CONNECT AND PROTECT

Fire Sprinkler System Freeze Protection — XL-Trace Edge System

This step-by-step design guide provides the tools necessary to design a nVent RAYCHEM XL-Trace Edge fire sprinkler freeze protection system. For other applications or for design assistance, contact your nVent representative or call (800) 545-6258. Also, visit our website at nVent.com/RAYCHEM.

Table of Contents

This design guide presents nVent recommendations for designing an XL-Trace Edge pipe freeze protection system for fire sprinkler piping. It provides design and performance data, control options, electrical sizing information, and application configuration suggestions. This guide does not give information on how to design your fire protection system.

This guide does **not** cover applications in which any of the following conditions exist:

- Hazardous locations, as defined in national electrical codes
- Supply voltage other than 120 V or 208–277 V

If your application conditions are different, or if you have any questions, contact your nVent representative or call (800) 545-6258.

How to Use this Guide

This design guide takes you step by step through designing a freeze protection system for fire suppression piping. Following these recommendations will result in a reliable, energy-efficient system.

Other Required Documents

This guide is not intended to provide comprehensive installation instructions. For complete system installation instructions, please refer to the following additional required documents:

- XL-Trace Edge System Installation and Operation Manual (H58033)
- Additional installation instructions are included with the connection kits, controllers, and accessories

If you do not have the above documents, you can obtain them from our website at nVent.com/RAYCHEM.

For products and applications not covered by this design guide, please contact your nVent representative or call (800) 545-6258.

Safety Guidelines

As with any electrical equipment, the safety and reliability of any system depends on the quality of the products selected and the manner in which they are installed and maintained. Incorrect design, handling, installation, or maintenance of any of the system connection kits could damage the system and may result in inadequate performance, overheating, electric shock, or fire. To minimize these risks and to ensure that the system performs reliably, read and carefully follow the information, warnings, and instructions in this guide.

This symbol identifies important instructions or information.

⚠ This symbol identifies particularly important safety warnings that must be followed.

⚠ **WARNING:** To minimize the danger of fire from sustained electrical arcing if the heating cable is damaged or improperly installed, and to comply with the requirements of nVent, agency certifications, and national electrical codes, ground fault equipment protection must be used on each heating cable branch circuit. Arcing may not be stopped by conventional circuit protection.

Warranty

nVent standard limited warranty applies to all products.

An extension of the limited warranty period to ten (10) years from the date of installation is available if a properly completed online warranty form is submitted within thirty (30) days from the date of installation. You can access the complete warranty on our website at https://www.nVent.com/RAYCHEM/support/warranty-information

The XL-Trace Edge system is designed to freeze protect aboveground and buried supply pipes, fire standpipes, branch lines and branch lines containing sprinklers when run in areas subject to freezing.

nVent offers the option of three self-regulating heating cables with the XL-Trace Edge system; 5XLE, 8XLE, and 12XLE for applications using 120 V and 208–277 V power supplies. The XL-Trace Edge system is based on self-regulating heating cable technology whereby the heating cable's output is reduced automatically as the pipe warms; eliminating the possibility of sprinkler system overheating.

An XL-Trace Edge system includes the heating cable, power connection, splice, tee connections, controls, power distribution panels, accessories, and the tools necessary for a complete installation.

Approvals

NFPA 13 (Standard for the Installation of Sprinkler Systems) allows Listed electrical heat tracing to freeze protect fire suppression systems including supply lines, standpipes and branch lines containing sprinklers. nVent RAYCHEM C910-485 and ACS-30 control systems are suitable for use on fire suppression systems. 5XLE and 8XLE heating cables are c-UL-us listed for use on fire suppression systems (VGNJ) with the nVent RAYCHEM 465 control system. The system covered in this manual includes supply lines, stand pipes, branch lines and sprinkler heads.

Note: The XL-Trace Edge system is not UL Listed for plastic fire sprinkler pipes.

c-UL-us Listed and c-CSA-us Certified for nonhazardous locations general purpose.

c UL us LISTED				c SP us
3XLE1-CR 3XLE2-CR	5XLE1-CR, -CT 5XLE2-CR, -CT 460 controller	8XLE1-CR, -CT 8XLE2-CR, -CT	12XLE2-CR, -CT	C910-485, ACS-CRM or ACS-CRMS Controllers

c-UL-us Listed for fire sprinkler application.

c UL us LISTED EX28156	
5XLE1-CR, -CT 5XLE2-CR, -CT 465 controller	8XLE1-CR, -CT 8XLE2-CR, -CT

Self-Regulating Heating Cable Construction

XL-Trace Edge self-regulating heating cables are comprised of two parallel nickel-plated bus wires in a cross-linked polymer core, a tinned copper braid, and a fluoropolymer or polyolefin outer jacket. These cables are cut to length, simplifying the application design and installation.

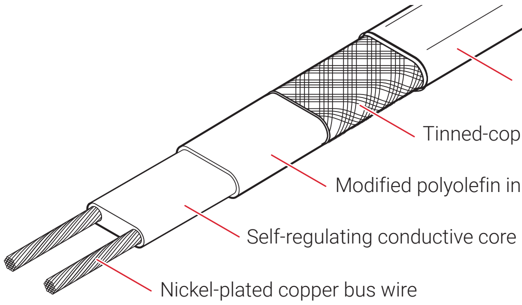
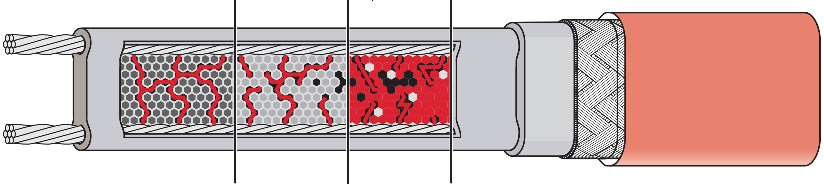


Fig. 1 XL-Trace Edge heating cable construction

With self-regulating technology, the number of electrical paths between bus wires changes in response to temperature fluctuations. As the temperature surrounding the heater decreases, the conductive core contracts microscopically. This contraction decreases electrical resistance and creates numerous electrical paths between the bus wires. Current flows across these paths to warm the core.

As the temperature rises, the core expands microscopically. This expansion increases electrical resistance and the number of electrical paths decreases. The heating cable automatically reduces its output.



The following graphs illustrate the response of self-regulating heating cables to changes in temperature. As the temperature rises, electrical resistance increases, and our heaters reduce their power output.

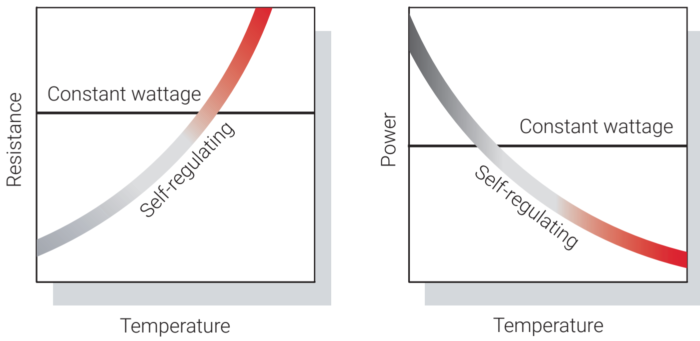


Fig. 2 Self-regulating heating cable technology

A freeze protection system is designed to maintain water temperature at a minimum of 40°F (4°C) to prevent fire suppression piping from freezing.

Typical Pipe Freeze Protection System

A typical freeze protection system includes the XL-Trace Edge self-regulating heating cables, connection kits, temperature control, and power distribution.

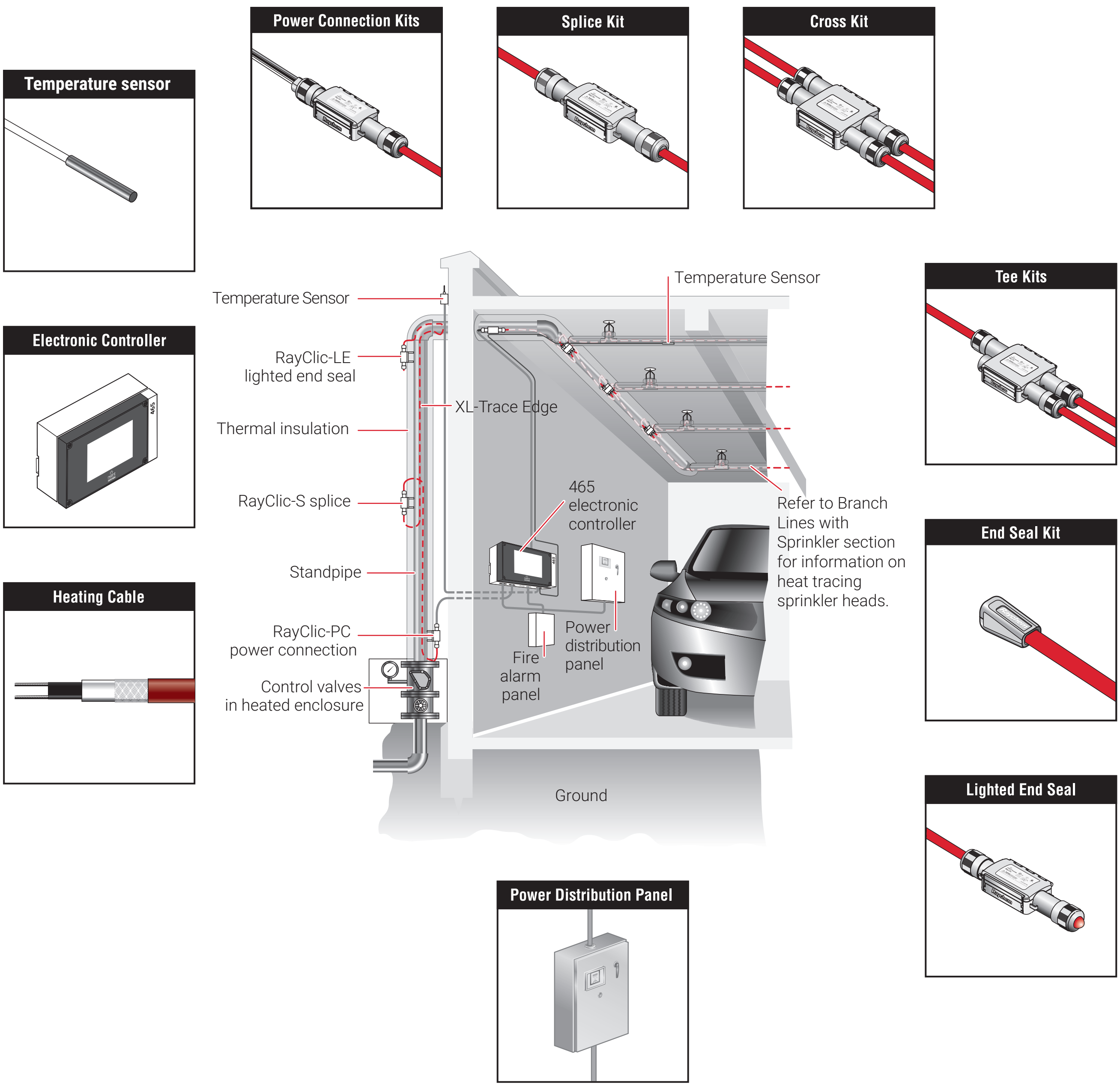


Fig. 3 Typical XL-Trace Edge pipe freeze protection system

Fire Supply Lines

XL-Trace Edge is designed to maintain fire supply lines at 40°F (4°C) in areas subject to freezing.

Aboveground Supply Piping

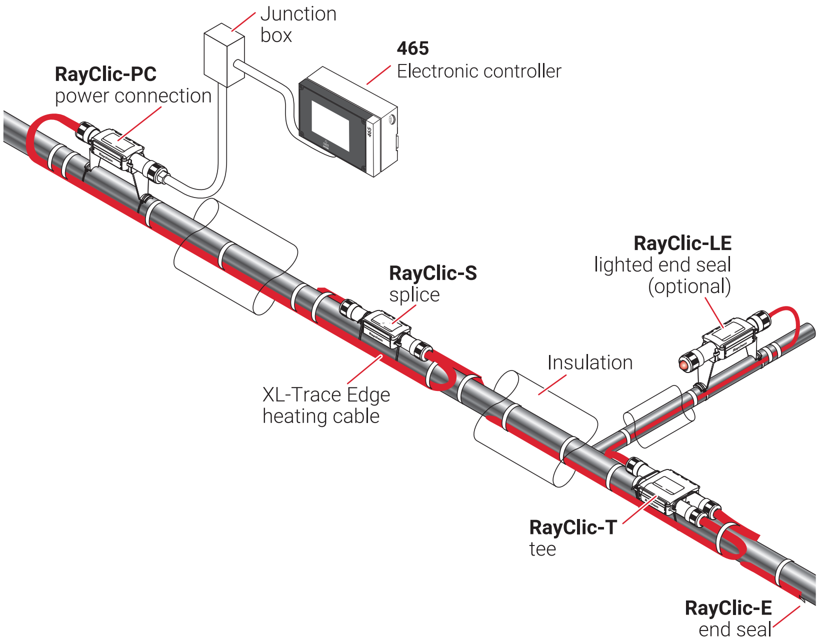


Fig. 4 Typical aboveground supply piping system

Application Requirements

The system complies with nVent requirements for aboveground general water piping when:

- The heating cable is permanently secured to insulated metal pipes with GT-66 glass tape or to plastic pipes using AT-180 aluminum tape.
- 465, C910-485, or ACS-30 controllers with integrated ground fault protection and alarm contacts are used and are connected to a fire control panel.
- The heating cable is installed per manufacturer's instructions with approved nVent RAYCHEM connection kits. See Table 11 on page 25 and the XL-Trace Edge System Installation and Operation Manual (H58033).

Buried Piping

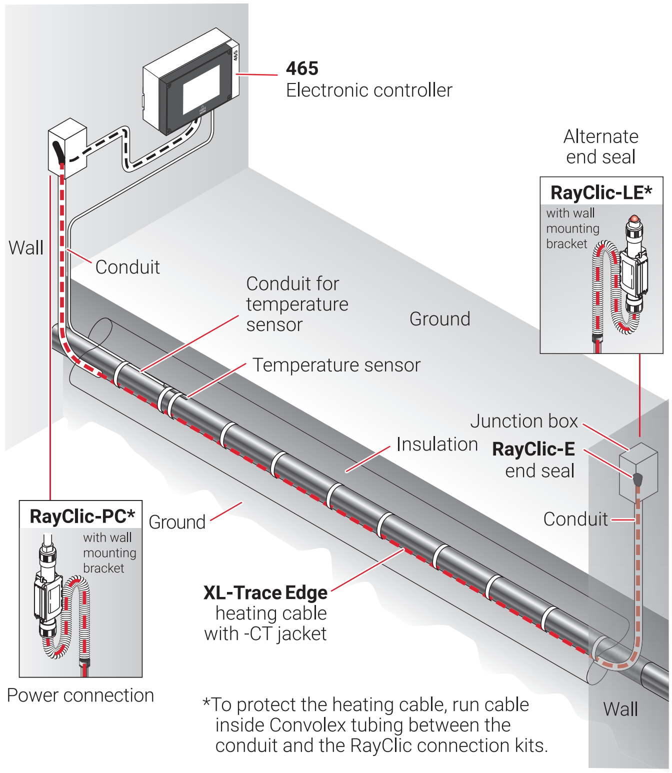


Fig. 5 Typical buried piping system

Application Requirements

The system complies with nVent requirements for use on buried insulated metal or plastic pipe when:

- The heating cable is permanently secured to insulated metal pipes with GT-66 glass tape or to plastic pipes using AT-180 aluminum tape.
- The pipeline is buried at least 2-feet deep.
- The heating cable has a fluoropolymer outer jacket (-CT).
- All heating cable connections (power, splice, tee, and end termination) are made aboveground. No buried or in-conduit splices or tees are allowed.
- The power connection and end seal are made in UL Listed and CSA Certified junction boxes, or nVent RAYCHEM RayClic connection kits, above grade.
- The heating cable is protected from the pipe to the power connection box in UL Listed and CSA Certified water-sealed conduit (minimum 3/4-inch diameter) suitable for the location.
- 465, C910-485, or ACS-30 controllers with integrated ground fault protection and alarm contacts are used and are connected to a fire control panel.
- Closed-cell, waterproof thermal insulation with fire-retardant, waterproof covering approved for direct burial is used.
- The heating cable is installed per manufacturer's instructions with approved nVent connection kits. See Table 13 on page 27 and the XL-Trace Edge System Installation and Operation Manual (H58033).

Sprinkler Standpipes

XL-Trace Edge is designed to maintain fire suppression system standpipes at 40°F (4°C) in areas subject to freezing.

For Aboveground Standpipes

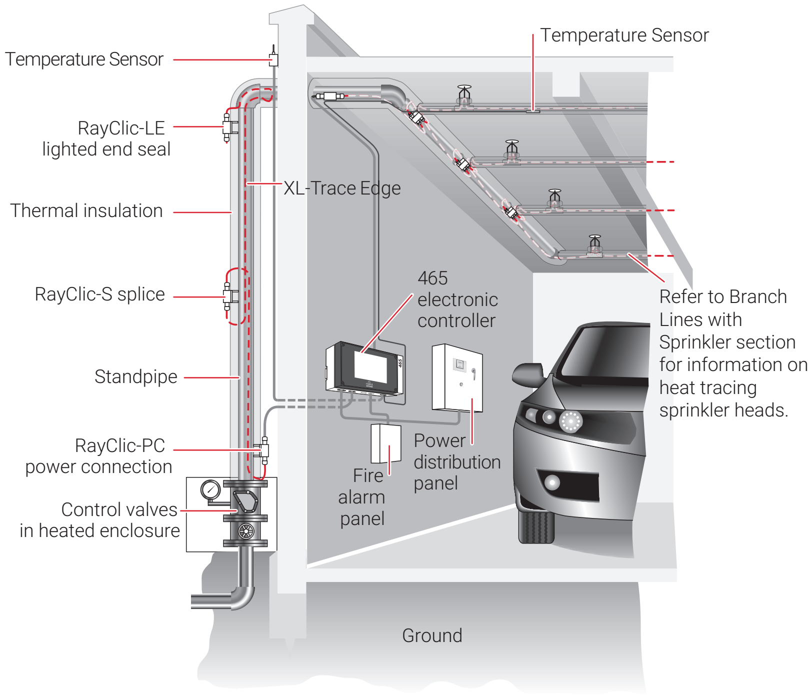


Fig. 6 Standard sprinkler standpipe heating system layout

Application Requirements

The system complies with nVent requirements for freeze protection of sprinkler system piping when:

- The heating cable is permanently secured to insulated metal pipes with GT-66 glass tape or to plastic pipes using AT-180 aluminum tape.
- Schedule 5, 10, 20, or 40 steel sprinkler standpipe up to and including 20 inches in diameter is used.
- UL Listed fiberglass or closed cell flame-retardant insulation with weatherproof cladding is used.
- 465, C910-485, or ACS-30 controllers with integrated ground fault protection and alarm contacts are used and are connected to a fire control panel.
- The heating cable is installed per manufacturer's instructions with approved nVent connection kits. See Table 11 on page 25 and the XL-Trace Edge System Installation and Operation Manual (H58033).

Branch Lines with Sprinklers

XL-Trace Edge is designed to maintain branch lines containing sprinklers at 40°F (4°C) in areas subject to freezing.

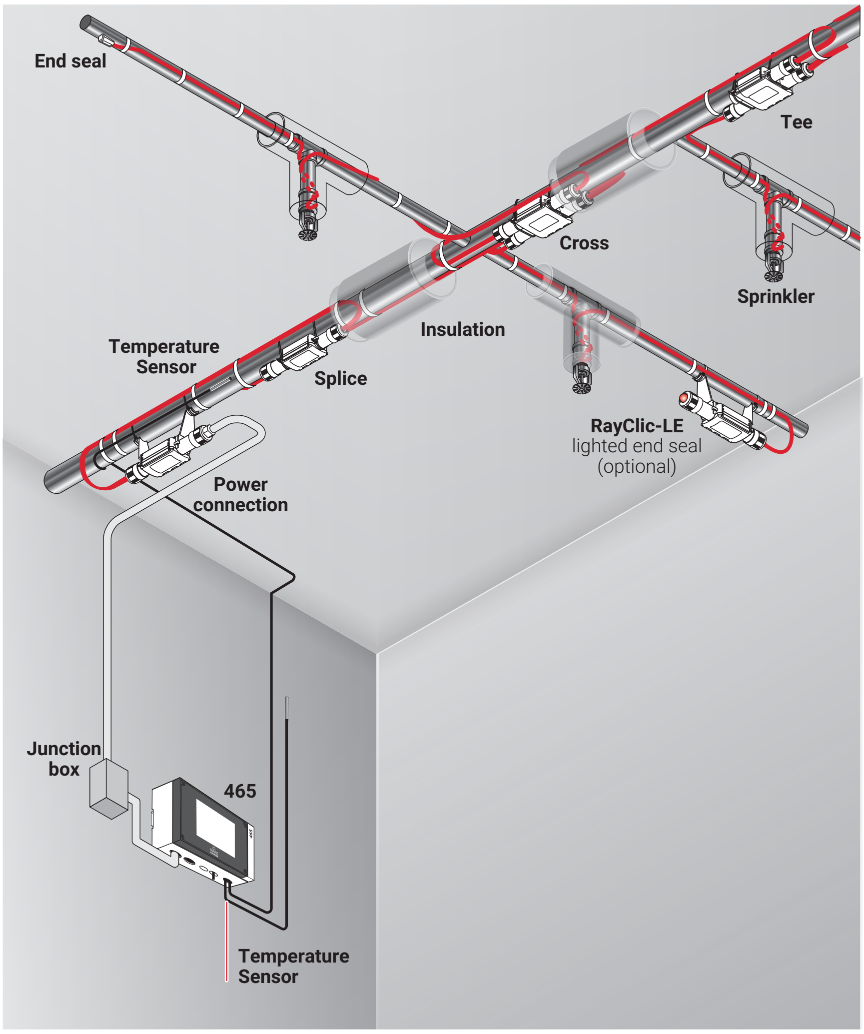


Fig. 7 Typical fire suppression system for branch lines with sprinklers

Application Requirements

The system complies with nVent requirements for fire suppression branch lines with sprinklers when:

- The heating cable is permanently secured to metal pipes with GT-66 glass tape, or to plastic pipes using AT-180 aluminum tape.
- 465, C910-485, or ACS-30 controllers with integrated ground fault protection with alarm contacts are used and are connected to a fire control panel.
- The sprinkler design accounts for the sprinkler shadow created by the outer diameter of the thermal pipe insulation.
- Closed-cell, waterproof thermal insulation with fire-retardant, waterproof covering is used.
- The heating cable is installed per manufacturer's instructions with approved nVent connection kits. See Table 13 on page 27 and the XL-Trace Edge System Installation and Operation Manual (H58033).
- Additional heating cable is installed to compensate for sprinkler heads, sprigs, valves and pipe supports as detailed in the Table 6 on page 20 of this document and the XL-Trace Edge System Installation and Operation Manual (H58033).

Freezer Application

XL-Trace Edge is designed to keep condensate in dry sprinklers from freezing and may be installed in freezers located in areas subject to freezing.

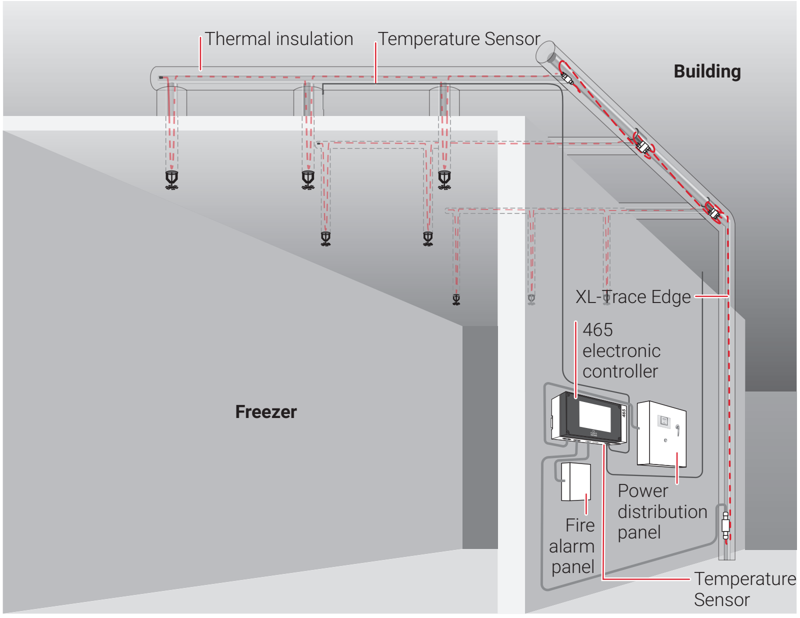


Fig. 8 Typical fire suppression system for freezer applications

Application Requirements

The system complies with nVent requirements for fire suppression systems for freezer applications when:

- The system is for freezer and freezer within a freezer applications.
- The heating cable is permanently secured to metal pipes with GT-66 glass tape, or to plastic pipes using AT-180 aluminum tape.
- 465, C910-485, or ACS-30 controllers with integrated ground fault protection and alarm contacts are used and are connected to a fire control panel.
- Closed-cell, waterproof thermal insulation with fire-retardant, waterproof covering is used for pipes and sprigs in areas subject to freezing.
- The sprinkler design accounts for sprinkler shadow created by the outer diameter of the thermal pipe insulation.
- The heating cable is installed per manufacturer's instructions with approved nVent connection kits. See Table 13 on page 27 and the XL-Trace Edge System Installation and Operation Manual (H58033).
- Additional heating cable is installed to compensate for sprinkler heads, sprigs, valves and pipe supports as detailed in the Table 6 on page 20 of this document and the XL-Trace Edge System Installation and Operation Manual (H58033).

This section details the design steps necessary to design your application. The examples provided in each step are intended to incrementally illustrate the project parameter output for two sample designs from start to finish. As you go through each step, use the "XL-Trace Edge System Fire Sprinkler System Freeze Protection Design Worksheet" page 32, to document your project parameters, so that by the end of this section you will have the information you need for your Bill of Materials.

TraceCalc Pro for Buildings is an online design tool available to help you create simple or complex heat-tracing designs for pipe freeze protection or flow maintenance applications. It is available at nVent.com/RAYCHEM.

Design Step by Step

Your system design requires the following essential steps.

1 Determine design conditions and pipe heat loss

2 Select the heating cable

3 Determine the heating cable length

4 Determine the electrical parameters

5 Select the connection kits and accessories

6 Select the control system

7 Complete the Bill of Materials

Step 1 Determine design conditions and pipe heat loss

Collect the following information to determine your design conditions:

- Location
  - Indoors
  - Outdoors
  - Aboveground
  - Buried
- Maintain temperature (T_M)
- Minimum ambient temperature (T_A)
- Pipe diameter and material
- Pipe length
- Thermal insulation type and thickness
- Supply voltage

Example: Fire Standpipe

Location	Aboveground, outdoors
Maintain temperature (T_M)	40°F (4°C)
Minimum ambient temperature (T_A)	–20°F (–29°C)
Pipe diameter and material	10-inch metal
Pipe length	50 ft (16.4 m)
Thermal insulation type and thickness	1 1/2-inch fiberglass
Supply voltage	208 V

Branch Line with Sprinkler

Location	Indoors
Maintain temperature (T_M)	40°F (4°C)
Minimum ambient temperature (T_A)	0°F (–18°C)
Pipe diameter and material	1-inch metal
Pipe length	200 ft (61 m)
Thermal insulation type and thickness	1/2-inch closed-cell foamed elastomer
Supply voltage	208 V

Pipe Heat Loss Calculations

To select the proper heating cable you must first determine the pipe heat loss. To do this you must first calculate the temperature differential (ΔT) between the pipe maintain temperature and the minimum ambient temperature.

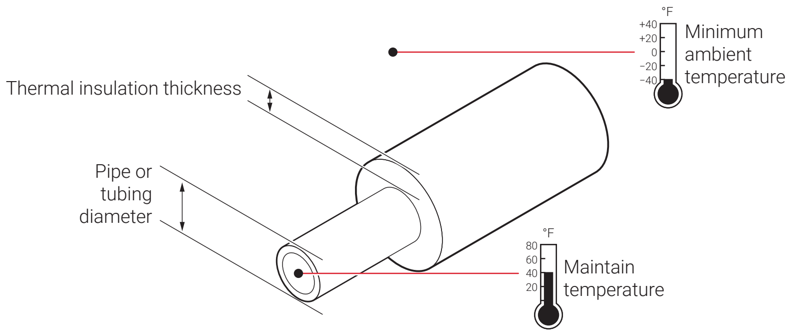


Fig. 9 Pipe heat loss

Calculate temperature differential ΔT

To calculate the temperature differential ΔT), use the formula below:

$\Delta T = T_M - T_A$

Example: Fire Standpipe

T_M	40°F (4°C)
T_A	–20°F (–29°C)
	ΔT = 40°F – (–20°F) = **60°F**
	ΔT = 4°C – (–29°C) = **33°C**

Example: Branch Line with Sprinkler

T_M	40°F (4°C)
T_A	0°F (–18°C)
	ΔT = 40°F – (0°F) = **40°F**
	ΔT = 4°C – (–18°C) = **22°C**

Determine the pipe heat loss

Match the pipe size, insulation thickness, and temperature differential (ΔT) from Table 1 on page 15 to determine the base heat loss of the pipe (Q_B).

Example: Fire Standpipe

Pipe diameter	10 inch
Insulation thickness	1 1/2 inch
ΔT	60°F (33°C)

Heat loss (Q_B) for 60°F must be calculated through interpolation between ΔT at 50°F and ΔT at 100°F from Table 1. For difference between the ΔT of 50°F and the ΔT of 100°F:

$Q_{B\text{-}50}$	8.1 W/ft (from Table 1)
$Q_{B\text{-}100}$	16.8 W/ft (from Table 1)
ΔT interpolation	ΔT 60°F is 20% of the distance between ΔT 50°F and ΔT 100°F
$Q_{B\text{-}60}$	$Q_{B\text{-}50} + [0.20 \times (Q_{B\text{-}100} - Q_{B\text{-}50})] = 8.1 + [0.20 \times (16.8 - 8.1)] = 9.8$ W/ft
Pipe heat loss (Q_B)	**9.8 W/ft @ T_M 40°F (32.1 W/m @ T_M 4°C)**

Example: Branch Line with Sprinkler

Pipe diameter	1 inch
Insulation thickness	1/2 inch
ΔT	40°F (22°C)

Q_B for 40°F must be calculated through interpolation between ΔT at 20°F and ΔT at 50°F from Table 1. For difference between the ΔT of 20°F and the ΔT of 50°F:

$Q_{B\text{-}20}$	1.4 W/ft (from Table 1)
$Q_{B\text{-}50}$	3.5 W/ft (from Table 1)
ΔT interpolation	ΔT 40°F is 67% of the distance between ΔT 20°F and ΔT 50°F
$Q_{B\text{-}40}$	$Q_{B\text{-}50}$ + [0.67 x ($Q_{B\text{-}50}$ – $Q_{B\text{-}20}$)] = 1.4 + [0.67 x (3.5 – 1.4)] = 2.8 W/ft
Pipe heat loss Q_B	**2.8 W/ft @ T_M 40°F (9.2 W/m @ T_M 4°C)**

Compensate for insulation type and pipe location

The base heat loss is calculated for a pipe insulated with thermal insulation with a k-factor ranging from 0.2 to 0.3 BTU/hr–°F–ft²/in (fiberglass or foamed elastomer) in an outdoor, or buried application. To get the heat loss for pipes insulated with alternate types of thermal insulation and for pipes installed indoors, multiply the base heat loss of the pipe (Q_B) from Step 3 by the insulation multiple from Table 3 on page 16 and the indoor multiple from Table 2 on page 16 to get the corrected heat loss:

$Q_{CORRECTED} = Q_B$ x Insulation multiple x Indoor multiple

Example: Fire Standpipe

Location	Aboveground, outdoors
Thermal insulation thickness and type	1 1/2-inch fiberglass
Pipe heat loss Q_B	9.8 W/ft @ T_M 40°F (32.1 W/m @ T_M 4°C)
$Q_{CORRECTED}$	9.8 W/ft x 1.00 x 1.00 = **9.8 W/ft @ T_M 40°F (32.1 W/m @ T_M 4°C)**

Example: Branch Line with Sprinkler

Location	Aboveground, indoors
Thermal insulation type and thickness	1/2-inch closed cell foamed elastomer
Pipe heat loss Q_B =	2.8 W/ft @ T_M 40°F (9.2 W/m @ T_M 4°C)
$Q_{CORRECTED}$ =	2.8 W/ft x 1.0 x 0.79 = **2.20 W/ft @ T_M 410°F (7.3 W/m @ T_M 4°C)**

Table 1 Pipe Heat Loss (Q_b) for Outdoor or Buried Pipe (W/ft) for 1/2 to 3-1/2 inches

Insulation thickness (in)	(ΔT)		Pipe diameter (IPS) in inches								
	°F	°C	1/2	3/4	1	1-1/4	1-1/2	2	2-1/2	3	3-1/2
0.5	20	11	1.0	1.2	1.4	1.6	1.8	2.2	2.5	3.0	3.4
	50	28	2.5	2.9	3.5	4.1	4.6	5.5	6.5	7.7	8.6
	100	56	5.2	6.1	7.2	8.6	9.6	11.5	13.5	16.0	18.0
	150	83	8.1	9.5	11.2	13.4	14.9	17.9	21.1	25.0	28.1
1.0	20	11	0.6	0.7	0.8	1.0	1.1	1.3	1.5	1.7	1.9
	50	28	1.6	1.9	2.2	2.5	2.8	3.2	3.8	4.4	4.9
	100	56	3.4	3.9	4.5	5.2	5.8	6.8	7.8	9.1	10.2
	150	83	5.3	6.1	7.0	8.2	9.0	10.6	12.2	14.2	15.9
1.5	20	11	0.5	0.6	0.7	0.8	0.8	1.0	1.1	1.3	1.4
	50	28	1.3	1.5	1.7	1.9	2.1	2.4	2.8	3.2	3.6
	100	56	2.8	3.1	3.5	4.0	4.4	5.1	5.8	6.7	7.4
	150	83	4.3	4.8	5.5	6.3	6.9	8.0	9.1	10.5	11.6
2.0	20	11	0.5	0.5	0.6	0.6	0.7	0.8	0.9	1.0	1.1
	50	28	1.1	1.3	1.4	1.6	1.8	2.0	2.3	2.6	2.9
	100	56	2.4	2.7	3.0	3.4	3.7	4.2	4.8	5.5	6.0
	150	83	3.7	4.2	4.7	5.3	5.8	6.6	7.5	8.5	9.4
2.5	20	11	0.4	0.5	0.5	0.6	0.6	0.7	0.8	0.9	1.0
	50	28	1.0	1.2	1.3	1.4	1.6	1.8	2.0	2.3	2.5
	100	56	2.2	2.4	2.7	3.0	3.3	3.7	4.2	4.7	5.2
	150	83	3.4	3.7	4.2	4.7	5.1	5.8	6.5	7.4	8.1
3.0	20	11	0.4	0.4	0.5	0.5	0.6	0.6	0.7	0.8	0.9
	50	28	1.0	1.1	1.2	1.3	1.4	1.6	1.8	2.0	2.2
	100	56	2.0	2.2	2.4	2.7	2.9	3.3	3.7	4.2	4.6
	150	83	3.1	3.4	3.8	4.3	4.6	5.2	5.8	6.6	7.1
4.0	20	11	0.3	0.4	0.4	0.5	0.5	0.5	0.6	0.7	0.7
	50	28	0.9	0.9	1.0	1.1	1.2	1.4	1.5	1.7	1.8
	100	56	1.8	2.0	2.1	2.4	2.5	2.9	3.2	3.5	3.8
	150	83	2.8	3.0	3.4	3.7	4.0	4.4	4.9	5.5	6.0

Note: Multiply the W/ft heat loss values by 3.28 for W/m.

Table 1 continued Pipe Heat Loss (Q_B) for Outdoor or Buried Pipe (W/ft) for 4 to 20 inches

Insulation thickness (in)	(ΔT)		Pipe diameter (IPS) in inches								
	°F	°C	4	6	8	10	12	14	16	18	20
0.5	20	11	3.8	5.3	6.8	8.4	9.9	10.8	12.2	13.7	15.2
	50	28	9.6	13.6	17.4	21.4	25.2	27.5	31.3	35.0	38.8
	100	56	20.0	28.4	36.3	44.6	52.5	57.4	65.2	73.0	80.8
	150	83	31.2	44.3	56.6	69.6	81.9	89.5	101.7	113.8	126.0
1.0	20	11	2.1	2.9	3.7	4.5	5.3	5.8	6.5	7.3	8.0
	50	28	5.4	7.5	9.4	11.5	13.5	14.7	16.6	18.6	20.5
	100	56	11.2	15.6	19.7	24.0	28.1	30.6	34.7	38.7	42.8
	150	83	17.5	24.3	30.7	37.4	43.8	47.8	54.1	60.4	66.7
1.5	20	11	1.5	2.1	2.6	3.2	3.7	4.0	4.5	5.0	5.5
	50	28	3.9	5.3	6.7	8.1	9.4	10.2	11.5	12.9	14.2
	100	56	8.1	11.1	13.9	16.8	19.6	21.3	24.0	26.8	29.5
	150	83	12.7	17.3	21.6	26.2	30.5	33.2	37.5	41.8	46.1
2.0	20	11	1.2	1.7	2.1	2.5	2.9	3.1	3.5	3.9	4.3
	50	28	3.1	4.2	5.2	6.3	7.3	7.9	8.9	9.9	10.9
	100	56	6.6	8.8	10.9	13.1	15.2	16.5	18.6	20.7	22.8
	150	83	10.2	13.8	17.0	20.5	23.8	25.8	29.0	32.3	35.5
2.5	20	11	1.1	1.4	1.7	2.1	2.4	2.6	2.9	3.2	3.5
	50	28	2.7	3.6	4.4	5.2	6.1	6.6	7.4	8.2	9.0
	100	56	5.6	7.4	9.1	10.9	12.6	13.7	15.3	17.0	18.7
	150	83	8.7	11.6	14.2	17.0	19.7	21.3	23.9	26.5	29.1
3.0	20	11	0.9	1.2	1.5	1.8	2.0	2.2	2.5	2.7	3.0
	50	28	2.4	3.1	3.8	4.5	5.2	5.6	6.3	7.0	7.6
	100	56	4.9	6.5	7.9	9.4	10.8	11.7	13.1	14.5	15.9
	150	83	7.7	10.1	12.4	14.7	16.9	18.3	20.5	22.6	24.8
4.0	20	11	0.8	1.0	1.2	1.4	1.6	1.7	1.9	2.1	2.3
	50	28	2.0	2.5	3.1	3.6	4.1	4.4	5.0	5.5	6.0
	100	56	4.1	5.3	6.4	7.5	8.6	9.3	10.3	11.4	12.4
	150	83	6.4	8.3	10.0	11.8	13.4	14.5	16.1	17.8	19.4

Note: Multiply the W/ft heat loss values by 3.28 for W/m.

Table 2 Indoor Pipe Heat Loss Multiples

Fiberglass thickness (in)	Indoor multiple	
0.5	0.79	
1	0.88	
1.5	0.91	
2	0.93	
2.5	0.94	
3	0.95	
4	0.97	

Table 3 Insulation Heat Loss Multiples

k factor at 50°F (10°C) (BTU/hr–°F–ft²/in)	Insulation multiple	Examples of preformed pipe insulation
0.1–0.2	0.6	Rigid cellular urethane (ASTM C591)
0.2–0.3	1	Glass fiber (ASTM C547) Foamed elastomer (ASTM C534)
0.3–0.4	1.4	Cellular glass (ASTM C552) Mineral fiber blanket (ASTM C553)

Step 2 Select the heating cable

To select the appropriate XL-Trace Edge heating cable for your application, you must determine your cable supply voltage, power output, and outer jacket. Once you have selected these, you will be able to determine the catalog number for your cable.

Heating Cable Catalog Number

Before beginning, take a moment to understand the structure of the heating cable catalog numbers. You will refer to this numbering convention throughout the product selection process. Your goal is to determine the catalog number for the product that best suits your needs.

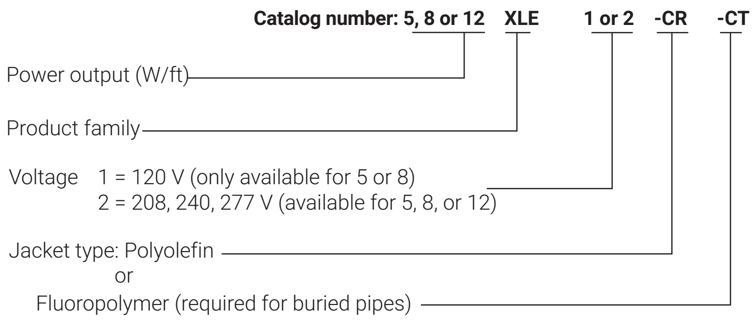
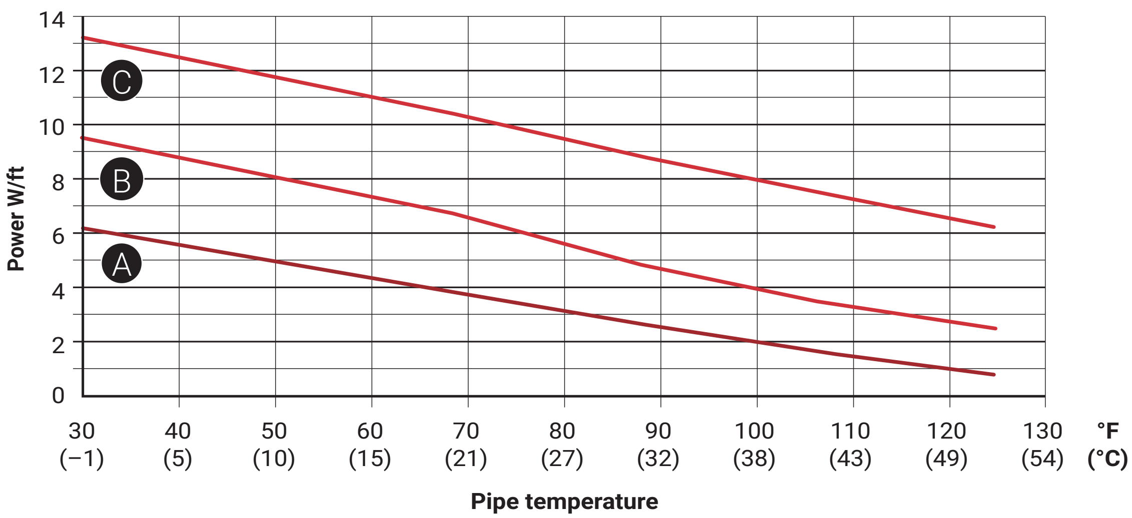


Fig. 10 Heating cable catalog number

Select the heating cable from Fig. 11 that provides the required power output to match the corrected heat loss for your application. Fig. 11 shows the power output for the heating cables on metal pipe at 120/240 volts. To correct the power output for other applied voltage or plastic pipes multiply the power output at the desired maintain temperature by the factors listed in Table 4 on page 18. If the pipe heat loss, $Q_{CORRECTED}$, is between the two heating cable power output curves, select the higher-rated heating cable.



Ⓐ 5XLE1-CR and 5XLE1-CT (120 V)
5XLE2-CR and 5XLE2-CT (240 V)

Ⓑ 8XLE1-CR and 8XLE1-CT (120 V)
8XLE2-CR and 8XLE2-CT (240 V)

Ⓒ 12XLE2-CR and 12XLE2-CT (240 V)

Fig. 11 Heating cable power output on metal pipe

Table 4 Power Output Correction Factors

Voltage correction factors	5XLE1	8XLE1	5XLE2	8XLE2	12XLE2
120 V	1.00	1.00	–	–	–
208 V	–	–	0.90	0.94	0.88
240 V	–	–	1.00	1.00	1.00
277 V	–	–	1.10	1.06	1.14
Plastic pipe correction factor (With AT-180 Aluminum tape)	0.75	0.75	0.75	0.75	0.75

Confirm that the corrected power output of the heating cable selected is greater than the corrected pipe heat loss ($Q_{CORRECTED}$). If $Q_{CORRECTED}$ is greater than the power output of the highest-rated heating cable, you can:

- Use two or more heating cables run in parallel
- Use thicker insulation to reduce heat loss
- Use insulation material with a lower k factor to reduce heat loss

Example: Fire Standpipe

Pipe maintain temperature (T_M)	40°F (4°C) (from Step 1)
$Q_{CORRECTED}$	$Q_{CORRECTED}$ = 9.8 W/ft @ T_M 40°F (32.1 W/m @ T_M 4°C)
Supply voltage	208 V (from Step 1)
Pipe material	Metal (from Step 1)
Select heating cable	$Q_{CORRECTED}$ = 9.8 W/ft @ T_M 40°F (from Step 1)
	12XLE2 = 12.4 W/ft @ 40°F (from Fig. 11)
Supply voltage correction factor	1.00 (from Table 4)
Pipe material correction factor	Metal = 1.00 (from Table 4)
Corrected heating cable power	9.8 W/ft x 0.88 x 1.00 = 8.6 W/ft
Selected heating cable	**12XLE2**

Example: Branch Line with Sprinkler

Pipe maintain temperature (T_M)	40°F (4°C) (from Step 1)
$Q_{CORRECTED}$	2.8 W/ft x 1.0 x 0.97 = 2.2 W/ft @ T_M 40°F (7.3 W/m @ T_M 4°C)
Supply voltage	208 V (from Step 1)
Pipe material	Metal (from Step 1)
Select heating cable	$Q_{CORRECTED}$ = 2.2 W/ft @ T_M 40°F (from Step 1)
	5XLE2 = 5.6 W/ft @ 40°F (from Fig. 11)
Supply voltage correction factor	0.90 (from Table 4)
Pipe material correction factor	Metal = 1.00
Corrected heating cable power	5.6 x 0.90 x 1.00 = 5.0 W/ft
Selected heating cable	**5XLE2**

Select Outer Jacket

Select the appropriate heating cable outer jacket for the application. Jacket options are:

-CR Compatible with most XL-Trace Edge applications

-CT Required for buried piping; may be used in other XL-Trace Edge applications for improved mechanical strength and chemical resistance.

Example: Fire Standpipe

Location:	Aboveground, outdoors
Selection:	12XLE2-CR

Example: Branch Line with Sprinkler

Location:	Aboveground, indoors
Selection:	5XLE2-CR

Pipe Freeze Protection and Flow Maintenance
1. Determine design conditions and pipe heat loss
2. Select the heating cable
3. Determine the heating cable length
4. Determine the electrical parameters
5. Select the connection kits and accessories
6. Select the control system
7. Complete the Bill of Materials

Step 3 Determine the heating cable length

In Step 2 you selected the appropriate heating cable and the number of runs of heating cable required for the pipe. Multiply the length of the pipe by the number of heating cable runs for the heating cable length.

Heating cable length = Pipe length x No. heating cable runs

Additional heating cable will be required for heat sinks and connection kits. Use Table 5 and Table 6 to determine the additional footage required for heat sinks (valves, flanges, and pipe supports). You will determine the additional heating cable for connection kits in Step 5. Round up fractional lengths to ensure heating cable lengths are sufficient.

Total heating cable length required = (Pipe length x No. heating cable runs) + Additional heating cable for heat sinks (valves, pipe supports, and flanges)

Table 5 Additional Heating Cable for Valves

Pipe diameter (IPS) inches	Heating cable feet (meters)	
1/2	0.8	(0.24)
3/4	1.3	(0.4)
1	2.0	(0.6)
1-1/4	3.3	(1.1)
1-1/2	4.3	(1.3)
2	4.3	(1.3)
3	4.3	(1.3)
4	4.3	(1.3)
6	5.0	(1.5)
8	5.0	(1.5)
10	5.6	(1.7)
12	5.9	(1.9)
14	7.3	(2.2)
18	9.4	(2.9)
20	10.5	(3.2)

Table 6 Additional Heating Cable for Pipe Supports, Flanges and Sprinklers

Support	Additional cable
Pipe hangers (insulated)	No additional heating cable
Pipe hangers (noninsulated) and U-bolt supports	Add 2x pipe diameter
Welded support shoes	Add 3x the length of the shoe
Flanges	Add 2x pipe diameter
Sprinklers	
Sprinkler without sprig	Add 4x pipe diameter
Sprinkler with sprig	Add 3x sprig length
Dry sprinkler for freezer application	Add 2x sprinkler length

Note: For applications where more than one heating cable is required per foot of pipe, this correction factor applies for each cable run.

Example: Fire Standpipe

Pipe length	50 ft (60 m) (from Step 1)
Pipe diameter	10-inch metal (from Step 1)
Number of heating cable runs	1 (from Step 2)
Valves	Per NFPA 13-2019 section 8.3.1.8.2.3: Heat tracing shall not be used in lieu of heated valve enclosure rooms to protect preaction and deluge valves and supply pipe against freezing.
Pipe supports	5 pipe hangers with U-bolts 10-inch pipe diameter = 10/12 = 0.83 [0.83 ft pipe diameter x 2] x 5 pipe supports = 8.3 ft (2.5 m)
Flanges	3 10-inch pipe diameter – 10/12 = 0.83 ft [0.83 ft pipe diameter x 2] x 3 pipe supports = 5.0 ft (1.5 m)
Total heating cable for heat sinks	5.6 ft (1.7 m) + 8.3 ft (2.5 m) + 5.0 ft (1.5 m) = 18.9 ft (4.2 m) Rounded up to 19 ft (65 m)
Total heating cable length required	50 ft (15 m) x 1 run + 19 ft = **69 ft (21 m) of 12XLE2-CR**

Example: Branch Line with Sprinkler

Pipe length	200 ft (61 m) (from Step 1)
Pipe diameter	1-inch metal (from Step 1)
Number of heating cable runs	1 (from Step 2)
Valves	2 gate valves [2.0 ft x 2 gate valves] x 1 run = 4.0 ft (1.2 m)
Pipe supports	10 noninsulated hangers 1-inch pipe diameter = 1 /12 = 0.1 ft [0.1 ft pipe diameter x 2) x 10 pipe supports] x 1 run = 2.0 ft (0.6 m)
Sprinklers	20 with 1 foot sprigs [3 x 1 ft sprig] x 20 = 60 ft (18.3 m)
Total heating cable for heat sinks	4.0 ft (1.2 m) + 2.0 ft (0.6 m) + 60 ft (18.3 m) = 66 ft (20.1 m)
Total heating cable length required	200 ft x 1 run + 66 ft = **266 ft (81 m) of 5XLE2-CR**

Pipe Freeze Protection and Flow Maintenance
1. Determine design conditions and pipe heat loss
2. Select the heating cable
3. Determine the heating cable length
4. Determine the electrical parameters
5. Select the connection kits and accessories
6. Select the control system
7. Complete the Bill of Materials

Step 4 Determine the electrical parameters

To determine the electrical requirements for your application, you must determine the number of circuits and calculate the transformer load.

Determine Number of Circuits

To determine the number of circuits, you need to know:

- Total heating cable length
- Supply voltage
- Minimum start-up temperature

Use Table 7 to determine the maximum circuit length allowed. If the total heating cable length exceeds the maximum circuit length for the expected start-up temperature, more than one circuit will be required.

$$\text{Number of circuits} = \frac{\text{Heating cable length required}}{\text{Maximum heating cable circuit length}}$$

Important: Select the smallest appropriate ground fault circuit breaker size.

⚠ **WARNING:** To minimize the danger of fire from sustained electrical arcing if the heating cable is damaged or improperly installed, and to comply with the requirements of nVent, agency certifications, and national electrical codes, ground fault equipment protection must be used on each heating cable branch circuit. Arcing may not be stopped by conventional circuit protection.

Table 7 Maximum Circuit Length in Feet

Start-up temperature (°F)	CB size (A)	40°F / 110°F Maintain*											
		5XLE1	8XLE1	5XLE2			8XLE2			12XLE2			
		120 V	120 V	208 V	240 V	277 V	208 V	240 V	277 V	208 V	240 V	277 V	
–20°F	15	96	75	201	209	221	138	116	99	127	129	130	
	20	129	100	268	279	294	210	180	148	169	171	174	
	30	193	150	402	419	441	316	341	370	253	257	260	
	40	207	151	469	474	487	339	359	384	338	343	347	
0°F	15	112	84	227	237	250	170	142	120	129	131	133	
	20	149	113	303	316	333	236	239	190	172	175	177	
	30	223	169	455	474	499	354	382	414	258	262	265	
	40	245	173	535	544	558	384	407	435	340/344	349	354	
20°F	15	132	98	262	273	288	200	185	154	144	146	148	
	20	176	131	349	364	383	267	288	276	192	194	197	
	30	264	196	523	546	575	400	432	469	287	292	296	
	40	287	205	535	584	642	407/442	452/467	499	340/383	360/389	380/394	
40°F	15	160	117	311	324	342	232	250	221	162	165	167	
	20	214	156	414	432	456	309	334	362	216	219	222	
	30	287	223	535	584	642	407/464	452/500	504/543	324	329	333	
	40	287	223	535	584	642	407/526	452/555	504/591	340/430	360/439	380/444	
50°F	15	–	–	–	–	–	253	273	296	173	176	178	
	20	–	–	–	–	–	337	364	395	231	234	237	
	30	–	–	–	–	–	506	546	592	346	352	356	
	40	–	–	–	–	–	586	617	656	430	460	475	
65°F	15	–	–	–	–	–	296	319	347	192	195	197	
	20	–	–	–	–	–	395	426	462	256	260	263	
	30	–	–	–	–	–	592	639	693	384	390	395	
	40	–	–	–	–	–	686	756	801	430	460	490	

* When maximum circuit length is listed in:
- black type, the value is for applications with a 40°F maintain
- red type, the value is for applications with a 110°F maintain

Table 8 Maximum Circuit Length in Meters

Start-up temperature (°C)	CB size (A)	4°C / 43°C Maintain*										
		5XLE1	8XLE1	5XLE2			8XLE2			12XLE2		
		120 V	120 V	208 V	240 V	277 V	208 V	240 V	277 V	208 V	240 V	277 V
–29°C	15	29	23	61	64	67	42	35	30	39	39	40
	20	39	30	82	85	90	64	55	45	52	52	53
	30	59	46	123	128	134	96	104	113	77	78	79
	40	63	46	143	145	148	103	109	117	103	105	106
–18°C	15	34	26	69	72	76	52	43	37	39	40	41
	20	45	34	92	96	102	72	73	58	52	53	54
	30	68	52	139	145	152	108	116	126	79	80	81
	40	75	53	163	166	170	117	124	133	104/105	106	108
–7°C	15	40	30	80	83	88	61	56	47	44	45	45
	20	54	40	106	111	117	81	88	84	59	59	60
	30	80	60	159	166	175	122	132	143	88	89	90
	40	88	63	163	178	196	124/135	138/142	152	104/117	110/119	116/120
4°C	15	49	36	95	99	104	71	76	67	49	50	51
	20	65	48	126	132	139	94	102	110	66	67	68
	30	88	68	163	178	196	124/160	138/169	154/180	99	100	102
	40	88	68	163	178	196	124/160	138/169	154/180	104/131	110/134	116/135
10°C	15	–	–	–	–	–	77	83	90	53	54	54
	20	–	–	–	–	–	103	111	120	70	71	72
	30	–	–	–	–	–	154	166	180	105	107	109
	40	–	–	–	–	–	179	188	200	131	140	145
18°C	15	–	–	–	–	–	90	97	106	59	59	60
	20	–	–	–	–	–	120	130	141	78	79	80
	30	–	–	–	–	–	180	195	211	117	119	120
	40	–	–	–	–	–	209	230	244	131	140	149

*When maximum circuit length is listed in:
– black type, the value is for applications with a 40°F maintain
– red type, the value is for applications with a 110°F maintain

Example: Fire Standpipe

Total heating cable length	69 ft (21 m) of 12XLE2-CR (from Step 3)
Supply voltage	208 V (from Step 1)
Minimum start-up temperature	–20°F (–29°C) (from Step 1)
Number of circuits	69 ft / (127 ft max 15 A CB at –20°F) = 0.54 circuits
	Round up to 1 circuit

Example: Branch Line with Sprinkler

Total heating cable length	266 ft (81 m) of 5XLE2-CT (from Step 3)
Supply voltage	208 V (from Step 1)
Minimum start-up temperature	0°F (–18°C) (from Step 1)
Number of circuits	266 ft / (455 ft max 30 A CB at 0°F) = 0.58 circuits
	Round up to 1 circuit

Determine Transformer Load

Transformers must be sized to handle the load of the heating cable. Use the following tables to calculate the total transformer load.

Table 9 Transformer Sizing (Amperes/foot)

Minimum start-up temperature (°F)	5XLE1	8XLE1	5XLE2			8XLE2			12XLE2		
	120V	120V	208V	240V	277V	208V	240V	277V	208V	240V	277V
–20	0.124	0.160	0.060	0.057	0.054	0.076	0.070	0.065	0.095	0.093	0.092
0	0.107	0.142	0.053	0.051	0.048	0.068	0.063	0.058	0.093	0.092	0.090
20	0.091	0.122	0.046	0.044	0.042	0.060	0.056	0.051	0.084	0.082	0.081
40	0.075	0.102	0.039	0.037	0.035	0.052	0.048	0.044	0.074	0.073	0.072

Table 10 Transformer Sizing (Amperes/meter)

Minimum start-up temperature (°C)	5XLE1	8XLE1	5XLE2			8XLE2			12XLE2		
	120V	120V	208V	240V	277V	208V	240V	277V	208V	240V	277V
–29	0.407	0.525	0.197	0.187	0.177	0.249	0.230	0.213	0.312	0.305	0.302
–18	0.351	0.466	0.174	0.167	0.157	0.223	0.207	0.190	0.305	0.302	0.295
–7	0.298	0.400	0.151	0.144	0.138	0.197	0.184	0.167	0.276	0.269	0.266
4	0.246	0.335	0.128	0.121	0.115	0.171	0.157	0.144	0.243	0.239	0.236

Use Table 9 or Table 10 to determine the applied voltage and the maximum A/ft (A/m) at the minimum start-up temperature to calculate the transformer load as follows:

$$\frac{\text{Max A/ft at minimum start-up temperature} \times \text{Heating cable length (ft)} \times \text{Supply voltage}}{1000} = \text{Transformer load (kW)}$$

Example: Fire Standpipe

Total heating cable length	69 ft (21 m) of 12XLE2-CR (from Step 3)
Supply voltage	208 V
Minimum start-up temperature	–20°F (–29°C) (from Step 1)

$$\frac{\text{Max A/ft at } -20°\text{F} \times \text{Total feet} \times \text{Supply voltage}}{1000} = (0.095 \text{ A/ft} \times 69 \text{ ft} \times 208 \text{ V}) / 1000$$

Transformer load (kW) = 1.36 kW

Example: Branch Line with Sprinkler

Total heating cable length	266 ft (81 m) of 5XLE2-CT (from Step 3)
Supply voltage	208 V
Minimum start-up temperature	0°F (–18°C) (from Step 1)

$$\frac{\text{Max A/ft at } 0°\text{F} \times \text{Total feet} \times \text{Supply voltage}}{1000} = (0.053 \text{ A/ft} \times 266 \text{ ft} \times 208 \text{ V}) / 1000$$

Transformer load (kW) = 2.93 kW

Pipe Freeze Protection and Flow Maintenance
1. Determine design conditions and pipe heat loss
2. Select the heating cable
3. Determine the heating cable length
4. Determine the electrical parameters
5. Select the connection kits and accessories
6. Select the control system
7. Complete the Bill of Materials

Step 5 Select the connection kits and accessories

All XL-Trace Edge systems require a power connection and end seal kit. Splice and tee kits are used as required. Use Table 11 on page 25 (for aboveground applications) and Table 13 on page 27 (for buried applications) to select the appropriate connection kits.

Note: Add extra cable on your Bill of Materials for power connections, tees, and end seals. See Table 11 on page 25, Table 13 on page 27, and Table 14 on page 28 for more information.

WARNING: Approvals and performance are based on the use of nVent-specified parts only. Do not substitute parts or use vinyl electrical tape.

Aboveground Piping

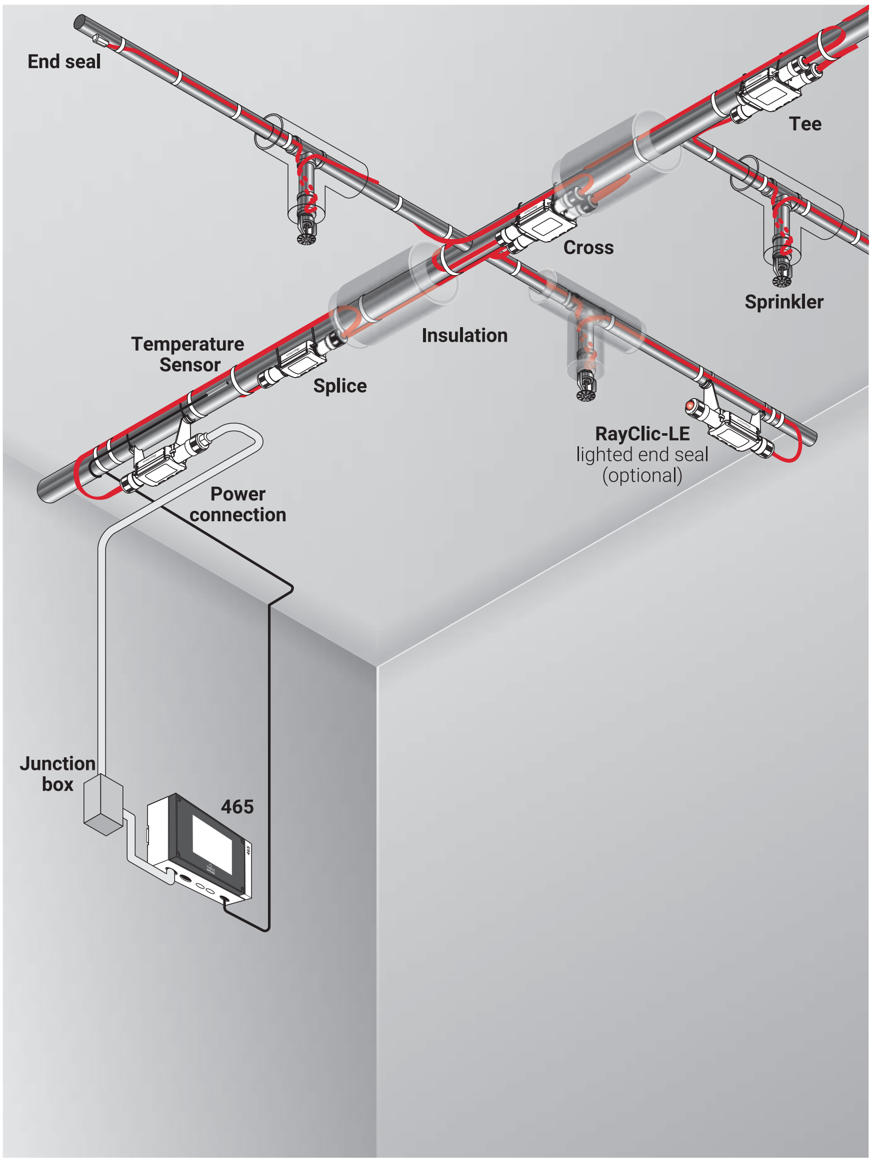


Fig. 12 RayClic connection system

Use the following table for general piping, standpipe and sprinkler. Develop a Bill of Materials from the connection kits listed in the following table

Table 11 Connection Kits and Accessories for Aboveground Piping

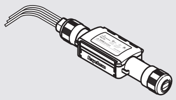
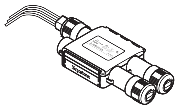
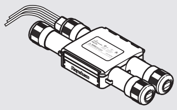
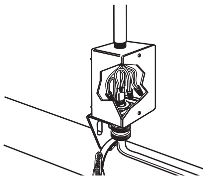
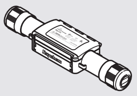
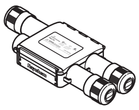
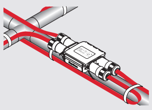
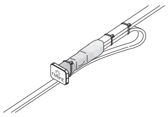
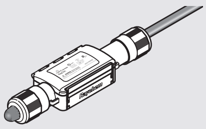
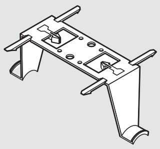
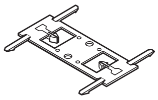
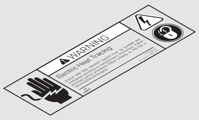
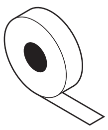
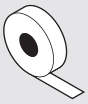
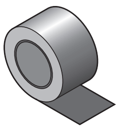
	Catalog number	Description	Standard packaging	Usage	Heating cable allowance[1]
Connection kits					
	RayClic-PC	Power connection and end seal (RayClic-SB-04 pipe mounting bracket included)	1	1 per circuit	2 ft (0.6 m)
	RayClic-PS	Powered splice and end seal (RayClic-SB-04 pipe mounting bracket included)	1	1 per circuit	4 ft (1.2 m)
	RayClic-PT	Powered tee and end seal (RayClic-SB-04 pipe mounting bracket included)	1	1 per circuit	6 ft (1.8 m)
	FTC-P[2]	Power connection and end seal kit **Note:** FTC-P is required for circuits requiring 40 A circuit breakers.	1	1 per circuit	3 ft (0.9 m)
	RayClic-S	Splice used to join two sections of heating cable	1	As required	2 ft (0.6 m)
	RayClic-T	Tee kit with end seal; use as needed for pipe branches	1	As required	3 ft (0.9 m)
	RayClic-X	Cross connection to connect four heating cables	1	As required	8 ft (2.4 m)
	FTC-HST-PLUS[3]	Low-profile splice/tee; use as needed for pipe branches	2	As required	2 ft (0.6 m) for a splice 3 ft (0.9 m) for a tee
	RayClic-LE	Lighted end seal (RayClic-SB-04 pipe mounting bracket included)	1	Alternate end seal	2 ft (0.6 m)
	RayClic-E	Replacement end seal	1	Additional end seal	0.3 ft (0.1 m)

Table 11 Connection Kits and Accessories for Aboveground Piping

	Catalog number	Description	Standard packaging	Usage	Heating cable allowance[1]
Accessories					
	RayClic-SB-04	Pipe mounting bracket. Required for mounting the kits off the pipe for exposure temperatures greater than 150°F (65°C) and for grease and fuel line splices and tees.	1	As required	–
	RayClic-SB-02	Wall mounting bracket	1	As required	–
	ETL	"Electric Traced" label (use 1 label per 10 feet of pipe)	1	1 label per 10 feet (3 m) of pipe	–
	GT-66	Glass cloth adhesive tape for attaching heating cable to pipe at 40°F (4°C) or above.	66 ft (20 m)	See Table 12	–
	GS-54	Glass cloth adhesive tape for attaching heating cable to pipe above −40°F (−40°C).	54 ft (20 m)	See Table 12	–
	AT-180	Aluminum tape. Required for attaching heating cable to plastic pipe (use 1 foot of tape per foot of heating cable)	180 ft (55 m)	1 ft/ft (0.3 m/m) of heating cable	–

[1] Allow extra heating cable for ease of component installation.
[2] Junction box not included.
[3] One RayClic-E end seal is required for each FTC-HST-PLUS used as a tee kit.

Table 12 Quantity of Glass Cloth Adhesive Tape Required (attach at 1-foot intervals)

Pipe size (in)	<2	3	4	6	8	10
Feet of pipe per GT-66 roll	60 (18 m)	50 (15 m)	40 (12 m)	25 (8 m)	20 (6 m)	15 (5 m)
Feet of pipe per GS-54 roll	49 (15 m)	41 (13 m)	33 (10 m)	20 (6 m)	16 (5 m)	12 (4 m)

Buried Piping

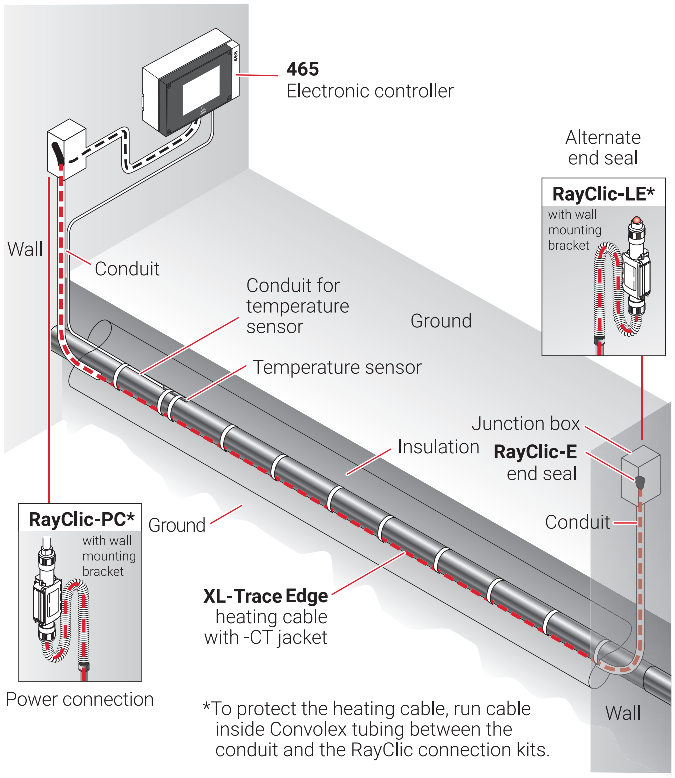


Fig. 13 Typical buried supply piping system

Use the following for buried water supply piping. Note that all connections must be aboveground and that no splices/tees are allowed. Develop a Bill of Materials from the connection kits in this table.

Table 13 Connection Kits and Accessories for Buried Piping

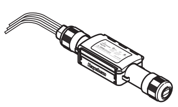
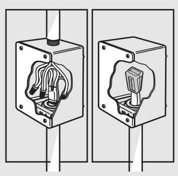
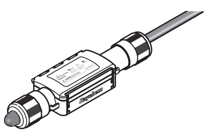
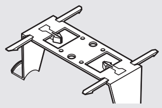
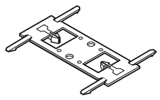
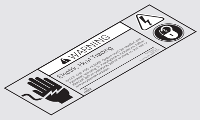
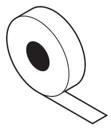
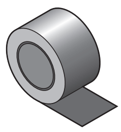
	Catalog number	Description	Standard packaging	Usage	Heating cable allowance[1]
	RayClic-PC	Power connection and end seal kit (RayClic-SB-04 pipe mounting bracket included)	1	1 per circuit	2 ft (0.6 m)
	FTC-XC[2]	The FTC-XC power connection and end seal kit is for use with XL-Trace Edge heating cable that is run through conduit to a junction box. Materials for one power connection and end seal is included in the kit. **Note:** FTC-XC is required for circuits requiring 40 A circuit breakers.	1	1 per circuit	2 ft (0.6 m)
	RayClic-LE	Lighted end seal (RayClic-SB-04 pipe mounting bracket included)	1	Alternate end seal	2 ft (0.6 m)
	RayClic-E	Replacement end seal	1	Additional end seal	0.3 ft (0.1 m)

Table 13 Connection Kits and Accessories for Buried Piping

	Catalog number	Description	Standard packaging	Usage	Heating cable allowance[1]
Accessories					
	RayClic-SB-04	Pipe mounting bracket	1	As required	–
	RayClic-SB-02	Wall mounting bracket	1	As required	–
	ETL	“Electric Traced” label (use 1 label per 10 feet of pipe)	1	1 label per 10 feet (3 m) of pipe	–
	GT-66	Glass cloth adhesive tape for attaching heating cable to pipe at 40°F (4°C) or above	66 ft (20 m)	See Table 14	–
	GS-54	Glass cloth adhesive tape for attaching heating cable to pipe above −40°F (−40°C)	54 ft (20 m)	See Table 14	–
	AT-180	Aluminum tape. Required for attaching heating cable to plastic pipe (use 1 foot of tape per foot of heating cable)	180 ft (55 m)	1 ft/ft (0.3 m/m) of heating cable	–

[1] Allow extra heating cable for ease of component installation.
[2] Junction box not included.

Table 14 Quantity of Glass Cloth Adhesive Tape Required (attach at 1-foot intervals)

Pipe size (in)	<2	3	4	6	8	10
Feet of pipe per GT-66 roll	60 (18 m)	50 (15 m)	40 (12 m)	25 (8 m)	20 (6 m)	15 (5 m)
Feet of pipe per GS-54 roll	49 (15 m)	41 (13 m)	33 (10 m)	20 (6 m)	16 (5 m)	12 (4 m)

Step 6 Select the control system

Temperature control with heating cable circuit supervision is required by approval agencies, codes and nVent. To satisfy this requirement nVent offers a wide variety of monitoring and control options for fire suppression system.

465, C910-485, or ACS-30 is are the only controllers approved for this application:

- Temperature controls save energy by ensuring that the system is energized only when necessary.
- Superior accuracy and reliability with RTD temperature sensors.
- Integrated 30 mA ground fault protection for cost savings and circuit protection.
- Self-test features to ensure the heating cable circuit integrity even when the system is not in demand.
- Dry contact alarm relay outputs for loss of power, low temperature, RTD failure, relay failure and ground fault trip.

Note: NFPA 13 requires that heat tracing for fire suppression systems are supervised by controllers with alarm relays connected to the fire control panel.

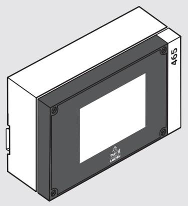
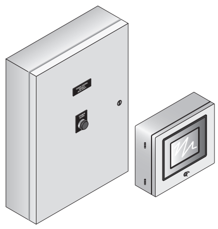
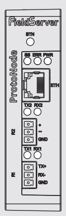
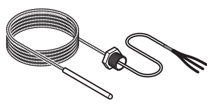
Use the following table to identify the control system suitable for your application. Contact your nVent representative or call (800) 545-6258 for more information and other control options.

Table 15 Temperature Control Options

Application	465	ACS-30
Ambient sensing	Yes	Yes
Line sensing	Yes	Yes
Buried pipe	Yes	Yes
Proportional ambient control	Yes	Yes
Fire sprinklers	Yes	Yes
Sensor	Thermistor	RTD
Sensor length	See data sheet	See data sheet
Setpoint range	32°F to 104°F (0°C to 40°C)	"
Enclosure	Type 12 - indoor use	"
Differential	3°F (1.6°C)	"
Setpoint repeatability	3°F (1.6°C)	"
Enclosure limits	–4°F to 122°F (–20°C to 50°C)	"
Switch rating	24 A	30 A
Switch type	SPST	DPST
Electrical rating	120–277V	100–277 V
Approvals	c-UL-us	c-ETL-us
Ground fault protection	20 mA to 200 mA	20 mA to 100 mA
BMS interface	N/A	Modbus[1]

[1] ProtoNode multi-protocol gateways are available from nVent.

Table 16 Control Systems

	Catalog number	Description
Electronic Controllers and Sensors		
	465	The 465 is a single point heat tracing controller designed for fire sprinkler systems. It includes a 5" inch color touch screen display for intuitive set up and programming right out of the box. The 465 controller may be used with line-sensing or ambient-sensing and proportional ambient-sensing control (PASC) modes. It measures temperatures with two Thermistor 2 KOhm / 77°F (25°C), 2-wire connected directly to the unit. The controller can also measure ground fault current to ensure system integrity.
	ACS-UIT3 ACS-PCM2-5	The ACS-30 Advanced Commercial Control System is a multipoint electronic control and monitoring system for heat-tracing used in commercial freeze protection and flow maintenance applications. The ACS-30 system can control up to 260 circuits with multiple networked ACS-PCM2-5 panels, with a single ACS-UIT3 user interface terminal. The ACS-PCM2-5 panel can directly control up to 5 individual heat-tracing circuits using electromechanical relays rated at 30 A up to 277 V.
	ProtoNode-RER	The ProtoNode is an external, high performance multi-protocol gateway for customers needing protocol translation between Building Management Systems (BMS) and the ACS-30 or C910-485 controllers. The ProtoNode-RER is for BACnet® or Metasys® N2 systems.
	RTD-200 RTD3CS RTD10CS RTD50CS	Stainless steel jacketed three-wire RTD (Resistance Temperature Detector) used with C910-485 and ACS-30 controllers. RTD-200: 3-in (76 mm) temperature sensor with a 6-ft (1.8 m) lead wire and 1/2-in NPT bushing RTD3CS: temperature sensor with a 3-ft (0.9 m) flexible armor, 18-in (457 mm) lead wire and 1/2-in NPT bushing RTD10CS: temperature sensor with a 10-ft (3 m) flexible armor, 18-in (457 mm) lead wire and 1/2-inch NPT bushing RTD50CS: temperature sensor with a 50-ft (3 m) flexible armor, 18-in (457 mm) lead wire and 1/2-in NPT bushing

Pipe Freeze Protection and Flow Maintenance

1. Determine design conditions and pipe heat loss
2. Select the heating cable
3. Determine the heating cable length
4. Determine the electrical parameters
5. Select the connection kits and accessories
6. Select the control system
7. Complete the Bill of Materials

Step 7 Complete the Bill of Materials

If you used the Design Worksheet to document all your design parameters, you should have all the details necessary complete your Bill of Materials.

Follow the installation and maintenance procedures in the XL-Trace Edge System Installation and Operation Manual (H58033) when installing XL-Trace Edge on fire suppression systems with the following additional instructions.

When installing XL-Trace Edge on sprinklers follow the methods shown below:

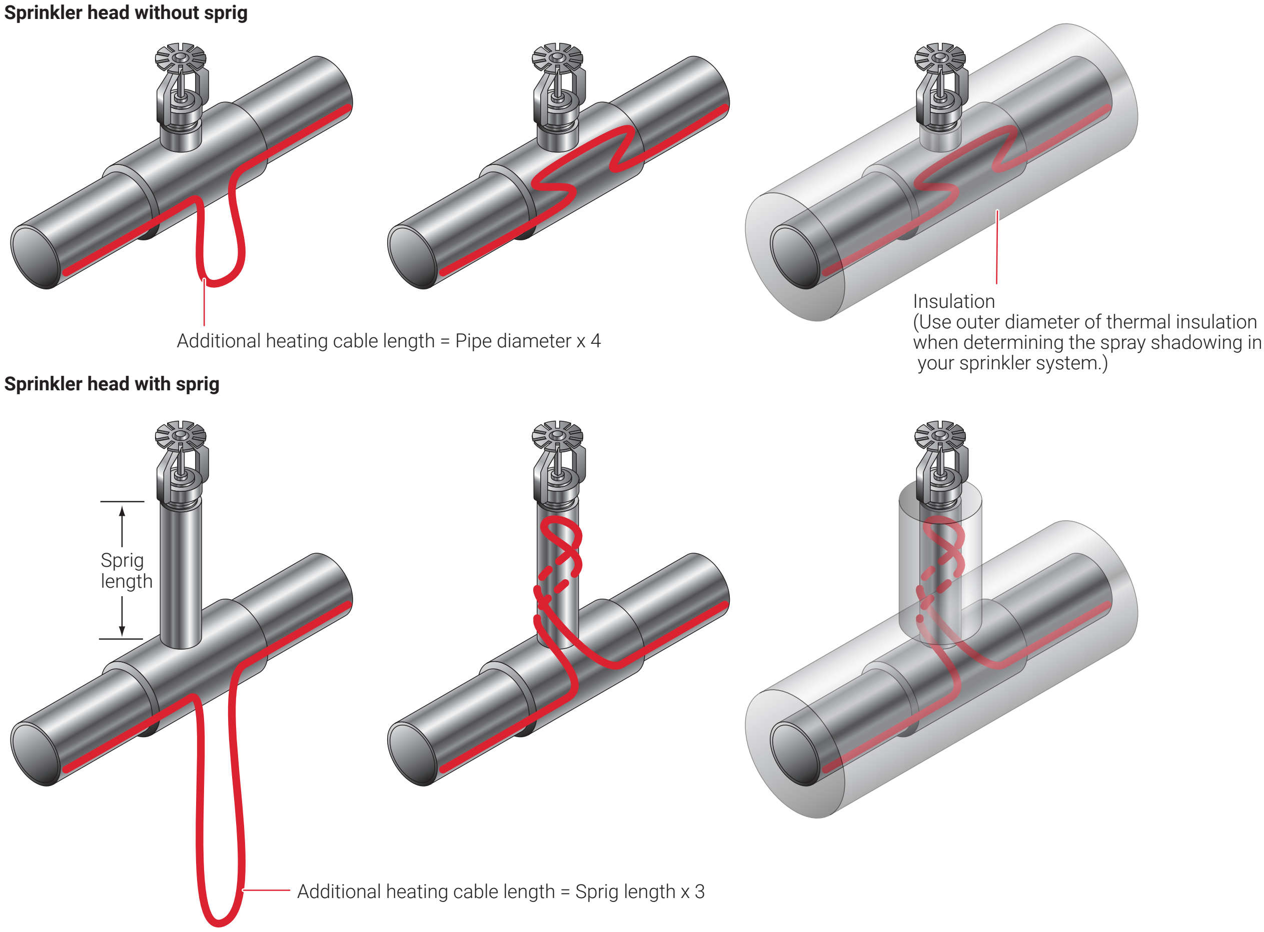


Fig. 14 XL-Trace Edge on sprinklers

Note: The orientation and type of sprinkler head shown above is only for reference. The illustrations only depict the amount of heat tracing required and how to install it.

Verify that thermal insulation around the sprinkler heads does not impede the water pattern emitted by the sprinkler head as described in IEEE 515.1, 6.2.5.2.

When installing XL-Trace Edge on dry pendant sprinklers used in freezer applications follow the methods shown below:

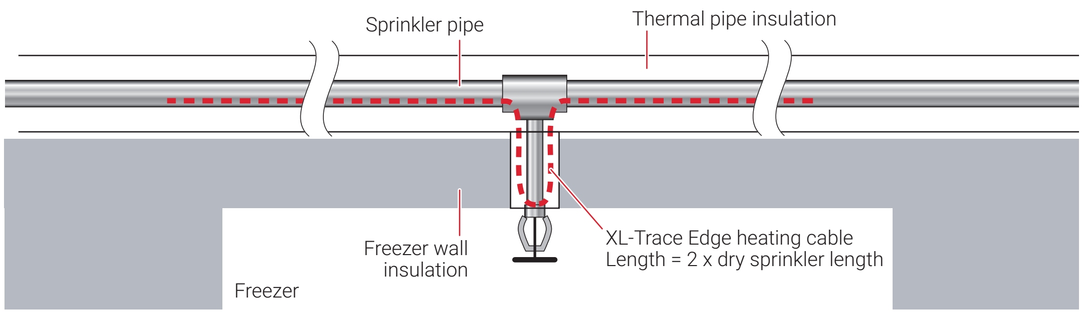


Fig. 15 XL-Trace Edge on extended pendant sprinklers

TraceCalc Pro for Buildings is an online design tool available to help you create simple or complex heat-tracing designs for pipe freeze protection or flow maintenance applications. It is available at nVent.com/RAYCHEM.

Step 1 Determine design conditions and pipe heat loss

Design conditions

Fire sprinkler system	Location		Maintain temp. (T_M)	Min. ambient temp. (T_A)	Pipe diameter and material		Pipe length	Thermal insulation type and thickness	
❑ Supply piping ❑ Standpipe	❑ Indoors ❑ Outdoors	❑ Aboveground ❑ Buried	_____	_____	____ in	❑ Metal ❑ Plastic	_____ ft (m)	❑ Fiberglass ❑ _______	___ in
❑ Sprinkler piping	❑ Indoors ❑ Outdoors	❑ Aboveground ❑ Buried	_____	_____	____ in	❑ Metal ❑ Plastic	_____ ft (m)	❑ Fiberglass ❑ _______	___ in
❑ Branchpipe	❑ Indoors ❑ Outdoors	❑ Aboveground	_____	_____	____ in	❑ Metal ❑ Plastic	_____ ft (m)	❑ Fiberglass ❑ _______	___ in
❑ Branchpipe with sprinkler	❑ Indoors ❑ Outdoors	❑ Aboveground	_____	_____	____ in	❑ Metal ❑ Plastic	_____ ft (m)	❑ Fiberglass ❑ _______	___ in
Example: **✓ Branch line with sprinkler**	**✓ Indoor**		**40°F**	**50°F**	**1 in**	**✓ Metal**	**200 ft**	**✓ Foam elastomer**	**1/2 in**

Pipe heat loss

Calculate temperature differential ΔT

Pipe maintain temperature (T_M) ______________ °F (°C)

Ambient temperature (T_A) ______________ °F (°C)

______________ – ______________ ————————→ = ______________

T_M T_A **ΔT**

Example: Pipe Freeze Protection – Branch line with sprinkler

Pipe maintain temperature (T_M) 40 °F (from Step 1)
°F

Ambient temperature (T_A) 0 °F (from Step 1)
°F

40 °F – 0 °F ————————→ = **40 °F**

T_M T_A **ΔT**

RAYCHEM-DG-H58489-XLTraceEdgeFS-EN-2405

Determine the pipe heat loss: See Table 1 for the base heat loss of the pipe (Q_B). If the ΔT for your system is not listed, interpolate between the two closest values.

Q_{B-50} ΔT1	______	W/ft (W/m)
Q_{B-100} ΔT2	______	W/ft (W/m)
Q_B	______	W/ft (W/m)
Pipe diameter	______	in
Insulation thickness	______	in
ΔT	______	°F (°C)
Q_{B-50}	______	W/ft (W/m)
Q_{B-50}	______	W/ft (W/m)

Example: Pipe Freeze Protection – Branch line with sprinkler

Pipe diameter	1 in
Insulation thickness	1/2 in
ΔT	40°F
Q_{B-T1}	1.4 W/ft
Q_{B-T2}	3.5 W/ft
ΔT interpolation	ΔT 40°F is 67% of the distance between ΔT 20°F and ΔT 50°F
Q_{B-40}	Q_{B-50} + [0.67 x (Q_{B-50} – Q_{B-20})] = 1.4 + [0.67 x (3.5 – 1.4)] = 2.8 W/ft
Pipe heat loss (Q_B)	**2.8 W/ft @ T_M 40°F (9.2 W/m @ T_M 4°C)**

Compensate for insulation type and pipe location

See Table 1 for the pipe heat loss (Q_B). If the ΔT for your system is not listed, interpolate between the two closest values.
See Table 3 for insulation multiple
See Table 2 for indoor multiple

Location	____________
Insulation thickness and type	____________
Q_B	____________ W/ft (W/m)
Insulation multiple	____________
Indoor multiple (if applicable)	____________

____________ x ____________ x ____________ = ____________
Q_B x Insulation multiple x Indoor multiple (if applicable) = $Q_{CORRECTED}$

Example: Pipe Freeze Protection – Branch line with sprinklers

Location	Indoors
Insulation thickness and type	1-1/2 in foamed elastomer
Q_B	2.8 W/ft @ T_M 40°F (9.2 W/m @ T_M 4°C)
Insulation multiple	1.00
Indoor multiple	0.79
$Q_{CORRECTED}$	2.8 W/ft x 1.0 x 0.79 = 2.2 W/ft @ T_M40°F (7.3/m @ T_M4°C)

Step 2 Select the heating cable

Power output data: See Fig. 11

Power output correction factors: See Table 4

Pipe maintain temperature (T_M)	____________	(from Step 1)
Corrected heat loss ($Q_{CORRECTED}$)	____________	(from Step 1)
Supply voltage	____________	(from Step 1)
Pipe material (metal or plastic)	____________	(from Step 1)
XL-Trace Edge application (water, fuel oil, or greasy waste)		(from Step 1)
Pipe freeze protection: general water piping, sprinkler piping	____________	
Flow maintenance: greasy waste lines, fuel lines	____________	
Maximum system use temperature (T_{MAX})	____________	(from Step 1)
Heating cable selected	____________	(from Step 1)
Power at T_M (120/208 V)	____________	
Power output correction factor	____________	(from Step 1)
Plastic pipe correction factor	____________	

____________ x ____________ = ____________

Power at rated V factor   Plastic pipe correction factor   Corrected power

Is the heating cable power output ($P_{CORRECTED}$) ≥ the corrected heat loss? ❑ Yes ❑No

If No, then design with additional runs of heating cable or thicker thermal insulation.

Example: Pipe Freeze Protection – Branch line with sprinklers

Maintain temperature (T_M)	40°F
Corrected heat loss ($Q_{CORRECTED}$)	2.2 W/ft @ T_M 40°F
Supply voltage	208 V
Pipe material (metal or plastic*) (*AT-180 aluminum tape required for installing heating cable on plastic pipes)	metal

Q_B = 2.2 W/ft @ T_M 40°F

Select curve C: 5XLE2 = **5.6 W/ft @ 40°F**

Power output correction factor: 208 V = 0.90

Pipe material correction factor: Metal = 1.00

Corrected heating cable power: 5.6 @/ft x 0.90 x 1.00 = **5.0 W/ft**

Select: **5XLE2**

Select outer jacket

❑ -CR

❑ -CT (Required for buried applications)

Example: Pipe Freeze Protection – Branch line with sprinklers

Location	Aboveground, indoors
Selection:	5XLE2-CR

Step 3 Determine the heating cable length

For additional heating cable allowance for valves: See Table 5

For additional heating cable allowance for pipe supports, flanges and sprinklers: See Table 6.

Additional heating cable for heat sinks

______ Type of valves	→	______ How many	x	______ Additional heating cable	=	______ **Total heating cable for valves**
______ Type of pipe supports	→	______ How many	x	______ Additional heating cable	=	______ **Total heating cable for pipe supports**
______ Type of flanges	→	______ How many	x	______ Additional heating cable	=	______ **Total heating cable for flanges**
______ Type of sprinklers	→	______ How many	x	______ Additional heating cable	=	______ **Total heating cable for sprinklers**

Total heating cable for heat sinks: ______

Total heating cable length

(______ Pipe length x ______ Number of heating cable runs) + ______ Additional cable for valves, pipe supports, flanges, and sprinklers = ______ **Total heating cable length required**

Example:

Additional heating cable for heat sinks

Gate valves Type of valves	→	2 How many	x	2 ft Additional heating cable	=	**4 ft** **Total**
Noninsulated hangers Type of pipe supports	→	10 How many	x	(0.1 ft* x 2) x 10 = 2 ft Additional heating cable (*1-in pipe = 1-in/12-in = 0.1 ft)	=	**1.7 ft** **Total**
1 foot springs Type of sprinklers	→	20 How many	x	3 Additional heating cable	=	**60 ft** **Total**

Total: **66 ft**

Total heating cable length

(200 ft Pipe length x 1 Number of heating cable runs) + 66 ft Additional cable for valves, pipe supports, flanges, and sprinklers = **266 ft** **Total heating cable length required**

Step 4 Determine the electrical parameters

Determine maximum circuit length and number of circuits

See Table 7 and Table 8.

Total heating cable length required ____________

Supply voltage: ❑ 120 V ❑ 208 V ❑ 240 V ❑ 277 V

Circuit breaker size: ❑ 15 A ❑ 20 A ❑ 30 A ❑ 40 A

Minimum start-up temperature ____________

Maximum circuit length ____________

____________	/	____________	=	____________
Total heating cable length required		Maximum heating cable circuit length		**Number of circuits**

Example:

Total heating cable length required 266 ft of 5XLE2-CT

Supply voltage: ❑ 120 V ☑ 208 V ❑ 240 V ❑ 277 V

Circuit breaker size: ❑ 15 A ❑ 20 A ☑ 30 A ❑ 40 A

Minimum start-up temperature 0°F

Maximum circuit length 455 ft

266 ft	/	455 ft	=	**0.58 circuits, round up to 1**
Total heating cable length required		Maximum heating cable circuit length		**Number of circuits**

Determine transformer load

SeeTable 9 and Table 10.

____________	x	____________	x	____________	/	1000	=	____________
Max A/ft* at minimum start-up temperature		Heating cable length		Supply voltage				**Transformer load (kW)**

Example:

0.053 A/ft	x	266 ft	x	208 V	/	1000	=	**2.93 kW**
Max A/ft* at minimum start-up temperature		Heating cable length		Supply voltage				**Transformer load (kW)**

Step 5 Select the connection kits and accessories

See Table 11.

Connection kits – Aboveground	Description	Quantity	Heating cable allowance
❑ RayClic-PC	Power connection and end seal	________	____________
❑ RayClic-PS	Power splice and end seal	________	____________
❑ RayClic-PT	Powered tee and end seal	________	____________
❑ FTC-P	Power connection and end seal	________	____________
❑ RayClic-S	Splice	________	____________
❑ RayClic-T	Tee kit with end seal	________	____________
❑ RayClic-X	Cross connection	________	____________
❑ FTC-HST-PLUS	Low-profile splice/tee	________	____________
❑ RayClic-LE	Lighted end seal	________	____________
❑ RayClic-E	Extra end seal	________	____________

Connection kits – Buried	Description	Quantity	Heating cable allowance
❑ RayClic-PC	Power connection and end seal	________	____________
❑ FTC-XC	Power splice and end seal	________	____________
❑ RayClic-LE	Lighted end seal	________	____________
❑ RayClic-E	Extra end seal	________	____________

Accessories – Aboveground and buried	Description	Quantity
❑ RayClic-SB-04	Pipe mounting bracket	________
❑ RayClic-SB-02	Wall mounting bracket	________
❑ ETL	“Electric-Traced” label	________
❑ GT-66	Glass cloth adhesive tape	________
❑ GS-54	Glass cloth adhesive tape	________
❑ AT-180	Aluminum tape (for plastic pipes)	________

____
Total heating cable allowance for connection kits

______________ + ______________________ = ______________

Total heating cable length + Total heating cable allowance for connection kits = **Total heating cable length required**

Step 6 Select the control system

See Table 16.

Thermostats, controllers and accessories	Description	Quantity
❑ 465	Single point heat tracing controller for fire sprinkler systems	________
❑ ACS-UIT3	ACS-30 user interface terminal	________
❑ ACS-PCM2-5	ACS-30 power control panel	________
❑ ProtoNode-RER	Multi-protocol gateway	________
❑ RTD3CS	Resistance temperature device	________
❑ RTD10CS	Resistance temperature device	________
❑ RTD-200	Resistance temperature device	________
❑ RTD50CS	Resistance temperature device	________

Step 7 Complete the Bill of Materials

Use the information recorded in this worksheet to complete the Bill of Materials.

North America

Tel +1.800.545.6258
Fax +1.800.527.5703
thermal.info@nVent.com

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