

PART 1 GENERAL

1.1 WORK INCLUDED

- .1 Complete and operational electrical system as required by the drawings and as herein specified.

1.2 REFERENCE STANDARDS

- .1 Within the text of these specifications, reference may be made to the following standards:

CSA - Canadian Standards Association
EEMAC - Electrical and Electronic Manufacturers Association of Canada
CEMA - Canadian Electrical Manufacturers Association
IEEE - Institute of Electrical and Electronic Engineers
IPCEA - Insulated Power Cable Engineers Association
ULC - Underwriters Laboratory of Canada
CEC – Canadian Electrical Code
- .2 Electrical materials, products and equipment shall be CSA approved and conform with EEMAC standards. Where necessary, obtain local CSA approval.
- .3 Equipment, wiring and wiring devices shall meet the requirements of the Current Edition of the Canadian Electrical Code, Part 1, including all bulletins in force at the time of tender submission.

1.3 DRAWINGS AND SPECIFICATIONS

- .1 The General Conditions, Supplementary Conditions and Division 01 are a part of this specification and shall apply to this Division.
- .2 The intent of the drawings and specifications is to include all labour, products and services necessary for complete work, tested and ready for operation.
- .3 Symbols used to represent various electrical devices often occupy more space on the drawing than the actual device does when installed. In such instances, do not scale locations of devices from electrical symbols. Install these devices with primary regard for usage of wall space, convenience of operation and grouping of devices.
- .4 These specifications and the drawings and specifications of all other divisions shall be considered as an integral part of the accompanying drawings. Any item or subject omitted from either the specifications or the drawings but which is mentioned or reasonably specified in and by the others, shall be considered as properly and sufficiently specified and shall be provided.
- .5 Provide all minor items and work not shown or specified but which are reasonably necessary to complete the Work.

- .6 If discrepancies or omissions in the drawings or specifications are found, or if the intent or meaning is not clear, advise the Departmental Representative for clarification before submitting tender.
- .7 Responsibility to determine which Division provides various products and work rests with the General Contractor. Additional compensation will not be considered because of differences in interpretation of specifications.
- .8 Contractor to provide all cost associated with the elevator manufacturer to access the elevator during demolition, construction, verification and general access to the elevator pit and shaft.

1.4 QUALITY ASSURANCES

- .1 Codes, Rules, Permits and Fees
 - .1 Comply with all laws, ordinances, rules, regulations, codes and orders of all authorities having jurisdiction relating to this work.
 - .2 Comply with all rules of the Canadian Electrical Code, CSA Standard C22.1 and the applicable building codes.
 - .3 Quality of work specified and/or shown on the drawings shall not be reduced by the foregoing requirements.
 - .4 Immediately after award of contract and prior to installation, verify location, arrangement and point of attachment for service and service entrance equipment with supply authority and inspection departments. Failure to do so will render this Division responsible for any corrections necessary without additional compensation.
 - .5 Give all required notices, submit drawings, obtain all permits, licenses and certificates and pay all fees required for this work.
 - .6 Furnish a Certificate of Final Inspection and approvals from inspection authority to the Departmental Representative.
- .2 Standards of Workmanship
 - .1 Execute all work in a competent manner and to present an acceptable appearance when completed.
 - .2 Employ a competent supervisor and a sufficient number of licensed tradesmen to complete the Work in the required time.
 - .3 Arrange and install products to fit properly into designated building spaces.
 - .4 Unless otherwise specified or shown, install products in accordance with recommendations and ratings of manufacturers.
 - .5 The work shall be executed to the satisfaction of the Departmental Representative. The Electrical Contractor shall, at all times, keep a competent foreman in charge of the work and this foreman shall facilitate the inspection of the work as directed by the Departmental Representative; there shall be no charges for this. The Electrical Contractor shall complete his work as quickly as possible, and immediately make any changes or modifications requested by the Departmental Representative during specific or routine inspections; whether requested to do so verbally or in writing.

1.5 SHOP DRAWINGS

- .1 Within fourteen (14) days of award of contract, the contractor shall submit a completed equipment procurement schedule which lists the manufacturer and model of equipment, indicating the projected ordering, shop drawing submittal date and delivery dates of all products to meet the required construction schedule.
- .2 Submit samples as required where specified in Divisions 26 and 28.
- .3 Prior to delivery of any products to job site and sufficiently in advance of requirements to allow ample time for checking, submit shop drawings for review as specified in Division 01. Submit shop drawings for all equipment as required in each section of this specification.
- .4 Prior to submitting the shop drawings to the Departmental Representative, the Contractor shall review the shop drawings to determine that the equipment complies with the requirements of the specifications and drawings.
- .5 The term "shop drawing" means drawings, diagrams, illustrations, schedules, performance characteristics, brochures and other data which are to be provided by the Contractor to illustrate details of a portion of the Work.

Indicate materials, methods of construction and attachment of support wiring, diagrams, connections, recommended installation details, explanatory notes and other information necessary for completion of Work. Where equipment is connected to other equipment, indicate that such items have been coordinated, regardless of the section under which the adjacent items will be supplied and installed. Indicate cross references to design drawings and specifications.

Adjustments made on shop drawings by the Departmental Representative are not intended to change the contract price. If adjustments affect the value of the work state such in writing to the Departmental Representative prior to proceeding with the Work.
- .6 Manufacture of products shall conform to revised shop drawings.
- .7 Keep one (1) complete set of shop drawings at job site during construction.
- .8 Submittals shall include:
 - .1 Date and revision dates;
 - .2 PROJECT TITLE AND NUMBER (MUST appear on ALL copies of ALL shop drawings submitted for approval);
 - .3 Applicable name of Electrical, Contractor, Subcontractor, Supplier, Manufacturer and separate details when pertinent;
 - .4 Identification of product or materials;
 - .5 Applicable standards, such as CSA or CGSB numbers;
 - .6 ELECTRICAL CONTRACTOR'S STAMP, INITIALED OR SIGNED, certifying to review of submittal, verification of field measurements and compliance with Contract Documents.
- .9 The Electrical Contractor shall review each shop drawing before submitting it to determine that it is acceptable in terms of the means, methods, techniques, sequences and operations of construction, safety precautions and programs incidental thereto, all of which are the electrical contractor's responsibility.

1.6 RECORD DRAWINGS

- .1 The Contractor shall keep one (1) complete set of white prints at the site office, including all addendums, change orders, site instructions, clarifications and revisions for the purpose of record drawings. As the work on-site proceeds, the Contractor shall clearly record in Red Pencil all as-built conditions which deviate from the original contract documents. Record drawings to include circuiting of all devices, conduit and feeder runs (complete with conductor size and number) and locations of all electrical equipment.

1.7 PRODUCT HANDLING

- .1 Use all means necessary to protect the products of this Division before, during and after installation and to protect products and installed work of all other trades.
- .2 Immediately make good any damage by repair or replacement at no additional cost to the project and to the approval of the Departmental Representative.
- .3 Remove advertising labels from all electrical equipment. Do not remove identification of certification labels.
- .4 Remove dirt, rubbish, grease, etc. resulting from this work from all surfaces, including the inside of all cabinets, equipment enclosures, panelboard tubs, etc.

1.8 ALTERNATE AND SEPARATE PRICES

- .1 In accordance with the other sections, state on the Tender Form in the space provided, the amount to be added or deleted from the base bid tender amount for the use and installation of equipment as an alternate to those specified.

1.9 GUARANTEE

- .1 Furnish a written guarantee to the Departmental Representative prior to final contract payment, which will be in effect for one (1) year from the date of final acceptance of the complete work. Replace or repair at no cost to the project any defective material or workmanship except where, in the opinion of the Departmental Representative, such defects are due to the misuse or neglect by the end user.
- .2 This general guarantee shall not act as a waiver of any specified or special equipment guarantees which cover a greater length of time.

1.10 PROGRESS CLAIMS

- .1 Refer to Cost Breakdown Form. Ensure progress claims include the numbers for Demolition; Rough-in; Material of Fire Alarm Devices; Installation of Fire Alarm Devices; Conduit, Cables, Fitting, etc. (Material and Installation); Patch and Repair; Miscellaneous (shop drawings, meetings, training, O&M, etc.); Fire Alarm Verification; As-Built / Record Drawings.
- .2 Photos of the Construction are to be provided upon each progress claim and at the request of the Departmental Representative.

PART 2 PRODUCTS

2.1 SELECTED PRODUCTS & EQUIVALENTS

- .1 Products and materials provided shall be new and free from all defects. Defective products or materials will be rejected, regardless of previous inspections. The Contractor shall be responsible to remove and replace defective products at their expense, and shall be responsible for any resulting delays and associated expenses which result from defective products being rejected. Related materials shall be of the same manufacturer throughout the project.
- .2 Products and materials referred to in the specifications by trade names, manufacturer's name and catalogue reference are those which shall be used as the basis for the Tender.
- .3 The design has been based on the use of the specified product.
- .4 Refer to other sections.

2.2 ALTERNATIVE PRODUCTS

- .1 All product substitutions must be approved by the Departmental Representative. Failure to obtain approval from the Departmental Representative will result in the alternative product being rejected, in which case the Contractor shall provide an approved product at no additional cost to the project.
- .2 The Contractor shall assume full responsibility for ensuring that when providing alternative products or materials, all space, weight, connections, power and wiring requirements etc. are considered. Any costs incurred for additional components, changes to services, structural or space requirements, layouts and plans, etc. that may be necessary will be borne by the contractor.
- .3 All submissions which are approved by the Departmental Representative shall be identified as "Approved Alternatives" in an Addendum. Alternative products not listed in the Addendum will be rejected.
- .4 Approval of an alternate is not intended to change the original specifications unless specifically stated in the addenda. The submitter is responsible for all costs incurred by other trades as well as his own, to install the product/system in accordance with the contract documents.
- .5 All submissions to be provided with technical data and whatever pertinent information that may be required by the Departmental Representative to evaluate equivalency to the specified product. The responsibility to provide sufficient technical data with respect to submissions will remain solely with those making the submission.

2.3 QUALITY OF PRODUCTS

- .1 All products provided shall be CSA Approved, Canadian Underwriters' Laboratory approved where applicable, and new, unless otherwise specified.
- .2 If products specified are not CSA approved, obtain special approval from the local regulatory authority. Pay all applicable charges levied and make all modifications required for approval.
- .3 Products provided, if not specified, shall be new, of a quality best suited to the purpose required and their use subject to approval by the Departmental Representative.

2.4 UNIFORMITY OF MANUFACTURE

- .1 Unless otherwise specifically called for in the Specifications, uniformity of manufacture shall be maintained for similar products throughout the work.

2.5 PRODUCT FINISHES, REPAIRS, TOUCH UPS

- .1 Apply primer on all items which are to be finished on the job.
- .2 Touch up all damaged painted finishes with matching lacquer, or, if required by the Departmental Representative, completely repaint damaged surface.
- .3 All painting, patching, sanding, repair, replacement is required to be provided by the Contractor; this includes, but not limited to: drywall, gypsum, ceiling tile, concrete, bricks, etc.
- .4 All new painting is to be taken to the next transition point to minimize the notice of difference in paint match.

2.6 USE OF PRODUCTS DURING CONSTRUCTION

- .1 Any equipment used for temporary or construction purposes shall be approved by the Departmental Representative. Clean and restore to "as new" condition all equipment prior to the time of substantial completion.
- .2 The warranty period shall not begin until the date of final acceptance of the work.

PART 3 EXECUTION

3.1 SITE EXAMINATION

- .1 Examine the site of work and become familiar with all features and characteristics affecting this work before submitting tender.
- .2 No additional compensation will be given for extra work due to existing conditions which such examination should have disclosed.
- .3 Report to the Departmental Representative any unsatisfactory conditions which may adversely affect the proper completion of this work.

3.2 COORDINATION WITH OTHER DIVISIONS

- .1 Examine the drawings and specifications of all divisions and become fully familiar with their work. Before commencing work, obtain a ruling from the Departmental Representative if any conflict exists, otherwise no additional compensation will be made for any necessary adjustments.
- .2 Lay out the work and equipment with due regard to architectural, structural and mechanical features. Architectural and structural drawings take precedence over electrical drawings regarding locations of walls, doors and equipment.
- .3 Do not cut structural members without approval of a Departmental Representative. All cost associated to this work is to be included in the Contractor's bid.
- .4 Coordinate with all Divisions installing equipment and services, and ensure that there are no conflicts.
- .5 Install anchors, bolts, pipe sleeves, hanger inserts, etc. in ample time to prevent delays.
- .6 Examine previously constructed work and notify the Departmental Representative of any conditions which prejudice the proper completion of this work. Commencement of this work without such notification shall constitute acceptance of other work.

3.3 LOCATION OF DEVICES

- .1 Electrical drawings are, unless otherwise indicated, drawn to scale and approximate distances and dimensions may be obtained by scaling. Figured dimensions shall govern over scaled dimensions. Where exact dimensions and details are required site measure on site.
- .2 Outlet and equipment locations shown on the drawings are approximate. Locations may be revised up to 3 meters to suit construction and equipment arrangements without additional cost to the project. Confirm with Departmental Representative prior to the installation of the outlets, or equipment.
- .3 Maintain locations wherever possible. Notify the Departmental Representative of conflicts with other services.
- .4 Unless otherwise specified or shown, install products in accordance with recommendations and ratings of manufacturers.

3.4 SEPARATION OF SERVICES

- .1 Maintain separation between electrical wiring system and building piping, ductwork, etc. so that wiring system is isolated (except at approved connections to such systems) to prevent galvanic corrosion.
- .2 In particular, contact between dissimilar metals, such as copper and aluminum, in damp or wet locations is not permitted.
- .3 Do not support wiring from pipes, ductwork, etc. Hangers for suspended ceilings may be used for the support of wiring only when approval is obtained from the Departmental Representative and the ceiling installer, and approved clips or hangers are used.

3.5 EQUIPMENT IDENTIFICATION

- .1 Three (3) mm thick plastic lamicoid name plates, black face, white core, mechanically attached with self-tapping screws, 20 mm high with 8 mm high lettering, to be attached to the front face of the equipment.
- .2 Colour code exposed conduits (including conduits above T-bar ceilings), junction and pull boxes, covers, couplings, LB's and LB covers, and metallic sheathed cables with paint (25 mm wide band) at 15 metre intervals. Colour coding to be as follows:

SYSTEM	MAJOR BAND
347/600V Normal	Sand
347/600V Emerg.	Sand (covers marked "EM") Grey
120/208V Normal	Grey (covers marked "EM")
120/208V Emerg.	
Fire Alarm System	Red

- .3 Provide neatly typed circuit directories in panelboards to indicate the area or equipment controlled by each branch circuit.

- .4 All conductors shall be identifiable by coloured insulation and permanent markers at every terminal and accessible points throughout its entire run.

Conductors:

Equipment Grounding - Green

Neutral Conductor - White

Fire Alarm System

Neutrals	White
Switch Legs	Phase Colour with White Tracer
Speaker Cct.	Blue with Yellow Tracer
Box Circuit	Black with Yellow Tracer
Annunciator	Brown with Yellow Tracer

- .5 Low Voltage Wiring: per manufacturer's standard, i.e. CGE low voltage relay switching system.

3.6 ACCESS PANELS

- .1 Where electrical equipment, junction boxes, remote ballasts or the like are concealed, access panels shall be supplied. Panels shall be of adequate size for servicing of the electrical work and complete with necessary frames and hinged doors held closed with captive fasteners. Coordinate type and size of panels with the Departmental Representative.
- .2 In removable ceiling areas, provide markers on ceiling tile to locate equipment requiring access. Markers shall be of a type approved by the Departmental Representative.

3.7 MOUNTING HEIGHTS

- .1 Unless otherwise noted on the drawings, or a conflict exists, use the following as mounting heights from finished floors to centre of device.
- | | | |
|----|----------------------------|---------|
| .1 | Fire Alarm Manual Stations | 1150 mm |
| .2 | Fire Alarm Horn/Strobes | 2100 mm |
| .3 | End of Line Resistors | 1800 mm |
| .4 | Fire Alarm Panel | 1800 mm |
| .5 | Fire Alarm Annunciator | 1800 mm |

3.8 SEALING OF WALL AND FLOOR AND CEILING OPENINGS

- .1 All conduit and cable entries through outside walls of buildings, through partition walls separating electrical rooms from other areas, through fire separations, and through floors above grade shall be sealed to prevent passage of moisture, dust, gasses, flame, or to maintain pressurization. Existing fire rating shall be maintained.
- .2 Openings shall be sealed when all wiring entries shown on the drawings have been completed.
- .3 Sealing material shall be fire resistant and shall not contain any compounds which will chemically affect the wiring jacket or insulating material. Cable penetrations through fire separations to be sealed and existing fire rating shall be maintained.

3.9 SPRINKLER PROOF EQUIPMENT

- .1 Electrical equipment installed where sprinklers are also installed shall be constructed so that water from the sprinkler heads shall not impair the effectiveness of the equipment.
- .2 A separate and complete roof shall be provided on free-standing or surface mounted equipment. An overhang at the front, rear and sides shall prevent the entrance of water either at the top or through projecting face plates, meters, etc.
- .3 Where conduits or cables are required to penetrate sprinkler proof roofs, rain tight connectors shall be used in conjunction with T & B 5260 Series sealing rings. Connectors shall be equal to:
 - .1 Rigid Conduit - T & B Bullet Hubs
 - .2 EMT - T & B 5123 Series (steel)
 - .3 Teck Cable - T & B 10460 Series
- .4 Distribution, power and lighting panelboards and switchboards shall be complete with gasketted covers and doors.
- .5 Louvres shall be of the outdoor type.
- .6 All connectors entering top of the fire alarm control panel (FACP) must be of rain tight type.

3.10 SLEEVES

- .1 Provide sleeves of galvanized steel pipe with machine cut ends of ample size to accommodate conduits passing through walls, partitions, ceilings, floors, etc.
- .2 For wall, partitions and ceilings the ends shall be flush with the finish on both sides but for floors they shall extend 100 mm above finished floor level.

- .3 The space between the sleeve and the conduit shall be filled with Dow Corning silicone RTV foam for fire stop and caulked around the top and bottom with approved permanently resilient, non-flammable and weatherproof silicone base compound and ensure that the seal is compatible with the floor and ceiling finishes.
- .4 Locate and position sleeves exactly prior to construction of walls, floors.
- .5 Failure to comply with the above requirements shall be remedied at this Division's expense.

END OF SECTION

PART 1 GENERAL

1.1 DESCRIPTION

- .1 Supply and install a complete secondary grounding system. Securely and adequately ground all components of the electrical system in accordance with the requirements of all related sections in the latest Canadian Electrical Code, National Building Code of Canada and the local Electrical Inspection Authority.
- .2 The system is to consist of cables, ground rods, supports, and all necessary materials and inter-connections to provide a complete system. Measured resistance to ground of the network shall not exceed 5 ohms.
- .3 All ground conductors shall be run in conduit.

1.2 REFERENCES

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

PART 2 EXECUTION

2.1 GENERAL

- .1 Install complete permanent, continuous grounding system including: electrodes, conductors, accessories. Where EMT is used, run ground wire in conduit. All connectors shall be installed in accordance with manufacturer's requirements. All frames and metallic enclosures of all electrical equipment and electrically operated equipment shall be grounded through the conduit system or via a ground wire.

2.2 EQUIPMENT GROUNDING

- .1 Install grounding connections to typical equipment.

2.3 COMMUNICATION SYSTEMS

- .1 Install grounding connections for fire alarm systems.

2.4 FIELD QUALITY CONTROL

- .1 Perform ground continuity and resistance tests using method appropriate to site conditions and to approval of Departmental Representative and local Authority Having Jurisdiction over installation.
- .2 Perform tests before energizing electrical system.
- .3 Disconnect ground fault indicator during tests.

END OF SECTION

PART 1 GENERAL

1.1 WORK INCLUDED

- .1 Supply and install all hangers, supports and inserts for the installation shown on the drawings and specified herein, as necessary to fasten electrical equipment securely to the building structure.

PART 2 PRODUCT

2.1 FRAMING AND SUPPORT SYSTEM

- .1 Materials:
 - .1 Intermediate duty supporting structures shall employ P1000 Unistrut or equal together with the manufacturer's connecting components and fasteners for a complete system.
 - .2 Heavy duty supporting structures to be fabricated and welded from steel structural members and prime painted before installation.
- .2 Finishes:
 - .1 Outdoors, wet locations: Hot dipped galvanized.
 - .2 Indoors, dry locations: Galvanized when available, prime painted if not available.
 - .3 Nuts, bolts, machine screws: Zinc plated.
- .3 Unistrut:
 - .1 Section P1000, P3300 or as required for load and span, with mounting screws, or approved. P1000 or equal is a minimum standard for supporting conduits 50 mm and larger.

2.2 CONCRETE AND MASONRY ANCHORS

- .1 Materials: Hardened steel inserts, zinc plated for corrosion resistance. All anchor bolts must be galvanized.
- .2 Components: Non-drilling anchors for use in predrilled holes, sized to safely support the applied load with a minimum safety factor of four.
- .3 Manufacturer: Hilti (Canada) Limited or approved equal.

2.3 NON-METALLIC ANCHORS

- .1 Material: Plastic anchors for sheet metal screws.

2.4 CONDUIT SUPPORTS

- .1 Unistrut support racks: Unistrut conduit clamps.

2.5 CABLE SUPPORTS AND CLAMPS

- .1 General: As per conduit supports, except that for single conductor cables, suitable non-ferrous, or approved stainless steel or aluminum clamps shall be used.

2.6 SUPPORT CHANNELS

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

2.7 FASTENERS

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

2.8 MANUFACTURERS

- .1 Acceptable Channel manufacturers: Burndy Ltd., T&B., B-Line.

PART 3 EXECUTION

3.1 GENERAL

- .1 Do not cut or drill beams, joists or structural steel unless written permission of a Structural Engineer of Alberta is obtained. All cost associated for obtaining permissions from a Structural Engineer is the responsibility of the contractor.
- .2 Distance between conduit or cable supports not to exceed code requirements.
- .3 Supports to be suitable for the real loads imposed by equipment.
- .4 Supports to be securely fastened, free from vibration and excessive deflection or rotation. Maximum deflections are 4 mm over a 1 meter span and 8 mm over a 2 meter span.
- .5 Install fastenings and supports as required for each type of equipment cables and conduits, and in accordance with manufacturer's installation recommendations.
- .6 Provide conduit rack with 25% spare capacity for multiple runs.
- .7 Provide channel support with fittings for vertical runs of conduit and cables.
- .8 Secure equipment to poured concrete with expandable inserts.
- .9 Secure equipment to hollow masonry walls or suspended ceilings with toggle bolts.
- .10 Secure surface mounted equipment with twist clip fasteners to inverted "T" bar ceilings. Ensure that "T" bars are adequately supported to carry weight of equipment specified before installation of same.
- .11 Support equipment, conduit or cables using clips, spring-loaded bolts, cable clamps designed as accessories to basic channel members.

3.2 INSTALLATION

- .1 Suspended support systems.
 - .1 Support individual cable or conduit runs with 6 mm dia. threaded rods and spring clips.
 - .2 Support two (2) or more cables or conduits on channels supported by 6 mm dia. threaded rod hangers where direct fastening to building construction is impractical.
- .2 Use plastic anchors for light loads only. Use metal anchors for all other loads.
- .3 Lead anchors and plastic anchors will not be permitted.
- .4 Shot driven pins may only be used with written approval of the structural engineer.
- .5 Use round or pan head screws for fastening straps, boxes, etc.
- .6 Do not support heavy loads from the bottom chord of open web steel joists.
- .7 Support outlet boxes, junction boxes, panel tubs, etc., independent of conduits running to them. Support conduits within 600 mm of outlet boxes. Support surface mounted panel tubs with a minimum of four (4) 6 mm fasteners.
- .8 For surface mounting of two (2) or more conduits use strut channels at 1.5 m oc spacing.
- .9 Provide metal brackets, frames, hangers, clamps and related types of support structures where indicated or as required to support conduit and cable runs.
- .10 Ensure adequate support for raceways and cables dropped vertically to equipment where there is no wall support.
- .11 Do not use wire lashing, tie wraps or perforated strap to support or secure raceways or cables.
- .12 Do not use supports or equipment installed for other trades for conduit or cable support except with permission of other trade and approval of the electrical consultant.
- .13 Install fastenings and supports as required for each type of equipment cables and conduits, and to Manufacturer's installation recommendations.
- .14 Do not install screws through upper flute portion of metal roof deck when roof membrane is located directly on top of metal roof deck. Confirm with general contractor.
- .15 Fasten conduit or cables to building construction or support system using straps
 - .1 One-hole steel straps to secure surface conduits and cables 50 mm and smaller.
 - .2 Two-hole steel straps for conduits and cables larger than 50 mm.
 - .3 Beam clamps to secure conduit to exposed steel work.

END OF SECTION

PART 1 GENERAL

1.1 WORK INCLUDED

- .1 Provide a complete system of splitters boxes and cabinets for the installation of wiring and equipment.

PART 2 PRODUCTS

2.1 JUNCTION BOXES AND PULL BOXES

- .1 Materials:
 - .1 Code gauge sheet steel, welded construction, phosphatized and factory paint finish.
 - .2 Junction and pull boxes: to CSA C22.2 No. 40, welded steel construction with screw-on flat covers for surface mounting
 - .3 Lockable, weatherproof and corrosion resistant when installed outdoors.
 - .4 Covers with 25 mm minimum extension all around, for flush-mounted pull and junction boxes.
- .2 Components:
 - .1 Boxes 200 mm x 200 mm and larger are to be complete with hinged covers. Hinged covers are to be constructed using pin style or piano hinges. Formed steel hinge assemblies are not acceptable.
 - .2 For flush mounting, covers to overlap box by 25 mm minimum all around with quarter turn latch.
 - .3 Use rolled edges for surface boxes.
- .3 Junction boxes mounted in exterior walls shall be complete with box vapour barriers.

2.2 CABINETS

- .1 Materials:
 - .1 Cabinets: Code gauge sheet steel, welded construction, phosphatized and factory paint finish, suitable for field painting.
 - .2 Locks: to match panelboards.
 - .3 Backboards: 19 mm GIS fir plywood, one piece per cabinet, covering entire cabinet interior.

.2 Components:

- .1 With hinged door and return flange overlapping sides, with handle, lock and catch for surface mounting, size as indicated or to suit.
- .2 Type T: sheet steel cabinet with hinged door, latch, lock (two (2) keys), containing 19 mm G1S painted plywood backboard, suitable for flush or surface mounting as noted.
- .3 Surface or flush with trim and hinged door, latch and lock and two (2) keys, size as indicated or to suit. Keyed to match panelboard keys 19 mm GIS Fir Plywood backboard.

PART 3 EXECUTION

3.1 INSTALLATION

.1 Junction Boxes and Pull Boxes:

- .1 Supply all pull boxes and junction boxes shown on the drawings or required for the installation.
- .2 Install junction and pull boxes in accessible locations.
- .3 Boxes installed in party walls to be offset by a minimum of one stud space.
- .4 Install in inconspicuous but accessible locations, above removable ceilings or in electrical rooms, utility rooms or storage areas.
- .5 Identify with system name and circuit designation as applicable.
- .6 Size in accordance with the Canadian Electrical Code, as a minimum.
- .7 Support boxes independently of connecting conduits. Secure boxes to building structure.
- .8 Extension rings will not be allowed on junction or pullboxes.
- .9 Only main junction and pull boxes are indicated. Provide pull boxes so as not to exceed 30 meters of conduit run between pull boxes

.2 Cabinets:

- .1 Mount cabinets with top not greater than 1980 mm above finished floor, coordinated with masonry, panelboards, fire hose cabinets and similar items. Securely fasten backboards to cabinet interiors.
- .2 Install terminal block where indicated.

.3 Identification:

- .1 Junction, pull boxes, and splitters with size 2 identification labels indicating system name, ampacity, voltage and phase.
- .2 Provide equipment identification in accordance with Section 26 05 00 – Electrical General Requirements.
- .3 Identify all 100 mm square or 100 mm octagon junction boxes, containing branch circuit conductors, with black felt marker indicating panel and breaker number (i.e. "B-24").

END OF SECTION

PART 1 GENERAL

1.1 WORK INCLUDED

- .1 Provide a complete system of boxes for the installation of wiring and equipment.

1.2 REFERENCES

- .1 CSA C22.1-Canadian Electrical Codes, Part 1.

PART 2 PRODUCTS

2.1 MATERIAL

- .1 Interior Boxes: Provide galvanized sheet steel boxes, blanked for conduit, attached lugs for locating.
- .2 Exterior Boxes: Cast aluminum deep type boxes, FA series with threaded hubs.
- .3 Masonry Boxes: 90 mm deep, conduit knockouts for mounting in masonry walls.
- .4 Combination boxes with barriers where outlets for more than one system are grouped.

2.2 COMPONENTS

- .1 Ceiling outlets, surface mounting, concealed:
 - .1 101 mm square, depth 54 mm, Iberville 52171 series or approved equal.
 - .2 119 mm square, depth 54 mm, Iberville 72171 series or approved equal.
- .2 Ceiling outlets, concealed mounting in concrete:
 - .1 101 mm octagonal concrete rings, depth from 38 mm to 152 mm Iberville 54521 series or approved equal.
 - .2 Extension ring to change from recessed conduit to exposed conduit, 101 mm octagonal, 38 mm deep square Iberville 53151-1/2 or 38 mm deep octagonal Iberville 51151C or 54 mm deeper, Iberville 55171C or approved equal.
- .3 Wall boxes, concealed in concrete or masonry: for one (1) and two (2) gang applications shall be 101 mm square, 54 mm deep, 52171 series complete with suitable 52-C-49 series square cornered raised tile wall cover for proper device and wall surface application. Masonry boxes may be used for line voltage switching.
- .4 Wall outlets, concealed non-masonry construction, with plaster finish: for one (1) or two (2) gangs used with switches, receptacles, etc., use 54 mm deep Iberville 52171 series, with matching plaster covers, depth to suit. Alternately, use 119 mm square boxes, Iberville 72171 series and covers as required or approved equal. (For more than two (2) gangs use solid boxes Iberville GSB series with GBC series cover, or special boxes as required.)

- .5 Wall outlets, surface, exposed mounting or used for outdoor outlets: one or more gang, Crouse-Hinds FS series or FD series, conduit or approved equal.
- .6 Covers: Unless wiring devices and plates are mounted, provide blank, round canopy covers to match boxes.

2.3 CONDUIT BOXES

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

2.4 OUTLET BOXES FOR NON-METALLIC SHEATHED CABLE

- .1 Electro-galvanized, sectional, screw ganging steel boxes, minimum size 76 x 50 x 63 mm with two (2) double clamps to take non-metallic sheathed cables.

PART 3 EXECUTION

3.1 INSTALLATION

- .1 All outlet boxes to be flush mounted in all areas except mechanical rooms, electrical rooms, above removable ceiling and crawl spaces.
- .2 Support boxes independently of connecting conduits.
- .3 No sectional, gangable or handy boxes are to be used.
- .4 Fill boxes with paper, sponges or foam or similar approved material to prevent entry of debris during construction. Remove upon completion of work.
- .5 For flush installations mount outlets flush with finished wall using plaster rings to permit wall finish to come within 6 mm of opening.
- .6 Provide correct size of openings in boxes for conduit or cable connections. Reducing washers are not allowed.
- .7 Adjust position of outlets in finished masonry walls to suit course lines. Coordinate cutting of masonry walls to achieve neat openings for all boxes.
- .8 Do not distort boxes during installation. If boxes are distorted, replace with new boxes.
- .9 Use plaster rings to correct depth. Use 30 mm on concrete block.
- .10 Provide boxes sized as required by the Canadian Electrical Code. All boxes are to be the deep type as a minimum.
- .11 Install vapour barrier material to surround and seal all outlet boxes located on exterior walls of building. Maintain wall insulation.
- .12 Outlets installed in party walls to be offset by a minimum of one stud space.

- .13 Ceiling outlet boxes shall be provided for every surface mounted fixture or row of fixtures installed on suspended "hard" ceilings.
- .14 For outlets mounted above counters or in millwork coordinate location and mounting heights prior to installation. Refer to architectural details.
- .15 Adjust height of outlets above heating cabinets. Coordinate with mechanical contractor.
- .16 Outlets flush mounted in T-bar ceilings shall be supported with "Caddy" type supports spanning to T-bar grid.
- .17 Outlet boxes in metal stud walls are to be solidly anchored on two sides of the box to the wall system to ensure box will not move within the wall.

END OF SECTION

PART 1 GENERAL

1.1 WORK INCLUDED

- .1 This section describes the conduit and conduit fittings that will be utilized on the project. The drawings to not indicate all the necessary conduit runs, offsets, bends, or configurations. Provide a complete system of conduit and fittings for installation of wiring. The contractor is to layout the conduit system to suit the encounter conditions on-site and as specified herein.
- .2 Conduit layouts to be planned to a maximum fill of 60% of the fill allowed by the appropriate sections of CEC.
- .3 All wiring to be installed in conduit.
- .4 Minimum conduit size to be 21 mm. No exceptions.

PART 2 PRODUCTS

2.1 RIGID STEEL CONDUIT

- .1 Galvanized with threaded joints and connections.
- .2 Connections in dry locations; Couplings: steel or malleable iron locknuts inside and outside enclosures. Insulated bushings Thomas & Betts Series 222 or approved alternate.
- .3 Connectors; Couplings subjected to moisture interior and exterior: liquid and dust tight with insulated throat, Thomas & Betts "Bullet Hub" 370 Series or approved alternate.
- .4 Fittings: cast metal "Condulet" as manufactured by Crouse-Hinds Canada Ltd. including gasketted covers in damp locations.
- .5 Expansion joints: cast metal Crouse-Hinds Type XJ or approved alternate.

2.2 ELECTRICAL METALLIC TUBING (E.M.T.)

- .1 Fittings in dry locations: Zinc set screw connectors (or Steel with insulated throat). Zinc set screw (or Steel) couplings.
- .2 Fittings in wet locations: Steel rain tite connectors with insulated throat. Steel rain tite couplings.
- .3 Couplings: rigid threaded galvanized steel, set screw and liquidtight. All EMT connectors and couplings over 41 mm to be steel. Die cast zinc is NOT permitted.

2.4 LIQUID-TIGHT FLEXIBLE CONDUIT

- .1 Conduit: flexible metal conduit with liquid-tight PVC jacket. Industrial Wire & Cable "Liquiseal".
- .2 Connectors: captive sealing jacket and ground cone insulated throat, steel (Thomas & Betts Ltd. "Super-Tight", Series 6000) or approved equal.

2.5 FLEXIBLE CONDUIT

- .1 Steel armour, flexible plastic jacket type with liquidtight connectors.
- .2 Provide bonding conductor sized for the appropriate use.
- .3 Connectors: slip-proof, insulated throat or non-metallic bushings, steel, Thomas & Betts Ltd. "Tite-Bite", Series 300 or approved equal.

2.6 ARMOURED CABLE ("BX")

- .1 Interlocked aluminum armored cable AC90 shall not be used on this project.

2.7 ZINC FITTINGS

- .1 Connectors and couplings to be manufactured of No. 3A alloy conforming to ASTM designation B.240.

PART 3 EXECUTION

3.1 RIGID STEEL CONDUIT

- .1 Use as raceways for following applications:
 - Expose conduit stub-ups from concrete slabs.
 - In all areas exposed to weather.
 - Locations where mechanical damage may occur and in mechanical rooms to a height of 1 metre.
 - Through grade beams or where "shear" conditions are present.
 - Encased in concrete where installed below structural floor slab, below slab-on-grade and for all stub outs to underground site wiring. All steel conduit installed below grade that is not encased in concrete to be painted with two (2) coats of asphaltum base paint.

3.2 E.M.T.

- .1 Use as raceways for following applications: 21 mm (3/4" minimum size).
- .2 It may not be used in damp locations, corrosive atmosphere, underground, outdoors, nor in areas exposed to mechanical damage.
- .3 EMT may be utilized in poured concrete walls or block walls filled with concrete provided that all stub-ups through floors or walls are of rigid threaded galvanized steel.
- .4 EMT may be utilized for exposed runs except where subject to mechanical injury in accordance with CEC.

3.3 INSTALLATION

- .1 Install all conduit and wiring concealed, unless otherwise shown on the drawings. Do not recess conduit in columns, except as noted, without permission.
- .2 Where conduit is run exposed, run parallel to building lines. Where conduits are grouped (two or more), space evenly, make bends concentric and mount on Unistrut racks.
- .3 Lay out conduit to avoid interference with other work. Maintain a minimum clearance of 150 mm from steam or hot water piping, vents, etc.
- .4 Coordinate installation of conduit in brick or block walls with masonry trade to allow mason to thread bricks or blocks over conduit.
- .5 Install liquid tight flexible conduit connections to all motors from conduit stub-ups and from junction boxes to avoid transmission of vibration from machinery to building structure.
- .6 Provide bushing at end of conduit. Stub-ups into accessible ceiling space.
- .7 Install conduit to avoid interference with work or equipment of other trades and to maintain maximum headroom.
- .8 All conduits installed in ceiling spaces to be mounted on conduit racks. Conduit racks to be coordinated with mechanical ducting and the specific rack configuration to be approved by the Departmental Representative prior to installation. Conduit racks to be sized and configured to provide at least twenty-five (25%) percent future capacity.
- .9 Where steel conduit is required to be bent, do not heat, and do not bend conduit in such a way as to reduce pipe cross section area at any point. Radii of bends shall be as per Canadian Electrical Code.
- .10 For all runs of conduits, do not include more than equivalent of three (3) 90° bends. Provide conduit fittings, pullboxes and junction boxes where necessary. Pulling elbows shall not be used.

- .11 Where possible, install conduits so that they are not trapped, cap turned up conduits to prevent the entrance of dirt or moisture during construction. Swab out conduit and thoroughly clean internally before wires and cables are pulled.
- .12 Take extreme care in reaming ends of all conduit to ensure a smooth interior finish that will not damage the insulation of the wires.
- .13 Use insulated non-metallic bushings on all conduit terminations 27 mm (1") and larger.
- .14 Ensure electrical continuity in all conduit systems.
- .15 All conduits shown exposed in finished areas is to be free of unnecessary labels and trademarks.
- .16 Install a 90 lb. test line in all conduits left empty by this contractor including those which others will pull cables, wires, etc.
- .17 Conduits crossing building expansion joints shall have conduit expansion fittings to suit the type of conduit used, and shall be Crouse-Hinds, Appleton or approved fitting.
- .18 Seal conduits with duct seal where conduits are run between heated and unheated areas. Where conduits, cables, or cable trays pierce fire separations, seal openings with Dow Corning 3-6548 sealant or approved equal.
- .19 Where conduits pass through walls, they shall be grouped and installed through openings. After all conduits shown on the drawings are installed, wall openings shall be closed with material compatible with the wall construction. Review size and quantity of conduit sleeves with the Consultant.
- .20 All openings for conduit penetrations in fire rated and smoke separations to be sealed using materials approved by the Departmental Representative. All block-outs and access slots to be sealed using sealant approved for use in fire rated walls. Install using approved damming material as required to provide designated fire rating.
- .21 Where drawings show conduit designations, these conduits shall be identified at each point of termination with Thomas & Betts "Ty-Rap" No. TY532M labels.
- .22 Where conduit finish is damaged, repair or replace.
- .23 All branch circuit wiring, home-runs, communication and data to be minimum 21 mm diameter unless otherwise stated.
- .24 Provide necessary flashing and pitch pockets, making watertight joints where conduits pass through roof or watertight membranes.
- .25 Where panelboard branch circuit conduits are amalgamated, size shall not exceed 25 mm diameter.
- .26 Colour code conduits as per Specification Section 26 05 00.

- .27 The Departmental Representative reserves the right to retain other contractors to install electrical or other systems in empty conduit systems prior to substantial completion of the contract.
- .28 Slabs-on-grade: Install rigid PVC conduit 35 mm (1 1/4") and larger in the gravel base below concrete slabs. Provide mechanical protection around stub-ups through slab and extend 150 mm beyond concrete. When rigid steel conduit is installed in contact with earth it shall be protected by Polykin #940 tape. Extend taping 300 mm above finished grade.
- .29 Underground wiring to be installed in rigid PVC plastic pipe or rigid steel conduit as indicated on the drawings. Adaption from plastic to steel to be by means of conduit or plastic pipe connector with conduit to plastic being threaded and plastic to plastic being welded. Connections to be watertight. All steel conduit and steel conduit portions stubbing out from the building to be painted two (2) coats of asphaltum base paint. Where non-metallic conduit is utilized, all bends and elbows shall be rigid galvanized steel.
- .30 Rigid galvanized steel conduit shall be used where installed through grade beams, foundation walls and for all stub-outs from car heater post bases, exterior distribution centre bases and luminaire bases. In all cases rigid galvanized steel sections to be not less than 3 m in length, terminating not less than 2 m from concrete base or wall surface.
- .31 Do not place conduit in concrete slabs in which slab thickness is less than four times conduit diameter. Place conduits larger than this size under floor. Conduits to have minimum 25 mm concrete cover.
- .32 Where conduit is installed in floor slabs to run up at equipment or motors, carefully check all conduit locations. Verify conduit locations for mechanical equipment from shop drawings or detail drawings. Brace all stub-ups. Stub-ups shall be rigid steel.
- .33 Provide underground warning tapes 300 mm below grade above all underground conduits. Tape shall be red warning tape, 150 mm wide.
- .34 Organize conduit in slabs to minimize crossovers. Obtain approval and minimum concrete cover required from structural engineer prior to installing conduits in slabs.
- .35 Conduit Installation for data/voice cabling:
 - .1 Install minimum 21 mm diameter EMT conduit inside walls from voice/data outlet connector and box and stub-up into ceiling space 150 mm above top of wall. Provide EMT bushing at top of EMT.
- .36 Slabs on grade: Install rigid PVC conduit 35 mm (1 1/4") and larger in the gravel base below concrete slabs. Provide mechanical protection around stub-ups through slab and extend 150 mm beyond concrete. When rigid steel conduit is installed in contact with earth it shall be protected by Polykin #940 tape. Extend taping 300 mm above finished grade.

END OF SECTION

PART 1 GENERAL

1.1 WORK INCLUDED

- .1 Provide a complete system of wiring, making all connections necessary for the installation shown on drawings.

1.2 REFERENCES, CODES AND STANDARDS

- .1 CSA C22.2 No. 0.3, Test Methods for Electrical Wires and Cables.
- .2 Canadian Electrical Code – Latest Edition.
- .3 Install and rate power cables in accordance with the Canadian Electrical Code requirements or in accordance with ICEA requirements where permissible.

1.3 PRODUCT DATA

- .1 Submit product data in accordance with Section 26 05 00 – Electrical General Requirements.

PART 2 PRODUCTS

2.1 BUILDING WIRES

- .1 Conductors: Stranded for 10 AWG and larger. Minimum size: 12 AWG.
- .2 Copper conductors: Size as indicated, with 600 V insulation of chemically cross-linked thermosetting polyethylene (XLPE) material rated RW90.
- .3 T-90 conductors may be used indoors.

PART 3 EXECUTION

3.1 INSTALLATION OF BUILDING WIRES

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

3.2 INSTALLATION OF TECK CABLE 0 – 1000 V

- .1 Install cables.
- .2 Group cables wherever possible on channels.

3.3 INSTALLATION OF ARMoured CABLES

- .1 Group cables wherever possible. Only should be used for luminaire drops.

3.4 INSTALLATION OF CONTROL CABLES

- .1 Install control cables in conduit.
- .2 Ground control cable shield.

3.5 WORKMANSHIP

- .1 Before pulling wire, ensure conduit is dry and clean. If moisture is present, thoroughly dry out conduits; vacuum if necessary. To facilitate pulling, recognized specially manufactured wire pulling lubricants may be used. Do not use grease. Employ suitable techniques to prevent damage to wire when ambient temperature is below the minimum permitted for each insulation type. Do not pull wires into incomplete conduit runs.
- .2 Installation to be free of opens and grounds. Before energization, measure insulation resistance and comply with the Canadian Electrical Code. Submit data sheet with values measured.
- .3 Do not install any conductor smaller than #12 AWG, except where specifically indicated otherwise, i.e. for fire alarm system station circuits, P.A. wiring, etc.
- .4 Provide sizes of conductors as shown on drawings. Voltage drop from lighting panels to farthest outlet must not exceed 2% at full load in any case. Advise Departmental Representative if problem is foreseen.
- .5 Exercise care in stripping insulation from wire. Do not nick conductors.

3.6 IDENTIFICATION, CODING AND BALANCING

- .1 For branch circuit wiring, follow identification system shown on the drawings and as specified in Section 26 05 00 – Electrical General Requirements.
- .2 Connect single phase equipment to minimize imbalance on feeders. Adjust branch circuiting shown as required for optimum balancing. Record all changes on "record" drawings.
- .3 Colour code all feeders at all terminations, at all points where taps are made, and at all panelboards, switchboards, motor control centres, etc. Use two (2) wraps of 3M #471 plastic film tape 48 mm wide.
- .4 Conductors sized No. 10 and smaller are required to be factory coloured, not taped on site.

END OF SECTION