

**Part 1 General****1.1 RELATED REQUIREMENTS**

- .1 Section 01 33 00 – Submittal Procedures
- .2 Section 26 05 21 – Wire and Cables (0 – 1000V)
- .3 Section 26 05 28 – Grounding – Secondary

**1.2 REFERENCES**

- .1 Canadian Standards Association (CSA International)
  - .1 CSA C22.1-12, Canadian Electrical Code, Part 1 (20th Edition), Safety Standard for Electrical Installations.
  - .2 CAN3-C235-83(R2000), Preferred Voltage Levels for AC Systems, 0 to 50,000 V.
- .2 Electrical and Electronic Manufacturer's Association of Canada (EEMAC)
  - .1 EEMAC 2Y-1-1958, Light Gray Colour for Indoor Switch Gear.
- .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.

**1.3 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.

**1.4 DESIGN REQUIREMENTS**

- .1 Operating voltages: to CAN3-C235.
- .2 Any reference to Codes, Standards, and Regulations in these Specifications shall be taken as the latest or the most current in effect at time of tender.
- .3 Comply with all requirements of the NFPA 30A, National Building Code of Canada including Saskatchewan Amendments, Workers' Compensation Board requirements, and the CSA C22.1 Canadian Electrical Code - Part I, including all Provincial and other amendments, Electrical Bulletins, and any local by-laws or rules regulating the installation of electrical equipment and their seismic restraint. In no instance, however, shall the standards established by the Contract Documents be reduced by any of these Codes or Regulations.
- .4 All equipment and materials shall bear the approval of the Canadian Standards Association and where applicable, the Underwriters' Laboratories of Canada or alternate shall bear local approval from the Electrical Inspection Department having jurisdiction. Include in the Tender all costs associated with obtaining local approvals.
- .5 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.
- .6 Language operating requirements: provide identification nameplates and labels for control items in English.

**1.5 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data: submit WHMIS MSDS in accordance with Section 01 35 43 – Environmental Procedures.
- .3 Shop drawings:
  - .1 Submit drawings stamped and signed by a Professional Engineer registered or licensed in Province of Saskatchewan, Canada.
  - .2 Submit wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, ductwork, and other items that must be shown to ensure co-ordinated installation.
  - .3 Identify on wiring diagrams circuit terminals and indicate internal wiring for each item of equipment and interconnection between each item of equipment.
  - .4 Indicate on drawings clearances for operation, maintenance, and replacement of operating equipment devices.
  - .5 Submit 2 copies of 600 x 600 mm minimum size drawings and product data to inspection authorities.
  - .6 If changes are required, notify Departmental Representative of these changes before they are made.
- .4 Provide CSA certified equipment and material.
  - .1 Where CSA certified equipment and material is not available, submit such equipment and material to authority having jurisdiction for special approval before delivery to site.
  - .2 Submit test results of installed electrical systems and instrumentation.
  - .3 Permits and fees: in accordance with General Conditions of contract.
  - .4 Submit certificate of acceptance from authority having jurisdiction upon completion of Work to Departmental Representative.
- .5 Manufacturer's Field Reports: submit to Departmental Representative manufacturer's written report, within 3 days of review, verifying compliance of Work and electrical system and instrumentation testing.

**1.6 QUALITY ASSURANCE**

- .1 Qualifications: electrical Work to be carried out by qualified, licensed electricians who hold valid Master Electrical Contractor license or apprentices as per the conditions of Provincial Act respecting manpower vocational training and qualification.
  - .1 Employees registered in provincial apprentices program: permitted, under direct supervision of qualified licensed electrician, to perform specific tasks.
  - .2 Permitted activities: determined based on training level attained and demonstration of ability to perform specific duties.
- .2 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

**1.7 DELIVERY, STORAGE AND HANDLING**

- .1 Material Delivery Schedule: provide Departmental Representative with schedule within 2 weeks after award of Contract.

**1.8 SYSTEM STARTUP**

- .1 Instruct Departmental Representative and operating personnel in operation, care and maintenance of systems, system equipment and components.

- .2 Arrange and pay for services of manufacturer's factory service engineer to supervise start-up of installation, check, adjust, balance and calibrate components and instruct operating personnel.
- .3 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.

## **1.9 OPERATING INSTRUCTIONS**

- .1 Provide for each system and principal item of equipment as specified in technical sections for use by operation and maintenance personnel.
- .2 Operating instructions to include following:
  - .1 Wiring diagrams, control diagrams, and control sequence for each principal system and item of equipment.
  - .2 Start up, proper adjustment, operating, lubrication, and shutdown procedures.
  - .3 Safety precautions.
  - .4 Procedures to be followed in event of equipment failure.
  - .5 Other items of instruction as recommended by manufacturer of each system or item of equipment.
- .3 Print or engrave operating instructions and frame under glass or in approved laminated plastic.
- .4 Post instructions where directed by the Departmental Representative.
- .5 For operating instructions exposed to weather, provide weather-resistant materials or weatherproof enclosures.
- .6 Ensure operating instructions will not fade when exposed to sunlight and are secured to prevent easy removal or peeling.

## **Part 2 Products**

### **1.10 MATERIALS AND EQUIPMENT**

- .1 Material and equipment to be CSA certified. Where CSA certified material and equipment are not available, obtain special approval from authority having jurisdiction before delivery to site and submit such approval as described in PART 1 - SUBMITTALS.
- .2 Factory assemble control panels and component assemblies.

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

- .1 Verify installation and co-ordination responsibilities related to motors, equipment and controls, as indicated.
- .2 Refer to mechanical drawings for pump and hose reel motors.

### **1.12 WARNING SIGNS**

- .1 Warning Signs: in accordance with requirements of authority having jurisdiction.

### **1.13 WIRING TERMINATIONS**

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

**1.14 EQUIPMENT IDENTIFICATION**

- .1 Identify electrical equipment with nameplates and labels as follows:
  - .1 Nameplates: lamicoid 3 mm thick plastic engraving sheet, matt white finish face, black core, lettering accurately aligned and engraved into core mechanically attached with self tapping screws.
  - .2 Sizes as follows:

NAMEPLATE SIZES			
Size 1	10 x 50 mm	1 line	3 mm high letters
Size 2	12 x 70 mm	1 line	5 mm high letters
Size 3	12 x 70 mm	2 lines	3 mm high letters
Size 4	20 x 90 mm	1 line	8 mm high letters
Size 5	20 x 90 mm	2 lines	5 mm high letters
Size 6	25 x 100 mm	1 line	12 mm high letters
Size 7	25 x 100 mm	2 lines	6 mm high letters

- .2 Labels: embossed plastic labels with 6mm high letters unless specified otherwise.
- .3 Wording on nameplates and labels to be approved by Departmental Representative prior to manufacture.
- .4 Allow for minimum of twenty-five (25) letters per nameplate and label.
- .5 Nameplates for terminal cabinets and junction boxes to indicate system and/or voltage characteristics.
- .6 Disconnects, starters and contactors: indicate equipment being controlled and voltage.
- .7 Terminal cabinets and pull boxes: indicate system and voltage.
- .8 Transformers: indicate capacity, primary and secondary voltages.

**1.15 WIRING IDENTIFICATION**

- .1 Identify wiring with permanent indelible identifying markings, numbered, 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.

**1.16 CONDUIT AND CABLE IDENTIFICATION**

- .1 Colour code conduits, boxes and metallic sheathed cables.
- .2 Code with plastic tape or paint at points where conduit or cable enters wall, ceiling, or floor, and at 15 m intervals.
- .3 Colours: 25 mm wide prime colour and 20 mm wide auxiliary colour.

	Prime	Auxiliary
up to 250 V	Yellow	
up to 600 V	Yellow	Green
up to 5 kV	Yellow	Blue
up to 15 kV	Yellow	Red
Telephone	Green	
Other Communication Systems	Green	Blue
Fire Alarm	Red	

	Prime	Auxiliary
Emergency Voice	Red	Blue
Other Security Systems	Red	Yellow

**1.17 FINISHES**

- .1 Shop finish metal enclosure surfaces by application of rust resistant primer inside and outside, and at least two coats of finish enamel.

**1.18 FIRESTOPPING**

- .1 Firestopping shall be performed by the Division 26 Contractor as required by the National Fire Code of Canada including Saskatchewan Amendments.
- .2 Rated sealing systems for penetrations of Fire Rated walls, ceilings and floors. Contractors are to submit ULC, cUL, WHI, or equivalent certified Design or System Data Sheets to demonstrate compliance of a particular Floor or Wall Assembly, Through Penetrant, and Sealant with requirements and for what period of time.
- .3 Submit product data of the proposed firestopping system for review prior to installation.
- .4 The Departmental Representative, at his or her discretion, shall disassemble up to 10% of the total firestopping assemblies for detailed inspection. The contractor shall make good the inspected firestopping assemblies at no cost to the project.
- .5 Should any of the inspected firestopping assemblies not comply with the manufacturer's assembly instructions or the National Fire Code of Canada including Saskatchewan Amendments, all firestopping assemblies shall be removed and replaced by the Division 26 Contractor at no cost to the Owner.
- .6 All firestop penetrations shall be labelled. Labels shall be secured to surface directly beside firestop penetration. Firestop penetration labels shall include the following information:
  - .1 Name of installer
  - .2 Date of installation
  - .3 Type of sealing
  - .4 Time duration of sealant

**Part 3 Execution****1.19 INSTALLATION**

- .1 Do complete installation in accordance with CSA C22.1 except where specified otherwise.
- .2 Do overhead and underground systems in accordance with CSA C22.3 No.1 except where specified otherwise.
- .3 Install equipment as indicated on Drawings.
- .4 Locations of all existing services, features and appurtenances shown on the drawings are to be considered approximate only. Verify all locations in the field prior to construction.

**1.20 NAMEPLATES AND LABELS**

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

**1.21 CONDUIT AND CABLE INSTALLATION**

- .1 Install conduit and sleeves prior to pouring of concrete.
  - .1 Sleeves through concrete: plastic, sized for free passage of conduit, and protruding 50 mm.
- .2 If plastic sleeves are used in fire rated walls or floors, remove before conduit installation.
- .3 Install cables, conduits and fittings embedded or plastered over, close to building structure so furring can be kept to minimum.

**1.22 MOUNTING HEIGHTS**

- .1 Mounting height of equipment is from finished floor to centreline of equipment unless specified or indicated otherwise.
- .2 If mounting height of equipment is not specified or indicated, verify before proceeding with installation.

**1.23 FIELD QUALITY CONTROL**

- .1 Manufacturer's Field Services:
  - .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - SUBMITTALS.
  - .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.
  - .3 Schedule site visits, to review Work, as directed in PART 1 - QUALITY ASSURANCE.

**1.24 CLEANING**

- .1 Clean and touch up surfaces of shop-painted equipment scratched or marred during shipment or installation, to match original paint.
- .2 Clean and prime exposed non-galvanized hangers, racks and fastenings to prevent rusting.

**END OF SECTION**

## **PART 1        GENERAL**

### **1.1       RELATED REQUIREMENTS**

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

### **1.2       REFERENCES**

- .1       CSA C22.2 No. 0.3 (latest edition) – Test Methods for Electrical Wires and Cables.
- .2       CSA C22.2 No. 65 – Wire Connectors.

### **1.3       PRODUCT DATA**

- .1       Provide product data in accordance with Section 01 33 00 – Submittal Procedures.

## **PART 2       PRODUCTS**

### **2.1       WIRES**

- .1       Conductors: stranded for 10 AWG and larger. Minimum size: 12 AWG.
- .2       Copper conductors: size as indicated, with 600V insulation of cross-linked thermosetting polyethylene material rated RW90 XLPE, Jacketted.
- .3       All branch circuits shall be installed with separate, dedicated neutrals.
- .4       All wiring shall be rated at 75°C when connected to equipment rated 75°C.
- .5       All wiring shall be listed for the application for which it is installed.

### **2.2       TECK 90 HL CABLE**

- .1       Cable: in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2       Conductors:
  - .1       Size as indicated on Drawings.
  - .2       Grounding conductor: copper
  - .3       Circuit conductors: copper, size as indicated.
  - .4       Rated for hazardous areas as indicated on Drawings.
- .3       Insulation: Chemically cross-linked thermosetting polyethylene, type RW90, rated 600 V.
- .4       Inner jacket: polyvinyl chloride material.
- .5       Armour: interlocking aluminum.
- .6       Overall covering: thermoplastic polyvinyl chloride, compliant to applicable Building Code classification for this project.
- .7       Fastenings:
  - .1       One hole steel straps to secure surface cables 50 mm and smaller. Two hole steel straps for cables larger than 50 mm.
  - .2       Channel type supports for two or more cables at 2000 mm centers.
  - .3       Threaded rods: 6 mm diameter to support suspended channels.
- .8       Connectors:
  - .1       Watertight, explosion-proof approved for TECK cable.

## **2.3 OUTDOOR FLEXIBLE CABLES**

- .1 Approved for wet locations.
- .2 Insulation: 90<sup>0</sup> EPDM, type SOOW, rated 600V.

## **2.4 WIRE AND BOX CONNECTORS AND MISCELLANEOUS MATERIALS**

- .1 Connectors for wire and cable splices and taps.
- .2 Clamps, glanding connectors, or box connectors for armoured cable, aluminum sheathed cable, mineral-insulated cable, flexible conduit, as required.
- .3 Lugs, terminals, screws used for termination of wiring shall be suitable for either copper or aluminum conductors.
- .4 Plastic electrical insulation tape.
- .5 Kellems grips: double-eye, double-weave, stainless steel.

# **PART 3 EXECUTION**

## **3.1 FIELD QUALITY CONTROL**

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Perform tests using method appropriate to site conditions and to approval of Departmental Representative and local authority having jurisdiction over installation.
- .3 Perform tests before energizing electrical system.

## **3.2 GENERAL CABLE INSTALLATION**

- .1 All wiring shall be in conduit unless otherwise indicated.
- .2 Install cable in trenches in accordance with the Canadian Electrical Code and the Drawings.
- .3 Terminate cables in accordance with the Canadian Electrical Code.
- .4 Cable Colour Coding: to Section 26 05 00 - Common Work Results for Electrical.
- .5 Conductor length for parallel feeders to be identical.
- .6 Lace or clip groups of feeder cables at distribution centres, pull boxes, and termination points.
- .7 Wiring in walls: typically drop or loop vertically from above to better facilitate future renovations. Generally wiring from below and horizontal wiring in walls to be avoided unless indicated.
- .8 Provide numbered wire collars for control wiring. Numbers to correspond to control shop drawing legend. Obtain wiring diagram for control wiring.

## **3.3 INSTALLATION OF WIRES**

- .1 Install wiring in accordance with the Canadian Electrical Code.
- .2 The number of splices in any circuit shall be kept to an absolute minimum consistent with available coil length and installation conditions.



- .3 Branch circuits shall be sized for a maximum 3% voltage drop.
- .4 Install cable in trenches in accordance with the Canadian Electrical Code and the Drawings.
- .5 Cable Color Coding: to Section 26 05 00 Common Work Results for Electrical.

### **3.4 INSTALLATION OF TECK90 HL CABLE (0 -1000 V)**

- .1 Group cables wherever possible on channels.
- .2 Install cable exposed, securely supported by straps.
- .3 Provide adequate protection and strain relief for cables between stub-up and devices.
- .4 All cables shall include grounding conductor.

### **3.5 INSTALLATION OF FLEXIBLE CABLES**

- .1 Install flexible cables in existing raceways to dock.

### **3.6 INSTALLATION OF WIRE AND BOX CONNECTORS**

- .1 Remove insulation carefully from ends of conductors and:
  - .1 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.
  - .2 Install fixture type connectors and tighten. Replace insulating cap.
- .2 Wire and cable splices and taps shall be made with approved connectors used in accordance with the manufacturer's instructions.
- .3 After installation, wrap connectors having exposed conductive surfaces with plastic electrical tape, applying enough servings to provide uniform covering not thinner than the insulation of the largest conductor connected and overlapping the insulation of each connected conductor by not less than 12mm.

**END OF SECTION**

## **PART 1 GENERAL**

### **1.1 RELATED REQUIREMENTS**

- .1 Section 01 33 00 – Submittal Procedures.

### **1.2 REFERENCES**

- .1 American National Standards Institute /Institute of Electrical and Electronics Engineers (ANSI/IEEE)
  - .1 ANSI/IEEE 837-02, IEEE Standard for Qualifying Permanent Connections Used in Substation Grounding.

### **1.3 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for grounding equipment and include product characteristics, performance criteria, physical size, finish and limitations.

### **1.4 CLOSEOUT SUBMITTALS**

- .1 Operation and Maintenance Data: submit operation and maintenance data for grounding equipment for incorporation into manual.

### **1.5 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
  - .1 Store materials in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect grounding equipment from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.

## **PART 2 PRODUCTS**

### **2.1 EQUIPMENT**

- .1 Copper conductor: minimum 6 m long for each concrete encased electrode, bare, stranded, soft annealed, size as indicated on drawings.
- .2 Rod electrodes: stainless steel 19 mm diameter by minimum 3 m long.
- .3 Plate electrodes: galvanized steel surface area 0.2 m<sup>2</sup>, minimum 6 mm thick.
- .4 Grounding conductors: bare stranded copper, soft annealed, size as indicated.
- .5 Insulated grounding conductors: green, copper conductors, size as indicated.

- .6 Ground bus: copper, size as indicated, complete with insulated supports, fastenings, connectors.
- .7 Non-corroding accessories necessary for grounding system, type, size, material as indicated, including but not necessarily limited to:
  - .1 Grounding and bonding bushings.
  - .2 Protective type clamps.
  - .3 Bolted type conductor connectors.
  - .4 Thermit welded type conductor connectors.
  - .5 Bonding jumpers, straps.
  - .6 Pressure wire connectors.

### **PART 3 EXECUTION**

#### **3.1 INSTALLATION GENERAL**

- .1 Install complete permanent, continuous grounding system including, electrodes, conductors, connectors, accessories.
- .2 Install connectors in accordance with manufacturer's instructions.
- .3 Protect exposed grounding conductors from mechanical injury.
- .4 Make buried connections, and connections to conductive water main, electrodes, using copper welding by thermit process, permanent mechanical connectors or inspectable wrought copper compression connectors to ANSI/IEEE 837.
- .5 Use mechanical connectors for grounding connections to equipment provided with lugs.
- .6 Soldered joints not permitted.
- .7 Minimum depth of burial for ground loop and grounding cables shall be minimum 450mm, maximum 600mm.
- .8 Install bonding wire for flexible conduit, connected at both ends to grounding bushing, solderless lug, clamp or cup washer and screw. Neatly cleat bonding wire to exterior of flexible conduit.
- .9 Install flexible ground straps for bus duct enclosure joints, where such bonding is not inherently provided with equipment.
- .10 Bond single conductor, metallic armoured cables to cabinet at supply end.
- .11 Ground secondary service pedestals.

#### **3.2 MAINTENANCE HOLES**

- .1 Install conveniently located grounding stud, electrode, size as indicated stranded copper conductor in each manhole.
- .2 Install ground rod in each manhole so that top projects through bottom of manhole. Provide with lug to which grounding connection can be made. Confirm ground resistance meets or exceeds Canadian Electrical Code minimum requirements.

**3.3 ELECTRODES**

- .1 Install rod and plate electrodes and make grounding connections as indicated.
- .2 Bond separate, multiple electrodes together.
- .3 Use size 2/0 AWG copper conductors for connections to electrodes.
- .4 Make special provision for installing electrodes that will give acceptable resistance to ground value where rock or sand terrain prevails. Ground as indicated.

**3.4 FIELD QUALITY CONTROL**

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Perform ground continuity and resistance tests using method appropriate to site conditions and to approval of Departmental Representative and local authority having jurisdiction over installation.
- .3 Perform tests before energizing electrical system.

**3.5 CLEANING**

- .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.

**END OF SECTION**

**PART 1 GENERAL****1.1 REFERENCES**

- .1 Canadian Standards Association (CSA International)
  - .1 CAN/CSA C22.2 No. 18.2-06, Nonmetallic Outlet Boxes.
  - .2 CSA C22.2 No. 45.1-07, Rigid Metal Conduit – Steel.
  - .3 CSA C22.2 No. 56-04 (R2009), Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit.
  - .4 CSA C22.2 No. 83-M1985(R2008), Electrical Metallic Tubing.
  - .5 CSA C22.2 No. 211.2-06(R2011), Rigid PVC (Unplasticized) Conduit.
  - .6 CAN/CSA C22.2 No. 227.3-05(R2010), Nonmetallic Mechanical Protection Tubing (NMPT), A National Standard of Canada (February 2006).

**1.2 SUBMITTALS**

- .1 Provide shop drawings in accordance with Section 01 33 00 Submittal Procedures.
- .2 Product data: submit manufacturer's printed product literature, specifications and datasheets.

**PART 2 PRODUCTS****2.1 CABLES AND REELS**

- .1 Provide cables on reels or coils.
  - .1 Mark or tag each cable and outside of each reel or coil, to indicate cable length, voltage rating, conductor size, and manufacturer's lot number and reel number.
- .2 Each coil or reel of cable to contain only one continuous cable without splices.
- .3 Identify cables for exclusively dc applications.
- .4 Reel and mark shielded cables rated 2,001 volts and above.

**2.2 CONDUITS**

- .1 Rigid metal conduit: to CSA C22.2 No. 45, galvanized steel threaded.
- .2 Epoxy coated conduit: to CSA C22.2 No. 45, with zinc coating and corrosion resistant epoxy finish inside and outside.
- .3 Electrical metallic tubing (EMT): to CSA C22.2 No. 83, with couplings.
- .4 Rigid PVC conduit: to CSA C22.2 No. 211.2.

**2.3 CONDUIT FASTENINGS**

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

- .3 Channel type supports for two or more conduits at 2 m on centre.
- .4 Threaded rods, 6 mm diameter, to support suspended channels.

## 2.4 CONDUIT FITTINGS

- .1 Fittings: to CAN/CSA C22.2 No. 18 manufactured for use with conduit specified.  
Coating: same as conduit.
- .2 Ensure factory "ells" where 90 degrees bends for 25 mm and larger conduits.
- .3 Watertight connectors and couplings for EMT.
  - .1 Set-screws are not acceptable.

## 2.5 FISH CORD

- .1 Polypropylene.

# PART 3 EXECUTION

## 3.1 MANUFACTURER'S INSTRUCTIONS

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

## 3.2 INSTALLATION

- .1 Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass.
- .2 Conceal conduits except in mechanical and electrical service rooms.
- .3 Surface mount conduits except where specified otherwise.
- .4 Use rigid galvanized steel threaded conduit outdoors except where specified otherwise.
- .5 Use epoxy coated conduit in corrosive areas.
- .6 Use electrical metallic tubing (EMT) indoors, except where specified otherwise.
- .7 Use explosion proof flexible connection for connection to explosion proof devices.
- .8 Install conduit sealing fittings in hazardous areas.
  - .1 Fill with compound.
- .9 Minimum conduit size: 21 mm.
- .10 Bend conduit cold:
  - .1 Replace conduit if kinked or flattened more than 1/10th of its original diameter.
- .11 Mechanically bend steel conduit over 27 mm diameter.
- .12 Field threads on rigid conduit must be of sufficient length to draw conduits up tight.

- .13 Install fish cord in empty conduits.
- .14 Remove and replace blocked conduit sections.
  - .1 Do not use liquids to clean out conduits.
- .15 Dry conduits out before installing wire.
- .16 Remove burrs and sharp edges of conduits prior to installation.

### **3.3 SURFACE CONDUITS**

- .1 Run parallel or perpendicular to building lines.
- .2 Run conduits in flanged portion of structural steel.
- .3 Group conduits wherever possible on surface channels.
- .4 Do not pass conduits through structural members except as indicated.
- .5 Do not locate conduits less than 75 mm parallel to steam or hot water lines with minimum of 25 mm at crossovers.

### **3.4 CONCEALED CONDUITS**

- .1 Run parallel or perpendicular to building lines.
- .2 Do not install horizontal runs in masonry walls.
- .3 Do not install conduits in terrazzo or concrete toppings.

### **3.5 CONDUITS UNDERGROUND**

- .1 Slope conduits to provide drainage.
- .2 Waterproof joints (PVC accepted) with heavy coat of bituminous paint.

### **3.6 CLEANING**

- .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.

**END OF SECTION**

## **PART 1        GENERAL**

### **1.1        RELATED WORK**

- .1        This Section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

### **1.2        REFERENCES**

- .1        Canadian Standards Association (CSA International):
  - .1        CSA C22.2 No.14, Industrial Control Equipment.

### **1.3        PRODUCT DATA**

- .1        Submit product data in accordance with Section 26 05 00.

## **PART 2        PRODUCTS**

### **2.1        CONTACTOR EQUIPMENT**

- .1        Contactors: to CSA C22.2 No.14.
- .2        Half size contactors not accepted.
- .3        Electrically operated, electrically or mechanically held, multi-pole full voltage type.
- .4        Contactors to have 120V operating (and unlatching) coils unless otherwise noted.
- .5        Controlled by pilot devices as indicated and rated for type of load controlled.
- .6        Breaker or Fused switch combination contactor as indicated.
- .7        Complete with 1 normally open and 1 normally closed auxiliary contacts unless indicated otherwise.
- .8        Provide National Electrical Manufacturers Association (NEMA) enclosure as required for location unless indicated otherwise.

### **2.2        CONTACTOR REMOTE CONTROLS**

- .1        Include following options in cover or in remote locations where indicated:
  - .1        Red LED indicating lamp (incandescent not acceptable)
  - .2        Stop-Start pushbutton or
  - .3        Hand-Off-Auto selector switch or
  - .4        On-Off selector switch.
- .2        Include following remote control options where indicated:
  - .1        Key operated remote control buttons shall heavy duty type, momentary contact, two (2) position spring return to centre, key operated control switch complete with engraved lamicoid nameplate reading "Off/On". Provide and adjacent standard bullseye type, LED 120 volt rated, red pilot light indicating "power on". Mount pilot light on same faceplate as control switch. Confirm keying requirements (master/submaster) and provide 2 sets of keys.



- .2 Mushroom style "STOP" controls to be heavy duty type, large red button, momentary contact, non-latching spring return switch complete with engraved lamicoid nameplate reading "STOP".
- .3 Provide flush mounting boxes and satin stainless steel plates for remote control devices in finished areas. Provide industrial quality, malleable die cast surface mounted units to suit the application classification.

### **2.3 EQUIPMENT IDENTIFICATION**

- .1 Indicate name of load controlled on size 4 name plate to Section 26 05 00.

### **2.4 STANDARD OF ACCEPTANCE**

- .1 Cutler Hammer – Heavy Duty
- .2 Schneider - Heavy Duty
- .3 Siemens - Heavy Duty

## **PART 3 EXECUTION**

### **3.1 INSTALLATION**

- .1 Install contactors and connect auxiliary control devices.
- .2 Pilot lights to be illuminated when contactor is closed.
- .3 Control wire to be minimum #14 AWG. Remote control wiring to be 5A fuse protected and the wiring shall be upsized to limit voltage drop to no more than 2%.
- .4 Control circuits shall fail safe leaving the contactor in the open position if the power fails or where automatic reset could be a safety or operational concern. Provide a control circuit seal-in contact for all momentary contact control devices unless otherwise indicated.
- .5 The contactor shall not automatically reset after a power failure unless otherwise indicated or for such items as automatic freeze protection, snow melting, light control etc.
- .6 Electrically held contactors to be located in service rooms where practical.

**END OF SECTION**

## **PART 1        GENERAL**

### **1.1        RELATED REQUIREMENTS**

- .1        Section 01 33 00 Submittal Procedures
- .2        Section 26 05 00 – Common Work Results for Electrical
- .3        Section 01 78 00 – Closeout Submittals
- .4        Section 01 61 00 - Common Product Requirements

### **1.2        REFERENCES**

- .1        National Electrical Manufacturers Association (NEMA)
  - .1        NEMA ICS 1-2000(R2008), Industrial Control and Systems: General Requirements.

### **1.3        ACTION AND INFORMATIONAL SUBMITTALS**

- .1        Submit in accordance with Section 01 33 00 Submittal Procedures.
- .2        Product Data:
  - .1        Submit manufacturer's instructions, printed product literature and data sheets for control devices and include product characteristics, performance criteria, physical size, finish and limitations.
- .3        Shop Drawings:
  - .1        Submit drawings stamped and signed by a Professional Engineer registered or licensed in Province of Saskatchewan, Canada.
  - .2        Include schematic, wiring, interconnection diagrams.

### **1.4        QUALITY ASSURANCE**

- .1        Conduct tests in accordance with Section 26 05 00 - Common Work Results for Electrical.

### **1.5        CLOSEOUT SUBMITTALS**

- .1        Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2        Operation and Maintenance Data: submit operation and maintenance data for control devices for incorporation into manual.

### **1.6        DELIVERY, STORAGE AND HANDLING**

- .1        Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2        Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

- .3 Storage and Handling Requirements:
  - .1 Store materials in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect control devices from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.

## **PART 2 PRODUCTS**

### **2.1 E-STOP BUTTONS**

- .1 Standard, marine grade, outdoor rated and hazardous area rated mushroom type. 1-NO and 1-NC contacts rated at 120 V, AC, labels as indicated. Stop pushbuttons coloured red, labeled "emergency stop".
- .2 Provide marine, outdoor and hazardous area rated enclosures as required.

### **2.2 SWITCHES**

- .1 Hazardous area rated, 2 position switches as indicated on drawings. Standard wing lever rated at 120V AC, labels as indicated.
- .2 Provide outdoor and hazardous area rated enclosures as required.

## **PART 3 EXECUTION**

### **3.1 INSTALLATION**

- .1 Install switches and E-stop pushbuttons as indicated on the Drawings.
- .2 Comply with all manufacturer's installation instructions and requirements.
- .3 Provide wiring for control devices.

### **3.2 FIELD QUALITY CONTROL**

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Depending upon magnitude and complexity, divide control system into convenient sections, energize one section at time and check out operation of section.
- .3 Upon completion of sectional test, undertake group testing.
- .4 Check out complete system for operational sequencing.

### **3.3 CLEANING**

- .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.

**END OF SECTION**