

**Part 1 General**

**1.1 REFERENCES**

- .1 Canadian Standards Association (CSA International)
  - .1 CSA C22.1-15, Canadian Electrical Code, Part 1 (23rd Edition), Safety Standard for Electrical Installations.
  - .2 CSA C22.2 No.0, General Requirements.
  - .3 CAN3-C235-83(R2010), Preferred Voltage Levels for AC Systems, 0 to 50,000 V.
- .2 Electrical and Electronic Manufacturer's Association of Canada (EEMAC)

**1.2 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.

**1.3 SUBMITTALS**

- .1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Shop drawings:
  - .1 Submit drawings stamped and signed by professional engineer.
  - .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 of drawings clearances for operation, maintenance, and replacement of operating equipment devices.
- .3 Quality Control: in accordance with Section 01 45 00 - Quality Control.
  - .1 Provide CSA certified equipment and material.
  - .2 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.
  - .3 Submit test results of installed electrical systems and instrumentation.
  - .4 Permits and fees: in accordance with General Conditions of contract.
- .4 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, as described in PART 3 - FIELD QUALITY CONTROL.

#### **1.4 QUALITY ASSURANCE**

- .1 Quality Assurance: in accordance with Section 01 45 00 - Quality Control.
- .2 Qualifications: electrical Work to be carried out by qualified, licensed electricians who hold valid Master Electrical Contractor license or apprentices in accordance with authorities having jurisdiction.
- .3 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

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

- .1 Material Delivery Schedule: provide Departmental Representative with schedule within 2 weeks after award of Contract.
- .2 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

#### **1.6 SYSTEM STARTUP**

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

#### **1.7 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.
- .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**

**2.1 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.

**2.2 ELECTRIC MOTORS, EQUIPMENT AND CONTROLS**

- .1 Verify installation and co-ordination responsibilities related to motors, equipment, and controls, as indicated.
- .2 Control wiring and conduit: in accordance with Section 26 29 03 - Control Devices except for conduit, wiring and connections below 50 V which are related to control systems specified in mechanical sections and as shown on mechanical drawings.

**2.3 WARNING SIGNS**

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

**2.4 WIRING TERMINATIONS**

- .1 Ensure lugs, terminals, screws used for termination of wiring are suitable for copper conductors, solid or stranded to suit application.

**2.5 EQUIPMENT IDENTIFICATION**

- .1 Identify electrical equipment with nameplates and labels as follows:
  - .1 Nameplates: lamicoïd 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:

<u>NAMEPLATE SIZES</u>			
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 6 mm 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.

## **2.6 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.

## **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 to EEMAC-Y1-1-1955.
  - .2 Paint indoor distribution enclosures light gray to EEMAC 2Y-1.

## **Part 3 Execution**

### **3.1 INSTALLATION**

- .1 Do complete installation in accordance with CSA C22.1 except where specified otherwise.

### **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 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.
- .3 Install electrical equipment at following heights unless indicated otherwise.
  - .1 Local switches: 1400 mm.
  - .2 Wall receptacles:
    - .1 General: 300 mm.
    - .2 In mechanical rooms: 1400 mm.
    - .3 Panelboards: as required by Code or as indicated.
    - .4 Wall mounted speakers: 2100 mm.

**3.4 FIELD QUALITY CONTROL**

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

**3.5 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           SECTION INCLUDES**

- .1       Materials and installation for wire and box connectors.

### **1.2           REFERENCES**

- .1       Canadian Standards Association (CSA International)
  - .1       CAN/CSA-C22.2 No.18-2001, Outlet Boxes, Conduit Boxes, Fittings and Associated Hardware.
  - .2       CSA C22.2 No.65-13, Wire Connectors.
- .2       Electrical and Electronic Manufacturers' Association of Canada (EEMAC)
- .3       National Electrical Manufacturers Association (NEMA)

### **1.3           WASTE MANAGEMENT AND DISPOSAL**

- .1       Separate and recycle waste materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management And Disposal.
- .2       Remove from site and dispose of all packaging materials at appropriate recycling facilities.
- .3       Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard, packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.
- .4       Divert unused wiring materials from landfill to metal recycling facility as approved by Departmental Representative.

## **Part 2           Products**

### **2.1           MATERIALS**

- .1       Pressure type wire connectors to: CSA C22.2 No.65, with current carrying parts of copper sized to fit copper conductors as required.
- .2       Fixture type splicing connectors to: CSA C22.2 No.65, with current carrying parts of copper sized to fit copper conductors 10 AWG or less.

## **Part 3           Execution**

### **3.1           INSTALLATION**

- .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 after each use.

**END OF SECTION**

**Part 1            General**

**1.1                RELATED REQUIREMENTS**

- .1            Section 26 05 20   Wire and Box Connectors   0-1000 V

**1.2                PRODUCT DATA**

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

**1.3                DELIVERY, STORAGE AND HANDLING**

- .1            Packaging Waste Management: remove for reuse of pallets, crates, padding and packaging materials] in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

**Part 2            Products**

**2.1                BUILDING WIRES**

- .1            Conductors: stranded for 10 AWG and larger. Minimum size: 12 AWG unless otherwise specified.
- .2            Copper conductors: size as indicated, with 600 insulation of cross-linked thermosetting polyethylene material rated RW90 XLPE.

**2.2                CONTROL CABLES**

- .1            Type: 600 V stranded annealed copper conductors, sizes as indicated:
  - .1            Insulation: TW and RW90 XLPE.

**2.3                INSTRUMENTATION FIELD WIRING**

- .1            Analog Signals (4-20 mA)
  - .1            Analog signals are typically 4-20 mA inputs received from remote devices and 4-20 mA outputs transmitted to remote control elements.
  - .2            Stranded and continuous run wires shall be used only, 300 volt minimum rating.
  - .3            Only 100% shielded twisted pair wiring shall be used. The shield will protect the wires from radiated EMI and RFI and reduce common mode noise problems. The twisted wire pair also eliminates noise caused by EMI and RFI sources.
  - .4            Each twisted pair shall have a complete covering of conductive material, complete with drain wire, with no opening or areas where the cable is not shielded. Braided shields shall only be permitted if they are 100% shielded. Certain braided shields do not provide 100% shielding. Each twisted pair in a multipair cable shall have its own shield. The multipair cable shall also have an overall shield, which provides extra protection for each shielded twisted pair.
  - .5            Cable Type and Manufacturer: Belden 87760

**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 before energizing electrical system.

**3.2 GENERAL CABLE INSTALLATION**

- .1 Terminate cables in accordance with Section 26 05 20 - Wire and Box Connectors - (0-1000 V).
- .2 Cable Colour Coding: to Section 26 05 00 Common Work Results for Electrical.
- .3 Conductor length for parallel feeders to be identical.
- .4 Lace or clip groups of feeder cables at distribution centres, pull boxes, and termination points.
- .5 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 BUILDING WIRES**

- .1 Install wiring as follows:
  - .1 In conduit systems in accordance with Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.

**3.4 INSTALLATION OF CONTROL CABLES**

- .1 Install control cables in conduit.
- .2 Ground control cable shield.

**3.5 INSTALLATION OF INSTRUMENTATION FIELD WIRING**

- .1 Provide and install wires of number and size (including corresponding raceways) required, with spare conductors as indicated. Provide adequate wiring for actual equipment installed.
- .2 Provide and install wire and cable according to drawings and electrical system requirements.
- .3 Pull cable into ducts, conduits in accordance with cable Section 26 05 34 – Conduits, Conduit Fastenings and Conduit fittings.

**END OF SECTION**

## **Part 1           General**

### **1.1               REFERENCES**

- .1     American National Standards Institute (ANSI)/Institute of Electrical and Electronics Engineers (IEEE)
- .2     Canadian Standards Association, (CSA International)

### **1.2               WASTE MANAGEMENT AND DISPOSAL**

- .1     Separate and recycle waste materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management And Disposal.

## **Part 2           Products**

### **2.1               EQUIPMENT**

- .1     Insulated grounding conductors: green.
- .2     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 conductors, connectors, accessories. Where conduit is used, run ground wire in conduit.
- .2     Install connectors in accordance with manufacturer's instructions.
- .3     Protect exposed grounding conductors from mechanical injury.
- .4     Use mechanical connectors for grounding connections to equipment provided with lugs.
- .5     Soldered joints not permitted.
- .6     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.
- .7     Make grounding connections in radial configuration only, with connections terminating at single grounding point. Avoid loop connections.

- .8 Bond single conductor, metallic armoured cables to cabinet at supply end.

### **3.2 EQUIPMENT GROUNDING**

- .1 Install grounding connections to typical equipment included in, but not necessarily limited to following list:
  - .1 Duct systems.
  - .2 Panels and enclosure.
  - .3 Racks and supports.

### **3.3 FIELD QUALITY CONTROL**

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Perform tests before energizing electrical system.
- .3 Disconnect ground fault indicator during tests.

**END OF SECTION**

**Part 1           General**

**1.1               WASTE MANAGEMENT AND DISPOSAL**

- .1       Separate and recycle waste materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management And Disposal.

**Part 2           Products**

**2.1               SUPPORT CHANNELS**

- .1       Hot dipped galvanized U shape, size 41 x 41 mm, 2.5 mm thick, surface mounted or suspended set in poured concrete walls and ceilings.

**2.2               FITTINGS**

- .1       Hot dipped galvanized throughout.
- .2       Sized to suit application.

**Part 3           Execution**

**3.1               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 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 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       Provide metal brackets, frames, hangers, clamps and related types of support structures where indicated or as required to support conduit and cable runs.
- .6       Ensure adequate support for raceways and cables dropped vertically to equipment where there is no wall support.
- .7       Do not use wire lashing or perforated strap to support or secure raceways or cables.
- .8       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.

- .9 Install fastenings and supports as required for each type of equipment cables and conduits, and in accordance with manufacturer's installation recommendations.

**END OF SECTION**

**Part 1            General**

**1.1                REFERENCES**

- .1        Canadian Standards Association (CSA International)
  - .1            CSA C22.1-12, Canadian Electrical Code, Part 1, 22nd Edition.

**1.2                SUBMITTALS**

- .1        Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2        Product Data:
  - .1            Provide manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.
- .3        Provide shop drawings: in accordance with Section 01 33 00 - Submittal Procedures.

**1.3                DELIVERY, STORAGE AND HANDLING**

- .1        Waste Management and Disposal:
  - .1            Separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

**Part 2            Products**

**2.1                JUNCTION AND PULL BOXES**

- .1        Construction: welded steel enclosure.
- .2        Covers Surface Mounted: screw-on flat covers.

**2.2                CONDUIT BOXES**

- .1        Cast iron boxes with factory-threaded hubs and mounting feet for surface wiring of devices.
- .2        Suitable for use as pull or splice box, change in conduit direction or to terminate cable connections.
- .3        Sized to suit number of conductors, and rated for the available voltage.

**Part 3            Execution**

**3.1                INSTALLATION**

- .1        Support boxes independently of connecting conduits.
- .2        Fill boxes with paper, sponges or foam or similar approved material to prevent entry of debris during construction. Remove upon completion of work.

- .3 For flush installations mount outlets flush with finished wall using plaster rings to permit wall finish to come within 6 mm of opening.
- .4 Provide correct size of openings in boxes for conduit, mineral insulated and armoured cable connections. Do not install reducing washers.
- .5 Vacuum clean interior of outlet boxes before installation of wiring devices.

**3.2 IDENTIFICATION**

- .1 Equipment Identification: to Section 26 05 00 - Common Work Results for Electrical.
- .2 Identification Labels: size 2 indicating system name, voltage and phase or as indicated.

**END OF SECTION**

## **Part 1 General**

### **1.1 REFERENCES**

- .1 Canadian Standards Association (CSA International)
  - .1 CAN/CSA C22.2 No. 18, Outlet Boxes, Conduit Boxes, Fittings and Associated Hardware, A National Standard of Canada.
  - .2 CSA C22.2 No. 45, Rigid Metal Conduit.
  - .3 CSA C22.2 No. 56, Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit.

### **1.2 SUBMITTALS**

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

### **1.3 WASTE MANAGEMENT AND DISPOSAL**

- .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

## **Part 2 Products**

### **2.1 CONDUITS**

- .1 Rigid metal conduit: to CSA C22.2 No. 45, galvanized steel threaded.
- .2 Electrical metallic tubing (EMT): to CSA C22.2 No. 83, with couplings.
- .3 Flexible metal conduit: to CSA C22.2 No. 56, steel liquid-tight flexible metal.

### **2.2 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 Threaded rods to support suspended channels.

### **2.3 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.

### **2.4 EXPANSION FITTINGS FOR RIGID CONDUIT**

- .1 Weatherproof expansion fittings with internal bonding assembly suitable for 100 mm linear expansion.

- .2 Watertight expansion fittings with integral bonding jumper suitable for linear expansion and 19 mm deflection.
- .3 Weatherproof expansion fittings for linear expansion at entry to panel.

## **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 Surface mount conduits except where specified otherwise.
- .3 Minimum conduit size: 21 mm except where specified otherwise.
- .4 Bend conduit cold:
  - .1 Replace conduit if kinked or flattened more than 1/10th of its original diameter.
- .5 Mechanically bend steel conduit over 21 mm diameter.
- .6 Field threads on rigid conduit must be of sufficient length to draw conduits up tight.
- .7 Install fish cord in empty conduits.
- .8 Remove and replace blocked conduit sections.
  - .1 Do not use liquids to clean out conduits.
- .9 Dry conduits out before installing wire.

### **3.3 SURFACE CONDUITS**

- .1 Run parallel or perpendicular to building lines.
- .2 Locate conduits behind infrared or gas fired heaters with 1.5 m clearance.
- .3 Run conduits in flanged portion of structural steel.
- .4 Group conduits wherever possible on surface channels.
- .5 Do not pass conduits through structural members except as indicated.
- .6 Do not locate conduits less than 75 mm parallel to steam or hot water lines with minimum of 25 mm at crossovers.

### **3.4 CLEANING**

- .1 Proceed in accordance with Section 01 74 11 - Cleaning.

- .2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

**END OF SECTION**

**Part 1            General**

**1.1                SECTION INCLUDES**

- .1        Materials and installation for industrial control devices including control and relay panels.

**1.2                REFERENCES**

- .1        Canadian Standards Association (CSA International)
  - .1        CSA C22.2 No.14-95(R2013), Industrial Control Equipment.
- .2        National Electrical Manufacturers Association (NEMA)
  - .1        NEMA ICS 1-2006, Industrial Control and Systems: General Requirements.

**1.3                SHOP DRAWINGS**

- .1        Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
- .2        Include schematic, wiring, interconnection diagrams.

**1.4                QUALITY ASSURANCE**

- .1        Submit to Departmental Representative one copy of test results.

**1.5                WASTE MANAGEMENT AND DISPOSAL**

- .1        Separate and recycle waste materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management And Disposal.

**Part 2            Products**

**2.1                TANK FILL ALARM REMOTE PANEL**

- .1        3 hole enclosure for 30mm pilot devices
- .2        Material: Thermoplastic
- .3        Seals: EPDM
- .4        Top entry for 16mm threaded RGS conduit
- .5        Furnish with:
  - .1        Qty 2 pushbuttons, 1 N.O and 1 N.C. contact block, black with custom legend plates:
    - .1        "Acknowledge"
    - .2        "Test"
  - .2        Qty 1 pilot light, Red LED, 120VAC power module, with custom legend plate:
    - .1        "Overfill"
- .6        Degree of protection: IP66, Type 4X, Class 1, Zone 1 hazardous location

- .7 Operational temperature range: -55°C to +70°C
- .8 Acceptable manufactures:
  - .1 Allen-Bradly model bulletin 800G Hazardous Location Control Station, or
  - .2 Approved equal

## **2.2 INDICATING HORNS**

- .1 Degree of protection: IP66, Type 4X
- .2 Operational temperature range: -55°C to +50°C
- .3 Sound level: minimum 80db
- .4 Input voltage: 120VAC, 60Hz
- .5 Conduit entry for 21mm threaded RGS conduit
- .6 Mounting: surface or conduit
- .7 Acceptable manufactures:
  - .1 Crouse-Hinds model ETH Series, or
  - .2 Approved equal

## **2.3 FUEL MANAGEMENT SYSTEM**

- .1 Multiple tank liquid level detection system complete with LCD touch screen and thermal printer.
- .2 Input voltage: 120VAC
- .3 Features:
  - .1 Minimum tanks to be monitored: 1
  - .2 Maximum tanks to be monitored: 4
  - .3 Display type: touch screen backlit LCD
  - .4 Printer: thermal
  - .5 Capable of measuring petroleum (diesel)
  - .6 Remote alarm testing
- .4 Input / Output
  - .1 Inputs for tank level sensors (up to four minimum)
  - .2 Input for remote TEST and ACKNOWLEDGE pushbuttons
  - .3 Output for remote audible and visual alarm conditions
- .5 Acceptable manufacturer:
  - .1 Incon model TS-550 Fuel Management System, or
  - .2 Approved equal

## **2.4 LEVEL PROBE**

- .1 Measurement technology: Magnetostrictive position
- .2 Operating temperature: -40°C to +60°C

- .3 Non-linearity: +/- 0.025% of full scale
- .4 Repeatability: +/- 0.001”
- .5 Temperature sensors: 5 thermistors located in shaft
- .6 Temperature resolution: +/- 0.01°C
- .7 Probe pigtail: 3048mm long two conductor cable with shield and polyurethane jacket
- .8 Shaft, E-ring and washer materials:
  - .1 #316 stainless steel
  - .2 Housing; anodized aluminum, MIL-A-8625C, Type 2, Class 2
- .9 Floats: nitrophenyl, PVDF and nickel plated brass
- .10 Length: as required (contractor to verify tank dimensions)
- .11 Compatibility: must work with Fuel Management System
- .12 Acceptable manufacturer:
  - .1 Incon model TSP-LL2, or
  - .2 Approved equal

### **Part 3 Execution**

#### **3.1 INSTALLATION**

- .1 Install control panels, control devices and interconnect as indicated in drawings and per manufacturer’s instruction.

#### **3.2 START-UP AND FIELD QUALITY CONTROL**

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Coordinate and modify the system hardware and software components for continuous reliable operation of equipment and system features.
- .3 Provide the necessary manpower and test equipment to perform tests and demonstrations.
- .4 Correct any deficiencies detected, and schedule a new time for continuing the tests.
- .5 Arrange for and retain a manufacturer’s representative field service technician to setup, adjust, calibrate, and commission the fuel management system.

#### **3.3 SITE ACCEPTANCE TESTS (SAT)**

- .1 Perform Site Acceptance tests for the following:
  - .1 Fuel Management System
    - .1 Fuel level is accurately displayed at controller
    - .2 An overflow alarm is enunciated at 85% tank full and,
      - .1 The outside alarm horn is enabled
      - .2 The outside fill light is on
    - .3 The outside ‘acknowledge’ button will silence the alarm horn
    - .4 The outside fill light turns off when the fuel oil level is less than 85%

- .5 The outside 'test' button activates the outside alarm horn and fill light until the 'acknowledge' button is pressed
- .6 Ability to recover after a power down event
- .2 Test Format: Cause and Effect.
  - .1 Person conducting test initiates an input (cause).
  - .2 Specific test requirement is satisfied if correct result (effect), occurs.
- .3 Procedures, Forms, and Checklists:
  - .1 Conduct tests in accordance with, and documented on, Departmental Representative accepted procedures, forms and checklists.
  - .2 Describe each test item to be performed.
  - .3 Have space after each test item description for sign off by appropriate party after satisfactory completion.
- .4 Conducting Tests:
  - .1 Wherever possible, perform tests using actual process variables, equipment, and data.
  - .2 If not practical to test with real process variables, equipment, and data, provide suitable means of simulation.
  - .3 Define simulation techniques in test procedures.
- .5 Test Requirements:
  - .1 Conduct the tests when the installation of fuel management system has been completed and equipment has been thoroughly tested.
  - .2 Perform a witnessed SAT on the complete system to demonstrate that it is operating as required. Demonstrate each required function on an equipment by equipment basis.
  - .3 Demonstrate that the system functions as specified.

- .4 Make updated versions of documentation required for SAT available to Departmental Representative at site, both before and during tests.
- .5 Make one copy of O&M manual available to Departmental Representative at the site both before and during testing.
- .6 Co-ordinate site acceptance testing with Departmental Representative and affected Subcontractors.
- .7 Departmental Representative may actively participate in the tests.
- .8 Departmental Representative reserves right to test or retest all specified functions whether or not explicitly stated within test procedures. The Departmental Representative's decision will be final regarding acceptability and completeness of all testing.

**END OF SECTION**