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DIVISION 16

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ELECTRICAL GENERAL REQUIREMENTS

1. GENERAL

1.1 Work Included

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

1.2 Related Work

.1 General Requirements: Division 1

.2 Equipment: Division 11

.3 Instrumentation and Controls: Division 17

1.3 Drawings and Specifications

.1 The General Conditions, Supplementary Conditions and Division 1 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 Contract Administrator for clarification before submitting Bid in accordance with B5 Enquiries.

.7 Responsibility to determine which Division provides various products and Work rests with the Contractor. Additional compensation will not be considered because of differences in interpretation of Specifications.

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 Contract Administrator.

.2 Standard 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.

1.5 Submittals

.1 Within 30 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 Division 16.

.3 Prior to delivery of any products to Site and sufficiently in advance of requirements to allow ample time for checking, submit Shop Drawings for review as specified in Division 1. Submit Shop Drawings for all equipment as required in each Section of this Specification.

.4 Prior to submitting the Shop Drawings to the Contract Administrator, the Contractor shall review the Shop Drawings to determine that the equipment complies with the requirements of the Specifications and Drawings.

.5 Shop Drawings shall 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.

.6 Adjustments made on Shop Drawings by the Contract Administrator are not intended to change the Contract price. If adjustments affect the value of the Work, state such in writing to the Contract Administrator prior to proceeding with the Work.

.7 Manufacture of products shall conform to revised Shop Drawings.

.8 Keep one (1) complete set of Shop Drawings at jobsite during construction.

1.6 As-Constructed Drawings

.1 The Contractor shall keep one (1) complete set of white prints at the Site office, including all addenda, change orders, field instructions, clarifications, and revisions for the purpose of As-Constructed Drawings. As the Work on-site proceeds, the Contractor shall clearly record in red pencil all As-Constructed conditions which deviate from the original Contract Documents. As-Constructed Drawings to include circuiting of all devices, conduit and feeder runs (complete with conductor size and number), and locations of all electrical equipment.

.2 Prior to Substantial Performance, the Contractor shall obtain CAD files of all electrical Drawings, using the latest AutoCAD release, and use the services of a competent CAD operator to transfer all As-Constructed information, including: addenda, change orders, clarifications, revisions, Site instructions and Shop Drawings. Upon completion, the Contractor shall certify, in writing, that the As-Constructed Drawings are complete and that they accurately indicate all electrical services, including exposed as well as concealed items.

.3 On completion of the Work, two weeks prior to the final inspection, submit As-Constructed Drawings to the Contract Administrator for review.

.4 Within one month after return of the As-Constructed Drawing by the Contract Administrator, obtain and pay for a complete set of original reproductive sepias. Transfer all changes from the As-Constructed Drawings to electronic drawings (AutoCAD) and certify accuracy. Deliver Electronic Drawings to the Contract Administrator.

1.7 Operation and Maintenance Manuals

.1 All maintenance data shall be submitted in an electronic format in accordance with the requirements of Division 1.

.2 Each section of the manual shall contain the following information:

.1 Systems Descriptions. A brief synopsis of each system typed and inserted at the beginning of each section. Include sketches and diagrams where appropriate.

.2 Descriptive and technical data.

.3 Maintenance and operating instructions for all electrical equipment and controls. (These operating instructions need not be manufacturer's data but may be typewritten instructions in simple language to guide the City in the proper operation and maintenance of his installation.)

.4 Lubricating and servicing intervals recommended.

.5 A copy of all wiring diagrams complete with wire coding.

.6 List of spare parts of all electrical equipment complete with names and addresses of sales, service representatives and suppliers.

.7 Copy of test data

.8 Include type and accuracy of instruments used to obtain test data.

.9 Copy of final inspection certificate.

.10 Copy of the purchase order, showing equipment make and model numbers issued to the manufacturer complete with all addenda. All cost details may be hidden.

.11 Copy of all warranty certificates.

.12 Set of final reviewed Shop Drawings.

.13 Names, addresses, phone numbers, and facsimile numbers of Contractor, Consultants, sub-contractors, and suppliers used on the Work together with a specification reference of the portion of the Work they undertook.

1.8 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 City and to the approval of the Contract Administrator.

.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.

1.9 Guarantee

.1 Furnish a written guarantee to the City prior to final Contract payment, which will be in effect for one year from the date of final acceptance of the complete Work. Replace or repair at no cost to the City any defective material or workmanship except where, in the opinion of the Contract Administrator, such defects are due to the misuse or neglect by the City.

.2 This general guarantee shall not act as a waiver of any specified or special equipment guarantees which cover a greater length of time.

2. PRODUCTS

2.1 Selected Products and 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 Work.

.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 Bid.

.3 The design has been based on the use of the specified product.

2.2 Quality of Products

.1 All products provided shall be CSA Approved, ULC 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 Contract Administrator.

2.3 Uniformity of Manufacture

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

2.4 Product Finishes

.1 Finish all cabinets, panelboards, switchboards, equipment cabinets, cable trays, etc. in ANSI 61 grey enamel unless otherwise specified.

.2 Apply primer on all items which are to be finished on-site.

.3 Touch up all damaged painted finishes with matching lacquer, or, if required by the Contract Administrator, completely repaint damaged surface.

2.5 Use of Products During Construction

.1 Any equipment used for temporary or construction purposes shall be approved by the Contract Administrator and in accordance with the General Conditions, "Use of Premises." Clean and restore to "as new" condition all equipment prior to the time of Total Performance.

.2 The warranty period shall not begin until the date of Total Performance of the Work.

2.6 Non-Specific Date/Time Compliance

.1 All equipment, hardware, software and firmware (for the purposes of this clause, the "product") delivered or deliverables resulting from any services provided are fully date compliant and the product will not adversely or materially effect the daily business operations as a result of a date related computer problem (for the purposes of this clause, the "warranty"). Date compliant means that the product accurately and correctly processes and stores date/time data (including, but not limited to, calculating, comparing, displaying, recording and sequencing operations) including year, century and leap year calculations.

.2 Provide documentary proof of date compliance prior to Substantial Completion listing all equipment and certifying their compliance.

.3 Notwithstanding any other remedy available under this agreement or at law for breach of the Warranty, any product that is not Date Compliant shall, within 24 hours of receipt of notice of the breach, be repaired or replaced at the Contractors sole cost and expense, including parts, labour, transportation and insurance, so as to correct any failure to meet the Warranty.

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 Bid.

.2 No additional compensation will be given for extra Work due to existing conditions which such examination should have disclosed.

.3 Report to the Contract Administrator any unsatisfactory conditions which may adversely affect the proper completion of this Work.

3.2 Location of Outlets and Luminaires

.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, refer to structural Drawings.

.2 Outlet and equipment locations shown on the drawings are approximate. Locations may be revised up to 3000 m to suit construction and equipment arrangements without additional cost to the City, provided that the Contractor is notified prior to the installation of the outlets, or equipment.

.3 Maintain luminaire locations wherever possible. Notify the Contract Administrator of conflicts with other services.

.4 Unless otherwise specified or shown, install products in accordance with recommendations and ratings of manufacturers.

3.3 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 shall not be used for the support of wiring

3.4 Equipment Identification

.1 3 mm thick plastic lamicoid name plates, black face, white core, mechanically attached with self tapping screws, 6 mm high lettering, to be attached to the front face of the following equipment:

.1 Distribution Centres (Indicate designation, bus capacity, voltage)

.2 MCC (Designation, voltage)

.3 Starters, contactors, Disconnects (Designation, voltage, load controlled)

.4 Panelboard (Designation, voltage, Bus Capacity)

.5 Terminal cabinets and pull boxes (system, voltage)

.6 Transformers (designation, capacity, primary and secondary voltage)

.2 Nameplate sizes

.1 Size 1: 10 x 50 mm, one line, 3 mm high letters

.2 Size 2: 12 x 70 mm, one line, 5 mm high letters

.3 Size 3: 12 x 70 mm, two lines, 3 mm high letters

.4 Size 4: 20 x 90 mm, one line, 8 mm high letters

.5 Size 5: 20 x 90 mm, two lines, 5 mm high letters

.6 Size 6: 25 x 100 mm, one line, 12 mm high letters

.7 Size 7: 25 x 100 mm, two lines, 6 mm high letters

.3 Color code exposed conduits (including conduits above T-bar ceilings), junction and pull boxes, and metallic sheathed cables with paint or plastic tape (25 mm wide band) at 15 metre intervals. Color coding to be as follows:

SYSTEM	MAJOR BAND	MAJOR BAND
120/208 V Normal	Lt. Blue	

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

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

.1 Conductors:

.1 Equipment Grounding – Green

.2 Neutral Conductor – White

.2 120/208 System

.1 Phase A: Red

.2 Phase B: Black

.3 Phase C: Blue

3.5 Wiring to Equipment Supplied by Other Divisions

.1 Make all required electrical connections to the equipment supplied by other Divisions.

3.6 Testing

.1 Refer to Section 16980 - Testing, Adjusting and Balancing of Electrical Equipment and Systems.

3.7 Instructions to City Personnel

.1 Refer to Section 16990 - Electrical Equipment and Systems Demonstration and Instruction.

3.8 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 Work and complete with necessary frames and hinged doors held closed with captive fasteners. Coordinate type and size of panels with the Contract Administrator.

.2 In removable ceiling areas, provide markers on ceiling tile to locate equipment requiring access. Markers shall be of a type approved by the Contract Administrator.

3.9 Sealing of Wall and Floor 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.

.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 shall be sealed.

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 and floors.

.5 Failure to comply with the above requirements shall be remedied at the Contractor's expense.

3.11 Insulation Resistance Testing

.1 Megger circuits, feeders and equipment up to 350 V with a 500 V instrument.

.2 Megger 350-600 V circuits, feeders, and equipment with a 1000 V instrument.

.3 Check resistance to ground before energizing.

.4 Carry out tests in presence of Contract Administrator.

.5 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.

.6 Submit test results for Contract Administrator's review.

3.12 Load Balance

.1 Measure phase current to panelboards with normal loads (lighting) operating at time of acceptance. Adjust branch circuit connections as required to obtain best balance of current between phases and record changes.

.2 Measure phase voltages at loads and adjust transformer taps to within 2% of rated voltage of equipment.

.3 Submit, at completion of Work, report listing phase and neutral currents on panelboards, dry-core transformers, and motor control centres, operating under normal load. State hour and date on which each load was measured, and voltage at time of test.

END OF SECTION

SCOPE OF WORK

1. GENERAL

.1 Supply and install all material, equipment, wiring and labour necessary for the installation of the systems detailed on the Drawings in accordance with the latest edition of the Canadian Electrical Code.

1.2 Related Work

.1 The administrative section under Parts A, B, C and Division 1 shall be part of these Specifications.

1.3 General Requirements

.1 General clean-up.

.2 All inspections and obtaining all permits and licenses required by various inspection agencies and local regulations related to electrical trade.

.3 Scaffolding.

.4 Shop Drawings.

.5 As-Constructed Drawings where specified.

.6 Operation and maintenance data, where specified.

1.4 Specific Requirements Including But Not Limited to Scope of Work

.1 Supply and install 120V breakers, as required for new equipment in the Grit Building, in existing Panel 5G located in the Grit Building Electrical Room.

.2 Supply and install wiring (Teck Cable) from existing Panel 5G to equipment as indicated on the drawings and hereafter specified.

.3 Supply and install hazardous electrical equipment suitable for Class 1, Group D, and Division 1 areas as required and indicated on the Drawings.

.4 Supply and install standard electrical equipment for devices located with the lower level of the Blower Room.

1.5 Work Excluded

.1 Temporary power

.2 Temporary light

.3 Hoisting

.4 Barriers

.5 Special testing or inspection not specified or covered by Cash Allowance

1.6 Other Work Excluded

.1 Control wiring associated with equipment (not necessarily mechanical equipment) not included in the Electrical Specifications, (buried conduit for such wiring shall be included).

.2 Special starters, including multi-speed switches, which are associated with packaged units not detailed in the Electrical Specifications.

.3 On-site painting, except touch-up of electrical equipment.

1.7 Units of Measure

.1 The Contract Documents have been prepared using the modified International System (SI) units of metric measurement. Whenever appropriate, available metric products shall be used unless otherwise specified herein.

.2 Only metres (m) and millimetres (mm) are used. Generally, metres are used for measurements of 10 m or more, and millimetres for measurements below 10 m.

.3 All measurements on Drawings are in millimetres unless otherwise indicated.

1.8 Conversions

.1 The following three conversion methods were used in product and location dimensions:

.1 Hard Conversion: industry available products which are manufactured in metric measurements.

.2 Soft Conversion: products which are still manufactured in Imperial units and are converted in specifications using arithmetic conversion factors.

.3 Rationalized Conversion: dimensions which are soft converted and rounded off for ease of measurements.

.2 In cases where measurements may be open for interpretation, dual dimensions have been incorporated until hard conversions can be used exclusively.

1.9 Definition

.1 All terminologies, abbreviations and acronyms used in this document are as listed in the various Standards, Codes, Rules and Bulletins used herein.

1.10 Reference

.1 Imperative tense has been used throughout this Document for Work intended for the successful Contractor. There shall be no Work exclusions unless they have been clearly identified as such herein.

.2 The word "provide" shall mean "supply and install" unless otherwise indicated.

1.11 Codes

.1 All Codes, Standards, Rules, Regulations, Bulletins, By-laws etc., shall be those that are currently enforced in the locality of jobsite, unless otherwise specified herein.

2. PRODUCTS

.1 Not used

3. EXECUTION

.1 Not used

END OF SECTION

1. GENERAL

1.1 Work Included

.1 Provide a complete system of conduit and fittings for installation of wiring.

2. PRODUCTS

2.1 Rigid Aluminum Conduit

.1 Aluminum with threaded joints and connections.

.2 All Connectors to be aluminum

.3 Fittings: cast aluminum "Condulet" as manufactured by Crouse-Hinds Canada Ltd. including gasketted covers in damp locations.

.4 Expansion joints: cast aluminum Crouse-Hinds or approved alternate in accordance with B6.

2.2 Liquid-Tight Flexible Conduit

.1 Conduit: flexible metal conduit with liquid-tight PVC jacket. Acceptable product: Industrial Wire & Cable "Liquiseal".

.2 Connectors: captive sealing jacket and ground cone insulated throat, steel. Acceptable product: Thomas & Betts Ltd. "Super-Tight", Series 6000.

3. EXECUTION

3.1 Rigid Aluminum Conduit

.1 Use as raceways for following applications:

.1 In all areas exposed to weather.

.2 Locations where mechanical damage may occur and in mechanical rooms to a height of 1000 m.

.3 In areas where Teck cable is not used.

3.2 Liquid-Tight Flexible Conduit

.1 Use as raceways for all motors, pipe mounted control devices, and other devices subject to movement or water.

.2 At all motors provide a short length before connecting to the motor terminal box. Minimum length shall be 450 mm plus 4 times the conduit diameter.

.3 Provide a separate ground wire within flexible conduit, bonded to motor frames and system ground.

3.3 Workmanship

.1 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.

.2 Lay out conduit to avoid interference with other Work. Maintain a minimum clearance of 150 mm from steam or hot water piping, vents, etc.

.3 Where 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 conform with the Canadian Electrical Code.

.4 For all runs of conduits, do not include more than equivalent of 4 quarter bends. Provide conduit fittings, pullboxes and junction boxes where necessary. Pulling elbows shall not be used except by special permission.

.5 Where possible, install conduits so that they are not trapped, cap turned up conduits to prevent the entrance of dirt of moisture during construction. Swab out conduit and thoroughly clean internally before wires and cables are pulled.

.6 Take extreme care in reaming ends of all conduit to ensure a smooth interior finish that will not damage the insulation of the wires.

.7 Use insulated non-metallic bushings on all conduit terminations.

.8 Ensure electrical continuity in all conduit systems.

.9 All conduits shown exposed in finished areas is to be free of unnecessary labels and trade marks.

.10 Install a 90 lb. test line in all conduits left empty by this contractor including those which others will pull cables, wires, etc.

.11 Conduits and ducts crossing building expansion joints shall have conduit expansion fittings to suit the type of conduit used, and shall be Crouse-Hinds, Sceptre, or approved fitting.

.12 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 in accordance with B6.

.13 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 Contract Administrator.

.14 Where Drawings show conduit designations, these conduits shall be identified at each point of termination with Thomas & Betts "Ty-Rap" No. TY532M labels.

.15 Where conduit finish is damaged, repair or replace.

.16 Use "Condulet" fittings for power and telephone type conduit terminations in lieu of boxes where support is not provided.

.17 All branch circuit wiring, home-runs, communication and data to be minimum 20 mm diameter unless otherwise stated.

.18 Provide necessary flashing and pitch pockets, making watertight joints where conduits pass through roof or watertight membranes.

.19 Where panelboard branch circuit conduits are amalgamated, size shall not exceed 25 mm diameter.

END OF SECTION

OUTLET BOXES, CONDUIT BOXES AND FITTINGS

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.

2. PRODUCTS

2.1 Outlet and Conduit Boxes General

.1 Size boxes in accordance with CSA C22.1.

.2 102 mm square or larger outlet boxes as required for special devices.

.3 Gang boxes where wiring devices are grouped.

.4 Blank cover plates for boxes without wiring devices.

.5 347 V outlet boxes for 347 V switching devices.

.6 Combination boxes with barriers where outlets for more than one system are grouped.

2.2 Outlet Boxes for Aluminum Conduit

.1 Materials:

.1 Surface or recessed concealed type: Formed aluminum.

.2 Surface mounting exposed: Cast aluminum for threaded conduit, with attached lugs, corrosion resistant two coats finish.

2.3 Conduit Boxes

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

2.4 Fittings - General

.1 Bushing and connectors with nylon insulated throats.

.2 Knock-out fillers to prevent entry of debris.

.3 Conduit outlet bodies for conduit up to 32 mm and pull boxes for larger conduits.

.4 Double locknuts and insulated bushings on sheet metal boxes.

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 Provide correct size of openings in boxes for conduit, mineral insulated and armoured cable connections. Reducing washers are not allowed.

.4 Do not use sectional boxes.

.5 Provide boxes sized as required by the Canadian Electrical Code.

.6 Install vapour barrier material to surround and seal all outlet boxes located on exterior walls of building. Maintain wall insulation.

.7 Primary bushings in termination box for cable connection.

.8 Secondary bushings in termination box for bus duct connection.

.9 Control junction box.

.10 Stainless steel nameplate and connection diagram.

END OF SECTION

WIRE AND BOX CONNECTORS-0-1000 V

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 Special Codes

.1 Install and rate power cables in accordance with the Canadian Electrical Code requirements, or in accordance with IPCEA requirements where permissible.

1.3 References

.1 CSA C22.2 No. 65 Wire Connectors.

2. PRODUCTS

2.1 Materials

.1 Pressure type wire connectors: with current carrying parts same material as conductors sized to fit the conductors as required.

.2 Fixture type splicing connectors: with current carrying parts same material as conductors sized to fit the conductors 10 AWG or less.

2.2 Wire Connectors

.1 Use 3M “Scotchlock”, self-insulated connectors for hand twist wire joints for lighting, small power, and control wiring.

.2 Use T & B non-insulated ring type compression lugs for terminating #10 AWG and smaller motor connections. Tape with rubber and scotchtape. Lugs to accept ten - 32 x 3/8 inch machine bolts.

.3 Terminate conductors #8 AWG and larger with Thomas & Betts Colour-Keyed compression connectors Series 54000, or on lugs provided with equipment.

.4 Thomas & Betts “KOPR-SHIELD” compound Series CP8 on all terminations for compression connectors.

3. EXECUTION

3.1 Installation

.1 Remove insulation carefully from ends of conductors and:

.1 Apply coat of zinc joint compound on aluminum conductors prior to installation of connectors.

.2 Install mechanical pressure type connectors and tighten screws with appropriate compression tool recommended by manufacturer. Installation shall meet secureness tests in accordance with CSA C22.2 No. 65.

.3 Install fixture type connectors and tighten. Replace insulating cap.

3.2 Wire Connectors

.1 Select hand twist connectors for wire size and install tightly on conductors.

.2 Brush "KOPR-SHIELD" compound on terminations for compression connectors as recommended by the manufacturer.

.3 Install compression connectors using methods and tools recommended by manufacturer.

.4 Do not install stranded conductors under screw terminals unless compression lugs are installed.

END OF SECTION

GROUNDING

1. GENERAL

1.1 Description

.1 Extend existing grounding system. Securely and adequately ground all new components of the electrical system in accordance with the requirements of all related sections in the latest edition of the Canadian Electrical Code, C22.1-06.

.2 The system to consist of cables, 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.

2. PRODUCTS

.1 Extend exiting ground cables to new equipment. Ground cable to match existing cable

.2 All ground wires to be stranded copper TWH complete with a green jacket unless otherwise shown.

3. EXECUTION

3.1 Grounding - General

.1 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 All bolted connections must be accessible.

.3 All motors shall be grounded by means of an adequately sized green ground wire contained within the feeder conduit.

.4 Include a separate green ground wire in all power conduits including branch circuit wiring sized to Table 16, Canadian Electrical Code.

.5 Expansion joints and telescoping sections of raceways shall be bonded using jumper cables as per Canadian Electrical Code.

.6 Use Burndy compression connectors or approved equal for all grounding splices and terminations unless otherwise shown on the Drawings. For bolted ground connections use Burndy Engineering Company's "Durium" or approved equal hardware in accordance with B6.

.7 Ground all utility services to the electrical system ground.

END OF SECTION

FASTENINGS AND SUPPORTS

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.

1.2 Related Work

.1 Material and Equipment - Fastenings and Supports: Section 16191

2. PRODUCT

2.1 Framing and Support System

.1 Materials:

.1 Intermediate duty supporting structures shall employ P1000 Unistrut or equal together with the manufactures 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 Wet locations: Aluminum.

.2 Indoors, dry locations: Aluminum.

.3 Nuts, bolts, machine screws: Cadmium plated.

.3 Unistrut:

.1 Section P1000 or as required for load and span, with mounting screws, or approved equal in accordance with B6. P1000 or equal in accordance with B6 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.

.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 in accordance with B6.

2.3 Conduit Supports

.1 General: malleable iron one-hole conduit straps where exposed to weather or damp locations.

.2 Structural Steel: Crouse-Hinds "Wedgetite" supports or equivalent manufactured by Appleton.

.3 Masonry, concrete, stone, etc.: Anchors.

.4 Title: Toggle bolts.

.5 Unistrut: Unistrut conduit clamps.

2.4 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.

3. EXECUTION

3.1 General

.1 Do not cut or drill beams, joists or structural steel unless written permission of the Consultants is obtained.

.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 1000 mm span and 8 mm over a 2000 mm 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 percent spare capacity for multiple runs.

.7 Provide channel support with fittings for vertical runs of conduit and cables.

3.2 Installation

.1 Secure equipment to poured concrete with expandable inserts.

.2 Support equipment, conduit or cables using clips, spring loaded bolts, cable clamps designed as accessories to basic channel members.

.3 Fasten exposed conduit or cables to building construction or support system using straps.

.1 One-hole malleable iron or 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.

.4 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.

.5 Shot driven pins may only be used with written approval of the Contract Administrator.

.6 Use round or pan head screws for fastening straps, boxes, etc.

.7 Do not support heavy loads from the bottom chord of open web steel joists.

.8 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 6 mm fasteners.

.9 For surface mounting of two or more conduits use channels at 1.5 m oc spacing.

.10 Provide metal brackets, frames, hangers, clamps and related types of support structures where indicated or as required to support conduit and cable runs.

.11 Ensure adequate support for raceways and cables dropped vertically to equipment where there is no wall support.

.12 Do not use wire lashing or perforated strap to support or secure raceways or cables.

.13 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 Contract Administrator.

END OF SECTION

MOULDED CASE CIRCUIT BREAKERS

1. GENERAL

1.1 Product Data

.1 Submit product data in accordance with Section 16010 - Electrical General Requirements.

.2 Include time-current characteristic curves for breakers with interrupting capacity of 22,000 A symmetrical (rms) and over at system voltage.

2. PRODUCTS

2.1 Breakers General

.1 Bolt-On Moulded Case Circuit Breaker: Quick-make, quick-break type, for manual and automatic operation (with temperature compensation for 40°C ambient).

.2 Common-Trip Breakers: With single handle for multi-pole applications.

.3 Magnetic instantaneous trip elements in circuit breakers to operate only when value of current reaches setting. Trip settings on breakers with adjustable trips to range from 3 to 8 times current rating.

2.2 Thermal Magnetic Breakers (Design A)

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

2.3 Magnetic Breakers (Design B)

.1 Moulded case circuit breaker to operate automatically by means of magnetic tripping devices to provide instantaneous tripping for short circuit protection

3. EXECUTION

3.1 Installation

.1 Install circuit breakers as indicated in existing panel.

.2 Identification: Provide added breakers name in existing panel legend.

END OF SECTION

STARTING OF ELECTRICAL EQUIPMENT AND SYSTEM

1. GENERAL

1.1 Related Work

.1 Testing, Adjusting and Balancing of Electrical Equipment and Systems: Section 16980

.2 Electrical Equipment and Systems Demonstration and Instruction: Section 16990

1.2 Coordination

.1 Coordinate starting of electrical equipment and systems with testing, adjusting and balancing, and demonstration and instruction of:

.1 Electrical equipment and systems specified in Division 16

.2 Other equipment and systems specified in other Divisions

.2 Where any equipment or system requires testing, adjusting or balancing prior to starting, ensure that such Work has been completed prior to starting of electrical equipment and systems.

2. PRODUCTS

.1 Not used

3. EXECUTION

3.1 Starting Motors

.1 Prior to starting motors:

.1 Verify phase rotation at motor control centres.

.2 Confirm motor nameplate data with motor starter heater overloads.

3.2 Energizing Equipment

.1 Prior to energizing equipment provided under other Sections and equipment provided by the City.

.2 Confirm equipment nameplate data with characteristics of power supply.

END OF SECTION

1. GENERAL

1.1 Intent

.1 Except where otherwise specified, arrange and pay for testing, adjusting, balancing and related requirements specified herein.

.2 If test results do not conform with applicable requirements, repair, replace, adjust or balance equipment and systems. Repeat testing as necessary until acceptable results are achieved.

.3 Provide all labour, materials, instruments and equipment necessary to perform the tests specified.

.4 All tests shall be witnessed by persons designated by the Owner, who shall also sign the test documentation.

.5 Submit procedures proposed in writing for approval two weeks prior to test.

1.2 Related Work

.1 Electrical General Requirements: Section 16010

.2 Starting of Electrical Systems and Equipment: Section 16960

1.3 Manufacturer's Production Test Records

.1 If requested, submit copies of production test records for production tests required by EEMAC and CSA standards for manufactured electrical equipment.

1.4 Site Testing Reports

.1 Log and tabulate test results on appropriate test report forms.

.2 Submit forms to Contract Administrator for approval prior to use.

.3 Submit completed test report forms as specified, immediately after tests are performed.

1.5 Reference Documents

.1 Perform tests in accordance with:

.1 The Contract Documents

.2 Requirements of authorities having jurisdiction

.3 Manufacturer's published instructions

.4 Applicable CSA, IEEE, IPCEA, EEMAC and ASTM standards

.2 If requirements of any of the foregoing conflict, notify Contract Administrator before proceeding with test and obtain clarification.

1.6 Manufacturer's Site Services

.1 Arrange and pay for the Site Services of approximately qualified manufacturer's representatives where Site testing, adjusting, or balancing of electrical equipment or systems' performed by manufacturer's representatives is:

.1 Specified, or

.2 Otherwise required to ensure that electrical equipment and systems are operational in full compliance with the Contract Documents

1.7 Sequencing and Scheduling

.1 Except where otherwise specified, perform all testing, adjusting, balancing and related requirements specified herein prior to Acceptance of the Work.

2. PRODUCTS

2.1 Test Equipment

.1 Provide all equipment and tools necessary to perform testing, adjusting and balancing specified herein and as otherwise required.

3. EXECUTION

3.1 Testing of Wiring and Wiring Devices

.1 All power and control wiring shall be tested for insulation resistance value with a 1000 volt megger. Resistance values shall be as recommended by cable manufacturer. Test results shall be properly tabulated, signed, dated and submitted with maintenance manuals.

.2 Test service grounding conductors for ground resistance.

.3 Test all wiring devices for correct operation.

.4 Test all receptacles for proper polarity and circuitry.

END OF SECTION

ELECTRICAL EQUIPMENT AND SYSTEM DEMONSTRATION AND INSTRUCTION

1. GENERAL

1.1 Intent

.1 Provide demonstration and instruction sessions to familiarize City's operation and maintenance personnel with electrical systems and their operation and maintenance.

.2 Submit system sign off sheets for each system listed prior to Substantial Completion.

.3 All sign off and survey sheets shall be typewritten.

1.2 Manufacturer's Site Services

.1 Arrange and pay for appropriately qualified manufacturer's representatives to provide or assist in providing electrical equipment and system demonstration and instruction as specified herein.

1.3 Coordination

.1 The Contract Administrator will chair demonstration and instruction sessions.

.2 Establish agenda for demonstration and instruction sessions in conjunction with Contract Administrator. Coordinate scheduling of sessions with Contract Administrator.

2. PRODUCTS

.1 Not used

3. EXECUTION

3.1 Systems Demonstration

.1 Demonstrate operation of following systems:

.1 Grounding system

.2 Instrument control equipment

.3 Motorized valve actuators

SYSTEM COMPLETION AND COMMISSIONING

SYSTEM: _____

The above system is installed as per the drawings and specifications, is complete and has been commissioned.

Electrical Contractor

Signed by: _____Dated: _____

General Contractor

Signed by: _____Dated: _____

Deficiencies Attached

This system has been reviewed by:

The Contract Administrator

Signed by: _____Dated _____

The City's personnel have been instructed in the operation and maintenance of the above system:

The City

Signed by: _____Dated _____

The above does not constitute a waiver of any of the requirements of the Contract Documents.

	ELECTRICAL CONTRACTOR	GENERAL CONTRACTOR
	_____	_____
Address:	_____	_____
	_____	_____
	_____	_____
Phone:	_____	_____

END OF SECTION