

PART 1 GENERAL

- 1.1 Related Work
 - .1 General Requirements Section 01 00 00
 - .2 All Electrical Drawings
- 1.2 Quality Assurance
 - .1 Do complete installations in accordance with CSA C22.1-2002.
 - .2 While not identified, and specified by number in this Division, comply with CSA Electrical Bulletins in force at time of Bid Submission. Comply with the requirements of all Provincial and local laws, rules, ordinances and codes.
 - .3 Electrical installation shall be in accordance with the current edition of the Canadian Electrical Code, Provincial and other codes, rules and regulations. Supply material and labour required to meet the requirements of these codes, rules and regulations even though the Work is not shown on the drawings or mentioned in the specifications. Where the electrical installation calls for better quality materials or construction than the minimum requirements of these codes, rules and regulations, the electrical installation shall be as shown on the drawings and as specified.
 - .4 Electrical installation shall be in accordance with the requirements of the electrical supply authority and local inspection authority.
- 1.3 Permits, Fees
 - .1 Submit to Electrical Inspection Department and Supply Authority necessary number of drawings and specifications for examination and approval prior to commencement of the Work.
 - .2 Obtain all necessary permits and pay all fees as required for the electrical installation.
- 1.4 Materials and Equipment
 - .1 Provide labour, materials, transportation, equipment and facilities, etc., required for the complete electrical installation as indicated or implied on the drawings and specifications.
 - .2 Electrical equipment shall be new and of type and quality specified.
- 1.5 Submittals
 - .1 Submit shop drawings and product data for review by the Contract Administrator. All drawings shall be in English and Imperial dimensions or in metric where indicated. Manufacture of equipment shall not commence until shop drawings have been reviewed.
 - .2 Indicate details of construction, dimensions, capacities, weights and electrical performance characteristics of equipment or material. Where applicable, include wiring, single line and schematic diagrams.
 - .3 Submit shop drawings of service entrance equipment to utilities.
 - .4 Material submitted for Contract Administrator's review shall bear Contractor's, and where applicable, Utility reviewed stamp.
- 1.6 Operations and Maintenance Data

- .1 Provide operation and maintenance data for incorporation into Maintenance Manuals, including names and addresses of local suppliers for items included in Maintenance Manuals.
 - .2 Include 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.
 - .3 Include technical data, product data, supplemented by bulletins, component illustrations, exploded views, technical descriptions of items, and parts lists. Advertising or sales literature not acceptable.
 - .4 Include wiring and schematic diagrams and performance curves.
 - .5 Submit 4 copies of Maintenance Manuals to the Contract Administrator for review. Manuals that are incomplete shall be returned to the Contractor for completion. Completed manuals shall be submitted, to the satisfaction of the Contract Administrator, before substantial completion may be considered.
- 1.7 Voltage Ratings
- .1 Operating voltages: to CAN3-C235-83.
 - .2 Motors, electrical heating, control and distribution devices and equipment to operate satisfactorily at 60 Hz within normal operating limits established by above standard. Equipment shall operate in extreme operating conditions established in above standard without damage to equipment.
- 1.8 Inspection
- .1 Furnish a Certificate of Acceptance from the Inspection Authorities on completion of the Work. Copies of certificate shall be included in Maintenance Manuals. Certificate shall be submitted before final payment may be considered to be due.
 - .2 During the course of the project construction, the Contract Administrator will carry out periodic Site reviews and prepare a deficiency list for remedial action by the Contractor. The Contractor shall respond in writing to the Contract Administrator, stating corrective action and completion date for each item listed as deficient.
- 1.9 Care, Operation and Start-Up
- .1 Instruct the City's operating personnel in the operation, care and maintenance of equipment. Arrangement of such instructional sessions shall be done at a time convenient to the City, and ensure that operating personnel are conversant with all aspects of its care and operation.
 - .2 Arrange and pay for services of Manufacturer's factory service Engineer to supervise start-up of installation, check, adjust, balance and calibrate components.
- 1.10 Finishes
- .1 Finish outdoor electrical equipment – standard colour.
 - .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, fastenings to prevent rusting.
- 1.11 Equipment Identification
- .1 Identify electrical equipment with lamacoid nameplates.

.2 Provide lamacoid nameplates, 3mm (1/8") thick plastic engraving sheet, black or red face, white core, mechanically attached (screwed or riveted) unless specified otherwise. Sizes as follows:

Size 0	10 x 38mm	(3/8" x 1-1/2")	1 line	3mm	(1/8") high letters
Size 1	10 x 100mm	(3/8" x 4")	1 line	3mm	(1/8") high letters
Size 2	13 x 75mm	(1/2" x 3")	1 line	5mm	(3/16") high letters
Size 3	13 x 75mm	(1/2" x 3")	2 lines	3mm	(1/8") high letters
Size 4	19 x 75mm	(3/4" x 3")	1 line	10mm	(3/8") high letters
Size 5	19 x 100mm	(3/4" x 4")	2 lines	5mm	(3/16") high letters
Size 6	25 x 100mm	(1" x 4")	1 line	13mm	(1/2") high letters
Size 7	25 x 100mm	(1" x 4")	2 lines	6mm	(1/4") high letters

.3 Wording on nameplates shall be approved prior to manufacture. Submit schedule of nameplates and wording.

.4 Allow for average of twenty-five (25) letters per nameplate.

.5 Identification shall be English.

.6 Nameplates for terminal cabinets and junction boxes shall indicate system and/or voltage characteristics.

.7 Use black nameplates with white lettering for normal power and communications equipment. Use red nameplates with white lettering for emergency power equipment.

1.12 Project Record Documents

.1 The Electrical Subcontractor shall be responsible for the production of electrical as-constructed drawings which shall provide a complete and accurate record of the actual electrical installation. The Electrical Subcontractor shall affix his company name and the words "Record Drawings" on the drawings, and sign and date them. Submit hard copy for final review and submission to the City upon completion. Record documents that are incomplete shall be returned to the Contractor for remedial measures.

1.13 Labels and Warning Signs

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

.2 Provide warning signs on equipment, as required, to meet the requirements of the Inspection Authorities, including indication of multiple power sources.

1.14 Equipment Materials and Equipment

.1 Contractor shall submit a Bid based on the specified materials and equipment only.

.2 Contractor may submit, with their Bid, an alternate price based on alternate materials and equipment only if such items have been approved as alternates by the Contract Administrator.

.3 Requests for equals or alternates shall be done in accordance with B7.

1.15 Location of Outlets

.1 Locate outlets as indicated.

.2 Do not install outlets back-to-back in wall; allow minimum 400mm (16") horizontal clearance between boxes.

.3 Drawings are schematic only and do not indicate all architectural or structural elements.

- .4 Change location of outlets at no extra cost or credit, providing distance does not exceed 3m (10' – 0") and information is provided before installation.
 - .5 Locate light switches on latch side of doors, or as indicated on drawings.
 - .6 Vertically align outlets of different systems when shown in close proximity to each other and occurring at different mounting heights, or as indicated on drawings.
 - .7 Coordinate mounting heights and location of all equipment with Architectural, Mechanical and Structural Drawings prior to installation of rough-in boxes.
- 1.16 Mounting
- .1 Mounting height of equipment is from finished floor to centreline of equipment unless specified or indicate otherwise.
 - .2 If mounting height of equipment is not indicated, verify with Contract Administrator before proceeding with installation.
 - .3 Install electrical equipment at the following heights unless indicated or directed otherwise (to middle of outlet).
 - .1 Outlets above counters: 230mm: (9"): splash backs: 230mm (9").
 - .2 General receptacles, telephone and television outlets: 460mm (18").
 - .3 Receptacles in mechanical areas: 1m (40").
 - .4 Switches, dimmers, push buttons: 1070mm (42").
 - .5 Thermostats: 1220mm (48").
 - .6 Heights as above or at bottom of nearest block or brick course.
 - .7 Occupancy sensor as per Manufacturer's instruction.
- 1.17 Protection
- .1 Protect exposed live equipment during construction for personnel safety.
 - .2 Shield and mark live parts "LIVE () VOLTS", 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.
- 1.18 Load Balance
- .1 Measure phase current to panelboards with normal loads operating at time of measurement. Adjust branch circuit connections as required to obtain best balance of current between phases, record changes and add to record drawings.
- 1.19 Conduit Sleeves and Holes
- .1 Install conduit, and sleeves, prior to pouring of concrete. Sleeves through concrete shall be sized for free passage of conduit.
 - .2 Holes through exterior walls and roof shall be flashed and made weatherproof.

- .3 Make necessary arrangements for cutting of chases, drilling of holes and other structural Work required to install electrical conduits, cables, pull boxes and outlet boxes.
- .4 Install cables, conduits, and fittings to be embedded or plastered over, neatly and close to building structure so furring can be kept to minimum.
- 1.20 Fireproofing
 - .1 Where cables or conduits pass through floors, block or concrete walls and fire rated walls, seal openings with fire-stopping material with intumescent properties.
 - .2 Fire proofing of electrical cables, conduits, trays, etc., passing through fire barriers shall conform to local codes and inspection authorities.
 - .3 Fire stop materials shall be asbestos free and have been tested in accordance with ASTM E-84, E-136 and E-814 and UC-1479.
 - .4 Approved Manufacturer:
 - .1 Nelson Firestop Products.
 - .2 Spec Seal.
- 1.21 Insulation Resistance Testing
 - .1 Megger circuits, feeders and equipment up to 350V with a 500V instrument.
 - .2 Megger 350-600V circuits, feeders and equipment with a 1000V instrument.
 - .3 Check resistance to ground before energizing.
- 1.22 Cleaning
 - .1 Do final cleaning in accordance with Section 01 74 00 – Cleaning and Waste Processing.
 - .2 At time of final cleaning, clean lighting reflectors, lenses, and other lighting surfaces that have been exposed to construction dust and dirt.
- 1.23 Delivery Storage and Handlings
 - .1 Deliver all materials to Site in an orderly fashion.
 - .2 Store all materials in a clean and dry place, secure from vandalism or theft. All materials shall be left in shipping containers until required for use.
 - .3 Provide addition protection such as tarps, padding, wood skids, etc., where such is required to ensure protection of equipment.
- 1.24 Coordination with Other Trades
 - .1 Refer to Mechanical, Structural, Architectural and Interior Design drawings and specifications for additional electrical Work in connection with other Divisions. Where such Work is included in other sections of the specifications, provide equipment, conduit, wiring, etc. (in accordance with the Manufacturer's approved shop drawings), as required, for operation of the specified equipment.
 - .2 Coordinate electrical Work with Work of other trades to avoid conflicts with pipes, air ducts or other equipment. Provide additional supports, wiring, etc. to relocate electrical equipment, as required, where structural members, air ducts, piping or other equipment interferes with the electrical installation.
- 1.25 Examination of Site and Construction Documents

- .1 Prior to submitting a bid, examine the Site and local conditions which will affect the Work. Refer to the Architectural, Mechanical and Structural drawings, schedules and specifications for construction details to be certain that the electrical Work can be satisfactorily carried out as specified. Claims for extra payments, resulting from conditions which could reasonably be foreseen during an examination of the documents and/or Site, will not be recognized.
 - .2 Ensure that all equipment designate as “Existing to Remain” or “Existing to be Relocated” is suitable for its intended re-use, including panelboards and circuits. Report any discrepancies to the Contract Administrator BEFORE close of bid opportunity.
 - .3 Refer to Supplemental Conditions for instructions regarding any pre-arranged Site visit during the bidding period.
- 1.26 Cutting and Patching
- .1 Pay the costs of all cutting and patching required for the installation of electrical Work. Payment for cutting and patching shall be made through the Contractor.
 - .2 Obtain the approval of the Contract Administrator before arranging for any cutting. Patching shall restore the affected area to the original condition; materials and methods used for patching shall be in accordance with the requirements of the corresponding Divisions of the specifications.
- 1.27 Workmanship
- .1 Install equipment, conduit and cables in a workmanlike manner to present a neat appearance to the satisfaction of the Contract Administrator. Install conduit and cable runs parallel and perpendicular to building lines in chases, behind furring or above ceilings, where such concealment is possible. In areas where systems shall be exposed, install neatly and group in a tidy appearance.
 - .2 Install equipment and apparatus requiring maintenance, adjustment or eventual replacement, with adequate clearances and accessibility for same.
 - .3 Replace Work unsatisfactorily to the Contract Administrator without extra cost.
- 1.28 Access Doors
- .1 Access doors shall be a minimum #12 gauge prime coat painted bonderized steel. Each shall be complete with a heavy flush frame and anchor, concealed hinges, positive locking screwdriver lock, and mounting and finishing provisions to suit the finish material for which they are supplied. Access doors in fire rated ceilings, walls, partitions, structures, etc. shall be U.L.C. listed and labelled and of a rating to maintain the fire separation integrity.
 - .2 Before commencing installation of electrical Work submit, to the Contract Administrator for approval, a list of required access doors showing the exact sizes and locations of such access doors. Locate access doors in walls and partitions to the Contract Administrator’s approval, and arrange electrical Work to suit. Access doors shall be, wherever possible, of a standard size for all applications. Confirm exact dimensions with the Contract Administrator, prior to ordering.
 - .3 Access doors shall be installed by the Division responsible for the particular type of construction in which access doors are required. Supply the access doors to the Division installing same at the proper time to avoid construction delays.
 - .4 Completed and approved Maintenance Manuals as per Section 26 05 00. 1.6.
 - .5 Completed and approved Record Drawings as per item 26 05 00. 1.12

PART 2 PRODUCTS

2.1 Not Used

 .1 Not used.

PART 3 EXECUTION

3.1 Not Used

 .1 Not used.

PART 1 GENERAL

1.1 References

- .1 CSA C22.2 No.65-1956 (R1965) Wire Connectors.
- .2 EEMAC 1Y-2, 1961 Bushing Stud Connectors and Aluminum Adapters (1200 Ampere Maximum Rating).

PART 2 PRODUCTS

2.1 Materials

- .1 Pressure type wire connectors: with current carrying parts of copper sized to fit copper conductors as required.
- .2 Fixture type splicing connectors: with current carrying parts of copper sized to fit copper conductors 10 AWG or less.
- .3 Clamps or connectors for armoured cable, aluminum sheathed cable, mineral insulated cable, flexible conduit, non-metallic sheathed cable as required.

PART 3 EXECUTION

3.1 Installation

- .1 Remove insulation carefully from ends of conductors and:
 - .1 Install pressure type wire connectors and tighten.
 - .2 Install mechanical pressure type connectors and tighten screws with appropriate compression tool recommended by manufacturer. Installation shall meet secureness tests in accordance with CSA C22.2 No. 65.
 - .3 Install fixture type connectors and tighten. Replace insulating cap.
 - .4 Install bushing stud connectors in accordance with EEMAC 1Y-2.

PART 1 GENERAL

1.1 Related Work

- .1 Common Work Results – Electrical Section 26 05 00
- .2 Conduits, Conduit Fastenings and Conduit Fittings Section 26 05 34
- .3 Fastenings and Support Section 26 05 29

1.2 References

- .1 CSA C22.1-02 – Canadian Electrical Code, Part 1 (19th Edition), Safety Standard for Electrical Installations.
- .2 CSA C22.2 No. 0.3 – Test Methods for Electrical Wires and Cables.
- .3 CSA C22.2 No. 48-M90 (R2000) – Non-metallic Sheathed Cable.
- .4 CSA C22.2 No. 51 Armoured Cables.
- .5 CSA C22.2 No. 52-96 (R2000) – Underground Service-Entrance Cables.
- .6 CAN/CSA C22.2 No. 65-03 (CSA/UL/ANCE) – Wire Connectors.
- .7 CSA C22.2 No. 75-03 (CSA/UL/ANCE) – Thermoplastic-Insulated Wires and Cables.
- .8 CSA C22.2 No. 123 Aluminum Sheathed Cables.
- .9 CSA C22.2 No. 131 Type TECK 90 Cable.
- .10 NECA (National Electrical Contractors Association) – Standard of Installation.

PART 2 PRODUCTS

2.1 Materials

- .1 Conductors in Conduit:
 - .1 Type: RW90
 - .2 Conductors:
 - .1 Solid Copper #10 AWG and smaller.
 - .2 Stranded Copper #8 AWG and larger.
 - .3 Sized as indicated (Minimum #12 AWG).
 - .3 Insulation: Cross link polyethylene (RW90), (RWU90), 90 deg. C.
 - .4 Configuration: Single conductor.
 - .5 Voltage Rating: Minimum 600V.
 - .6 Certification: CSA C22.22 No. 38 or latest revision.
- .2 Armored Cable (BX):
 - .1 Type: AC90.
 - .2 Conductors:
 - .1 Solid Copper #10 AWG and smaller.
 - .2 Stranded Copper #8 AWG and larger.

- .3 Sized as indicated (Minimum #12 AWG).
- .3 Insulation: Cross link polyethylene (RW90), (RWU90), 90 deg. C.
- .4 Configuration: Multi-conductor, as required, c/w a separate bare CU ground wire.
- .5 Voltage Rating: Minimum 600V.
- .6 Certification: CSA C22.22 No. 51 or latest revision.
- .3 Armored Cable (TECK)
 - .1 Type: TECK
 - .2 Conductors:
 - .1 Solid Copper #10 AWG and smaller.
 - .2 Stranded Copper #8 AWG and larger.
 - .3 Sized as indicated (Minimum #12 AWG).
 - .3 Insulation: Cross link polyethylene (RW90), 90 deg. C.
 - .4 Configuration: Multi-conductor, as required, c/w a separate bare CU ground wire.
 - .5 Voltage Rating: 1KV, 5 KV, or 15KV as indicated.
 - .6 Inner Jacket:
 - .1 Black polyvinyl chloride (PVC).
 - .2 Low Flame Spread (LFS).
 - .3 Low Gas Emission (LGE).
 - .7 Armor: Inter-locked aluminum
 - .8 Outer Jacket:
 - .1 Black polyvinyl chloride (PVC), -40 deg. C.
 - .2 Low Flame Spread (LFS).
 - .3 Low Gas Emission (LGE).
 - .9 Flame Rating: FT4
 - .10 Certification: CSA C22.22 No. 131 or latest revision.
- .4 Low Voltage Control Cables
 - .1 Type: LVT.
 - .2 Conductor: Solid Copper #18 AWG.
 - .3 Insulation: Thermoplastic, colour coded.
 - .4 Configuration: single, two conductor – parallel, three or more conductors twisted.
 - .5 Voltage Rating: 30V.
 - .6 Outer Jacket: thermoplastic.
 - .7 Certification: CSA C22.22 No. 35
 - .8 Flame Rating: FT4.

- .5 Pressure type connectors, fixture type splicing connectors, cable clamps and lugs as required.
- .6 RA90 Cables
 - .1 Single conductor RW90 insulation, minimum 600V, -40C.
 - .2 Stranded copper, size as indicated.
 - .3 Liquid and vapour tight corrugated aluminum sheath.
 - .4 Overall PVC jacket rated FT-4.
- .7 Variable Frequency Drive Power Cables
 - .1 For input power wiring to the VFD and for output wiring to the motor, from the VFD.
 - .2 Use cable specifically designed for Variable Frequency Drives.
 - .1 Teck Drive RX cable as manufactured by Alcatel.
 - .2 PVC jacket rated at FT\$.
 - .3 Continuous corrugated impervious aluminum shield.
 - .4 CSA approved to standard C22.2 No. 123-96.
 - .5 Teck Drive RX cables are to be installed in connectors specifically made for use with the Drive RX cables.
 - .6 Terminate the Drive RX cable grounds as per the cable manufacturer's instructions, using ground bushings as directed. The ground connections are to be made at the ground points indicated by the VFD manufacturer. Coordinate with Division 15.
 - .7 Installed as per manufacturer's instructions.

PART 3 EXECUTION

3.1 General

- .1 All branch circuit wiring and conduit shall be installed to minimize voltage drop. Install additional conduit runs as required to take the most direct and shortest route to outlets, light fixtures, etc.

3.2 Installation in Raceways

- .1 Install wiring as follows:
 - .1 In conduit systems in accordance with Section 26 05 00 – Common Work Results – Electrical.
 - .2 In underground ducts in accordance with Section 26 05 44 – Installation of Cables in Trenches and in Ducts.
 - .3 Ensure conduits are dry and free of debris before pulling cables.
 - .4 Colour coding and identification as per the C.E.C.
 - .5 Wires in outlet, junction and switch boxes, not having a connection within box shall not be spliced, but shall continue unbroken through the box.
 - .6 Branch circuits exceeding 21 metres shall be #10 AWG, branch circuits exceeding 35 metres shall be #8 AWG or unless otherwise noted.

3.3 Installation of Single Conductor Cables

- .1 Single conductor cables shall be installed one cable diameter apart on suspended cable tray or channel supports and shall be clamped with aluminum cable clamps. Cables shall be terminated using non-magnetic connectors. Cable armor shall be grounded via an aluminum plate at the supply end and isolated via an insulating plate, at the load end of the cable. A #3/0 AWG bare (unless otherwise noted) copper ground wire shall be installed with each feeder. Cable bending radius shall be at least twelve times the overall cable diameter and bends shall not damage or distort the outer sheath.
- .2 Do not install PVC jacketed cables in circulating air plenums.
- .3 Single conductor cables installed underground shall be installed in the installation configuration outlined in Appendix B of the Canadian Electrical Code to provide the allowable ampacity required for the feeder.

3.4 Installation of Flexible Armoured Cable

- .1 Type AC90 armoured cable (BX) shall be used for connections from conduit systems to recessed luminaries in accessible ceilings. Cable to be of sufficient length to allow the lighting fixture to be relocated to any location within a 1.8M (6') radius. Cable shall be clamped before entering the lighting fixture and shall be clipped before entering the conduit system junction box.

3.5 Installation in Equipment

- .1 Group and lace-in neatly wire and cable installed in switchboards, panelboards, cabinets, wire ways and other such enclosures.

3.6 Terminations

- .1 Terminate wires and cables with appropriate connectors in an approved manner.

3.7 Identification

- .1 Wire in conduit #2 AWG and smaller shall have solid coloured insulation, colour coded as per Canadian Electrical Code.
- .2 Wire in conduit 1/0 AWG and larger and single conductor cables for normal power feeders shall be identified at each outlet box and termination with a 150 mm band of coloured vinyl tape of the appropriate colour. Emergency power feeders shall be provided with an additional 75 mm band of red vinyl tape installed adjacent to the 150 mm band of the coloured phase identification tape, as listed below. Neutral and ground conductors shall be identified. Paint or other means of colouring the insulation shall not be used.
- .3 Identify control conductors in motor control equipment, contactors, etc. with mylar/cloth wire markers.
- .4 Refer to Section 26 05 00 – Common Work Results.

PART 1 GENERAL

1.1 Related Work

- .1 Common Work Results – Electrical Section 26 05 00
- .2 Conduits, Conduit Fastenings and Conduit Fittings Section 26 05 34
- .3 Wires and Cables Section 26 05 21

1.2 References

- .1 CSA C22.1 – Canadian Electrical Code, Part 1 (2015), Safety Standard for Electrical Installations.
- .2 CECA – Canadian Electrical Contractors Association.

PART 2 PRODUCT

2.1 Support Channels

- .1 U shape, size 41 x 41mm, 2.5mm thick, surface mounted, suspended or set in poured concrete walls and ceilings or as required.
 - .1 Manufacturers: B-Line, Burndy, Electrovert, Unistrut, Pilgrim, Pursley.

PART 3 EXECUTION

3.1 Installation

- .1 Secure equipment to solid masonry, tile and plaster surfaces with lead anchors.
- .2 Secure equipment to poured concrete with cast in or expandable inserts.
- .3 Secure equipment to hollow masonry walls or suspended ceilings with toggle bolts.
- .4 Secure surface mounted equipment with twist clip fasteners to inverted T bar ceilings. Ensure that T bars are adequately supported to carry weight of equipment specified before installation. Provide additional support as required.
- .5 Support equipment, conduit or cables using clips, spring loaded bolts, cable clamps designed as accessories to basic channel members.
- .6 Fasten exposed conduit or cables to building construction or support system using straps.
 - .1 One-hole malleable iron straps to secure surface conduits and cables 50mm and smaller.
 - .2 Two-hole steel straps for conduits and cables larger than 50mm.
 - .3 Beam clamps to secure conduit to exposed steel Work.
- .7 Suspended support systems.
 - .1 Support individual cable or conduit runs with 6mm diameter threaded rods and spring clips.
 - .2 Support 2 or more cables or conduits on channels supported by 6mm diameter threaded rod hangers where direct fastening to building construction is impractical.
- .8 For surface mounting of two or more conduits use channels at 1500mm 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 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 Contract Administrator.
- .13 Install fastenings and supports as required for each type of equipment cables and conduits, and in accordance with manufacturer's installation recommendations.
- .14 Threaded rod to be minimum 6mm diameter galvanized or nickel plated. Black steel rod is not acceptable.

PART 1 GENERAL

1.1 Related Work

- .1 Common Work Results – Electrical Section 26 05 00
- .2 Conduits, Conduit Fastenings and Conduit Fittings Section 26 05 34
- .3 Fastenings and Supports Section 26 05 29

1.2 Location

- .1 Locate splitters, junction and pull boxes as indicated or as needed for each system.

PART 2 PRODUCTS

2.1 Splitters

- .1 Sheet metal enclosure, welded corners and formed hinged cover suitable for locking in closed position.
- .2 Main and branch lugs to match required size and number of incoming and outgoing conductors as indicated.
- .3 Minimum three spare terminals on each set of lugs in splitters.
- .4 Explosion proof in hazardous areas to suit the hazardous classification.
- .5 Weatherproof where installed outdoors.
- .6 Enclosures in other areas to suit environment.

2.2 Junction and Pull Boxes

- .1 Welded steel construction with screw-on flat covers for surface mounting.
- .2 Covers with 25mm minimum extension all around, for flush-mounted pull and junction boxes.
- .3 Cast type with gasketed covers where exposed to weather.
- .4 Explosion proof in hazardous areas to suit the hazardous classification.

2.3 Cabinets

- .1 Type E: sheet steel, hinged door and return flange overlapping sides, handle, lock and catch, for surface mounting.
- .2 Type T: sheet steel cabinet, with hinged door, latch, lock, 2 keys, containing 19mm G1S fir plywood backboard. Cabinets to be flush or surface mounted as indicated.
- .3 Provide other systems cabinets as specified and located on drawings.

PART 3 EXECUTION

3.1 Splitter Installation

- .1 Install splitters and mount plumb, true and square to the building lines.
- .2 Extend splitters full length of equipment arrangement except where indicated otherwise.

3.2 Junction, Pull Boxes and Cabinets Installation

- .1 Install pull boxes in inconspicuous but accessible locations.

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- .2 Mount cabinets with top not higher than 2m above finished floor, or as indicated on drawings.
 - .3 Install terminal block as indicated.
 - .4 Install pull boxes so as not to exceed 30m of conduit run between pull boxes.
 - .5 Install junction and pull boxes clear of all mechanical ductwork and piping.
- 3.3 Identification
- .1 Provide equipment identification in accordance with Section 26 05 00 – Common Work Results – Electrical.
 - .2 Identify splitters with size 7 nameplates.
 - .3 Identify junction and pull boxes with size 3 nameplates.
 - .4 Identify cabinets with size 5 nameplates.
- 3.4 Customer Service Termination Enclosure
- .1 Coordinate sleeving with Utility.
 - .2 Coordinate exact location and placement with Utility.
 - .3 Coordinate metering requirements with Utility.

PART 1 GENERAL

1.1 Related Work

- .1 Common Work Results – Electrical Section 26 05 00
- .2 Conduits, Conduit Fastenings and Conduit Fittings Section 26 05 34

1.2 References

- .1 CAN/CSA-C22.2 No. 18 – Outlet Boxes, Conduit Boxes, Fittings and Associated Hardware.
- .2 CSA C22.1 – Canadian Electrical Code, Part 1 (2015), Safety Standard for Electrical Installations.
- .3 CSA C22.2 No. 18.1 (CSA/UL/ANCE) – Metallic Outlet Boxes.
- .4 CSA C22.2 No. 40 – Cut-out, Junction and Pull Boxes.
- .5 CAN/CSA-C22.2 No. 85 – Rigid PVC Boxes and Fittings

PART 2 PRODUCTS

2.1 Outlet and Conduit Boxes General

- .1 Size boxes in accordance with CSA C22.1.
- .2 Sectional boxes shall not be used without specific approval of the Contract Administrator.
- .3 Gang boxes where wiring devices are grouped.
- .4 Blank cover plates for boxes without wiring devices.
- .5 Combination boxes with barriers where outlets for more than one system are grouped.
- .6 In moist or dusty areas, gasketed watertight or dust tight boxes and covers shall be provided.
- .7 Explosion proof in hazardous areas to suit requirements of authorities having jurisdiction.

2.2 Sheet Steel Outlet Boxes

- .1 Electro-galvanized steel device boxes for flush installation, minimum size 102mm square outlet boxes with extension and plaster rings as required.
- .2 Electro-galvanized steel device boxes for flush installation in drywall and minimum size 102mm square outlet boxes with extension and square cornered tile covers as required.
- .3 Electro-galvanized steel utility boxes for outlets connected to surface-mounted EMT conduit, sized as required for the installation.
- .4 102mm square or octagonal outlet boxes for lighting fixture outlets.

2.3 Masonry Boxes

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

2.4 Concrete Boxes

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

- 2.5 Floor Boxes
 - .1 Concrete tight electro-galvanized sheet steel floor boxes with gasket, floor plate, levelling screws and adjustable finishing rings to suit floor finish with brass faceplate. Device mounting plate to accommodate short or long ear duplex receptacles.
- 2.6 Conduit Boxes
 - .1 Cast FS or FD ferrous boxes with factory-threaded hubs and mounting feet for surface wiring of switches and receptacle where exposed to moisture.
- 2.7 Moulded Vapour Barrier Boxes
 - .1 Moulded box vapour barrier: factory moulded polyethylene box complete with flange for use with recessed electric switch and outlet boxes.
- 2.8 Fittings – General
 - .1 Bushing and connectors with nylon insulated throats.
 - .2 Knock-out fillers to prevent entry of debris.
 - .3 Conduit outlet bodies for conduit up to 32mm and pull boxes for larger conduits.
 - .4 Double locknuts and insulated bushings on sheet metal boxes.
- PART 3 EXECUTION**
- 3.1 Installation
 - .1 Support boxes independently of connecting conduits.
 - .2 Fill boxes with paper, sponges or foam or similar approved material to prevent entry of debris during construction. Remove upon completion of Work.
 - .3 For flush installations mount outlets flush with finished wall using plaster rings to permit wall finish to come within 6mm of opening.
 - .4 Provide correct size of openings in boxes for conduit, mineral insulated and armoured cable connections. Reducing washers are not allowed.
 - .5 Maintain continuity of vapor barrier where boxes are installed in exterior walls and ceilings. Use air/vapor barrier boxes for outlets installed in walls or ceilings with a vapor barrier.
 - .6 Boxes to be mounted plumb and square with building lines.
 - .7 Where outlet boxes are shown on the drawings as being “back-to-back” shall have a minimum offset of 200mm (8”) between boxes to reduce sound transmission. In no case shall “thru-wall” boxes be used.
 - .8 Install pull boxes, or fittings, in conduit runs where more than four bends are necessary.
 - .9 Install pull boxes where run exceeds 23.0 (75 feet) in length.
 - .10 All junction, outlets and pull boxes shall be so installed that they are always readily accessible.
 - .11 No power driven pins (Ramset) shall be utilized to secure boxes without specific approval from Contract Administrator.
 - .12 Check opening provided for each recessed outlet box and if it is not completely covered by cover plate, report discrepancy to the division responsible and ensure that it is rectified.

- .13 All concealed junction boxes, conduit fittings, etc., to be complete with galvanized steel covers, secured with two bolts.
- .14 Co-ordinate boxes in masonry with brick or block configuration, boxes to be saw cut in bottom of appropriate brick or block. They shall be of sufficient depth to allow conduit to pass through centre of block.
- .15 Co-ordinate locations with millwork.
- .16 Apply acoustic sealant to and seal wires penetrating moulded vapour barrier boxes.
- .17 Verify exact location of floor boxes with Contract Administrator. Adjust floor boxes level with finished floor.
- .18 Verify exact location of service fittings with furniture drawings and/or Contract Administrator. Service fittings to be installed parallel and perpendicular to building lines.
- .19 No more than two extension rings shall be used in sequence.
- .20 For installations in hazardous areas, meet all requirements of authorities having jurisdiction.
- .21 Locate raised floor outlet boxes in coordination with the City of Winnipeg's furniture. Coordinate as required.

PART 1 GENERAL

1.1 Related Work

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

1.2 Location of Conduit

- .1 Drawings do not indicate all conduit runs. Those indicated are in diagrammatic form only.
- .2 Produce layout sketches of conduit runs through mechanical and electrical service areas in order to pre-avoid any conflict with other construction elements and to determine the most efficient route to run conduit.

1.3 References

- .1 CSA C22.1 – Canadian Electrical Code, Part 1 (2015), Safety Standard for Electrical Installations.
- .2 CAN/CSA-C22.2 No. 18 – Outlet Boxes, Conduit Boxes, Fittings and Associated Hardware.
- .3 CSA C22.2 No. 45 – Rigid Metal Conduit.
- .4 CSA C22.2 No. 45.1 – Rigid Metal Conduit – Steel
- .5 CSA C22.2 No. 56 – Flexible Metal Conduit and Liquid – Tight Flexible Metal Conduit
- .6 CSA C22.2 No. 83.1 (CSA/UL) – Electrical Metallic Tubing – Steel.
- .7 CSA C22.2 No. 211.1 – Rigid Types EB1 and DB2/ES2 PVC Conduit.
- .8 CSA C22.2 No. 211.2 – Rigid PVC (Unplasticized) Conduit.
- .9 CSA C22.2 No. 211.3 (CSA/UL) – Reinforced Thermosetting Resin Conduit (RTRC) on Fittings.
- .10 CSA C22.2 No. 227.1 (CSA/UL) – Electrical Nonmetallic Tubing.
- .11 CSA C22.2 No. 227.2.1 (CSA/UL) Liquid-Tight Flexible Nonmetallic Conduit.
- .12 NFPA 70 – National Electrical Code.

PART 2 PRODUCTS

2.1 Conduits

- .1 Rigid galvanized steel threaded conduit.
- .2 Epoxy coated conduit: with zinc coating and corrosion resistant epoxy finish inside and outside.
- .3 Electrical metallic tubing (EMT): with couplings. Minimum size shall be 13mm.
- .4 Rigid PVC conduit.
- .5 Flexible metal conduit and liquid-tight flexible metal conduit.

2.2 Conduit Fastenings

- .1 One hole steel straps to secure surface conduits 50 mm and smaller. Two-hole steel straps for conduits larger than 50 mm.
- .2 Beam clamps to secure conduits to exposed steel Work.

- .3 U channel type supports for two or more conduits at 1500 mm oc. (Surface mounted or suspended).
- .4 Six mm diameter galvanized threaded rods to support suspended channels.
- 2.3 Conduit Fittings
 - .1 Fittings for raceways: to CSA C22.2 No. 18.
 - .2 Fittings: manufactured for use with conduit specified. Coating: same as conduit.
 - .3 Factory “ells” where 90 deg. bends are required for 25 mm and larger conduits.
 - .4 Steel set screw connectors and couplings. Insulated throat liners on connectors.
 - .5 Raintight connectors and fittings complete with O-rings for use on weatherproof or sprinkler proof enclosures. Raintight couplings to be used for surface conduit installations exposed to moisture or sprinkler heads.
 - .6 Explosion proof in hazardous areas to meet requirements of authorities having jurisdiction.
- 2.4 Expansion Fittings for Rigid Conduit
 - .1 Weatherproof expansion fittings with internal bonding assembly suitable for 100 or 200 mm linear expansion.
 - .2 Watertight expansion fittings with integral bonding jumper suitable for linear expansion and 19 mm deflection in all directions.
 - .3 Weatherproof expansion fittings for linear expansion at entry to panel.
- 2.5 Fish Cord
 - .1 Polypropylene complete with 3m spare length at each conduit end.
- PART 3 EXECUTION**
- 3.1 Installation
 - .1 Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass.
 - .2 Conceal conduits except in mechanical and electrical service rooms.
 - .3 Use rigid galvanized steel threaded conduit where specified.
 - .4 Use epoxy coated conduit in corrosive areas.
 - .5 Use electrical metallic tubing (EMT) except where specified otherwise.
 - .6 Use rigid PVC conduit for underground installations.
 - .7 Use flexible metal conduit for connection to motors in dry areas, connection to recessed incandescent fixtures without a prewired outlet box, connection to surface or recessed fluorescent fixtures, transformers and equipment subject to vibration or movement. Provide a separate insulated grounding conductor within flexible conduit.
 - .8 Use liquid tight flexible metal conduit for connection to motors or vibrating equipment in damp, wet or corrosive locations.
 - .9 Install conduit sealing fittings in hazardous areas, Fill with compound.
 - .10 Conduit stubs from floor slabs where exposed to damage to be rigid galvanized steel.

- .11 The conduit sizes as shown or indicated are the minimum acceptable and shall not be reduced without the approval of the Contract Administrator.
 - .12 Bend conduit cold. Replace conduit if kinked or flattened more than 1/10th of its original diameter.
 - .13 Mechanically bend steel conduit over 19 mm diameter.
 - .14 Field threads on rigid conduit must be of sufficient length to draw conduits up tight.
 - .15 Install fish cord in empty conduits.
 - .16 Run a minimum of 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 case of an exposed concrete slab, terminate each conduit in surface type box.
 - .17 Where conduits become blocked, remove and replace blocked section. Do not use liquids to clean out conduits.
 - .18 Dry conduits out before installing wire.
 - .19 Conduit to be sized as per Canadian Electrical Code or as shown on drawings. Note that the sizes of branch circuit conductors scheduled and/or specified on the drawings are minimum sizes and must be increased as required to suit length of run and voltage drop in accordance with Canadian Electrical Code. Where conductor sizes are increased to suit voltage drop requirements, increase the conduit size to suit.
 - .20 Running threads will not be permitted; proper couplings shall be used.
 - .21 Not less than 900mm (3' – 0") of flexible conduit (and of sufficient length to allow the lighting fixture to be relocated to any location within a 1.8m (6 ft.) radius) shall be used for the connection of recessed lighting fixtures. A separate drop to be used for each fixture unless fixtures are mounted in continuous rows.
 - .22 No circuits fed from emergency or essential power sources shall be run in the same conduit as other systems.
 - .23 Provide separate conduit system for emergency distribution.
 - .24 All conduit runs passing across expansion joints of the building shall be installed utilizing approved expansion fittings, and bonding devices.
 - .25 All conduit systems in hazardous areas to be rigid galvanized steel to meet the requirements of the authorities having jurisdiction.
- 3.2 Surface Conduits
- .1 Run parallel or perpendicular to building lines.
 - .2 Locate conduits behind infrared or gas fired heaters with 1.5 m clearance.
 - .3 Run conduits in flanged portion of structural steel.
 - .4 Group conduits wherever possible on suspended or surface channels.
 - .5 Do not pass conduits through structural members except as indicated.
 - .6 Do not locate conduits less than 150 mm parallel to steam or hot water lines with minimum of 75 mm at crossovers.
 - .7 No power-driven pins (Ramset) shall be utilized to secure any portion of the conduit.
- 3.3 Concealed Conduits

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- .1 Do not install horizontal runs in masonry walls.
 - .2 Do not install conduits in terrazzo or concrete toppings.
- 3.4 Conduits in Cast-in-Place Concrete
- .1 Except with the approval of the Contract Administrator, all conduit runs embedded in concrete shall not be larger in outside diameter than one quarter (1/4) the thickness of the slab, wall, or beam in which they are embedded, nor shall they be spaced closer than three diameters on centre, nor so located as to impair unduly the strength of the construction. Where installed in columns, the conduit shall be placed in the centre of the column and then offset to the outlet box. In no case, shall the conduits be placed so that there is less than 25 mm of concrete covering. All conduit runs in concrete shall be inspected and approved by Contract Administrator or his representative before concrete is poured. Conduit shall not be embedded in floating concrete slab construction unless specifically indicated otherwise.
 - .2 Protect conduits from damage where they stub out of concrete.
 - .3 Install sleeves where conduits pass through slab or wall.
 - .4 Where conduits pass through waterproof membrane provide oversized sleeve before membrane is installed. Use cold mastic between sleeve and conduit.
 - .5 Organize conduits in slab to minimize cross-overs.
- 3.5 Conduits Underground
- .1 Slope conduits to provide drainage.

PART 1 GENERAL

- 1.1 Related Work
 - .1 Cast-in-Place Concrete Section 03 30 00
 - .2 Common Work Results – Electrical Section 26 05 00
 - .3 Direct Buried Underground Cable Ducts Section 26 05 45
 - .4 Conduits, Conduit Fastenings and Conduit Fittings Section 26 05 34
 - .5 Wires and Cables Section 26 05 21

PART 2 PRODUCTS

- 2.1 Cable Protection
 - .1 38 x 140 mm planks pressure treated with coloured, naphthenate or 5% pentachlorophenol solution, water repellent preservative.
- 2.2 Markers
 - .1 Concrete type cable markers: 600 x 600 x 100 mm with words: “cable”, “joint” or “conduit” and name of electrical system impressed in top surface, with arrows to indicate change in direction of cable and duct runs.

PART 3 EXECUTION

- 3.1 Direct Burial of Cables
 - .1 After sand bed specified in Section 31 23 16 – Excavating, Trenching and Backfilling, is in place, lay cables maintaining 75 mm clearance from each side of trench to nearest cable. Do not pull cable into trench.
 - .2 Provide offsets for thermal action and minor earth movements. Offset cables 150 mm for each 60 m run, maintaining minimum cable separation and bending radius requirements.
 - .3 Underground cable splices not acceptable.
 - .4 Minimum permitted radius at cable bends for rubber, plastic or lead covered cables, 8 times diameter of cable; for metallic armoured cables, 12 times diameter of cables or in accordance with manufacturer’s instructions.
 - .5 Maintain 150mm minimum separation between cables of different circuits. Maintain 300 mm horizontal separation between low and high voltage cables. When low voltage cables cross high voltage cables maintain 300 mm vertical separation with low voltage cables in upper position. At crossover, maintain 75mm minimum vertical separation between low voltage cables and 150mm between high voltage cables. Maintain 300mm minimum lateral and vertical separation for fire alarm and control cables when crossing other cables, with fire alarm and control cables in upper position. Install treated planks on lower cables 0.6 m in each direction at crossings.
 - .6 After sand protective cover specified is in place, install continuous row of overlapping 38 x 140 mm pressure treated planks as indicated to cover length of run.
- 3.2 Markers
 - .1 Mark cable every 150 m along cable runs and changes in direction.
 - .2 Mark underground splices.

- .3 Where markers are removed to permit installation of additional cables, reinstall existing markers.
- 3.3 Field Quality Control
- .1 Perform tests in accordance with Section 26 05 00 – Common Work Results – Electrical.
 - .2 Perform tests using qualified personnel. Provide necessary instruments and equipment.
 - .3 Check each feeder for continuity, short circuits and grounds. Ensure resistance to ground of circuits is not less than 50 megohms.
 - .4 Pre-acceptance Tests:
 - .1 After installing cable but before terminating, perform insulation resistance test with 1000 V megger on each phase conductor. For mineral insulated (M.I.) cable co-ordinate megger voltage rating with manufacturer.
 - .2 Check insulation resistance after each termination to ensure that cable system is ready for acceptance testing.
 - .5 Acceptance Tests:
 - .1 Ensure that terminations and accessory equipment are disconnected.
 - .2 Ground shields, ground wires, metallic armour and conductors not under test.
 - .3 High Potential (Hipot) Testing.
 - .1 Conduct hipot testing at 100% of original factory test voltage in accordance with IPCEA recommendations.
 - .4 Leakage Current Testing.
 - .1 Raise voltage in steps from zero to maximum values as specified by IPCEA for type of cable being tested.
 - .2 Hold maximum voltage for specified time period by IPCEA.
 - .3 Record leakage current at each step.
 - .6 Provide Contract Administrator with list of test results showing location at which each test was made, circuit tested and result of each test and include copies in Maintenance Manuals.
 - .7 Remove and replace entire length of cable if cable fails to meet any of test criteria.

PART 1 GENERAL

1.1 Related Work

.1 Common Work Results – Electrical Section 26 05 00

.2 Wire and Cables Section 26 05 21

PART 2 PRODUCTS

2.1 PVC Ducts and Fittings

.1 Rigid PVC ducts for direct burial: with expanded flange ends, with minimum wall thickness at any point of 3.0mm. Nominal length: 3m plus or minus 12mm.

.2 Rigid PVC split ducts.

.3 Rigid PVC couplings, reducers, bell and fittings, plugs, caps, adaptors as required to make complete installation.

.4 Rigid PVC 90 degree and 45 degree bends as required.

.5 Rigid PVC 5 degree angle couplings as required.

.6 Expansion joints every 100m and as required.

2.2 Solvent Weld Compound

.1 Solvent weld compound for PVC duct joints.

2.3 Fibreglass Ducts

.1 Fibreglass reinforced epoxy underground cable duct: watertight self-extinguishing type.

.2 Couplings, reducers, plugs, caps, adaptors, and supports as required to make a complete installation.

.3 Expansion joints every 100m and as required.

2.4 Plastic Polyethylene Pipe

.1 Flexible plastic polyethylene pipe with approved couplings and fittings required to make a complete installation.

2.5 Cable Pulling Equipment

.1 6mm stranded nylon pull rope tensile strength 5 kN.

2.6 Markers

.1 Concrete type cable markers: as indicated, with words: "cable", "joint" or "conduit" and name of electrical system impressed in top surface, with arrows to indicate change in direction of duct runs.

PART 3 EXECUTION

3.1 Installation

.1 Install duct in accordance with manufacturer's instructions.

.2 Clean inside of ducts before laying.

.3 Ensure full, even support every 1.5m throughout duct length.

.4 Slope ducts with 1 to 400 minimum slope.

- .5 During construction, cap ends of ducts to prevent entrance of foreign materials.
- .6 Pull through each duct wooden mandrel not less than 300mm long and of diameter 6mm less than internal diameter of duct, followed by stiff bristle brush to remove sand, earth and other foreign matter. Pull stiff bristle brush through each duct immediately before pulling-in cables.
- .7 In each duct install pull rope continuous throughout each duct run with 3m spare rope at each end.
- .8 Install markers as required.
- .9 Clearly show locations on Record Drawings complete with dimensions from building, curbs, property lines, etc.

PART 1 GENERAL

1.1 Related Work

- .1 Common Work Results - Mechanical Section 23 05 00
- .2 Common Work Results – Electrical Section 26 05 00
- .3 Conduits, Conduit Fastenings and Conduit Fittings Section 26 05 34
- .4 Wires and Cables Section 26 05 21
- .5 Outlet Boxes, Conduit Boxes and Fittings Section 26 05 32
- .6 Wiring Devices Section 26 27 26

1.2 System Description

- .1 Make all required electrical connections to devices, equipment, appliances, etc. furnished by other trades or the City of Winnipeg, as indicated or implied on the drawings or in the specifications.
- .2 Provide and install miscellaneous electrical components where required.

1.3 Coordination

- .1 Verify electrical supply characteristics of all equipment prior to rough-in. Report any discrepancies immediately. Revise wire sizing, device type, connection type, breaker size, etc., as required, to accommodate the electrical supply characteristics of the equipment supplied by other trades.

PART 2 PRODUCTS

2.1 General

- .1 Provide all required electrical devices, components, conduits, fittings, wiring, disconnects, and miscellaneous equipment to make all connections to equipment.
- .2 Be familiar with the apparatus being supplied and carefully coordinate and cooperate with the supplier/installer to ensure a proper and complete installation.

2.2 Receptacles

- .1 Where equipment has line cord and plug, ensure cap is compatible with receptacle. Provide cord sets to equipment where required.

2.3 Pushbutton/Buzzers

- .1 Provide weatherproof pushbuttons where shown.
- .2 Provide buzzers where shown.
- .3 Provide 120/24V AC transformer where required.

PART 3 EXECUTION

3.1 Equipment Supplied by Other Trades

- .1 Wire and connect all equipment requiring an electrical connection. Install disconnect switches where required.
- .2 Provide a direct connection or receptacle and cord set to suit hook-up requirements of each piece of equipment. Confirm connection method with Contract Administrator.

PART 1 GENERAL

1.1 Related Work

- .1 Common Work Results – Electrical Section 26 05 00
- .2 Conduits, Conduit Fastenings and Conduit Fittings Section 26 05 34
- .3 Wires and Cables Section 26 05 21
- .4 Outlet Boxes, Conduit Boxes and Fittings Section 26 05 32
- .5 Motor and Disconnects Section 26 29 11

1.2 System Description

- .1 Provide complete electrical power and control connections for mechanical equipment, except as noted herein.

PART 2 PRODUCTS

2.1 Materials

- .1 Include motor starters, disconnects, thermostats, dehumidistats, actuators, conduit, wire, fittings, interlocks, outlet boxes, junction boxes, and all associated equipment required to provide power wiring for mechanical equipment, unless otherwise indicated.
- .2 Include pushbutton stations, motor protective switches, interlocks, conduit, wire, devices and fittings required to provide control wiring for mechanical equipment except for temperature/humidity control systems.
- .3 Unless otherwise noted, motors and control devices shall be supplied by Division 23. Motor voltage, horsepower rating and phase ratings shall be as shown on the Division 26 drawings.

2.2 Exterior Equipment

- .1 All equipment mounted on the exterior of the building shall be weatherproof.

PART 3 EXECUTION

3.1 Power Wiring

- .1 Install power feeders, starters, disconnects and associated equipment and make connections to all mechanical equipment.
- .2 Install branch circuit wiring for mechanical systems control panels, time clocks and control transformers.
- .3 Install main power feeders to starter/control panels furnished by Division 23. Install branch circuit wiring for motors, electric coils, etc.

3.2 Controls

- .1 Wire and connect remote thermostats, dehumidistats, control panels, P/E switches, etc. for furnaces, condensing units, force flows, heat recovery ventilators, electric heaters.
- .2 Wire and connect float switches, pressure switches, alternators, alarms, etc. for sump pumps, sewage pumps, domestic hot water recirculating pumps, booster pumps, jockey pumps and compressors.
- .3 Wire and connect control transformers, sensors, solenoids for auto-flush urinals, electronic faucets and wash basins.

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- .4 Install, wire and connect controls which are an integral part of any packaged unit and are supplied by the trade supplying the packaged unit. Include wiring for controls for such items as air handling units, exhaust ventilators, heat recovery ventilators (HRV), etc.
 - .5 Wire and connect electrical interlocks for starters supplied by Division 26.
 - .6 Division 26 shall supply and install all conduit, wire, and fittings required to connect control systems. Control wiring shall be installed in conduit.
 - .7 Wire and connect thermistor control devices, built-in to large motors, to motor starters as per wiring diagrams provided by Division 23.
- 3.3 Coordination
- .1 Refer to mechanical drawings for the exact location of motor control devices, and other mechanical equipment requiring an electrical connection.
 - .2 Obtain full information from Division 23, regarding wiring, controls, overload heaters, equipment ratings and overcurrent protection. Notify the Division 23 subcontractor, at once, if any information provided is incorrect or unsatisfactory.
 - .3 Coordinate control wiring requirements with Division 25 and provide all control wiring and connections as required to make the control systems operate as specified.
 - .4 Refer to Division 23 specifications for any further electrical requirements.
- 3.4 Shop Drawing Review
- .1 Review Division 23 equipment shop drawings and adjust breaker/feeder sizes as required.

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- PART 1 GENERAL**
- 1.1 Related Work
- .1 Common Work Results – Electrical Section 26 05 00
 - .2 Fastenings and Supports Section 26 05 29
 - .3 Outlet Boxes, Conduit Boxes and Fittings Section 26 05 32
- 1.2 Submittals
- .1 Submit shop drawings and product data in accordance with Section 26 05 00.
 - .2 Submit complete photometric data prepared by independent testing laboratory for luminaires where specified for approval by Contract Administrator.
 - .3 Submit list of replacement lamp data for each luminaire. Include lamp type, voltage, wattage, base type and order code. Include list in maintenance manual.
- 1.3 Guarantee
- .1 Replace:
 - .1 LED, drivers, incandescent and tungsten halogen lamps burnt out within 3 months of takeover.
 - .2 LED, drivers, fluorescent and HID lamps burning out within 12 months of takeover.
 - .3 Applicable drivers and ballasts that fail or exceed their labelled noise level rating within 12 months of takeover.
- 1.4 Coordination
- .1 Coordinate luminaire locations with Work of other trades.
 - .2 Coordinate luminaire types with ceiling finishes to ensure compatibility.
- 1.5 General
- .1 Luminaires shall carry the CSA label.
 - .2 Provide supporting devices, plaster frames, junction boxes and outlet boxes where required.
 - .3 Provide lenses or diffusers of glass or acrylic materials as indicated. Acrylic lenses used with LED and fluorescent luminaires shall be a minimum of .125" (3mm) thick.
 - .4 Where soffits or ceilings have thermal insulation, provide fixtures which are CSA approved for such use.
 - .5 Conduct lamp burn in procedures as per manufacturer's recommendations.
- 1.6 Lamps
- .1 Provide lamps as indicated.
- 1.7 Installation (Luminaires)
- .1 Install luminaires at locations indicated, complete with all wiring, connections, fittings, hangers, aligners, box covers and accessories, as required.
 - .2 Install luminaires and lens materials in architectural details, as indicated.

- .3 Install luminaries parallel with building lines. Wall-mounted luminaries shall be installed plumb.
 - .4 Review all ceiling type, construction details and mounting arrangements before placing luminaire orders and ensure that all mounting assemblies, frames, rings and similar features are included for and match the required installation.
 - .5 All luminaries and assemblies shall be properly secured and supported. Support luminaries independent of the ceiling construction, complete with all fasteners, framing and hangers, as may be required. Do not secure luminaries to mechanical ductwork or other vibration producing apparatus, unless specifically detailed on the drawings.
 - .6 Where a luminaire is suspended from the ceiling using a self-aligning box cover, an additional ground wire from the outlet box to the luminaire shall be provided.
 - .7 Coordinate the installation of luminaries with the Work of other trades, ensuring that the necessary depths and mounting spaces are provided. Luminaires which cannot be installed due to a conflict with structural members, pipes or ductwork shall be relocated to a more suitable location, as directed by the Contract Administrator.
- 1.8 Wiring
- .1 Connect luminaries to lighting circuits as indicated.
- 1.9 Lamps
- .1 Adjust lamp position in adjustable lamp holder-type luminaries to produce the proper beam distribution for the specified lamp.
- 1.10 Tests
- .1 Perform tests in accordance with Section 26 05 00
 - .2 Check luminaries and replace defective lamps, drivers, ballasts, lenses and accessories.
- 1.11 Cleaning
- .1 Prior to take-over of the project, clean the lenses and reflectors of all luminaries with a damp cloth to remove dust, smudges and fingerprints.

PART 1 GENERAL

- 1.1 Scope
 - .1 Furnish and install panels with arrangement as shown on drawings. The distribution shall be indoor with the following major components:
 - .1 **Transformers**
 - .2 MDP
 - .3 Panelboards
 - .4 Main breakers
- 1.2 Codes and Standards
 - .1 The components and accessories shall conform to the requirements of:
 - .1 CSA C22.1 – Canadian Electric Code
 - .2 NFPA 110 – Emergency and Standby Power Systems
 - .3 IEEE Standard 446 – IEEE Recommended Practice for Emergency and Standby Power Systems for Commercial and Industrial Applications
 - .4 CSA C22.2 No. 29 Enclosed Panels
 - .5 International Standards Organization ISO 9001: 2000

PART 2 PRODUCTS

- 2.1 Main Breaker
 - .1 The main breaker shall be rated as shown on drawings.
 - .2 The breaker shall be suitable for bottom cable connection without inverting the breaker.
- 2.2 MDP Panel
 - .1 Rated 600A 347/600V, 3-phase, 4wire
 - .2 Copper bus
 - .3 Minimum 5 circuit with at least 2 – future spaces for 100A, 120/208V, 3-phase, 4wire.
 - .4 The MDP shall be installed as an integral part of the Service Entrance panelboard
- 2.3 Service Representation
 - .1 The manufacturer shall maintain a Winnipeg based service organization of company-employed personnel. The service center's personnel must be factory trained and must be ready to provide electrical service 24 hours a day, 365 days a year.
- 2.4 Acceptable Manufacturers
 - .1 The distribution shall be as build by J.R. Stephenson Mfg. Ltd
 - .2 Any requests for alternates shall be submitted to the Contract Administrator in writing at least 10 days prior to closing of the bid. Each alternate request must list details of all comparable features and any deviations from this specification.

PART 1	GENERAL	
1.1	Related Work	
.1	Common Work Results – Electrical	Section 26 05 00
.2	Conduits, Conduit Fastenings and Conduit Fittings	Section 26 05 34
.3	Circuit Breakers	Section 26 28 21
1.2	Submittals	
.1	Submit shop drawings in accordance with Section 26 05 00 – Common Work Results – Electrical.	
.2	Drawings shall include electrical detail of panel, branch breaker type, quantity, ampacity and enclosure dimension.	
1.3	Plant Assembly	
.1	Install circuit breakers in panelboards before shipment.	
.2	In addition to CSA requirements, manufacturer's nameplate shall show fault current that panel, including breakers, has been built to withstand.	
1.4	Panelboards	
.1	Panelboards: to CSA C22.2 No. 29-M1989.	
.2	Panelboards shall be product of one manufacturer throughout project.	
.3	Each breaker shall be identified by permanent number identification as to circuit number.	
.4	Panelboards: mains, number of circuits, and number and size of branch circuit breakers as indicated.	
.5	Two keys for each panelboard and key panelboards alike.	
.6	Copper bus with full size neutral.	
.7	Flush or surface-mounted tubs as shown.	
.8	Finish trim and door baked grey enamel.	
1.5	Breakers	
.1	Breakers to Section 26 28 21.	
.2	Breakers with thermal magnetic tripping in panelboards, except as indicated otherwise.	
.3	Main breaker: mounted on top or bottom of panel to suit cable entry.	
.4	Lock-on devices for 5% of 15A branch breakers installed as indicated. Turn over unused lock-on devices to the City.	
1.6	Equipment Identification	
.1	Size 4 nameplate for each panelboard and MDP to indicate panel designation and voltage.	
.2	Size 3 nameplate for each breaker in MDP panelboards engraved to indicate load being supplied.	

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- .3 Complete circuit directory with typewritten legend showing room number and load of each circuit.
- 1.7 Manufacturers
- .1 Acceptable manufacturers: Eaton, CGE, Cutler-Hammer, Schneider Canada, Siemens or JRS.
- 1.8 Installation
- .1 Locate panelboards as indicated and mount securely, plumb, true and square, to adjoining surfaces.
 - .2 Install surface-mounted panelboards on U-channels. Where practical, group panelboards on common length of U-channel.
 - .3 Mount panelboards to height indicated in Section 26 05 00, unless otherwise indicated.
 - .4 Connect loads to circuits as indicated.
 - .5 Install spare conduits from recessed panelboards in accordance with Section 26 05 34.
 - .6 Connect isolated ground bus in panelboards to main building grounds source or distribution secondary neutral with #2/0 AWG, green insulated ground wire, in conduit.
 - .7 Mount panelboard such that the top is 6'-0" (1.83m) finished floor.

PART 1 - GENERAL

- 1.1 Related Work Specified Elsewhere
 - .1 Common Work Results - Electrical Section 26 05 00
 - .2 Outlet Boxes, Conduit Boxes and Fittings Section 26 05 32
- 1.2 Submittals
 - .1 Submit shop drawings and product data in accordance with Section 26 05 00 – Common Work Results - Electrical.
- 1.3 References
 - .1 CSA C22.1 – Canadian Electrical Code, Part 1 (2015), Safety Standard for Electrical Installations.
 - .2 CSA C22.2 No. 42 – General Use Receptacles, Attachment Plugs and Similar Devices.
 - .3 CSA C22.2 No. 42.1 – Cover Plates for Flush-Mounted Wiring Devices (Bi-National standard, with UL 5154D).
 - .4 CSA C22.2 No. 55 – Special Use Switches.
 - .5 CSA C22.2 No. 111 – General-Use Snap Switches (Bi-National standard, with UL 20, twelfth edition).
 - .6 C22.2 No. 184 – Solid State Lighting Controls.
 - .7 C22.2 No. 184.1 – Solid-State Dimming Controls (Bi-National standard with UL 1472).

PART 2 - PRODUCTS

- 1.1 Switches
 - .1 Toggle operated general purpose AC Switches 15A and 20A 120Vac and 240Vac single pole, double pole, three-way and four-way switches as indicated, with the following features:
 - .1 Terminal holes approved for No. 10 AWG wire.
 - .2 Silver alloy contacts.
 - .3 Urea molding.
 - .4 Suitable for back and side wiring.
 - .5 Fully rated for tungsten filament and fluorescent lamps, and up to 80% of rated capacity of motor loads.
 - .2 Switches of one manufacturer throughout project.
 - .3 Switches to be premium specification grade.
 - .4 Acceptable manufacturers:

<u>Manufacturer</u>	<u>120 Volt</u>
Hubbell	1200 Series
Bryant	4800 Series
Leviton	1200 Series
Pass & Seymour	AG-1 Series

- | | | |
|--|---------------|---------------|
| | Smith & Stone | 4-4800 Series |
| | Slater | 710 Series |
- 1.2 Receptacles
- .1 Duplex receptacles, CSA type 5-15 R, 125 VAC, 15 A, U ground, with following features:
 - .1 Suitable for No. 10 AWG for back and side wiring.
 - .2 Break-off links for use as split receptacles.
 - .3 Double wipe contacts and riveted grounding contacts.
 - .2 Single receptacles CSA type 5-15 R, 125 VAC, 15 A, U ground with following features:
 - .1 Suitable for No. 10 AWG for back and side wiring.
 - .3 Receptacles to be orange face isolated ground type where indicated. Provide a separate insulated ground wire and a separate neutral for each isolated ground circuit.
 - .4 Receptacles of one manufacturer throughout project.
 - .5 Acceptable manufacturers: Hubbell, Arrow Hart, Bryant, Pass & Seymour, Slater. Catalogue No. 5262 for all manufacturers.
 - .6 Acceptable manufacturers for ground fault receptacles shall be:
 - .1 Arrow Hart - GF 5242
 - .2 Bryant - GFR 52FT
 - .3 Hubbell - GF 5252
 - .4 Pass & Seymour - 1591-R
 - .7 Duplex safety receptacles in public waiting areas and public lounges shall be Hubbell #SG-62.
- 1.3 Special Wiring Devices
- .1 Special wiring devices: as indicated on drawings.
 - .2 Pushbutton stations to be flush or surface mounted as required. Units to be complete with up/down or start/stop buttons, as required, and green pilot light.
 - .3 Range outlets to be NEMA #14-50, 125/250V, 50 Amp., black, c/w cord set.
- 1.4 LED Lighting Dimmer Controls
- .1 Dimmer control devices to have a calibrated linear slide control lever from 0% to 100%. A separate ON/OFF switch or the bottom position of slider to have a positive OFF switch to turn off current flow to lamps.
 - .2 Dimmers shall be rated at 1500, 1000 or 600 watts as required by connected load plus 20% spare capacity.
 - .3 Colour of dimmer snap-on cover to be as selected by the Contract Administrator or as indicated on the drawings.
 - .4 Provide a separate neutral wire for each dimmer circuit.
 - .5 Approved Manufacturers
 - .1 Acuity Controls

- .2 Lutron
- .3 Leviton
- 1.5 Cover Plates
 - .1 Cover plates from one manufacturer throughout project.
 - .2 Stainless steel cover plates for wiring devices mounted in flush-mounted outlet boxes to be minimum plate thickness of 1.0mm.
 - .3 Sheet steel utility box cover for wiring devices installed in surface-mounted utility boxes.
 - .4 Cast casketed cover plates for wiring devices mounted in surface-mounted FS or FD type conduit boxes.
 - .5 Weatherproof double lift spring-loaded cast aluminum cover plates, complete with gaskets for duplex receptacles as indicated.
 - .6 Weatherproof cover plates complete with gaskets for single receptacles or switches as indicated.

PART 3 - EXECUTION

- 3.1 Installation
 - .1 Switches:
 - .1 Install single throw switches with handle in "UP" position when switch closed.
 - .2 Install switches in gang type outlet box when more than one switch is required in one location.
 - .3 Mount toggle switches at height specified in Section 26 05 00 or as indicated.
 - .4 Where pilot lights are required, or shown on the drawings, install flush neon pilots in outlet box grouped with associated switch.
 - .5 Study the Architectural plans and co-operate with other trades so that the location and elevation of switch outlets shall not necessitate any unnecessary cutting of dados, tile, fittings, etc. If this is not done, this Contractor will be required to move these outlets at no additional cost to the Contract. Properly locate all switches with reference to door swing, regardless of indicated position or door swing shown on electrical drawings.
 - .6 Where finished construction of walls consists of a symmetrical pattern of finish materials, install wall switches where directed by the Contract Administrator.
 - .2 Receptacles:
 - .1 Install receptacles in gang type outlet box when more than one receptacle is required in one location.
 - .2 Mount receptacles horizontally at height specified in Section 26 05 00 – Common Work Results - Electrical or as indicated.
 - .3 Install cord sets on ranges and dryers.
 - .4 Where switch and convenience outlets are shown close to one another, mount receptacles below and in line with the switch.
 - .5 Where finished construction of walls consists of a symmetrical pattern of wood or other panels, install and locate receptacles and switches as directed to suit the pattern.

- .6 Suitably ground all receptacles with #12 green insulated wire to outlet box.
- .3 Coverplates:
 - .1 Install suitable common cover plates where wiring devices are ganged.
 - .2 Do not use cover plates intended for flush outlet boxes on surface-mounted boxes.
 - .3 Provide a coverplate on each outlet.
- 3.2 Identification
 - .1 Identify receptacles with size 1 nameplate indicating panel and circuit number. Nameplates to be mechanically fastened. Refer to Section 26 05 00 – Common Work Results - Electrical.

PART 1 GENERAL

- 1.1 Related Work
 - .1 Common Work Results – Electrical Section 26 05 00
 - .2 Panelboards Section 26 24 17
- 1.2 Submittals
 - .1 Submit product data in accordance with Section 26 05 00.
 - .2 Include with requests for equal, time-current characteristics curves for breakers with ampacity of 800A and over, or with interrupting capacity of 18,000 symmetrical RMS and over at system voltage.
- 1.3 Breakers – General
 - .1 Bolt-on molded case circuit breaker, quick-make, quick-break type, for manual and automatic operation with temperature compensation for 40°C (104°F) ambient.
 - .2 Common-trip breakers with single handle for multi-pole applications.
 - .3 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 3-10 times current rating.
- 1.4 Thermal Magnetic Breakers
 - .1 Molded case circuit breaker shall operate automatically by means of thermal and magnetic tripping devices to provide inverse time current tripping under overload conditions and instantaneous magnetic tripping for short circuit protection.
- 1.5 Ground Fault Circuit Interrupters
 - .1 Molded case circuit breakers as above with integral Class A Group 1 ground fault interrupter.
- 1.6 Manufacturers
 - .1 Acceptable manufacturers: Eaton, CGE, Cutler-Hammer, Schneider Canada, Seimens.
- 1.7 Installation
 - .1 Install circuit breakers as indicated.

PART 1 GENERAL

- 1.1 Related Work
 - .1 Common Work Results – Electrical Section 26 05 00
 - .2 Mechanical Equipment Connections Section 26 05 47
- 1.2 Submittals
 - .1 Submit product data in accordance with Section 26 05 00.
- 1.3 Equipment
 - .1 Fusible and non-fusible disconnect switches in EEMAC '1' enclosure for interior applications, and EEMAC '3' enclosure for exterior applications, unless otherwise indicated.
 - .2 Provision for padlocking in "ON-OFF" position.
 - .3 Mechanically interlocked door to prevent opening when handle in "ON" position.
 - .4 Fuse holders in each switch suitable without adaptors, for type of fuse, as indicated.
 - .5 Quick-make, quick-break action.
 - .6 "ON-OFF" switch position indication on switch enclosure cover.
 - .7 Single-phase motor disconnect switches shall be one or two-pole toggle-type, 20 amp, 120/227V AC, brown handle with side and back wiring complete with pilot light.
- 1.4 Equipment Identification
 - .1 Indicate name of load controlled on Size 4 nameplate to Section 26 05 00.
- 1.5 Manufacturers
 - .1 Acceptable manufacturers: Eaton, CGE, Cutler-Hammer, Square D, Siemens.
- 1.6 Installation
 - .1 Install motor disconnect switches where indicated.
 - .2 Install fused circuit disconnect switches where indicated or where required by the inspection authorities and/or for equipment supplied by other trades.