

**SPECIFICATION NUMBER: TPCG91013**  
**TERREBONNE PARISH CONSOLIDATED GOVERNMENT**  
**SEWER-POLLUTION CONTROL**  
**STANDARD RADIO TELEMETRY PUMP CONTROL PANEL**

**SCOPE**

This specification shall cover the standard Terrebonne Parish Consolidated Government Sewer-Pollution Control's Radio Telemetry Duplex Pump Lift Station Electrical Control System as shown on the plans and as specified herein. All necessary appurtenances which might normally be considered a part of the complete Electrical Control System shall be provided. All of the automatic control equipment is to be supplied by one MANUFACTURER. It shall be assembled, wired and tested, and provided with complete electrical drawings and instructions.

**RADIO TELEMETRY DUPLEX PUMP CONTROL SYSTEM - GENERAL**

The Radio Telemetry Duplex Pump Control System shall include and not be limited to PLC, power supplies, digital input modules, analog input modules, Ethernet switch, touch screen, batteries, battery chargers, modems, circuit breakers, transformers, enclosures, and antenna, antenna tower, and antenna base structure as required for a complete Radio Telemetry Duplex Pump Control System capable of interfacing with the existing Terrebonne Parish Consolidated Government Sewer-Pollution Control's SCADA System by radio communications.

**CODES AND STANDARDS**

The Duplex Pump Control Panel shall comply with 2008:NFPA 70: Article 409, Industrial Control Panels and UL 508A, Industrial Control Panels. All component parts within the control panel assembly shall be UL listed for the application and shall be capable of operating within a temperature range of -5 to +60 degrees centigrade.

The battery compartment containing the battery chargers and batteries shall comply with 2008:NFPA 70: Article 409, Industrial Control Panels and UL 508A, Industrial Control Panels. All component parts within the control panel assembly shall be UL listed for the application and shall be capable of operating within a temperature range of -5 to +50 degrees centigrade.

The Antenna System shall comply with 2008:NFPA 70: Article 820, Community Antenna Television and Radio Distribution Systems.

**ENCLOSURES**

Enclosures shall be NEMA 4X, Type 304, stainless steel with painted steel backpanels, sized to accommodate controls, batteries, battery chargers, etc. as specified on drawings and as specified herein.

## **PROGRAMMABLE LOGIC CONTROLLER (PLC)**

The Duplex Pump Control Panel shall contain a backpanel mounted PLC to accept digital and analog inputs, produce digital signals, perform logical control functions, transmit measured and calculated values to the TPCG Sewer-Pollution Control's central SCADA System, control the operation of the two Duplex Pumps in the Lift Station, and receive command signals and configuration data from the TPCG Sewer-Pollution Control's central SCADA System. The PLC shall be 100% compatible with the existing TPCG Sewer-Pollution Control's SCADA System and shall be as manufactured by Modicon, BMXP342020. The PLC shall contain a LED display, a USB port, an Ethernet port, a memory card slot, and a modbus serial port. The PLC shall contain 8 MB program memory.

The PLC shall consist of the following component parts:

- One each PLC backplane-8 slot, Modicon BMXXBP0800
- One each 24 volt DC to DC power supply, Modicon BMXCPS3020
- One each digital input module, Modicon BMXDDI1602
- One each digital output module, Modicon BMXDRA1605
- One each PLC, Modicon BMXP342020
- One each memory card, 8 MB, Modicon BMXRMS008MPF
- One each analog input card, Modicon BMXAMI0410
- Three each screw terminal strip, Modicon BMXFTB2000

## **MOTOR CIRCUIT PROTECTORS**

Motor circuit protectors shall be provided for each pump and shall be sized for the pump horsepower and voltage. Motor circuit protectors shall be backpanel mounted and extend through the dead front door for operation without opening the dead front door. Motor circuit protectors interrupting capacity shall be not less than as specified in the Pump Control Panel Motor Schedule. Motor circuit protectors shall be as manufactured by Siemens, Square D, General Electric, or Cutler-Hammer.

## **ALTERNATING CURRENT (AC) CIRCUIT BREAKERS**

Alternating current circuit breakers (AC) shall be provided as shown on the drawings. Alternating current circuit breakers shall be backpanel mounted and extend through the dead front door for operation without opening the dead front door. Motor circuit breaker interrupting capacity shall not be less than as specified in the Pump Control Panel Motor Schedule. AC circuit breakers shall be as manufactured by Siemens, Square D, General Electric, or Cutler-Hammer.

## **DIRECT CURRENT (DC) CIRCUIT BREAKERS**

Direct current circuit breakers (DC) shall be provided as shown on the drawings. Direct current circuit breakers shall be backpanel mounted and extend through the dead front door for operation without opening the dead front door. Direct circuit breaker interrupting capacity shall not be less than 1,500 amps. DC circuit breakers shall be 10 amp rated, two-pole, as manufactured by IDEC #NRC210 0 L 10 ED or equal.

## **DC RELAYS**

DC relays shall be compact miniature power relays with 10 amp rated contacts, 24 DC volt coil, LED indicator, plug-in type with a standard DIN rail mounted socket. Relays shall be as manufactured by IDEC #RH\_BUL Series with SH\_B05 socket or equal.

## **AC RELAYS**

AC relays shall be compact miniature power relays with 10 amp rated contacts, 120 AC volt coil, LED indicator, plug-in type with a standard DIN rail mounted socket. Relays shall be as manufactured by IDEC #RH\_BUL Series with SH\_B05 socket or equal.

## **INTRINSICALLY SAFE BARRIER RELAY**

Intrinsically safe barrier relays shall be dual channel, DIN rail mountable, 20 to 125 volt AC input, dual form C (SPDT) output contacts as manufactured by Turck IM1-231Ex-R or approved equal.

## **UNIVERSAL THREE PHASE VOLTAGE MONITOR RELAY (PHASE MONITOR)**

Universal three phase voltage monitor relay (Phase Monitor) shall continuously monitor each of the three phases and compare the value to pre-set trip points. The relay shall sense phase reversal, over, under, and unbalanced voltages including phase lost, and over and under frequency. Adjustable time delays shall be included to prevent nuisance tripping. One normally open and one N.C. SPST contact shall be provided. Three phase voltage monitor relay shall be as manufactured by ABB #DLM U B N 04 A A or equal. Relay shall be DIN rail mounted on the backpanel.

## **240 VOLT SINGLE PHASE VOLTAGE MONITOR RELAY (PHASE MONITOR)**

240 volt single phase voltage monitor relays shall be compact miniature power relays with 10 amp rated contacts, 240 volt coil, LED indicator, plug-in type with a standard DIN rail mounted socket. Relays shall be as manufactured by IDEC #RH2-BUL with SH2-B05 socket or equal.

## **240 VOLT SINGLE PHASE MOTOR STARTING RELAY (SINGLE PHASE PUMPS)**

Universal single phase motor starting relays shall be rated for 110-270 volts AC, single phase with a maximum voltage contact rating of 502 VAC. Maximum motor starting rating shall be 10 horsepower. Contacts shall be rated 50 amps (break only), 400 VAC at .7 to .8 power factor. Universal single phase motor starting relays shall be as manufactured by ICM Controls, Model #UMSR-50 or equal. Motor starting relay shall be backpanel mounted.

## **MOTOR START AND RUN CAPACITORS**

The size and voltage rating of the motor start and run capacitors shall be as directed by the Pump Manufacturer. Motor start and run capacitors shall be backpanel mounted.

## **SUBMERSIBLE LEVEL TRANSMITTER WITH INTRINSICALLY SAFE BARRIER**

Submersible level transmitter shall be a loop powered/4-20 ma transmitter with a 316 stainless steel Teflon coated housing, heavy duty polyethylene with vent tube shielded 18 AWG cable, sealed breather system for atmosphere pressure equalization, 1" pipe mount, two layer diaphragm with Teflon and Buna-N material, 4-20 ma output, 15 psi pressure range, and a temperature range -40 to 85 degrees centigrade. Transmitter shall be FM approved and intrinsically safe Class 1, Div. 1, Groups A, B, C, D with approved barrier. Accuracy shall be .25% full scale with long term stability of .2% full scale per year. Transmitter shall be as manufactured by Siemens #6012950013 with #6012640003 housing/cable sub-assembly with 1/8"- 316 stainless steel chain, #601418001 cable suspension mounting pipe. Transmitter intrinsically safe barrier shall be as manufactured by Siemens #IS-2.

## **INCOMING POWER TERMINAL BLOCKS**

Incoming power terminal blocks shall be DIN rail mounted or backpanel mounted and shall be rated at the current and voltage rating of the main disconnect switch or service. Incoming power blocks wire size shall be sized for the wire size of the main disconnect.

## **CONTROL TERMINAL BLOCKS**

Control terminal blocks shall be DIN rail mounted, 120 volts at 20 amp rated, sized with a maximum wire size of #10.

## **120 VOLT INDICATOR LIGHTS**

120 volt indicator lights shall be 30 mm, heavy duty, watertight/oiltight, Class 52, full voltage type AC/DC with LED lamp and plastic lens' color as shown on drawings. Indicator lights shall be as manufactured by Siemens, Square D, Cutler-Hammer, General Electric, Allen-Bradley, or equal.

## **24 VOLT INDICATOR LIGHTS**

24 volt indicator lights shall be 30 mm, heavy duty, watertight/oiltight, Class 52, full voltage type AC/DC with LED lamp and plastic lens' color as shown on drawings. Indicator lights shall be as manufactured by Siemens, Square D, Cutler-Hammer, General Electric, Allen-Bradley, or equal.

## **HAND-OFF-AUTOMATIC SELECTOR SWITCHES**

Hand-Off-Automatic selector switches shall be 30 mm, heavy duty, watertight/oiltight, Class 52, non-illuminated, short lever, maintain contact, 120 volt rated, as manufactured by Siemens, Square D, Cutler-Hammer, General Electric, Allen-Bradley, or equal.

## **SEAL FAILURE/MOTOR HIGH TEMPERATURE CONTROLS**

Seal failure/motor high temperature controls shall be 120 VAC powered, backpanel or socket mounted, furnished by the Pump Manufacturer.

The Duplex Control Ladder Diagram shows three (3) terminal configurations for different types of seal failure/motor high temperature controls as follows:

1. Flyght pumps utilize two (2) 11 pin sockets for the 110 volt seal failure/motor high temperature control. The socket pin connections are shown as hexagons on the Duplex Control Ladder Diagram.
2. Pump Suppliers that utilize the Symcon seal failure module will require the installation of two (2) 8 pin sockets and a four (4) terminal strip for the motor high temperature control. The socket pin connection is shown as a circle on the Duplex Control Ladder Diagram with the terminal strips as a square.
3. Other manufacturers utilizing a backpanel mounted seal failure/motor high temperature control shall be wired to an eighteen (18) terminal strip. The terminal strip numbers are shown as squares on the Duplex Control Ladder Diagram.

### **SELF-PRIMING PUMP CONTROL PANELS**

Control panels for self-priming pumps shall be supplied with seal failure capabilities utilizing a backpanel mounted seal failure eighteen (18) terminal strip. Terminals 1 and 2 shall be supplied with a jumper. Terminals 3 and 4 shall be supplied with a jumper. Panel Manufacturer shall provide adequate space on the backpanel mounted din rail for the owner to install two (2) 8 pin or two (2) 11 pin sockets.

### **BATTERIES**

Batteries shall be absorbent glass mat technology, valve regulated, spill proof constructed with impact resistant ABSK case and cover (UL94-HB) and UL recognized under file number MH 20845. Batteries shall be 12 volt, 7.2 AH, rechargeable seal lead acid batteries as manufactured by Power Sonic Model PS-1272 F2 or equal.

### **BATTERY CHARGERS**

Battery chargers shall be 12 volt DC, 5 amp output rating with automatic shutoff. Battery charger(s) shall automatically shut down when battery is fully charged, automatically power ON when needed, and shall contain an LED charge light indicating charge status. Battery charger can be permanently attached. Input voltage is 120 volt VAC. Battery charger shall be as manufactured by Deltran, Battery Tender 0220157-1.

### **BATTERY ENCLOSURE 120 VOLT OUTLET**

Battery enclosure 120 volt outlet shall be installed in a backpanel mounted 4" x 2-1/8" x 2-1/8" deep metal utility box as manufactured by Steel City, #58371-1/2 with a 68-C-7 metal utility box cover. Receptacle outlet shall be 20 amp, 125 volt, duplex heavy duty specification grade, flush, nylon face, back and side wired, multiple drive screws, brown in color, as manufactured by Hubbell 5362.

## **CONTROL POWER TRANSFORMERS (480 VOLT PANELS ONLY)**

All 480 volt control panels shall be provided with a 480/1/60 primary to 120/240/1/60 volt secondary, NEMA 4X enclosed, 3,000 volt\*amp control power transformer to provide power to 120 volt loads. Control power transformers shall be insulated for Class 130°C. and shall be totally encapsulated. Transformer shall be as manufactured by Eaton, Square D, Siemens, General Electric equal. Installation shall be by Contractor.

## **FLOAT LEVEL SWITCHES**

Float level switches shall be suspended type containing a snap-action switch activated by a steel ball rolling back and forth within a switching tube in a plastic float housing. Minimum differential between "ON" and "OFF" shall be approximately 3.5 inches. Float switch shall be normally open, mercury free with 30' of cord. The cable shall be permanently connected to the enclosed snap-action switch, and the entire assembly shall be encapsulated to form a completely watertight and impact resistant unit. The unit shall include a built in weight. The cable shall be PVC type STO #18 conductor rated at 600 volts. Float switch shall be normally open, as manufactured by Anchor Scientific Eco-Float, Model #GSE30NO or equal.

## **DC TO DC CONVERTER**

DC to DC converter shall be DIN rail mounted with an input voltage range of 18 to 75 volts DC with an output voltage range of 24 to 28 volts DC at 1 amp. Maximum input power shall be 1.0 watts. Under voltage shutdown shall be 15.7 VDC. Converter efficiency shall be 86% minimum. Output ripple shall be less than 50 mV peak to peak. Output voltage regulation shall be  $\pm 0.5\%$  maximum. Converter shall be short circuit current limited at 110%.

Converter general specifications shall be as follows:

Temperature: Operating	-10°C to 70°C max (14°F to 158°F max)
Storage	
(non-operating)	-25°C to 85°C max (-13°F to 185°F max)
Derating	1.5%/K above 50°C (122°F)
Humidity (non-condensing)	95% relative humidity max
Temperature Coefficient	0.02%/K
Switching Frequency	55 – 180 kHz depending on load (frequency modulation)
Isolation Voltage (1 min) –	
Input/Output	1500 VDC
Electromagnetic Compatibility	
(EMC), Emissions	EN 61000-6-3
Electromagnetic Compatibility	
(EMC), Immunity	EN 6100-6-2

DC to DC converter shall be as manufactured by Rhino Model # PSP24-DC24-1 or prior approved equal.

## **TOUCHSCREEN**

The touchscreen shall be dead front door panel mounted where shown on the drawings. The touchscreen shall be 100% compatible with existing touchscreens currently in use by Terrebonne Parish Consolidated Government. The touchscreen shall be an advanced touchscreen type.

### Main

Range of product	Magelis XBTGT
Product or component type	Advanced touchscreen panel
Display type	Backlit colour TFT LCD
Display colour	256 colours
Display resolution	320 x 240 pixels QVGA
Display size	3.8 inch
Software type	Configuration software
Software designation	Vijeo Designer
Operating system	Magelis
Processor name	CPU RISC
Processor frequency	200 MHz
Memory description	Application memory flash EPROM 32 MB Back up of data SRAM 512 kB lithium battery
Integrated connection type	Ethernet TCP/IP RJ45 COM 1 serial link RJ45 RS232C/RS485 <=115.2 kbits/s Power supply removable screw terminal block USB type A master port (V1.1) Modicon M340 terminal port communication
Resistance to electrostatic discharge	6kV IEC 61000-4-2 level 3
Cut-out dimensions	118 (+ 1/-0) x 92.5 (+ 1/-0) mm

The Touchscreen shall be as manufactured by Magelis Model # XBTGT1335. Touchscreen shall be connected to the PLC with a Magelis Model # XBTZ9980 serial cable.

## **INDUSTRIAL 900 MHZ TRANSMITTER/RECEIVER**

The industrial 900 MHZ transmitter/receiver shall utilize advanced 900 MHZ FHSS technology for licensed-free operation in the 902 to 928 MHZ ISM band. The transmitter/receiver shall have a range of 15 miles with a 1 Mbps data rate for IP/Ethernet communications. The unit shall be configured as a remote Ethernet bridge.

### General

Data Rate	1 Mbps/512 Kbps user configured air link 1,200-115,200 bps serial ports
Frequency Band	902-928 MHz ISM band
Spreading Mode	DTS/FHSS
Range (512 Kbps) <sup>2</sup>	Typical fixed range: 12 miles Maximum fixed range: 30 miles

Range (1 Mbps) <sup>2</sup>	Typical fixed range: 8 miles Maximum fixed range: 15 miles
Available Configurations	Remote Ethernet Bridge – Ethernet only
<u>Physical Interface</u>	
Ethernet	10 BaseT, RJ-45
Serial	COM1: RS-232/V.24, DB-9F, DCE COM2: RS-232/V.24, DB-9M, DTE 1,200-115-200 bps serial ports
Antenna	TNC connector (female)
LEDs	Lan, Com1, Com2, Power, Link
<u>Protocols</u>	
Wireless	CSMA/CA (Collision Avoidance)
Ethernet	IEEE 802.3, Ethernet II, IEEE 802.1Q (trunk, access, and native) STP, IGMP
TCP/IP	DHCP, ICMP, UDP, TCP, ARP, Multicast, SNTP, TFTP
Serial	PPP, encapsulation over IP (tunneling) for serial async multidrop protocols including Modbus, DNP.3, DF1, BSAP
Optional	Allen-Bradley EtherNet/IP – Modbus/TCP
<u>Radio</u>	
System gain	139 dB @ 512 Kbps; 134 dB @ 1 Mbps
Carrier Power	100 mW to 1 watt (20 to 30 dBm)
Output Impedance	50 Ohms
Occupied Bandwidth	600 kHz
Modulation	CPFSK (Continuous Phase FSK)
Receiver Sensitivity	-92 dBm @ 512 Kbps with 10 <sup>-6</sup> BER -100 dBm @ 1 Mbps with 10 <sup>-6</sup> BER
<u>Management</u>	
	HTTP, HTTPS, SSH, TELNET, local console SNMPv1/v2/v3, MIB II, Enterprise MIB SYSLOG MDS NETview MS™
<u>MDS Cyber Security Suite,</u>	
<u>Level 4</u>	
Encryption	AES-128 with automatic key rotation (optional)
Authentication	802.1x, RADIUS, EAP/TLS, PKI, PAP, CHAP
Traffic Segregation	802.1Q VLAN
Management	SSL, SSH, HTTPS
<u>Environmental</u>	
Temperature	-30°C to 60°C (-22°F to 140°F)
Humidity	95% at 40°C (104°F) non-condensing
<u>Electrical</u>	



Input power	10.5-30 Vdc			
Current consumption (nominal)	Mode	Power	13.8 Vdc	24 Vdc
	Transmit	7W	510 mA	290 mA
	Receive	2.8W	200 mA	120 mA

Mechanical

Case	die cast aluminum
Dimensions	3.15 H x 17.2 W x 11.2 D cm (1.25 H x 6.75 W x 4.5 D in.)
Weight	908 g (2 lb.)
Mounting Options	DIN rail

Agency Approvals

FCC part 15.247 (DTS)  
IC

The Industrial 900 MHZ Transmitter/Receiver shall be as manufactured by GE Model# MDS INET-II 900 with 03-4125A04 Din Rail Bracket Kit.

**900 MHZ YAGI ANTENNA**

Antenna shall be a high gain, directional YAGI antenna for 902 to 928 MHZ frequency range. Antenna gain shall be 15 dBi with an impedance of 50 Ohms and a front-to-back ratio of 19 dB. Standard connector shall be N-female. Maximum input power shall be 50 watts.

Antenna shall be as manufactured by Wade Antenna, Inc. Model #Y915-15. Maximum projected antenna area is 1.0 square feet.

**ANTENNA CABLE**

Antenna cable shall be a flexible low loss outdoor/watertight coaxial communications cable with UV resistant polyethylene jacket for 20 year service. Specifications are as follows:

Mechanical Specifications

<u>Performance Property</u>	<u>Units</u>	<u>US</u>
Bend Radius: installation	in.	1.50
Bend Radius: repeated	in.	6.0
Bending Moment	ft-lb	2.75

Electrical Specifications

<u>Performance Property</u>	<u>Units</u>	<u>US</u>
Velocity of Propagation	%	87
Dielectric Constant	NA	1.32
Time Delay	nS/ft	1.17
Impedance	ohms	50
Capacitance	pF/ft	23.4
Inductance	uH/ft	0.058
Shielding Effectiveness	dB	>90

DC Resistance

Inner Conductor	ohms/1000ft	0.53
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Outer Conductor	ohms/1000ft	1.2
Voltage Withstand	Volts DC	4000
Jacket Spark	Volts RMS	8000
Peak Power	kW	40
Attenuation dB/100 ft	900 MHZ	2.5
Avg. Power kW	900 MHZ	0.93

Cable shall be as manufactured by TMS-COAX Model #LMR-600-DB or prior approved equal.

### **COAXIAL SURGE SUPPRESSOR**

The coaxial surge suppressor shall be installed on the bottom of the pump control panel through a one inch hole. The suppressor shall consist of a 50 ohms high energy coaxial gas tube. The device shall be hermetically sealed, bipolar, and terminated with N-female connectors. Surge suppressor maximum wattage shall be 30 watts. Maximum surge current with an 80/20  $\mu$ s surge shall be 75 kA.

Surge suppressor shall be as manufactured by Lightning Protection Corporation Model # LPC 10755-3 or prior approved equal.

### **CONTROL MANUFACTURER**

The control system described hereafter shall be as manufactured by a specialty MANUFACTURER with a minimum of five years experience in the construction of sewage pump control panels.

### **QUALITY ASSURANCE**

The MANUFACTURER shall maintain quality in both design and workmanship as well as materials used in the manufacture of equipment supplied. All equipment supplied under this Contract shall be of new and UL listed for the application.

The MANUFACTURER shall be a firm that is engaged in the manufacturing of control panels with a minimum of five years' experience.

MANUFACTURER shall be responsible for detailed engineering, manufacture, test, start-up and demonstration of all equipment.

Programming shall be provided by the OWNER.

MANUFACTURER shall provide coordination assistance, necessary for calibration of overall control system and to resolve interface discrepancies between panels, equipment, instrumentation and final control devices. Where interface conflicts exist, the MANUFACTURER shall document conflicts in writing to the ENGINEER providing absolute information such as terminal numbers, device name, tests performed and diagnosis of problem.

## **DOCUMENTATION**

The complete assembly shall be provided with job-specific wiring diagrams, parts lists, enclosure dimensional and door layout drawings and instructions.

Production Schematics shall be submitted for approval for all equipment herein specified. The Production Schematics Submittal shall include a document List. An Order Specification shall be included which shall describe in detail the major functionality of the equipment being provided as well as components used detailed down to major component level. Each panel shall be provided with a job-specific wiring diagram, parts list, enclosure door layout and enclosure dimension drawing. MANUFACTURER'S wiring diagrams that are not job-specific (standard drawings with options crossed out, etc.) are not acceptable. The wiring diagram requirement applies to all field mounted instrumentation and control equipment. Interconnection details shall be shown for all field mounted instrumentation. A Description of Operation shall be provided detailing the operation of the complete system, including the control and alarm handling.

MANUFACTURER shall provide As-built Drawings and Instruction Manuals. These manuals shall include corrected Shop Drawings. In addition, a detailed Operations Manual for the PLC shall be included. The manual shall include all information as detailed for the Shop Drawing Submittals above.

## **WIRING**

All wiring shall be minimum 600 volt UL type MTW or AWM and have a current-carrying capacity of not less than 125% of the full load current. The conductors shall be in complete conformity with the National Electric Codes, state, local and NEMA electrical standards. For ease of servicing and maintenance, all wiring shall be color coded. The wire color code shall be clearly shown on the drawings, with each wire's color indicated.

In addition, the equipment wiring shall be permanently marked with wire numbers that correspond to the system schematics. The numbering convention shall comply with the municipal industry standard.

All control wiring shall be contained within plastic/PVC wiring duct with covers. Where dimensional constraints prevent the use of wiring duct, wires shall be trained to panel components in groupings. The wire groupings shall be bundled and tied not less than every 3 inches with nylon self-locking cable ties as manufactured by Panduit or equal.

Every other cable tie shall be fastened to the enclosure door or inner device panel with a cable tie mounting plate with pressure tape. Where wiring crosses hinged areas, such as when trained from the inner device panel to the enclosure door, spiral wrap shall be used.

## **NAMEPLATES**

All major components and sub-assemblies shall be identified as to function with laminated, engraved bakelite nameplates, or similar approved means.

## **WARRANTY**

All equipment shall be guaranteed against defects in material and workmanship for a period of one year after installation, start-up, and beneficial use by OWNER or 18 months whichever occurs first.

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