture schedule on the drawings..

2.3 LUMINAIRE SUPPORTS

- .1 Provide supports for suspended fixtures as recommended by manufacturer
- .2 Additional T-Bar grid supports that may be required for light fixtures installed in, or secured to, T-Bar type ceilings, shall be identified accordingly to the applicable ceiling contractor, who in turn will be responsible for supplying and installing additional hangers as may be required.
- .3 The installation of any additional T-Bar grid ceiling support wires is the sole responsibility of the ceiling installation contractor.
- .4 Independent supporting of light fixtures in T-Bar grid ceilings utilizing materials other than tie-wires, i.e. threaded rods, metal channels, etc., are the sole responsibility of the electrical contractor.

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 This work shall include the supplying and installation and connection of all lighting units and allied equipment as specified hereinafter and on the drawings as well as the receiving, storing and testing of same.
- .2 Locate fixtures as indicated on drawings.
- .3 Catalogue references numbers given for individual fixtures may not necessarily be correct but are intended as a guide when read with the description and may not agree with the type of fixture finally supplied; therefore the catalogue reference shall be verified

with the description and co-ordinated with the installation conditions with particular regard to ceiling construction details, type and finish before ordering the fixtures.

- .4 Recessed fixtures shall have trim and frame details to match the ceiling suspension system and the Electrical Contractor shall co-ordinate with ceiling contractor.

3.2 WIRING

- .1 Connect fixtures to lighting circuits as indicated.
- .2 Recessed, surface and/or suspended fixtures shall not be wired in a daisy-chain manner, nor have their power sources looped between fixtures unless they are installed end-to-end.
- .3 Each luminaire shall be complete with its own separate fixture drop originating from a junction box located within the same ceiling space as the luminaire. An exception shall be made for recessed downlights, which may be wired from one fixture to another, provided they have integral junction boxes and the luminaire access opening is 150mm or greater in diameter.

3.3 RECESSED DOWNLIGHTS

- .1 Non Accessible Ceilings: If the luminaire opening is less than 150mm in diameter, a separate fixture drop shall be provided. Fixture drops shall be run to an accessible junction box above an accessible ceiling or an access panel. Fixture drops shall not exceed 4.5m in length.
- .2 Accessible ceilings: Fixtures are to be securely fastened to the T-bar ceiling. No part of the fixture is to derive support from the T-bar ceiling tiles.

3.4 FIXTURE ALIGNMENT

- .1 Align fixtures mounted in continuous rows to form straight uninterrupted line.
- .2 Align luminaries mounted individually parallel or perpendicular to building grid lines.

3.5 FIXTURE SUPPORTS

- .1 Provide luminaire supports required to mount fixtures as specified.
- .2 Hang all light fixtures in such a manner that their attachment to the ceiling shall be secure in all respects.
- .3 Fixtures shall not be hung directly from suspended gypsum board ceilings, but shall derive their support from channels independently mounted in the ceiling space.
- .4 Generally wire hangers shall be used to adequately secure and support the fixtures; these shall be provided and installed under work of this Contract.

3.6 DEFECTIVE OR DAMAGED FIXTURES

- .1 Check fixtures and replace all defective lamps, ballasts and accessories on any fixtures that have been damaged or scratched during construction.
- .2 Replace lamps that have burned out as per paragraph 1.5 of this section.

3.7 TESTS

- .1 Perform tests in accordance with Section 26 05 00.

3.8 BUILDING TAKEOVER

- .1 All fixtures shall be operable, undamaged, and as specified at the time of building takeover.
- .2 All lamps shall be new and burning at the time of takeover. All fixtures shall be clean and like new condition, at the time of takeover.

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCE STANDARDS

- .1 Unit equipment for emergency lighting to CSA C22.2 No. 141

1.2 RELATED WORK

- .1 Not Applicable

1.3 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings and product data in accordance with Division 1.
- .2 Data to indicate system components, mounting method, source of power and special attachments.

PART 2 - PRODUCTS

2.1 EQUIPMENT

- .1 Provide emergency lighting as per schedules on the drawings.

2.2 CONDUCTORS

- .1 120V AC supply: Use minimum #12 AWG conductors in minimum 13mm EMT.

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Install unit equipment for emergency lighting in accordance with CSA C22.1-2012.
- .2 Install unit equipment in ceiling or 2100mm above finished floor as indicated.
- .3 Direct heads as indicated to provide adequate emergency illumination, in accordance with NBC (2010).

3.2 TESTS

- .1 Perform tests in accordance with Section 26 05 00.
- .2 Test system for operation and adjust heads if necessary for best coverage. Do test for 30 minutes on battery power.

END OF SECTION

PART 2 - GENERAL

1.1 REFERENCE STANDARDS

- .1 CSA – C860 – Performance of Internally Lighted Exit Signs.

1.2 RELATED WORK

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

1.3 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings and product data in accordance with Section Division 1.
- .2 Submit complete photometric data prepared by independent testing laboratory for luminaires where specified or requested for approval by Engineer.

1.4 OPERATION AND MAINTENANCE DATA

- .1 Not Applicable.

PART 2 - PRODUCTS

2.1 EXIT LIGHTS GENERAL

- .1 Exit lights to be “Running Man” exit signs;
- .2 Light emitting diode lamp, 347V;
- .3 Die-cast aluminium housing;
- .4 Surface mount allowing for ceiling, wall or end mount as indicated;
- .5 Field adjustable pictograms;
- .6 Unit to be self-powered, with a high performance Ni-Cd battery and solid state transfer to battery charger, 90 minutes of battery life;
- .7 Provide a 10 year life warranty.

2.2 MANUFACTURERS

- .1 As per schedule on the drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Install exit lights as indicated, to requirements of NBC-2010.
- .2 Exit lighting fixtures mounted above doors shall be wall mounted wherever possible. Mount to ceiling only when wall mounting is not feasible.
- .3 Connect fixtures to exit light circuits as indicated.
- .4 Ensure that exit light circuit breakers are locked in on position.

END OF SECTION

PART 1 – GENERAL

1.1 REFERENCE STANDARDS

1.2 RELATED WORK

1.3 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit Shop Drawings in accordance with Division 1.

1.4 OPERATION AND MAINTENANCE DATA

- .1 Submit Shop Drawings in accordance with Division 1.

1.5 DESCRIPTION OF WORK

- .1 PA System – All speakers, cabling and conduit, head-end, all programming and commissioning will be provided by this contractor. This contractor to complete all terminations at speakers. This contractor to allow for one full eight hour day to trouble shoot any problems with the Departmental Representatives representative.

PART 2 – PRODUCTS

2.1 GENERAL

- .1 Provide all products as noted on the drawings.

2.2 WIRING

- .1 Wiring – As noted on the drawings in 12mm EMT, unless otherwise indicated.

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Install all components as indicated and test for operation.

3.2 SOUND SYSTEM TRAINING AND SUPPORT

- .1 Provide the initial programming, customizing and data entry.
- .2 Provide Demonstration, Operating and Maintenance Instructions as per Section 26 05 00.
- .3 Provide an initial five (5) hours of training to the Departmental Representative's designated representative. This is to take place prior to substantial completion.
- .4 Visit site 30 days following substantial performance and provide an additional three (3) hours of training. Visit site within 90 days following substantial performance

upon request from Departmental Representative and provide an additional two (2) hours of training.

- - END OF SECTION - -

PART 1 - GENERAL

1.1 RELATED WORK

- .1 General requirements: Division 1.
- .2 Common Work Results for Electrical - Section 26 05 00.
- .3 Facility Commissioning – General - Section 01 91 13.
- .4 Facility Commissioning – Electrical - Section 01 91 15.

1.2 GENERAL

- .1 The verification of all electrical systems installed on this project is the responsibility of the Electrical Contractor. Manufactured systems or components shall be commissioned by factory trained technicians representing the manufacturer, in the presence of the Departmental Representative's designated representatives, and under the direction of the electrical contractor.
- .2 The electrical contractor will provide assistance to the Departmental Representatives and ensure that the manufacturer's representative is on site during functional performance testing (FPT).
- .3 Tests shall be performed by qualified electricians or technicians as required by the nature and complexity of the test.
- .4 The correction of all electrical deficiencies identified throughout the project associated with this work shall be a condition of Substantial Performance and shall be corrected prior to achieving Substantial Performance.

1.3 SCOPE

- .1 Systems verification are called for throughout the individual specifications, however, this does not relieve this section from providing all testing and verification necessary to ensure that systems and equipment operate as required and that they interface with other systems and equipment as required.
- .2 Provide labour tools and supervision to conduct functional testing as described/specified herein and in related sections including but not limited to the following equipment and systems:
 - .1 Interior Lighting and Controls;
 - .2 Exterior Lighting and Controls;
 - .3 Main Service Entrance Board;
 - .4 Panelboards;
 - .5 Structured Cabling;
 - .6 Fire Alarm System;
 - .7 Building Security, CCTV and Access Control Systems;
 - .8 Motors and Motor Controls.
 - .9 PA System

1.4 QUALITY ASSURANCE

- .1 The Electrical Contractor is responsible for quality assurance and whenever necessary, to ensure compliance with operating requirements, CSA, these contract documents, the Authority having Jurisdiction and other requirements and codes as applicable.

1.5 CONTRACTOR'S RESPONSIBILITIES

- .1 Prepare each system for testing and verification.
- .2 Co-ordinate the efforts of testing and verification.
- .3 Provide personnel, operate systems at designated times, and under conditions required for proper testing and adjusting.
- .4 Provide all necessary test and calibration equipment, temporary facilities, meters, sensors, load banks, etc. necessary to simulate and verify correct operating conditions.
- .5 Co-ordinate and pay for all costs associated with testing and verification, including but not limited to costs for: travel, labour, equipment, testing agencies, manufacturers, testing and any other costs incurred to test and verify equipment and systems.
- .6 Make test instruments available to Engineer to facilitate spot checks during testing.
- .7 Retain possession of test instruments and remove at completion of services.
- .8 Verify system installation is complete and in continuous operation.
- .9 Where systems or equipment do not operate as required, make the necessary corrections or modifications, re-test and re-commission.

1.6 SUBMITTALS

- .1 The Contractor shall submit the following documentation prior to FPT:
 - .1 Record drawings.
 - .2 Operations and maintenance manuals.
 - .3 A letter of acceptance from the local inspection authority. A copy is to be included in the operations and maintenance manuals.
 - .4 A letter of guarantee. A copy is to be included in the operations and maintenance manuals.
- .2 A Commissioning and/or Certification Report from the manufacturer for the following systems (A copy is to be included in the operations and maintenance manuals):
 - .1 Intrusion Detection system.
 - .2 Structured wiring system.
 - .3 CATV system.
 - .4 Lighting Control System

- .5 Card Access System
- .6 CCTV System
- .3 Written verification from the end user that demonstrations have been performed for the following (A copy is to be included in the operations and maintenance manuals):
 - .1 Lighting Control System.
 - .2 Main switchboard including digital meter.
 - .3 Motor Control Centres (MCC's).
 - .4 Fire alarm system.
 - .5 Security system.
 - .6 Card Access System
 - .7 CCTV System

1.7 INSTRUCTION OF DEPARTMENTAL REPRESENTATIVE'S STAFF

- .1 Provide the following:
 - .1 Necessary instruction of equipment and systems operation to Departmental Representative's staff.
 - .1 At least 72 hours advance notifications in writing.
 - .2 Provision of factory trained technicians where necessary.
 - .3 Provision of presentation with the use of as-built drawings and data books required in other sections of these specifications.
- .2 Conduct presentation on project premises.

PART 2 – PRODUCTS N/A

PART 3 - EXECUTION

3.1 INSULATION RESISTANCE TESTING

- .1 Megger circuits, feeders and equipment up to 350 V with a 500 V instrument, up to 600 volts with a 1000 V unit.
- .2 Check resistance to ground before terminating cables and wires.

3.2 PANELBOARD PHASE CURRENT MEASUREMENT

- .1 Energize all possible loads.
- .2 Measure each phase and record voltage and current.

3.3 MOTOR INFORMATION FORM

- .1 Record all pertinent motor information for each motor installed.

- .2 Measure each motor full load amps, after the Balancing Technician has completed his final adjustments.
- .3 Set and record the installed overload and overcurrent data.

3.4 OTHER TESTS

- .1 Perform other tests, not mentioned in this section, but specified in individual specification sections, to the approval of the Engineer.
- .2 Pay specific attention to:
 - .1 Fire alarm system verification.
 - .2 Intrusion Detection system verification.
 - .3 Structured Wiring System Cabling Testing.
 - .4 Television System Testing.