

**Part 1 Consultant General**

**1.01 SUMMARY**

- .1 Section Includes:
  - .1 General requirements that are common to Sections of Division 26 - Electrical.

**1.02 RELATED SECTIONS**

- .1 Division 01 - General Requirements.

**1.03 REFERENCES**

- .1 Canadian Standards Association (CSA International):
  - .1 CSA C22.1-18, Canadian Electrical Code, Part 1 (22nd Edition), Safety Standard for Electrical Installations.
  - .2 CSA C22.2 No. 0-M91 (R2006), General Requirements.
  - .3 CAN3-C235-83 (R2006) Preferred Voltage Levels for AC Systems, 0 to 50,000 V.
- .2 National Building Code of Canada, (2015).
- .3 Institute of Electrical and Electronics (IEEE)/National Electrical Safety Code Product Line (NESC):
  - .1 IEEE SP1122-2000, The Authoritative Dictionary of IEEE Standards Terms, 7th Edition.

**1.04 DEFINITIONS**

- .1 Electrical and electronic terms: unless otherwise specified or indicated, terms used in these specifications, and on drawings, are those defined by IEEE SP1122.

**1.05 SCOPE OF WORK**

- .1 The work shall include all labour, materials and equipment necessary for the complete installation of the electrical, communications and electronic safety and systems shown on the drawings and described in these specifications.
- .2 It is the requirement of this work to provide all systems completely functioning in intended system operation, notwithstanding that every item necessarily required may not be specifically mentioned.

**1.06 DESIGN REQUIREMENTS**

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

**1.07 SUBMITTALS**

- .1 Submittals: in accordance with Division 01 - General Requirements.
- .2 Product Data: submit WHMIS MSDS in accordance with Division 01 - General Requirements.
- .3 Shop drawings:
  - .1 Refer to individual specification sections for shop drawing requirements.
  - .2 Submit shop drawings in accordance with Division 01 - General Requirements.
  - .3 Identify applicable specification section and paragraph number on each shop drawing.
  - .4 Submit installation details of proposed location, layout and arrangement of conduit and boxes, and other items that must be shown to ensure co-ordinated installation.
  - .5 Faxes are not acceptable for shop drawings. If sent by fax, they will not be reviewed.
  - .6 Do not begin fabrication until shop drawings have been reviewed by Departmental Representative. Allow ten (10) working days for Departmental Representative's review.
  - .7 Review of shop drawings does not relieve the contractor of the responsibility for co-ordination of field measurements required to complete the work.
  - .8 Contractor shall approve all shop drawings by signing and dating them prior to submitting to Departmental Representative.
- .4 Quality Control: in accordance with Division 01 - General Requirements.
  - .1 Provide CSA or other certification agency certified material, recognized by the Authority Having Jurisdiction.
  - .2 Where certified material is not available, submit such equipment and material to authority having jurisdiction for approval before delivery to site.
  - .3 Submit, upon completion of Work, load balance report as described in PART 3 - FIELD QUALITY CONTROL.
- .5 Submit test results for installed electrical systems.
- .6 Manufacturer's Field Reports: submit to Departmental Representative written report, within 3 days of review, verifying compliance of Work, as described in PART 3 - FIELD QUALITY CONTROL.

**1.08 TEST REPORTS**

- .1 Submit certified test reports and certificates to Departmental Representative from approved independent testing laboratories.
- .2 Indicate compliance with specifications for specified performance characteristics and physical properties.
- .3 Manufacturer's Field Services: submit copies of manufacturer's field inspection reports.

**1.09 EXISTING CONDITIONS**

- .1 Tie into existing systems at times coordinated with Departmental Representative.
- .2 Submit written request for approval 10 days minimum, prior to commencement of work.
- .3 Be responsible for damage to existing construction by this work.
- .4 Ensure daily clean-up of existing areas.

**1.10 INTERPRETATION OF PLANS AND SPECIFICATIONS**

- .1 These specifications are to be considered as an integral part of the plans which accompany them and neither the plans nor the specifications shall be used alone. Any item which is omitted in one but which is reasonably implied in the other shall be considered properly and sufficiently specified and must, therefore, be provided by this Contractor.
- .2 Drawings are diagrammatic. Building dimensions shall not be scaled from the Electrical plans.
- .3 Any discrepancy between the drawings and the building shall be questioned before proceeding with any installation.

**1.11 CO-OPERATION OF CONTRACTORS**

- .1 This Contractor shall become familiar with the work of other contractors and in laying out and installing the work shall co-operate with the other Contractors, so as to facilitate the progress of the work as a whole and avoid interference or delays. Where interference exists, this Contractor shall notify the Departmental Representative before installing the work. Any changes in the work or alterations of the Electrical Contractor's schedule required for such co-operation will not be considered as a claim for extra compensation.

**1.12 ERRORS AND OMISSIONS**

- .1 The drawings are not intended to show every item of accessory equipment, but the Contractor shall tender on and install all essential details to provide for efficiency of operation and ease of maintenance.
- .2 Should this Contractor discover errors or discrepancies in the plans or specification, he shall refer the matter to the Departmental Representative for change or clarification and shall not proceed with that portion of the work until advised by the Departmental Representative to do so.

**1.13 DELIVERY, STORAGE, AND HANDLING**

- .1 Material Delivery Schedule: Provide Departmental Representative with schedule within 14 days after award of contract.
- .2 Construction/Demolition Waste Management and Disposal: in accordance with Division 01 - General Requirements.
- .3 Store and handle materials in accordance with Division 01 - General Requirements and manufacturer's written instructions.

### **1.14 PERMITS, FEES AND INSPECTION**

- .1 Submit to Electrical Inspection Department necessary number of drawings and specifications for examination and approval prior to commencement of work.
- .2 Obtain an electrical work permit and pay associated fees.
- .3 Notify Departmental Representative of changes required by the Electrical Inspection Department.

### **1.15 WARRANTY**

- .1 Warranty duration: 12 calendar months following Substantial Completion.
- .2 Coverage: warrant against failure to perform to characteristics as specified.
- .3 Manufacturer's warranty: submit manufacturer's warranty, for Departmental Representative's acceptance.

## **Part 2 Products**

### **2.01 MATERIALS AND EQUIPMENT**

- .1 Provide material and equipment in accordance with Division 01-General Requirements.
- .2 Material and equipment to be CSA or ULC certified. Where CSA or ULC certified material and equipment are not available, obtain special approval from authority having jurisdiction, before delivery to site.
- .3 Ensure labels are visible and readable after equipment is installed.
- .4 Factory assemble electrical panels and component assemblies.

### **2.02 ELECTRIC MOTORS, EQUIPMENT AND CONTROLS**

- .1 Verify installation and co-ordination responsibilities related to motors, equipment and controls, as indicated.

### **2.03 WARNING SIGNS**

- .1 Warning Signs: in accordance with requirements of authority having jurisdiction, inspection authorities and Departmental Representative.
- .2 Signs, minimum size 178 x 254 mm.

### **2.04 WIRING TERMINATIONS**

- .1 Ensure lugs, terminals and screws used for termination of wiring are suitable for copper and aluminum conductors.

### **2.05 WIRING IDENTIFICATION**

- .1 Identify wiring with permanent indelible identifying markings, either numbered or coloured plastic tapes, on both ends of phase conductors of feeders and branch circuit wiring.
- .2 Maintain phase sequence and colour coding throughout.

- .3 Colour coding: to CSA C22.1-18.
- .4 Use colour coded wires in communication cables, matched throughout system.

### **Part 3 Execution**

#### **3.01 FIELD QUALITY CONTROL**

- .1 Confirm other related work is complete to receive work of this and related electrical sections.
- .2 Commission electrical systems.
- .3 Qualifications:
  - .1 Electricians: qualified, licensed electricians or apprentices in accordance with Provincial Act respecting manpower vocational training and qualifications.
  - .2 Apprentices: employees registered in provincial apprentices program permitted, under direct supervision of qualified licensed electrician, to perform specific tasks. Permitted activities determined based on level of training attained and demonstration of ability to perform specific duties.
- .4 Contractor holding valid Master Electrical contractor licensed as issued by Province that work is being constructed.

#### **3.02 INSTALLATION**

- .1 Comply with manufacturer's written data, including product technical bulletins, product catalogue installation instructions, product carton installation instructions, MSDS, and product datasheets.
- .2 Protect electrical equipment from dust and dirt. Plug or cap openings in conduit, fixtures and equipment during construction with Departmental Representative approved materials.
- .3 Conceal conduit in finished areas, unless otherwise authorized. Run exposed conduit parallel to building lines, and maintain maximum headroom.
- .4 Install outlets, plates and other visible items parallel to building lines. Line up exposed raceways, parallel and at right angles to building walls, partitions, and ceilings.
- .5 Set equipment and components plumb and level, accurate to position intended, and position hanger rods plumb.

#### **3.03 CONDUIT AND CABLE INSTALLATION**

- .1 Install conduit and sleeves prior to pouring of concrete.
  - .1 Sleeves through concrete: schedule 40 steel pipe, sized for free passage of conduit, and protruding 51 mm.
- .2 If plastic sleeves are used in fire rated walls or floors, remove before conduit installation.
- .3 Install cables, conduits and fittings to be embedded or plastered over, neatly and close to building structure so furring can be kept to minimum.

### **3.04 FIELD QUALITY CONTROL**

- .1 Conduct and pay for following tests in accordance with Division 01 - General Requirements:
  - .1 Circuits originating from branch and distribution panels.
  - .2 Systems: fire alarm system.
  - .3 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 Replace conductors as required.
- .2 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.
- .3 Manufacturer's Field Services:
  - .1 Obtain written certificates from manufacturers verifying compliance of Work, in handling, installing, applying, protecting and cleaning of products for inclusion in operation and maintenance manuals.
  - .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions as indicated in respective specification sections.

### **3.05 VERIFICATION**

- .1 Measure phase current to panelboards with normal loads 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.

### **3.06 FIELD TESTS**

- .1 Provide advance notice Departmental Representative of proposed testing schedule.
- .2 Perform tests at time of acceptance of work.
- .3 Conduct and pay for field tests:
  - .1 Power distribution, including phase voltage, grounding and load balancing.
  - .2 Circuits originating from branch distribution panels.
- .4 Perform tests in presence of Departmental Representative:
  - .1 Provide instruments, meters, equipment and personnel required to conduct required tests.
  - .2 Test systems to verify operation as specified.
- .5 Conduct di-electric tests, hi-pot tests, insulation resistance tests and ground continuity tests as required by nature of various systems and equipment.

- .6 Perform following tests on completed power systems:
  - .1 Control and switching: test circuits for correct operation of devices, switches and controls.
  - .2 Polarity tests: test circuits for correct operation of devices, switches and controls.
  - .3 Voltage tests: test voltage at last outlet of each circuit; maximum potential drop 2% on 120 V, and 208 V branch circuits, 2% on feeder circuits. Correct deficiencies.
  - .4 Phase balance: measure load on each phase at switchboards, splitter, distribution panel board and lighting and power panel board.
    - .1 Submit results to Departmental Representative in writing.
    - .2 Re-arrange phase connections as necessary to balance load on each phase as instructed by Departmental Representative.
    - .3 After marking such changes, submit revised drawings showing modified connections to Departmental Representative.
  - .5 Supply voltage: measure line voltage of each phase at load terminals of main breakers and report results in writing to Departmental Representative. Perform test with majority of electrical equipment in use.
  - .6 Motor loading: measure line current of each phase of motors with motor operating under load, and report results in writing to Departmental Representative.
    - .1 Upon indications of imbalances or overloads, thoroughly examine electrical connections and rectify defective parts or wiring.
    - .2 If electrical connections are correct, report overloads due to defects in driven machines in writing to Departmental Representative.
  - .7 Insulation resistance tests:
    - .1 Megger circuits, feeders and equipment up to 350 V with a 500 V instrument. Minimum insulation resistance shall be 0.5m $\Omega$ .
    - .2 Megger 350-600 V circuits, feeders and equipment with a 1000 V instrument. Minimum insulation resistance shall be 1.0m $\Omega$ .
    - .3 Check resistance to ground before energizing.
  - .8 Co-ordinate and carry out motor testing at same time as driven equipment is being tested. In addition to motor loading tests, provide labour and instruments to read and record motor load readings required to supplement tests on driven equipment through various load sequences, as required by driven equipment tests.
- .7 General operations: energize and operate electrical circuit and item. Repair, alter, replace, test and adjust as necessary for a complete and operating electrical system.
- .8 Provide labour, instruments, apparatus and pay expenses required for testing. Departmental Representative reserves right to demand proof of accuracy of instruments used.

- .9 Immediately prior to occupancy, test entire electrical system by performing loss and return of utility power test. Demonstrate operation of:
  - .1 Low voltage service equipment and metering.
  - .2 Fire alarm.
  - .3 User equipment shut-down and auto-restart.

### **3.07 TEST RESULTS**

- .1 Submit test results to Departmental Representative for review.
- .2 Testing methods and test results: to CSA, CEC and authorities having jurisdiction.
- .3 Remove and replace conductors found damaged, with new materials.
- .4 Provide required labour and tools, if during testing Departmental Representative requests equipment be opened and removed from their housings to examine equipment, terminations and connections.

### **3.08 TRAINING**

- .1 Train operating personnel in operation, care and maintenance of electrical equipment.
- .2 Arrange and pay for manufacturer's factory service engineer to provide training. Ensure operating personnel are conversant with its care and operation.
- .3 Obtain and submit written confirmation from operating personnel that satisfactory training has been received.

### **3.09 CLEANING**

- .1 Perform final cleaning of electrical equipment, systems and components.

### **3.10 PROTECTION**

- .1 Protect equipment and systems openings from dirt, dust, and other foreign materials with materials appropriate to system.

### **3.11 CONTROL OF HAZARDOUS ENERGY**

- .1 Lock out and tag out all electrical and other equipment before performing work as per CAN/CSA-Z460-05.

END OF SECTION

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**Part 1 General**

**1.01 RELATED SECTIONS**

- .1 Division 01 - General Requirements.
- .2 Section 26 05 00 - Common Work Results - Electrical.

**1.02 REFERENCES**

- .1 CSA C22.2 No .0.3-015 (R2005), Test Methods for Electrical Wires and Cables Latest Edition.
- .2 CAN/CSA-C22.2 No. 131-M89 (R2004), Type TECK 90 Cable Latest Edition.

**Part 2 Products**

**2.01 BUILDING WIRES**

- .1 Conductors: solid for #10 AWG and smaller; stranded for #8 AWG and larger. Minimum size: #12 AWG.
- .2 Conductors: size as indicated, with 600V insulation of chemically cross-linked thermosetting polyethylene material rated RW90.
- .3 Conductors: all wiring shall be copper.
- .4 Neutral conductor insulated for 600V shall be continuous with no fuses, switches, or breaks of any kind.
- .5 Wiring requirements for specialized systems such as fire alarm, public address, etc. are indicated in the respective specification sections or on drawings.
- .6 The voltage drop shall in no case exceed 3% of the line volts for branch circuits.
- .7 Voltage drop shall be calculated based on 80% of the circuit breaker current rating for all branch circuits unless noted otherwise.
- .8 Voltage drop for motor branch circuits shall be calculated based on current equal to 80% of the ampacity of the branch circuit conductors.
- .9 Branch circuit conductor sizes specified on drawings are the minimum required. Upsize branch circuit conductor sizes as required so that the voltage drop is less than the maximum value permitted.

**2.02 TECK CABLE**

- .1 Cable: to CAN/CSA-C22.2 No. 131.

- .2 Conductors:
  - .1 Grounding conductor: copper.
  - .2 Circuit conductors: copper, size as indicated.
- .3 Insulation:
  - .1 Type: ethylene propylene rubber.
  - .2 Chemically cross-linked thermosetting polyethylene rated type RW90, 600V.
- .4 Inner jacket: polyvinyl chloride material.
- .5 Armour: interlocking.
- .6 Overall covering: thermoplastic polyvinyl chloride material.
- .7 Fastenings:
  - .1 Channel type supports for two or more cables at 1.5 m centers.
  - .2 Threaded rods: 13 mm dia. to support suspended channels.
- .8 Connectors:
  - .1 Watertight, approved for TECK cable.

### **Part 3 Execution**

#### **3.01 MANUFACTURER'S INSTRUCTIONS**

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

#### **3.02 INSTALLATION OF BUILDING WIRES**

- .1 Fire rated cables shall be used for all 600 V, and 208 V essential power feeder as well as fire alarm system wiring as required by NBCC (latest edition).
- .2 Install wiring as follows:
  - .1 Use vibration proof expanding spring wire connectors for No. 10 and smaller.

#### **3.03 INSTALLATION OF TECK CABLE 0-1000 V**

- .1 Group cables wherever possible on channels.
- .2 Terminate cables in accordance with Manufacturer's recommendations.
- .3 Use only for portions of feeders located outdoors, unless indicated otherwise.

END OF SECTION

**Part 1      General**

**1.01      RELATED SECTIONS**

- .1      Division 01 - General Requirements.
- .2      Section 26 05 00 - Common Work Results - Electrical.

**Part 2      Products**

**2.01      SUPPORT CHANNELS**

- .1      U shape, size 41 x 41 x 2.5 mm thick, surface mounted or suspended.

**Part 3      Execution**

**3.01      MANUFACTURER'S INSTRUCTIONS**

- .1      Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

**3.02      INSTALLATION**

- .1      Secure equipment to hollow or solid masonry, tile and plaster surfaces with nylon shields.
- .2      Secure equipment to poured concrete with expandable inserts.
- .3      Secure equipment to hollow masonry walls or suspended ceilings with toggle bolts.
- .4      Secure surface mounted equipment with twist clip fasteners to inverted T bar ceilings. Ensure that T bars are adequately supported to carry weight of equipment specified before installation.
- .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 steel straps to secure surface conduits and cables 51mm and smaller.
  - .2      Two-hole steel straps for conduits and cables larger than 51mm.
  - .3      Beam clamps to secure conduit to exposed steel work.
- .7      Suspended support systems:
  - .1      Support individual cable or conduit runs with 6 mm dia threaded rods and spring clips.
  - .2      Support 2 or more cables or conduits on channels supported by 10 mm dia threaded rod hangers where direct fastening to building construction is impractical.

- .8 For surface mounting of two or more conduits use channels at 1.5 m on centre 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 Departmental Representative.
- .13 Install fastenings and supports as required for each type of equipment, cable and conduit, and in accordance with manufacturer's installation recommendations.
- .14 Do not support conduit from other conduit.

END OF SECTION