

## COMMON WORK RESULTS FOR ELECTRICAL

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### 1. GENERAL

#### 1.1 Reference Standards

- .1 CSA Group:
  - .1 CSA C22.1-21, Canadian Electrical Code, Part 1 (25th Edition), Safety Standard for Electrical Installations.
  - .2 CSA C235:19, Preferred Voltage Levels for AC Systems up to 50,000 V.
- .2 Institute of Electrical and Electronics (IEEE)/National Electrical Safety Code Product Line (NESC):
  - .1 Online IEEE Standards Dictionary at:  
<https://ieeexplore.ieee.org/browse/standards/dictionary?activeStatus=true>.
- .3 City of Winnipeg Water and Waste Department – Electrical Design Guide, Rev 05.
- .4 City of Winnipeg Water and Waste Department – Identification Standard, Rev 04.

#### 1.2 Definitions

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

#### 1.3 Action and Informational Submittals

- .1 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for electrical equipment and include product characteristics, performance criteria, physical size, finish and limitations.
- .2 Shop drawings:
  - .1 Submit wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, accessories, and other items that must be shown to ensure coordinated installation.
  - .2 Identify on wiring diagrams circuit terminals and indicate internal wiring for each item of equipment and interconnection between each item of equipment.
  - .3 If changes are required, notify Contract Administrator of these changes before they are made.
- .3 Certificates:
  - .1 Provide CSA certified equipment and material.

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- .2 Where CSA certified equipment and material is not available, submit such equipment and material to authority having jurisdiction and/or inspection authorities for special approval before delivery to site.
- .3 Submit test results of installed electrical systems and instrumentation.
- .4 Permits and fees: in accordance with General Conditions of Contract.
- .5 Submit, upon completion of Work, load balance report as described in PART 3 - LOAD BALANCE.
- .6 Submit certificate of acceptance from authority having jurisdiction upon completion of Work to the City and Contract Administrator.

## **2. PRODUCTS**

### **2.1 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.
- .3 Language operating requirements: provide identification nameplates and labels for control items in English.

### **2.2 Materials and Equipment**

- .1 Material and equipment to be CSA certified. Where CSA certified material and equipment is not available, obtain special approval from authority having jurisdiction and/or inspection authorities before delivery to site and submit such approval as described in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS.

Factory assemble control panels and component assemblies.

### **2.3 Wiring Terminations**

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

### **2.4 Identification Lamacoids**

- .1 Identification lamacoids: to Electrical Design Guide.
- .2 All lamacoids to be 3 mm thick plastic lamacoid nameplates, white face, black lettering.
- .3 Mechanically attach with self-tapping stainless steel screws. Where mechanically fastened lamacoids will compromise the enclosure rating of the electrical equipment or are not practical adhesive such as 3M 467MP is allowable.

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- .4 Apply lamacoids as per Electrical Design Guide Table 2-1: Lamacoid Requirements. Additional information shall be provided where required.
- .5 Provide warning and caution lamacoids in conformance with the latest requirements of the CEC. Lamacoids will have white lettering on a red background

### 2.5 Wiring Identification

- .1 Identify wiring with permanent indelible identifying markings, 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.
- .4 Use colour coded wires in communication cables, matched throughout system.

### 2.6 Conduit and Cable Identification

- .1 Wiring and cabling type identification: to Electrical Design Guide.
- .2 Colour code conduits, boxes and metallic sheathed cables.
- .3 Code with plastic tape or paint at points where conduit or cable enters wall, ceiling, or floor, and at 5 m intervals.
- .4 Colours: 38 mm wide prime colour and 19 mm wide auxiliary colour.

Type	Prime	Auxiliary
208/120/240V Power	Black	
347/600V Power	Yellow	

### 2.7 Finishes

- .1 Shop finish metal enclosure surfaces by application of rust resistant primer inside and outside, and at least two coats of finish enamel.
  - .1 Paint outdoor electrical equipment "equipment green" finish.
  - .2 Paint indoor switchgear and distribution enclosures light gray to ANSI 61.

## 3. EXECUTION

### 3.1 Installation

- .1 Do complete installation in accordance with CSA C22.1 except where specified otherwise.
- .2 Do overhead and underground systems in accordance with CAN/CSA-C22.3 No.1 except where specified otherwise.

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**3.2 Nameplates and Labels**

- .1 Ensure manufacturer's nameplates, CSA labels and identification nameplates are visible and legible after equipment is installed.

**3.3 Field Quality Control**

- .1 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 Provide upon completion of work, load balance report as directed in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS, phase and neutral currents on panelboards, operating under normal load, as well as hour and date on which each load was measured, and voltage at time of test.
- .2 Conduct following tests in accordance with Section 01 45 00 - Quality Control.
  - .1 Circuits originating from branch distribution panels.
  - .2 Lighting and its control.
  - .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.
- .3 Carry out tests in presence of Contract Administrator.
- .4 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.

**3.4 System Start-up**

- .1 Instruct the City and operating personnel in operation, care and maintenance of systems, system equipment and components.
- .2 Provide these services for such period, and for as many visits as necessary to put equipment in operation and ensure that operating personnel are conversant with aspects of its care and operation.

**END OF SECTION**

## **SPLITTERS, JUNCTION, PULL BOXES, AND CABINETS**

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### **1. GENERAL**

#### **1.1 Section Includes**

- .1 Materials and components for splitters, junction, pull boxes and cabinets.

#### **1.2 References**

- .1 Canadian Standards Association (CSA International):
  - .1 CSA C22.2 No. 0, General requirements – Canadian Electrical Code, Part II.
  - .2 CSA C22.2 No. 0.4, Bonding of electrical equipment.
  - .3 CSA C22.2 No. 14, Industrial control equipment.
  - .4 CSA C22.2 No.76, Splitters.
  - .5 CSA C22.2 No. 30, Explosion-proof equipment.
  - .6 CSA C22.2 No. 40, Junction and pull boxes.
  - .7 CSA C22.2 No. 94, Special Purpose Enclosures.
  - .8 CSA C22.2 No. 94.1, Enclosures for electrical equipment, non-environmental considerations (Tri-national standard with NMX-J-235/1-ANCE and UL-50).
  - .9 CSA C22.2 No. 94.2, Enclosures for electrical equipment, environmental considerations (Tri-national standard with NMX-J-235/2-ANCE and UL-50E).
  - .10 CSA C22.2 No. 286, Industrial control panels and assemblies.
- .2 Electrical Equipment Manufacturers Association of Canada (EEMAC), now known as Electro-Federation Canada.
- .3 Manitoba Building Code (MBC):
  - .1 The Buildings and Mobile Home Act amendments to the National Building Code of Canada (NBC).
- .4 Manitoba Electrical Code (MEC):
  - .1 Manitoba amendments to the Canadian Electrical Code (CEC).
- .5 National Electrical Manufacturers Association (NEMA):
  - .1 NEMA ICS 6, Industrial Control and Systems: Enclosures.
- .6 Winnipeg Electrical By-law (WEB):

## **SPLITTERS, JUNCTION, PULL BOXES, AND CABINETS**

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- .1 Winnipeg amendments to the Canadian Electrical Code (CEC).
- .7 Winnipeg Building By-law (WBB):
  - .1 Winnipeg amendments to the National Building Code of Canada (NBC).
- .8 Underwriters Laboratories Canada (cUL):
  - .1 508A, Industrial Control Panels.
  - .2 698A, Industrial Control Panels Relating to Hazardous (Classified) Locations.
  - .3 1203, Explosion Proof and Dust-Ignition Proof Electrical Equipment for Use in Hazardous (Classified) Locations.

## **2. PRODUCTS**

### **2.1 Environmental Considerations**

- .1 Intended to be installed in dry, non-hazardous, non-corrosive process locations:
  - .1 To be constructed of painted, mild steel.
  - .2 Back-plate with offsets for installation of devices.
  - .3 Continuous piano hinge, gasketed seal on door with quarter turn latch and handle.
- .2 Intended to be installed in wet or corrosive locations:
  - .1 Constructed of cast aluminum with threaded connection.
  - .2 Termination of underground PVC conduit system may be made into an exterior mounted, rigid PVC or Fiberglass enclosure type 4X as applicable.
  - .3 Utilize 316 stainless steel bolts, washers and mounting hardware.
- .3 Intended to be installed in hazardous locations:
  - .1 Constructed of cast copper free aluminum with threaded connection.
  - .2 Hinged, bolt-on style aluminum cover with neoprene gasket.
  - .3 Factory installed aluminum mounting plate for terminals, lugs and electrical devices.
  - .4 Factory installed threaded openings for conduit and cable connections.
  - .5 Utilize 316 stainless steel bolts, washers and mounting hardware.

### **2.2 Junction Boxes, and Pull Boxes**

- .1 Materials:

## **SPLITTERS, JUNCTION, PULL BOXES, AND CABINETS**

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- .1 Code gauge sheet steel, welded construction, phosphatized and factory paint finish.
- .2 Components:
  - .1 For flush mounting, covers to overlap box by 25 mm minimum all around with flush head cover retaining screws.
  - .2 Use rolled edges for surface boxes.

### **2.3 Splitters**

- .1 General:
  - .1 Three (3) sets of lugs for phases plus neutral, minimum, sized and suitable for conductor termination.
  - .2 Main and branch lugs to match required size and number of incoming and outgoing conductors as indicated.
  - .3 Provide ground bar, with a minimum of three (3) terminals.
- .2 Splitters shall include a hinged lockable cover.
- .3 Do not install splitters in hazardous or corrosive areas. If required, install suitable, Class I junction boxes.

## **3. EXECUTION**

### **3.1 Installation**

- .1 Boxes mounted in exterior walls shall be complete with box vapour barriers and gasketing/flashing/sealing per Manitoba Building Code. Maintain wall insulation.
- .2 Install in inconspicuous but accessible locations, with a minimum 1m of clearance in front of the equipment in accordance to CEC for working space, and to egress requirements per Building Code.
  - .1 If junction boxes are required in inaccessible location, provide a suitable access panel which allows sufficient space for opening the junction box.
- .3 Junction Boxes and Pull Boxes:
  - .1 Supply all pull boxes and junction boxes shown on the Drawings or required for the installation.
  - .2 Boxes installed in party walls to be offset by a minimum of one stud space.
  - .3 Install in inconspicuous but accessible locations, above removable ceilings or in electrical rooms, utility rooms or storage areas.
  - .4 Identify with system name and circuit designation as applicable.

### **SPLITTERS, JUNCTION, PULL BOXES, AND CABINETS**

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- .5 Size in accordance with the Canadian Electrical Code, as a minimum.
- .6 Terminate cables and conductors as required.
  - .1 For control signals install terminal block, Weidmuller WDU4 or equivalent.
- .7 Make all necessary cable entry holes in junction boxes supplied by Contractor or others, regardless of material.
- .4 Splitters:
  - .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 Identification**

- .1 Provide equipment identification.

**END OF SECTION**



**DISCONNECT SWITCHES FUSED AND NON-FUSED UP TO 600 V PRIMARY**

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**1. GENERAL**

**1.1 Section Includes**

- .1 Provide disconnect switches for 120/240 V distribution as indicated on the Drawings.

**1.2 References**

- .1 National Electrical Manufacturers Association (NEMA):
  - .1 NEMA 250 - 2014, Enclosures for Electrical Equipment (1000 Volts Maximum).
  - .2 NEMA ICS 6: 1993 (R2011), Industrial Control and Systems: Enclosures.
- .2 Canadian Standards Association:
  - .1 CAN/CSA C22.2 No.4-M89, Enclosed Switches.
  - .2 CSA 22.2 No.39-M89, Fuseholder Assemblies.

**2. PRODUCTS**

**2.1 Disconnect Switches**

- .1 Ratings: Ampere ratings as shown on the Drawings or to suit load requirements. For motors, use disconnects switches with HP ratings at least equal to motor HP.
- .2 Provide ON-OFF switch position indication on switch enclosure cover.
- .3 Finish: one (1) primer coat and one (1) finish coat on all metal surfaces, colours as per Section 26 05 00 - Common Work Results for Electrical.
- .4 Switch mechanisms: quick-make and quick-break action with self-wiping contacts, solderless pressure lug connectors.
  - .1 All switch poles to operate together from a common operating bar.
- .5 Provide for padlocking disconnect switches in OFF position by three (3) locks. Doors to be interlocked and complete with defeat mechanism, to prevent opening when handle in ON position.
- .6 Provide NEMA 4X rated disconnect switch.
- .7 Neutral Bars: where distribution system has grounded neutral conductor, provide neutral bar where required with ampere rating equal to switch rating, in enclosure. Provide ground bar for terminating ground conductors.
- .8 Fuse Holders: to CSA C22.2 No.39 relocatable and suitable without adaptors, for type and size of fuse indicated.

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**DISCONNECT SWITCHES FUSED AND NON-FUSED UP TO 600 V PRIMARY**

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.9 Approved Manufacturers:

.1 Eaton.

.2 Schneider Electric.

.3 Siemens.

## **2.2 Equipment Identification**

.1 Identification: provide lamacoid plate in accordance with Section 25 05 00, on each switch showing voltage, source of supply and load being fed, for example:

DOOR CONTROLLER 120/240 V FED FROM PPA
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.2 Indicate name of load controlled on size 4 nameplate.

## **3. EXECUTION**

### **3.1 Installation**

.1 Install disconnect switches complete with fuses if applicable.

.2 Mounting: provide supports independent of conduits. Wall-mount where possible, otherwise provided Unistrut frame support. Where switches are grouped mount in uniform arrangement.

.3 Wiring: connect line and load cable to all switches.

.4 Fuse Rating: install so that rating is visible.

**END OF SECTION**

## COMMON WORK RESULTS

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### 1. GENERAL

#### 1.1 General

- .1 This section covers items common to sections of Division 40. This section supplements the requirements of Division 1.

#### 1.2 Codes and Standards

- .1 Complete installation in accordance with latest CSA C22.1 except where specified otherwise.
- .2 Comply with all laws, ordinances, rules, regulations, codes, and orders of all authorities having jurisdiction relating to this Work.

#### 1.3 Care, Operation, and Start-Up

- .1 Instruct City maintenance and operating personnel in the operation, care, and maintenance of systems, system equipment, and components.
- .2 Provide these services for such period and for as many visits as necessary to put equipment in operation, and ensure that operating personnel are conversant with all aspects of its care and operation.

#### 1.4 Permits, Fees, and Inspection

- .1 Submit to Electrical Inspection Department and Supply Authority necessary number of Drawings and Specifications for examination and approval prior to commencement of Work.
- .2 Pay associated fees.
- .3 Notify the Contract Administrator of changes required by Electrical Inspection Department and Supply Authority prior to making changes.
- .4 Furnish a Certificate of Final Inspection and approvals from Electrical Inspection Department and Supply Authority to the Contract Administrator.

#### 1.5 Materials and Equipment

- .1 Equipment and material to be CSA certified. Where there is no alternative to supplying equipment which is not CSA certified, obtain special approval from Electrical Inspection Department and Supply Authority.
- .2 Minimum enclosure type to be used is NEMA 4 unless otherwise specified.

#### 1.6 Equipment Identification

- .1 Identify equipment with nameplates as follows:
  - .2 Nameplates:
    - .1 Lamicoid 3 mm thick plastic lamicoid nameplates, white face, black lettering, mechanically attached with self tapping screws.

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- .3 Wording on nameplates to be approved by the Contract Administrator prior to manufacture.
- .4 Allow for average of 25 letters per nameplate.
- .5 Identification to be English.

#### **1.7 Wiring Identification**

- .1 Identify wiring with permanent indelible identifying markings on both ends of all conductors and circuit wiring.
  - .1 Wire tags to be heat shrink type with black letters on white background.
  - .2 Wire tags to be legible and visible after the system is installed (i.e. not blocked).

#### **2. PRODUCTS (NOT USED)**

#### **3. EXECUTION (NOT USED)**

**END OF SECTION**

## **AUTOMATION WIRES AND CABLES**

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### **1. GENERAL**

#### **1.1 References**

- .1 The following is a list of standards which may be applicable in this Section:
  - .1 Canadian Standards Association (CSA):
    - .1 CSA C22.1, Canadian Electrical Code, Part I - Safety Standard for Electrical Installations.
    - .2 CSA C22.2 No .0.3, Test Methods for Electrical Wires and Cables.
    - .3 CAN/CSA-C22.2 No. 38, Thermoset-Insulated Wires and Cables.
    - .4 CAN/CSA-C22.2 No. 131, Type TECK 90 Cable.
    - .5 CAN/CSA-C22.2 No. 174, Cables and Cable Glands for use in Hazardous locations.
    - .6 CAN/CSA-C22.2 No. 239, Control and Instrumentation Cables.
    - .7 CAN/CSA-C22.2 No. 214, Communications Cables.

### **2. PRODUCTS**

#### **2.1 Wires in Conduit**

- .1 Wire : to CAN/CSA-C22.2 No. 38.
- .2 Conductors:
  - .1 Size as indicated.
  - .2 Copper conductors.
- .3 Insulation: chemically cross-linked thermosetting polyethylene rated type RW90.
  - .1 Insulation Voltage Rating:
    - .1 Circuits 120 V and less: 600 V.
- .4 Wire Colour Coding:
  - .1 Utilize the following wire colours for the types of voltage/signals indicated:
    - .1 120 VAC Line: Black.
    - .2 120 VAC Control: Red.

## **AUTOMATION WIRES AND CABLES**

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- .3 120 VAC Neutral: White.
- .4 24 VDC Supply: Blue.
- .5 24 VDC Control: Blue.
- .6 24 VDC Common: Brown.
- .7 4-20 mA Signal: White (+), Black (-).
- .8 Protective Earth: Green.
- .9 Signal Ground: Green/Yellow.
- .10 Profibus: Red/Green.

### **2.2 TECK90 Multi-Conductor 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: chemically cross-linked thermosetting polyethylene (XLPE), rated type RW90.
  - .1 Insulation Voltage Rating: 600 V.
- .4 Inner jacket: polyvinyl chloride material.
- .5 Armour: interlocking aluminum.
- .6 Overall covering: polyvinyl chloride material.
- .7 Fastenings:
  - .1 One-hole aluminum straps to secure surface cables 50 mm and smaller. Two-hole aluminum straps for cables larger than 50 mm.
  - .2 Channel type or cable tray supports for two (2) or more cables.
- .8 Cable Connectors / Fittings:
  - .1 Minimum requirements: Watertight, approved for TECK cable.
  - .2 Hazardous Locations:
    - .1 CSA approved.

## **AUTOMATION WIRES AND CABLES**

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- .2 Watertight type with:
    - .1 An elastomeric bevelled bushing.
    - .2 A funnel entry, splined gland nut.
    - .3 A non-magnetic, stainless steel grounding device with dual grounding action.
    - .4 A taper threaded hub.
    - .5 A hexagonal body and gland nut.
  - .3 Integral seal type with metal-to-metal contact construction.
  - .4 Sealing of multi-conductor cable shall be accomplished with a liquid-type polyurethane compound.
  - .5 The fitting must:
    - .1 Provide an environmental seal around the outer jacket of the cable and electrically bond the fitting to the cable armour prior to potting the explosion-proof seal.
    - .2 Allow the possibility of disconnection without disturbing the environmental seal, the electrical bonding, or the explosion proof seal.
  - .6 All metal-clad cable fittings, for jacketed and non-jacketed interlocked armour cable, shall incorporate an easily removable armour stop (not requiring fitting disassembly) ensuring proper positioning of the cable armour during cable termination.
- .3 Approved products: Thomas & Betts Star® Teck XP series or approved equal.

### **2.3 ACIC/CIC Control Cable**

- .1 Cable: to CAN/CSA-C22.2 No. 239, Control and Instrumentation Cables.
- .2 Conductors: copper, stranded, size as indicated.
- .3 Insulation: chemically cross-linked thermosetting polyethylene(XLPE) rated type RW90.
  - .1 Voltage: As noted.
- .4 Shielding as indicated on the drawings:
  - .1 ISOS – Individually shielded pairs with overall shield.
  - .2 OS – Overall shield.
- .5 Armour Type: Aluminum Interlocked.

## **AUTOMATION WIRES AND CABLES**

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- .6 RoHS compliant.
- .7 Fastenings:
  - .1 One-hole aluminum straps to secure surface cables 50 mm and smaller. Two-hole aluminum straps for cables larger than 50 mm.
  - .2 Channel type supports for two (2) or more cables at 1000 mm centres.
  - .3 Threaded rods: 6 mm dia. To support suspended channels.
- .8 Cable Fittings:
  - .1 Minimum requirements: Watertight, approved for TECK cable.
  - .2 Hazardous Locations:
    - .1 CSA approved.
    - .2 Watertight type with:
      - .1 An elastomeric bevelled bushing.
      - .2 A funnel entry, splined gland nut.
      - .3 A non-magnetic, stainless steel grounding device with dual grounding action.
      - .4 A taper threaded hub.
      - .5 A hexagonal body and gland nut.
    - .3 Integral seal type with metal-to-metal contact construction.
    - .4 Sealing of multi-conductor cable shall be accomplished with a liquid-type polyurethane compound.
    - .5 The fitting must:
      - .1 Provide an environmental seal around the outer jacket of the cable and electrically bond the fitting to the cable armour prior to potting the explosion-proof seal.
      - .2 Allow the possibility of disconnection without disturbing the environmental seal, the electrical bonding, or the explosion proof seal.
    - .6 All metal-clad cable fittings, for jacketed and non-jacketed interlocked armour cable, shall incorporate an easily removable armour stop (not requiring fitting disassembly) ensuring proper positioning of the cable armour during cable termination.
  - .3 Approved products: Thomas & Betts Star® Teck XP series or approved equal.



## **AUTOMATION WIRES AND CABLES**

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### **3. EXECUTION**

#### **3.1 General**

- .1 Do not splice cables. A continuous length is required for all feeds.
- .2 Install in accordance with manufacturer's recommendations, observing requirements for minimum bending radius and pulling tensions.
- .3 Exercise care in stripping insulation from wire. Do not nick conductors.

#### **3.2 Installation of Wires in Conduit**

- .1 Ensure conduit is dry and clean prior to pulling wire. If moisture is present, thoroughly dry conduits. Vacuum as required.
- .2 Utilize wire-pulling lubricant.

#### **3.3 Installation of TECK cable 0-600V**

- .1 Where surface mounted, provide clamps spaced a maximum of 1 m apart, unless otherwise indicated.
- .2 Perform an insulation-resistance test on each conductor, prior to termination, utilizing a megohmmeter with a voltage output of 1000 volts DC. Individually test each conductor with all other conductors and shields grounded. The test duration shall be one minute. Investigate resistances less than 50 megaohms, or deviations between parallel conductors. Conductors with insulation resistance values, at one (1) minute, less than 25 megaohms, or that deviate from other similar conductors by more than 50% will be rejected.

#### **3.4 Installation of Control Cables**

- .1 Install control cables in conduit or cable tray as indicated.
- .2 Provide separation of cables from sources of noise, including other cables.
  - .1 For analog signals, provide separation distances as follows:
    - .1 120 VAC, 8 AWG and smaller: 100 mm.
    - .2 120 VAC, >8 AWG: 300 mm.
    - .3 600 VAC power: 300 mm.
    - .4 VFD or other high harmonic cable: 300 mm in metallic conduit/600 mm other raceway.
    - .5 Medium Voltage: 450 mm.
  - .2 For control signals < 50 V, provide separation distances as follows:

### **AUTOMATION WIRES AND CABLES**

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- .1 120 VAC, 8 AWG and smaller: 50 mm.
  - .2 120 VAC, >8 AWG: 300 mm.
  - .3 600 VAC power: 300 mm.
  - .4 VFD or other high harmonic cable: 300 mm in metallic conduit/600 mm other raceway.
  - .5 Medium Voltage: 450 mm.
- .3 For 120 VAC control signals, provide separation distances as follows:
- .1 120 VAC, 8 AWG and smaller: none.
  - .2 120 VAC, >8 AWG: metal barrier or 150 mm.
  - .3 600 VAC power: metal barrier or 150 mm.
  - .4 VFD or other high harmonic cable: 150 mm in metallic conduit/300 mm other raceway.
  - .5 Medium Voltage: 450 mm.
- .4 Advise the Contract Administrator if these separations cannot be achieved.
- .3 Where surface mounted, provide clamps spaced a maximum of 1 m apart, unless otherwise indicated.
- .4 Ground shields at one end only. Where possible, ground shields at the end where power is supplied to the cable. Utilize shield grounding bar in panels, where present, to ground overall shields. Individual pair shields to be grounded on appropriate terminals.
- .5 Shield drain wires, at the ungrounded end, are to be taped back to the cable. Do not cut the shield drain wire off.
- .6 CIC cable may not be installed in cable tray. Protection in conduit is required over the entire length.
- .7 ACIC cable may be installed in cable tray, provided that:
- .1 There is a barrier separating power and control cables within the tray, or
  - .2 The cable tray does not contain power cables, unless specifically authorized by the Contract Administrator in writing, and
  - .3 The ACIC cable voltage rating is equal or greater than the highest voltage contained in the cable tray.

## **AUTOMATION WIRES AND CABLES**

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### **3.5 Cable Identification**

- .1 Install cable tags at both ends of cable.

### **3.6 Testing**

- .1 Perform an insulation resistance test on all new and existing power conductors that are being terminated as part of the Work.

**END OF SECTION**

## **AUTOMATION – PROCESS MEASUREMENT DEVICES**

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### **1. GENERAL**

#### **1.1 References**

- .1 National Electrical Manufacturers Association (NEMA).
- .2 Canadian Standards Association (CSA International).
- .3 Canadian Electrical Code (CEC).
- .4 Canadian Underwriters Laboratory, Inc. (cUL).
- .5 National Pipe Thread (NPT).
- .6 International Protection Code (IP).

#### **1.2 Submittals**

- .1 Submit Shop Drawings and manufacturer's installation instructions.
- .2 Manufacturer's Instructions:
  - .1 Include manufacturer's installation instructions for specified equipment and devices in operation and maintenance manuals.

### **2. PRODUCTS**

#### **2.1 General**

- .1 Control devices of each category to be of same type and manufacturer.
- .2 External trim materials to be corrosion resistant.
- .3 Operating conditions: 0-35°C with 5-95% RH (non-condensing) unless otherwise specified for indoor components.
- .4 All outdoor instrument and equipment to be rated for -40 to 40°C.
- .5 Account for hysteresis, relaxation time, maximum and minimum limits in applications of sensors and controls.

#### **2.2 Level Switch, Float**

- .1 General:
  - .1 Approvals: CSA or cUL.
  - .2 Function: Actuate contact at preset liquid level.
  - .3 Type: Direct-acting float with an enclosed switch and integral cable.
- .2 Service: Water and Wastewater, unless otherwise noted.

## **AUTOMATION – PROCESS MEASUREMENT DEVICES**

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- .3 Performance:
  - .1 Set Point: As noted.
  - .2 Temperature: 0 to 50°C.
- .4 Features:
  - .1 Entire Assembly: Watertight and impact-resistant.
  - .2 Float Material and Size: Polyethylene/foam filled; 114 mm diameter max.
- .5 Signal Interface: Switch Contacts: Form C Dry Contact rated 4.5 A continuous at 120 VAC.
- .6 Manufacturer and model:
  - .1 Flygt ENM-10.
  - .2 Or approved equal.

### **2.3 Leak Switch - Buoyancy Sensor**

- .1 General:
  - .1 Approvals: CSA or cUL.
  - .2 Ratings: NEMA 6.
  - .3 Function: detection of leak.
  - .4 Temperature: -40 to 90°C.
- .2 Service: Liquid; water, wastewater, unless otherwise noted.
- .3 Cable Type: 2.4 m (8'), 3-wire, 22 gauge with ground, shield and PP or PFA jacket
- .4 Accuracy:  $\pm 2$  mm in water.
- .5 Switch Contacts:
  - .1 Isolated, rated 15VA at 120 VAC.
  - .2 Close on liquid rise.
- .6 Manufacturer and Model:
  - .1 Omega LVV-110 Series.
  - .2 Or approved equal.

## **AUTOMATION – PROCESS MEASUREMENT DEVICES**

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### **3. EXECUTION**

#### **3.1 Installation**

- .1 Install equipment and components so that manufacturer's and CSA labels are visible and legible after commissioning is complete.
- .2 Install field control devices in accordance with manufacturer's recommended methods, procedures, and instructions.
- .3 Support field-mounted panels, transmitters, and sensors on pipe stands or channel brackets.
- .4 Electrical:
  - .1 Complete installation in accordance with Section 26 05 00.
  - .2 Install communication wiring in conduit or utilizing ACIC cabling if shown on the Drawings.
    - .1 Provide complete conduit/cable system to link instrumentation and the control panel(s).
    - .2 Conduit sizes to suit wiring requirements and to allow for future expansion capabilities specified for systems.
    - .3 Maximum conduit fill not to exceed 40%.
    - .4 Design Drawings do not show conduit layout.

#### **3.2 Identification**

- .1 Identify field devices with lamacoids. Install in a conspicuous location.

**END OF SECTION**