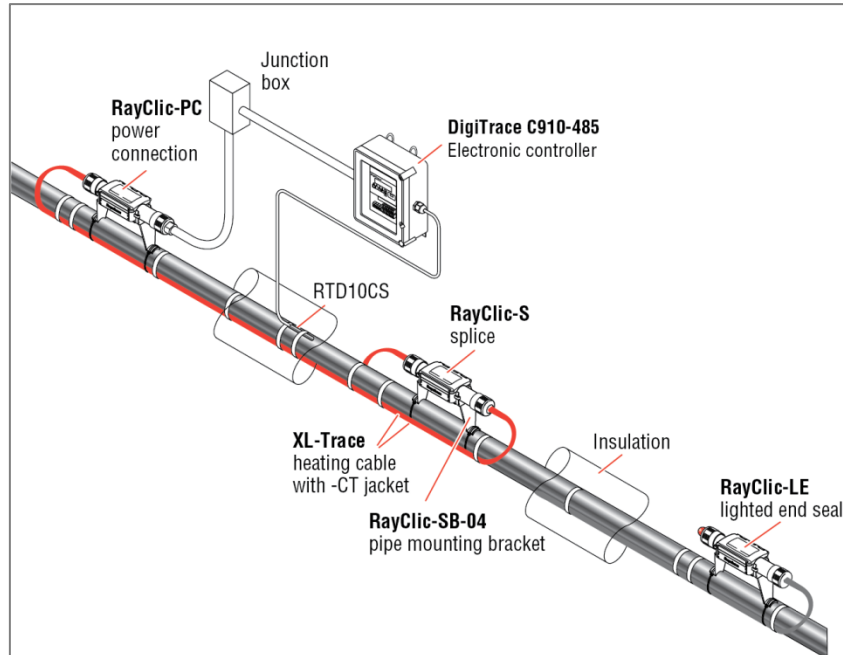


CSI Master Format 2004 Guide Specification for: Flow Maintenance of Aboveground Fuel Oil Lines



System for flow maintenance of aboveground fuel oil lines with Proportional Ambient Sensing Control (PASC), monitoring, integrated ground-fault circuit protection and BMS communication capabilities.

Scope

This specification describes an energy efficient flow maintenance system for aboveground fuel oil lines. Fuel lines are defined as those carrying #2 fuel oil. A fuel line flow maintenance system is designed to maintain the line at 40°F (4°C).

The first page gives a general overview of the system and the CSI formatted specification begins on page 4.

System Description

Self-Regulating Heating Cable

5/8/12 W/ft, 120-277 V, Raychem XL-Trace heating cable with fluoropolymer outer jacket (-CT). The heating cable shall be part of a UL Listed, CSA Certified and FM Approved system.

System Connection Kits

Raychem RayClic connection kits for power connections, tees/splices and end seals.

Controller

Single Circuit Control

DigiTrace C910-485 digital controller with:

- Proportional Ambient Sensing Control (PASC).
- BMS interface.
- Two (2) temperature inputs.
- 30 A switching capacity rating.
- Selectable fail safe mode, either ON or OFF.
- NEMA 4X enclosure

Distributed Group Control

DigiTrace ACS-30 Multi-circuit digital control system with:

- Pre-programmed application based heat-tracing controller.
- Touch-screen user interface (ACS-UIT2) communicates with up to 52 ACS-PCM2-5 modular control panels. The DigiTrace C910-485 digital controller may be included in the ACS-30 network for single circuit extensions.
- BMS interface.
- Controls up to 260 heat-tracing circuits with up to 388 temperature inputs (RTDs).
- Proportional Ambient Sensing Control (PASC).
- 30 A switching capacity rating.
- Enclosure:
 - ACS-UIT2: NEMA 4
 - ACS-PCM2-5: NEMA 4/12

Device Server

DigiTrace ProtoNode: A multi-protocol device server to interface the C910-485 or ACS-30 with a building management system (BMS).

Thermal Pipe Insulation

Flame retardant insulation (closed-cell or fiberglass) with waterproof covering is required following Pentair Thermal Managements' insulation schedule.

Designer Notes

1. For proper cable selection refer to the XL-Trace freeze protection design guide or the online design tool [XL-ERATE](#).
2. Heating cables must have fluoropolymer outer jacket (-CT).
3. All connections must be made off pipe.
4. Ground-fault circuit protection (adjustable) is integrated in the controller and does not need to be provided separately.
5. The C910-485 or ACS-30 may be connected to the BMS through the ProtoNode using two conductor twisted pair shielded RS-485 cable (PTM Catalog Number: MONI-RS485-WIRE). The ProtoNode is connected to the BMS by Ethernet or RS-485. The installation of the communication wiring is included in specification section 25 50 00.
6. The C910-485 is a wall mounted controller with a NEMA 4X rated enclosure and can be mounted indoors or outdoors.
7. ACS-UIT2 should be centrally located in the building connected to the remote ACS-PCM2-5 control panels using RS-485 cable. The ACS-PCM2-5 control panels may be located indoors or outdoors throughout the installation.
8. The location of the controller, power connection, tees/splices and end seals must be shown on the drawings.

Drawing Details

Installation details can be found at [CADdetails.com](#) under Fuel Oil Flow Maintenance folder.

PART 1 – GENERAL

1.1 SUMMARY

- A. This Section includes a UL Listed, CSA Certified and FM Approved heat tracing system for flow maintenance of aboveground fuel oil lines consisting of self-regulating heating cable, connection kits and electronic controller.

1.2 RELATED SECTIONS

- A. Section 01 51 19 – Temporary Fuel Oil
- B. Section 22 05 33 – Heat Tracing for Plumbing Piping
- C. Section 22 34 46 – Oil-Fired Domestic Water Heaters
- D. Section 25 34 00 – Integrated Automation Instrumentation and Terminal Devices for Plumbing
- E. Section 25 54 00 – Integrated Automation Control of Plumbing
- F. Section 26 32 13 – Engine Generators

1.3 SYSTEM DESCRIPTION

- A. System for flow maintenance of aboveground fuel oil lines with Proportional Ambient Sensing Control (PASC), monitoring, integrated ground-fault circuit protection and Building Management System (BMS) communication capabilities.

1.4 SUBMITTALS

- A. Product Data
 - 1. Heating cable data sheet
 - 2. UL, CSA, FM approval certificates for flow maintenance of aboveground fuel oil lines
 - 3. Flow maintenance design guide
 - 4. System installation and operation manual
 - 5. System installation details
 - 6. Connection kits and accessories data sheet
 - 7. Controller data sheet
 - 8. Controller wiring diagram

1.5 QUALITY ASSURANCE

- A. Manufacturers' Qualifications
 - 1. Manufacturer to show minimum of thirty (30) years' experience in manufacturing electric self-regulating heating cables.
 - 2. Manufacturer will be ISO-9001 registered.
 - 3. Manufacturer to provide products consistent with UL 515, CSA 22.2 No 130-03 and IEEE 515.1 requirements.
- B. Installer Qualifications
 - 1. System installer shall have complete understanding of product and product literature from manufacturer or authorized representative prior to installation. Electrical connections shall be performed by a licensed electrician.
- C. Regulatory Requirements and Approvals
 - 1. The system (heating cable, connection kits, and controller) shall be UL Listed, CSA Certified and FM Approved for flow maintenance of aboveground fuel oil lines.
- D. Electrical Components, Listed and labelled as defined in NFPA 70, Article 100, by a Nationally Recognized Testing Laboratory (NRTL), and marked for intended use.

1.6 DELIVERY, STORAGE AND HANDLING

- A. A. General Requirements: Deliver, store and handle products to prevent their deterioration or damage due to moisture, temperature changes, contaminants or other causes.
- B. Delivery and Acceptance Requirements: Deliver products to site in original, unopened containers or packages with intact and legible manufacturers' labels identifying the following:
 - 1. Product and Manufacturer
 - 2. Length/Quantity
 - 3. Lot Number
 - 4. Installation and Operation Manual
 - 5. MSDS (if applicable)

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- C. Storage and Handling Requirements
 - 1. Store the heating cable in a clean, dry location with a temperature range 0°F (-18°C) to 140°F (60°C).
 - 2. Protect the heating cable from mechanical damage.

1.7 WARRANTY

- A. Extended Warranty
 - 1. Manufacturer shall provide ten (10) year warranty for all heating cables and components. Provide one (1) year warranty for all heat trace controllers.
 - 2. Contractor shall submit to owner results of installation tests required by the manufacturer.

END OF PART 1

PART 2 - PRODUCTS

2.1 MANUFACTURERS AND PRODUCTS

- A. Contract Documents are based on manufacturer and products named below to establish a standard of quality.
- B. Basis of Design
 - 1. Basis of Design Product Selections
 - a. Manufacturer
 - 1. Manufacturers shall have more than thirty (30) years' experience with manufacture & installation self-regulating heating cables.
 - 2. Manufacturer shall provide UL, CSA, FM approval certificates for flow maintenance of aboveground fuel oil lines.
 - 3. Manufacturer shall be Pentair Thermal Management, LLC, located at, 7433 Harwin Drive, Houston, TX 77036 Tel: (800) 545-6258 www.pentair.thermal.com
 - b. Flow Maintenance System
 - 1. Raychem XL-Trace self-regulating heating cable with fluoropolymer outer jacket (-CT)
 - 2. Raychem RayClic or FTC **[Select one]** connection kits and accessories
 - 3. DigiTrace C910-485 or ACS-30 **[Select one]** digital controller
 - 4. DigiTrace ProtoNode multi-protocol device server

2.2 PRODUCTS, GENERAL

- A. Single Source Responsibility: Furnish heat tracing system for the flow maintenance of aboveground fuel oil lines from a single manufacturer.
- B. The system (heating cable, connection kits, and controller) shall be UL Listed, CSA Certified and FM Approved for flow maintenance of aboveground fuel oil lines. No parts of the system may be substituted or exchanged.

2.3 PRODUCTS

- A. Self-Regulating Heating Cable
 - 1. Heating cable shall be Raychem XL-Trace self-regulating heating cable manufactured by Pentair Thermal Management.
 - a. Model Numbers **[Select one]**
 - 1. 5XL1-CT, 5XL2-CT
 - 2. 8XL1-CT, 8XL2-CT
 - 3. 12XL2-CT
 - 2. The heating cable shall consist of a continuous core of conductive polymer that is radiation cross-linked, extruded between two (2) 16 AWG nickel-plated copper bus wires that varies its power output in response to pipe temperature changes.
 - 3. The heating cable shall have a modified polyolefin inner jacket and a tinned-copper braid to provide a

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- ground path and enhance the cables ruggedness.
4. The heating cable shall have a fluoropolymer outer jacket (-CT).
 5. The heating cable shall have a self-regulating factor of at least 90 percent for 5/8XL or at least 70 percent for 12XL. The self-regulating factor is defined as the percent reduction of the heating cable power output going from a 40°F pipe temperature to 150°F pipe temperature.
 6. The heating cable shall operate on line voltages of 120, 208, 220, 240 or 277 volts without the use of transformers. **[Select one]**
 7. The heating cable shall be part of a UL Listed, CSA Certified and FM Approved system.
 8. The outer jacket of the heating cable shall have the following markings:
 - a. Heating cable model number
 - b. Agency listings
 - c. Meter mark
 - d. Lot/Batch ID
- B. Heating Cable Connection Kits
1. Heating cable connection kits shall be Raychem RayClic or FTC **[Select one]** connection kits.
 2. Manufacturer shall provide power connection, splice/tee and end seal kits compatible with selected heating cable.
 3. Installation shall not require the installing contractor to cut into the heating-cable core to expose the bus wires. **[for RayClic connection kits only]**
 4. Connection kits shall be rated NEMA 4X to prevent water ingress and corrosion. All components shall be UV stabilized.
 5. Connection kits shall be UL Listed, CSA Certified and FM Approved.
- C. Heating Cable Installation Accessories
1. High temperature, glass filament tape for attachment of heating cable to aboveground fuel oil lines. Cable ties are not permitted. (PTM Catalog Number: GT-66)
 2. Plastic Piping – provide an aluminum self-adhesive tape over the heating cable on all plastic piping if required. (PTM Catalog Number: AT-180)
 3. Labels – Provide warning labels every 10 feet on exterior of insulation, opposite sides of pipe. (PTM Catalog Number: ETL)
- D. Digital Temperature Controller with built-in Ground-Fault Protection Device (GFPD) **[Select one option]**
1. **[Option 1]** Single Circuit Local Digital Controller
 - a. Local digital controller shall be DigiTrace C910-485.
 - b. Heating cable manufacturer shall provide a local digital controller with built-in GFPD compatible with selected heating cable.
 - c. Digital controller shall be capable of supporting up to two (2) RTD temperature sensors per control point using 18 AWG, 3-wire, shielded cable.
 - d. Enclosure type shall be NEMA 4X fiberglass reinforced plastic (FRP).
 - e. Digital controller shall have an integrated adjustable GFPD (10 – 200 mA).
 - f. Digital control system can be configured for line-sensing, ambient sensing and PASC modes. PASC control proportionally energizes the power to the heating cable to minimize energy based on ambient sensed conditions.
 - g. Digital controller shall be capable of operating with supply voltages from 100 V to 277 V.
 - h. Digital controller will have a built-in self-test feature to verify proper functionality of heating cable system.
 - i. Digital controller will also be able to communicate with BMS by one of the following protocols using the DigiTrace ProtoNode multi-protocol gateway. **[Select one]**
 1. Modbus[®]
 2. LonWorks[®] **[Select ProtoNode-LER]**
 3. BACnet[®] **[Select ProtoNode-RER]**
 4. Metasys[®] N2 **[Select ProtoNode-RER]**
 - j. Digital controller will also supply an isolated triac alarm relay and a dry contact relay for

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- alarm annunciation back to the BMS.
- k. The following variables will be monitored by the digital controller and reported back to the BMS.
1. Temperature
 2. Ground-fault
 3. Current draw
 4. Power consumption
 5. Associated alarms
- l. Digital controller shall have c-CSA-us approvals.
2. **[Option 2]** Multiple Circuit Distributed Digital Control System
- a. Distributed digital control system shall be DigiTrace ACS-30 heat-trace control system.
 - b. Heating cable manufacturer shall provide a distributed digital control system with pre-programmed parameters to provide concurrent control for heating cables used for pipe freeze protection, flow maintenance, hot water temperature maintenance, surface snow melting, roof and gutter de-icing, freezer frost heave prevention and floor heating applications.
 - c. All programming shall be done through the central User Interface Terminal (ACS-UIT2).
 - d. The ACS-UIT2 shall be a color LCD touch-screen display with password protection to prevent unauthorized access to the system.
 - e. The ACS-UIT2 shall communicate with up to fifty-two (52) ACS Power Control Panels (ACS-PCM2-5) where each panel can control up to five (5) circuits and accept up to five (5) temperature inputs. The C910-485 may be connected to the ACS-30 network for single circuit extensions.
 - f. Digital control system shall be capable of assigning up to four (4) RTD temperature inputs per heat-tracing circuit.
 - g. The ACS-UIT2 shall communicate with up to sixteen (16) Remote Monitoring Modules (RMM2), where each module can accept up to 8 temperature inputs.
 - h. The ACS-UIT2 shall have a USB port to allow for quick and easy software update.
 - i. The ACS-UIT2 shall have three (3) programmable alarm contacts including an alarm light on the enclosure cover.
 - j. A separate offline software tool shall be made available to allow users to pre-program the digital control system and transfer program via a USB drive or Ethernet.
 - k. The ACS-UIT2 enclosure shall be NEMA 4 for indoor or outdoor locations.
 - l. The ACS-PCM2-5 panel shall be in a NEMA 4/12 enclosure approved for nonhazardous indoor and outdoor locations.
 - m. The ACS-PCM2-5 panel shall provide ground-fault and line current sensing, alarming, switching and temperature inputs for five (5) heat tracing circuits.
 - n. Each ACS-PCM2-5 panel shall have five (5) 3-pole, 30 A contactors (EMR type).
 - o. The ACS-PCM2-5 panel shall be capable of operating at 120 V to 277 V.
 - p. The ACS-PCM2-5 shall have an alarm contact including an alarm light on the panel cover.
 - q. Digital controller shall have an integrated adjustable GFPD (10 – 200 mA).
 - r. Digital control system can be configured for On/Off, ambient sensing, PASC and timed duty cycle control (HWAT only) modes based on the application. PASC control proportionally energizes the power to the heating cable to minimize energy based on ambient sensed conditions.
 - s. Digital control system will have a built-in self-test feature to verify proper functionality of heating cable system.
 - t. Digital control system will also be able to communicate with BMS by one of the following protocols using the DigiTrace ProtoNode multi-protocol gateway. **[Select one]**
 1. Modbus®
 2. LonWorks® **[Select ProtoNode-LER]**

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- 3. BACnet® **[Select ProtoNode-RER]**
- 4. Metasys® N2 **[Select ProtoNode-RER]**
- u. The following variables will be monitored by the digital controller and reported back to the BMS.
 - 1. Temperature
 - 2. Ground-fault
 - 3. Current draw
 - 4. Power consumption
 - 5. Associated alarms
- v. The ACS-UIT2 shall be c-CSA-us Certified. The ACS-PCM2-5 panel shall be c-UL-us Listed.
- E. Thermal Pipe Insulation
 - 1. Pipes must be thermally insulated in accordance with the XL-Trace design guide requirements.
 - 2. Thermal insulation must be a type that is flame retardant (closed-cell or fiberglass) with waterproof covering.

2.4 SYSTEM LISTING

- A. The system (heating cable, connection kits, and controller) shall be UL Listed, CSA Certified and FM Approved for flow maintenance of aboveground fuel oil lines.
- B. The flow maintenance system shall have a design, installation and operating manual specific to aboveground fuel oil lines.

END OF PART 2

PART 3 - EXECUTION

3.1 INSTALLERS

- A. Acceptable Installers
 - 1. Subject to compliance with requirements of Contract Documents, installer shall be familiar with installing heat-trace cable and equipment.

3.2 INSTALLATION

- A. Comply with manufacturer's recommendations in the XL-Trace System Installation and Operation Manual.
- B. Apply the heating cable linearly on the pipe after piping has successfully completed any pressure tests. Secure the heating cable to piping with fiberglass tape.
- C. Install electric heating cable according to the drawings and the manufacturer's instructions. The installer shall be responsible for providing a complete functional system, installed in accordance with applicable national and local requirements.
- D. All connections must be made off pipe.
- E. Grounding of controller shall be equipment according to Division 26 05 26 Section "Grounding and Bonding for Electrical Systems."
- F. Connection of all electrical wiring shall be according to Division 26 05 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.3 FIELD QUALITY CONTROL

- A. Start-up of system shall be performed by factory technician or factory representative per the owner's requirements.
- B. Field Testing and Inspections
 - 1. The system shall be commissioned in accordance to the XL-Trace Installation and Operation manual.
 - 2. The heating cable circuit integrity shall be tested using a 2500 Vdc megohmmeter at the following intervals below. Minimum acceptable insulation resistance shall be 1000 megohms or greater.
 - a. Before installing the heating cable
 - b. After heating cable has been installed onto the pipe
 - c. After installing connection kits
 - d. After the thermal insulation is installed onto the pipe
 - e. Prior to initial start-up (commissioning)
 - f. As part of the regular system maintenance

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3. The technician shall verify that the C910-485 or ACS-30 **[Select one]** control parameters are set to the application requirements.
4. The technician shall verify that the C910-485 or ACS-30 **[Select one]** alarm contacts are corrected connected to the BMS.
5. The technician shall verify that the C910-485 or ACS-30 **[Select one]** and ProtoNode-RER/-LER [Select one] are configured correctly with the BMS.
6. All commissioning results will be recorded and presented to the owner.

3.4 MAINTENANCE

A. Maintenance Service

1. Comply with manufacturer's recommendations in XL-Trace System Installation and Operation Manual.

END OF SECTION



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