Self-Regulating Heating Cables

nVent RAYCHEM

CONNECT AND PROTECT

This section provides an overview and general design guidelines for nVent RAYCHEM self-regulating heat tracing systems. For complete design assistance, contact your nVent representative or visit our website at nVent.com/RAYCHEM.

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Conductive-Polymer Technology

nVent RAYCHEM invented self-regulating heating cable technology over 50 years ago and today has over 2 billion feet of nVent RAYCHEM brand self-regulating heating cable installed worldwide.

Self-regulating systems are the preferred choice for most complex pipe-tracing applications. This is due to their parallel construction, which allows them to be cut to length and spliced in the field, and their self-regulating output, which provides more heat where it is needed.

nVent RAYCHEM self-regulating heating cables are certified for use in hazardous locations and have been tested and approved for unconditional temperature classifications by worldwide approval agencies.

Typical Self-Regulating System

A typical self-regulating heating cable system is shown in Figure 1. The heating cable is cut to length at the job site and attached to the pipe with glass tape. A power connection kit connects the heating cable bus wires to power in a junction box. Tees and splices accommodate pipe branches to connect two or three heating cables together. An end seal kit is used to terminate the end of the heating cable. These required connection kits are designed and approved to provide a safe and reliable heat-tracing system. For applications requiring tight temperature control, electrical system monitoring, or remote operation, consider a control and monitoring system.

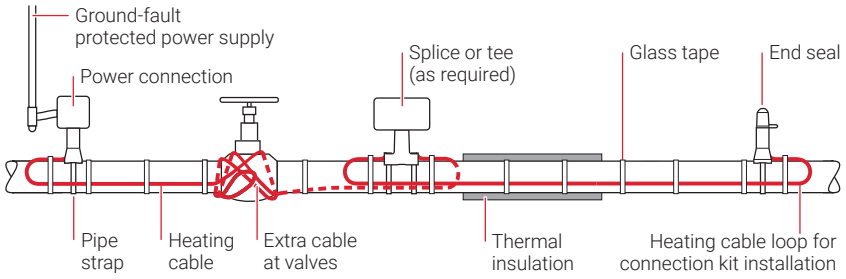


Fig. 1 Typical self-regulating heating cable system

Approvals and Certifications

nVent RAYCHEM self-regulating systems are approved and certified for use in nonhazardous and hazardous locations by many agencies. Please refer to the technical datasheets for more details.

Pipe Heat Loss Calculations

Note: All thermal and electrical design information provided here is based upon a "standard" installation; i.e., with heating cable installed on insulated pipes. For any other method of installation, consult your nVent representative for design assistance.

Note: Heat loss calculation is based on a nonflowing pipe.

To select the proper heating cable you must first calculate the pipe heat loss, as outlined in the following four steps:

1. Gather the necessary information.
   - T_M: Maintain temperature
   - T_A: Minimum expected ambient temperature
   - Pipe or tubing size and material
   - Thermal insulation type and thickness
2. Calculate the temperature differential between the pipe maintain temperature and the minimum ambient temperature.
3. Calculate the pipe heat loss.
4. Adjust the heat loss to compensate for specific insulation type.

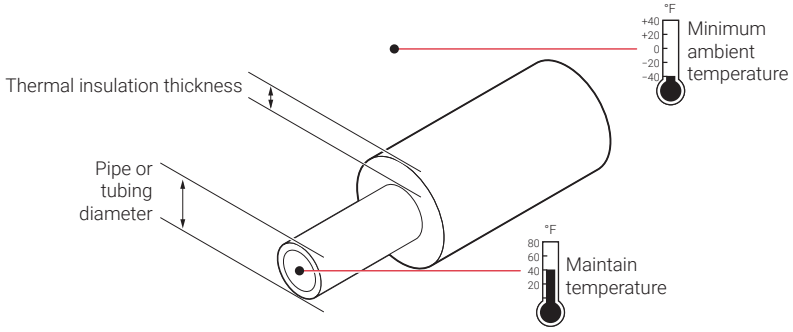


Fig. 2 Pipe heat loss

Thermal Design
1. Gather information
2. Calculate temperature differential
3. Calculate heat loss
4. Compensate for insulation type

Step 1. Gather the necessary information

To select the heating cable, gather and record the following information:

- T_M: Maintain temperature _____
- T_A: Minimum expected ambient temperature _____
- Pipe or tubing size and material _____
- Thermal insulation type and thickness _____

Example: Gather information

Maintain temperature	Water freeze protection at 40°F
Minimum ambient temperature	–40°F
Pipe size and material	6-inch diameter, steel
Insulation thickness and type	2-½ inch, cellular glass

Thermal Design
1. Gather information
2. Calculate temperature differential
3. Calculate heat loss
4. Compensate for insulation type

Step 2. Calculate temperature differential ΔT

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

Formula ΔT $T_M - T_A$

Example: Calculate temperature differential

Input T_M 40°F (from Step 1)

Input T_A –40°F (from Step 1)

Calculation ΔT = 40°F – (–40°F) = 80°F

ΔT = 80°F

Thermal Design
1. Gather information
2. Calculate temperature differential
3. Calculate heat loss
4. Compensate for insulation type

Step 3. Calculate the pipe heat loss

From Table 1 match the pipe size and insulation thickness with the temperature differential, ΔT, to find the base heat loss of the pipe (Q_B).

Example: Calculate pipe heat loss

Input Pipe size = 6 inch (from Step 1)

Input Insulation thickness = 2-½ inch (from Step 1)

Input ΔT = 80°F (from Step 2)

Input Pipe heat loss = 3.6 W/ft for ΔT of 50°F (from Table 1)

From Table 1, Q_B must be calculated through interpolation. For this example, ΔT of 80°F is ⅗ of the difference between the ΔT of 50°F and the ΔT of 100°F:

Q_B = 3.6 W/ft + [⅗ x (7.4 – 3.6)] (7.4 is pipe heat loss for the ΔT of 100°F; 3.6 is pipe heat loss for the ΔT of 50°F)

Calculation Q_B = 3.6 + 2.3 = 5.9 W/ft

Pipe heat loss Q_B= 5.9 W/ft @ 40°F

Thermal Design
1. Gather information
2. Calculate temperature differential
3. Calculate heat loss
4. Compensate for insulation type

Step 4. Compensate for insulation type

Multiply the base heat loss of the pipe (Q_B) from Step 3 by the insulation compensation factor (f) from Table 2 to get the total heat loss per foot of pipe (Q_T).

Formula $Q_T = Q_B \times f$

Example: Insulation type compensation

Input Insulation type = cellular glass (from Step 1)

Input f = 1.36 for cellular glass (from Table 2)

Input Q_B = 5.9 W/ft (from Step 3)

Calculation Q_T = 5.9 W/ft x 1.36 = 8.02 W/ft

Q_T = 8.02 W/ft at 40°F

Now proceed to the Heating Cable Selection section, page 8, to determine the heating cable that will compensate for this heat loss.

Note: Heat loss calculations are based on IEEE Standards.

TABLE 1 PIPE HEAT LOSS (W/FT)

			Pipe diameter (IPS) in inches							
			¼	½	¾	1	1-¼	1-½	2	2-½
	(ΔT)			Tubing size (inches)						
Insulation thickness	°F	°C		¾	1	1-¼	1-½	2		
0.5"	50	10	1.9	2.5	2.9	3.5	4.1	4.6	5.5	6.5
	100	37	3.9	5.2	6.1	7.2	8.6	9.6	11.5	13.5
	150	65	6.1	8.1	9.5	11.2	13.4	14.9	17.9	21.1
	200	93	8.5	11.3	13.2	15.6	18.6	20.7	24.9	29.2
1.0"	50	10	1.3	1.6	1.9	2.2	2.5	2.8	3.2	3.8
	100	37	2.7	3.4	3.9	4.5	5.2	5.8	6.8	7.8
	150	65	4.2	5.3	6.1	7.0	8.2	9.0	10.6	12.2
	200	93	5.8	7.4	8.4	9.7	11.3	12.4	14.6	16.9
	250	121	7.6	9.7	11.0	12.7	14.8	16.3	19.1	22.1
1.5"	50	10	1.1	1.3	1.5	1.7	1.9	2.1	2.4	2.8
	100	37	2.2	2.8	3.1	3.5	4.0	4.4	5.1	5.8
	150	65	3.5	4.3	4.8	5.5	6.3	6.9	8.0	9.1
	200	93	4.8	5.9	6.7	7.6	8.7	9.5	11.0	12.6
	250	121	6.3	7.8	8.7	9.9	11.4	12.4	14.4	16.5
	300	148	7.9	9.7	11.0	12.4	14.3	15.6	18.1	20.6
	350	176	9.6	11.9	13.3	15.1	17.4	19.0	22.0	25.1
2.0"	50	10	0.9	1.1	1.3	1.4	1.6	1.8	2.0	2.3
	100	37	2.0	2.4	2.7	3.0	3.4	3.7	4.2	4.8
	150	65	3.1	3.7	4.2	4.7	5.3	5.8	6.6	7.5
	200	93	4.3	5.2	5.8	6.5	7.4	8.0	9.2	10.4
	250	121	5.6	6.8	7.5	8.5	9.6	10.4	12.0	13.5
	300	148	7.0	8.5	9.4	10.6	12.1	13.1	15.0	17.0
	350	176	8.5	10.3	11.5	12.9	14.7	15.9	18.2	20.6
2.5"	50	10	0.9	1.0	1.2	1.3	1.4	1.6	1.8	2.0
	100	37	1.8	2.2	2.4	2.7	3.0	3.3	3.7	4.2
	150	65	2.8	3.4	3.7	4.2	4.7	5.1	5.8	6.5
	200	93	3.9	4.7	5.2	5.8	6.5	7.0	8.0	9.0
	250	121	5.1	6.1	6.8	7.6	8.5	9.2	10.5	11.7
	300	148	6.4	7.7	8.5	9.5	10.7	11.5	13.1	14.7
	350	176	7.8	9.3	10.3	11.5	13.0	14.0	15.9	17.9
3.0"	50	10	0.8	1.0	1.1	1.2	1.3	1.4	1.6	1.8
	100	37	1.7	2.0	2.2	2.4	2.7	2.9	3.3	3.7
	150	65	2.6	3.1	3.4	3.8	4.3	4.6	5.2	5.8
	200	93	3.6	4.3	4.8	5.3	5.9	6.4	7.2	8.0
	250	121	4.8	5.7	6.2	6.9	7.8	8.3	9.4	10.5
	300	148	6.0	7.1	7.8	8.7	9.7	10.4	11.8	13.2
	350	176	7.3	8.6	9.5	10.5	11.8	12.7	14.3	16.0
4.0"	50	10	0.7	0.9	0.9	1.0	1.1	1.2	1.4	1.5
	100	37	1.5	1.8	2.0	2.1	2.4	2.5	2.9	3.2
	150	65	2.4	2.8	3.0	3.4	3.7	4.0	4.4	4.9
	200	93	3.3	3.9	4.2	4.6	5.2	5.5	6.2	6.8
	250	121	4.3	5.1	5.5	6.1	6.7	7.2	8.1	8.9
	300	148	5.4	6.3	6.9	7.6	8.5	9.0	10.1	11.2
	350	176	6.6	7.7	8.4	9.3	10.3	11.0	12.3	13.6

Note: Pipe heat loss (Q_B) is shown in watts per foot. Heat loss calculations are based on IEEE Standards with the following provisions:

- Pipes insulated with glass fiber in accordance with ASTM C547
- Pipes located outdoors in a 20-mph wind
- No insulating air space assumed between pipe and insulation
- No insulating air space assumed between the insulation and outer cladding
- Includes a 10% safety factor

TABLE 1 PIPE HEAT LOSS (W/FT)

Pipe diameter (IPS) in inches											
3	3-½	4	6	8	10	12	14	16	18	20	24
7.7	8.6	9.6	13.6	17.4	21.4	25.2	27.5	31.3	35.0	38.8	46.2
16.0	18.0	20.0	28.4	36.3	44.6	52.5	57.4	65.2	73.0	80.8	96.3
25.0	28.1	31.2	44.3	56.6	69.6	81.9	89.5	101.7	113.8	126.0	150.2
34.6	39.0	43.3	61.5	78.5	96.6	113.6	124.2	141.1	158.0	174.8	208.5
4.4	4.9	5.4	7.5	9.4	11.5	13.5	14.7	16.6	18.6	20.5	24.4
9.1	10.2	11.2	15.6	19.7	24.0	28.1	30.6	34.7	38.7	42.8	50.9
14.2	15.9	17.5	24.3	30.7	37.4	43.8	47.8	54.1	60.4	66.7	79.4
19.7	22.0	24.2	33.7	42.5	51.9	60.7	66.2	75.0	83.8	92.5	110.0
25.8	28.7	31.7	44.0	55.6	67.9	79.4	86.6	98.1	109.6	121.0	143.9
3.2	3.6	3.9	5.3	6.7	8.1	9.4	10.2	11.5	12.9	14.2	16.8
6.7	7.4	8.1	11.1	13.9	16.8	19.6	21.3	24.0	26.8	29.5	35.0
10.5	11.6	12.7	17.3	21.6	26.2	30.5	33.2	37.5	41.8	46.1	54.6
14.5	16.1	17.6	24.0	30.0	36.3	42.3	46.0	52.0	57.9	63.8	75.7
19.0	21.0	23.0	31.4	39.2	47.5	55.3	60.2	68.0	75.7	83.5	99.0
23.8	26.3	28.8	39.3	49.2	59.6	69.3	75.4	85.1	94.9	104.6	124.0
28.9	32.0	35.0	47.8	59.8	72.4	84.3	91.7	103.5	115.4	127.2	150.8
2.6	2.9	3.1	4.2	5.2	6.3	7.3	7.9	8.9	9.9	10.9	12.9
5.5	6.0	6.6	8.8	10.9	13.1	15.2	16.5	18.6	20.7	22.8	26.9
8.5	9.4	10.2	13.8	17.0	20.5	23.8	25.8	29.0	32.3	35.5	42.0
11.8	13.0	14.2	19.1	23.6	28.4	32.9	35.7	40.2	44.7	49.2	58.2
15.5	17.0	18.5	24.9	30.9	37.2	43.1	46.7	52.6	58.5	64.3	76.1
19.4	21.3	23.2	31.2	38.7	46.6	54.0	58.6	65.9	73.3	80.6	95.3
23.6	25.9	28.3	38.0	47.1	56.6	65.6	71.2	80.2	89.1	98.1	115.9
2.3	2.5	2.7	3.6	4.4	5.2	6.1	6.6	7.4	8.2	9.0	10.6
4.7	5.2	5.6	7.4	9.1	10.9	12.6	13.7	15.3	17.0	18.7	22.0
7.4	8.1	8.7	11.6	14.2	17.0	19.7	21.3	23.9	26.5	29.1	34.3
10.2	11.2	12.1	16.1	19.7	23.6	27.2	29.5	33.1	36.7	40.3	47.5
13.3	14.6	15.8	21.0	25.8	30.9	35.6	38.6	43.3	48.0	52.8	62.2
16.7	18.3	19.8	26.3	32.3	38.7	44.6	48.4	54.3	60.2	66.1	77.9
20.3	22.2	24.1	32.0	39.3	47.1	54.3	58.8	66.0	73.2	80.4	94.7
2.0	2.2	2.4	3.1	3.8	4.5	5.2	5.6	6.3	7.0	7.6	9.0
4.2	4.6	4.9	6.5	7.9	9.4	10.8	11.7	13.1	14.5	15.9	18.7
6.6	7.1	7.7	10.1	12.4	14.7	16.9	18.3	20.5	22.6	24.8	29.2
9.1	9.9	10.7	14.0	17.1	20.4	23.4	25.3	28.3	31.4	34.4	40.4
11.9	12.9	14.0	18.3	22.4	26.6	30.6	33.1	37.1	41.0	45.0	52.8
14.9	16.2	17.5	23.0	28.1	33.4	38.4	41.5	46.5	51.4	56.3	66.2
18.1	19.7	21.3	28.0	34.1	40.6	46.7	50.5	56.5	62.5	68.5	80.5
1.7	1.8	2.0	2.5	3.1	3.6	4.1	4.4	5.0	5.5	6.0	7.0
3.5	3.8	4.1	5.3	6.4	7.5	8.6	9.3	10.3	11.4	12.4	14.5
5.5	6.0	6.4	8.3	10.0	11.8	13.4	14.5	16.1	17.8	19.4	22.7
7.6	8.3	8.9	11.4	13.8	16.3	18.6	20.0	22.3	24.6	26.9	31.4
10.0	10.8	11.6	15.0	18.1	21.3	24.3	26.2	29.2	32.2	35.2	41.1
12.5	13.5	14.6	18.8	22.6	26.7	30.5	32.8	36.6	40.3	44.1	51.5
15.2	16.5	17.7	22.8	27.5	32.4	37.1	39.9	44.5	49.0	53.6	62.6

TABLE 2 INSULATION FACTORS

Insulation	Insulation factor (f)	k factor at 50°F (10°C) (BTU/hr–°F–ft²/in)
Fiberglass (ASTM C547)	1.00	0.219
Calcium silicate (ASTM C533)	1.76	0.386
Cellular glass (ASTM C552)	1.36	0.298
Preformed Polyisocyanurate (ASTM C591)	0.87	0.19
Flexible Elastomer (ASTM C534)	1.25	0.273
Expanded perlite (ASTM C610)	2.13	0.466

Note: The data presented here are nominal and conservative. Additional engineering analysis at specific voltages may allow optimization that could extend circuit lengths and/or available power output. Consult nVent for more information.

If your application is freeze protection of water piping, follow the five-step heating cable selection process outlined below:

1. Gather the following information:
   - Pipe size and material
   - Insulation type and thickness
   - Maintain temperature (T_M)
   - Minimum ambient temperature (T_A)
   - Minimum start-up temperature
   - Service voltage
   - Chemical environment
   - Maximum intermittent exposure temperature*
   - Electrical area classification**
2. Select the heating cable family.
3. Select the service voltage.
4. Determine the heating cable power output rating.
5. Select the jacket type.

* Determines whether a higher exposure temperature heating cable is needed.

** Determines whether special design requirements and connection kits must be used.

If your application is maintenance of another fluid at a temperature other than 40°F (5°C) or is temperature-sensitive, you will need the information above plus the following data:

	Example data
• Process temperature	70°F
• Maximum ambient temperature	105°F
• Fluid degradation temperature***	150°F

*** Determines whether thermostatic control is necessary.

Heating Cable Catalog Number

Before beginning, take a moment to understand the structure underlying 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.

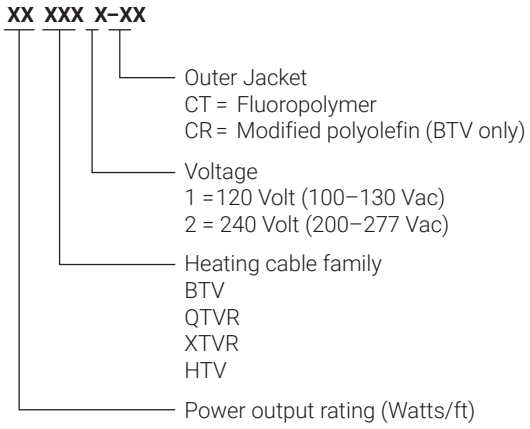


Fig. 3 Heating cable catalog number

Heating Cable Selection
1. Gather information
2. Select heating cable family
3. Select service voltage
4. Determine power output rating
5. Select jacket type

Step 1. Gather the necessary information

To select the heating cable, gather and record the following information:

- Pipe size and material _____
- Insulation type and thickness _____
- Maintain temperature (T_M) _____
- Minimum ambient temperature (T_A) _____
- Minimum start-up temperature _____
- Service voltage _____
- Chemical environment _____
- Maximum intermittent exposure temperature _____
- Electrical area classification _____

Example: Gather necessary information

• Pipe size and material*	6 inches in diameter, steel
• Insulation type and thickness*	2-½ inch, calcium silicate
• Maintain temperature (T_M)*	Water freeze protection at 40°F
• Minimum ambient temperature (T_A)*	–40°F
• Minimum start-up temperature	0°F
• Service voltage	120 Vac
• Chemical environment	Organic chemicals
• Maximum intermittent exposure temperature**	366°F
• Electrical area classification***	Nonhazardous

* From Thermal Design, Step 1

** Determines whether a higher exposure temperature heating cable is needed.

*** Determines whether special design requirements and connection kits must be used.

Heating Cable Selection
1. Gather information
2. Select heating cable family
3. Select service voltage
4. Determine power output rating
5. Select jacket type

Step 2. Select the heating cable family

Based on your application's maintain temperature, pipe material, maximum exposure temperature, and T-rating, select the appropriate heating cable.

For nonhazardous locations, use Table 3 to select the heating cable family. Base your selection on your application's maintain temperature, pipe material, and maximum intermittent exposure temperature.

For Class I, Division 1 or 2 hazardous locations, also use Table 3, but first determine the required T-rating for the area.

Temperature identification numbers (T-ratings) are defined by the National Electrical Code (NFPA 70), Articles 500 and 505; and the Canadian Electrical Code Part I, Section 18. If the T-rating of the area has been defined, then select a heating cable from Table 3 or Table 4 having a T-rating equivalent to or less than the T-rating of this location (for example, T6 is a lower T-rating than T3).

The purpose of the T-rating is to ensure that electrical equipment does not exceed the Auto Ignition Temperatures (AIT) of flammables handled in a hazardous location.

If the T-rating for the area has not been defined, use the following method.

- Select the material with the lowest AIT in °C.

This temperature is the maximum allowable heating cable sheath temperature.

TABLE 3 HEATING CABLE PRODUCT PERFORMANCE DATA

nVent RAYCHEM Heating Cable Family	Maximum maintain temperature	Maximum continuous operating temperature*	Maximum intermittent exposure temperature**	T-rating/ maximum sheath temperature	Pipe material
BTV	150°F (65°C)	150°F (65°C)	185°F (85°C)	T6 185°F (85°C)	plastic/ metal
QTVR	225°F (110°C)	225°F (110°C)	225°F (110°C)	T4 275°F (135°C)	plastic[1]/ metal
3XTVR2	302°F (150°C)	302°F (150°C)	482°F (250°C)	T3A 356°F (180°C)	metal only
5XTVR1/2	302°F (150°C)	302°F (150°C)	482°F (250°C)	T3A 356°F (180°C)	metal only
8XTVR2	302°F (150°C)	302°F (150°C)	482°F (250°C)	T3A 356°F (180°C)	metal only
10XTVR1/2	302°F (150°C)	302°F (150°C)	482°F (250°C)	T3 392°F (200°C)	metal only
12XTVR2	302°F (150°C)	302°F (150°C)	482°F (250°C)	T3 392°F (200°C)	metal only
15XTVR2	302°F (150°C)	302°F (150°C)	482°F (250°C)	T3 392°F (200°C)	metal only
15XTVR1	302°F (150°C)	302°F (150°C)	482°F (250°C)	T3 392°F (200°C)	metal only
20XTVR1/2	302°F (150°C)	302°F (150°C)	482°F (250°C)	T2D 419°F (215°C)	metal only
3 HTV1/2	400°F (205°C)	400°F (205°C)	500°F (260°C)	T3A 356°F (180°C)	metal only
5, 8, 10, 12, 15 HTV1/2	400°F (205°C)	400°F (205°C)	500°F (260°C)	T3 392°F (200°C)	metal only
20 HTV1/2	400°F (205°C)	400°F (205°C)	500°F (260°C)	T2D 420°F (215°C)	metal only
28HTV2	400°F (205°C)	400°F (205°C)	500°F (260°C)	T2B 464°F (240°C)	metal only

* With the heating cable power on

** 1000 hours (power on/power off) (2000 hours for HTV and XTVR)

[1] For plastic pipes please consult TraceCalc Pro design software or contact the Customer Service Center.

Example: Nonhazardous location

Input 40°F maintain temperature (from Thermal Design, Step 1)

Input 366°F intermittent exposure temperature (from Step 1)

Input Heating cable family XTVR (from Table 3)

Catalog number xx**XTVR**x-xx

FOR SYSTEMS IN DIVISION 1 HAZARDOUS LOCATIONS

Due to the potentially hazardous nature of Division 1 locations, use only nVent RAYCHEM brand BTV-CT, QTVR-CT, XTVR-CT and HTV-CT heating cables and HAK-C-100 connection kits.

Heating Cable Selection
1. Gather information
2. Select heating cable family
3. Select service voltage
4. Determine power output rating
5. Select jacket type

Step 3. Select the service voltage

Service voltage options: 1 = 120 volts (100–130 Vac)

2 = 240 volts (200–277 Vac)

Example: Service voltage selection

Input XTVR heating cable (from Step 2)

Input 120 volts (from Step 1)

Voltage option 1

Catalog number x**XTVR1-**-xx

Heating Cable Selection
1. Gather information
2. Select heating cable family
3. Select service voltage
4. Determine power output rating
5. Select jacket type

Step 4. Determine the heating cable power output rating

To select the heating cable power output, use Table 4 to determine the appropriate power output graph based on the heating cable family and voltage already determined.

TABLE 4 HEATING CABLE POWER OUTPUT GRAPH SELECTION

Pipe material	Heating cable	Voltage	Graph number
Metal pipe	BTV, QTVR	120	1
		208	2
		240	3
		277	4
Metal pipe	XTVR	120	5
		208	6
		240	7
		277	8
Plastic pipe*	BTV	120	9
		208	10
		240	11
		277	12
Metal Pipe	HTV	120	13
		208	14
		240	15
		277	16

*Graphs assume the use of aluminum tape over the heating cable. In Fig. 1, we use glass tape. Here we use aluminum tape.

Using the selected graph, locate the heating cable with thermal output greater than the heat loss (Q_T) at the pipe maintenance temperature (T_M).

If the pipe heat loss, Q_T, is between the two heating cable power output curves, select the higher-rated heating cable. If Q_T is greater than the power output of the highest-rated heating cable, you can:

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

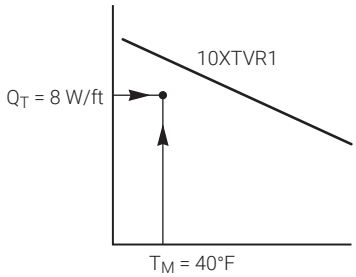


Fig. 4 Heating cable thermal output (from Graph 5)

Spiraling

If spiraling is elected, use the formula below to determine the spiral factor (length of heating cable per foot of pipe):

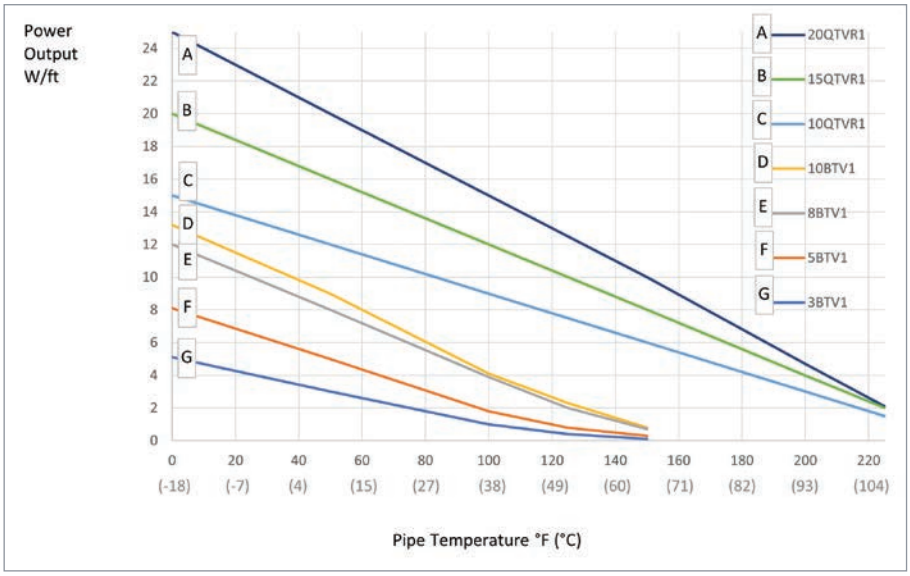
Spiral factor = Q_T / Heater power output at T_M

When the spiral factor exceeds 1.6 or the pipe size is less than three inches, consider using two or more heating cables run in parallel rather than spiraling.

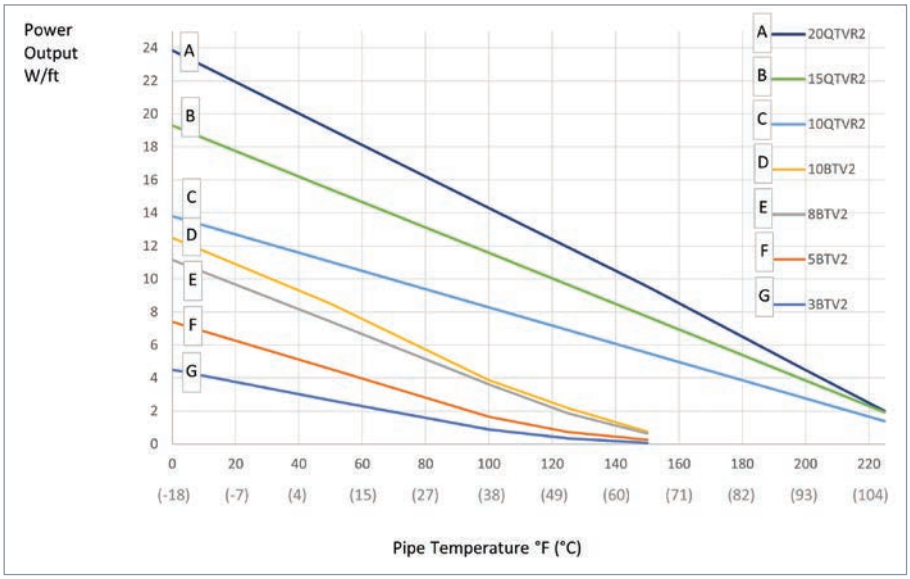
Example: Determine power output rating

Input	XTVR1 heating cable (from Step 3)
Input	Heat loss is 8 W/ft (from Thermal Design, Step 4 and Table 1)
Input	10XTVR1 output of 10.2 W/ft exceeds 8 W/ft at 40°F (from Graph 5)
Power output rating	10

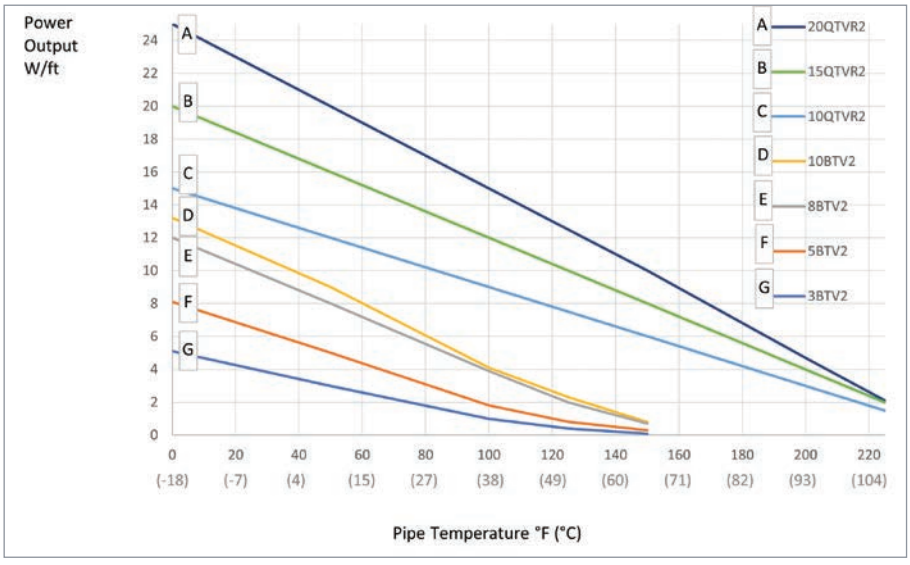
Catalog number **10XTVR1**-xx



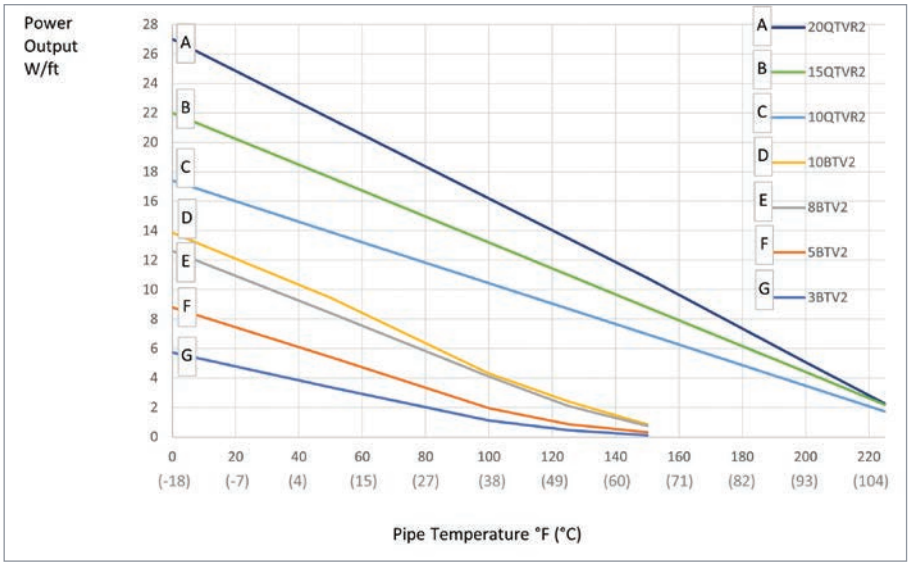
Graph 1 BTV and QTVR – Nominal power output on metal pipes at 120 volt



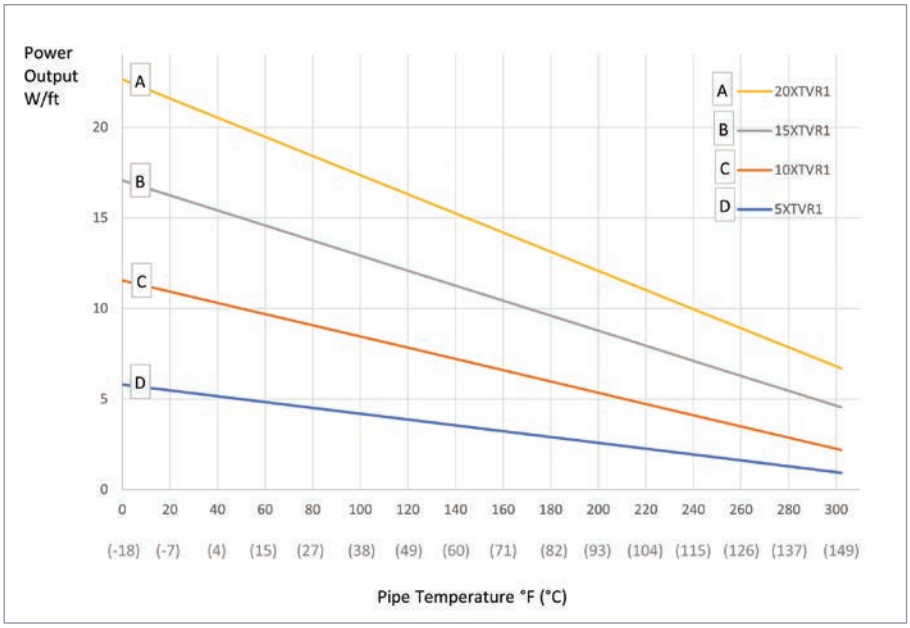
Graph 2 BTV and QTVR – Nominal power output on metal pipes at 208 volts



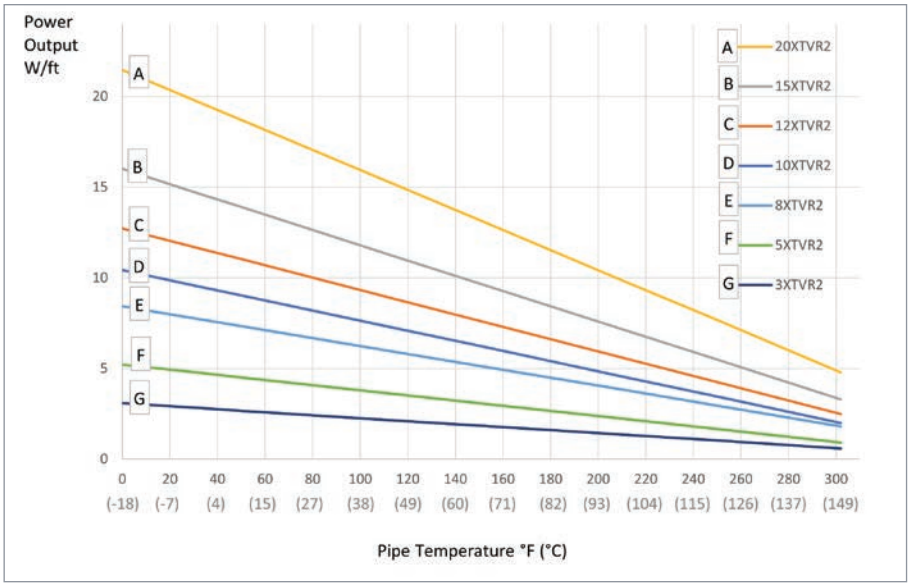
Graph 3 BTV and QTVR – Nominal power output on metal pipes at 240 volts



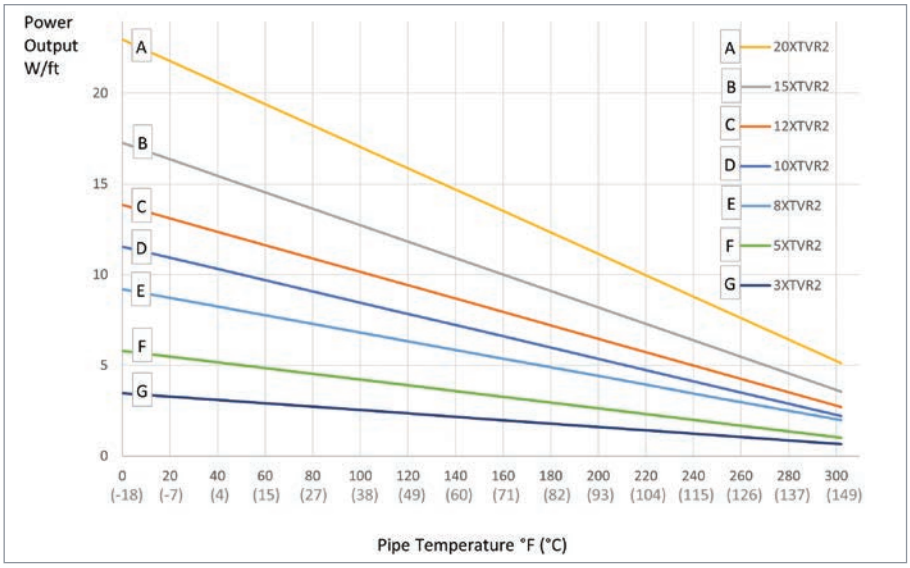
Graph 4 BTV and QTVR – Nominal power output on metal pipes at 277 volts



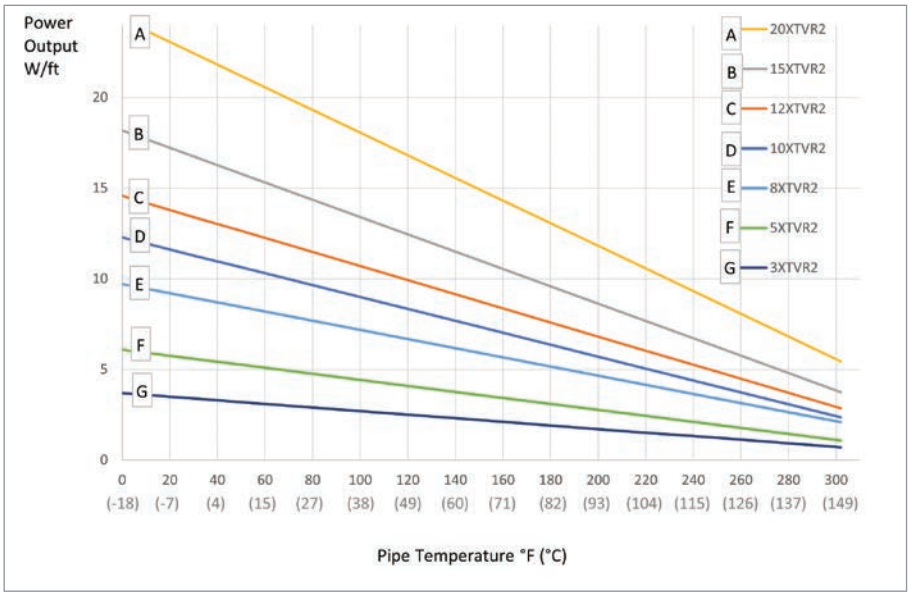
Graph 5 XTVR – Nominal power output on metal pipes at 120 volts



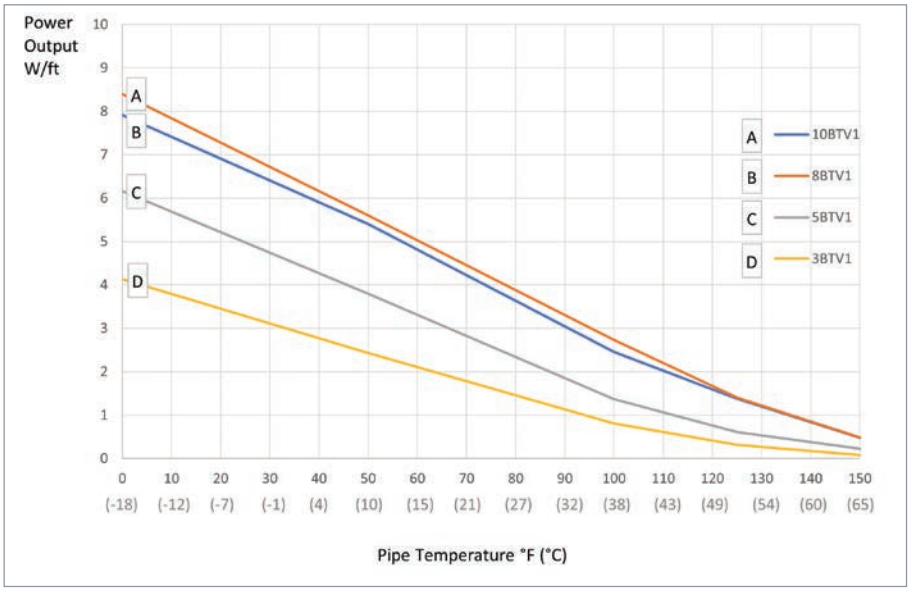
Graph 6 XTVR – Nominal power output on metal pipes at 208 volts



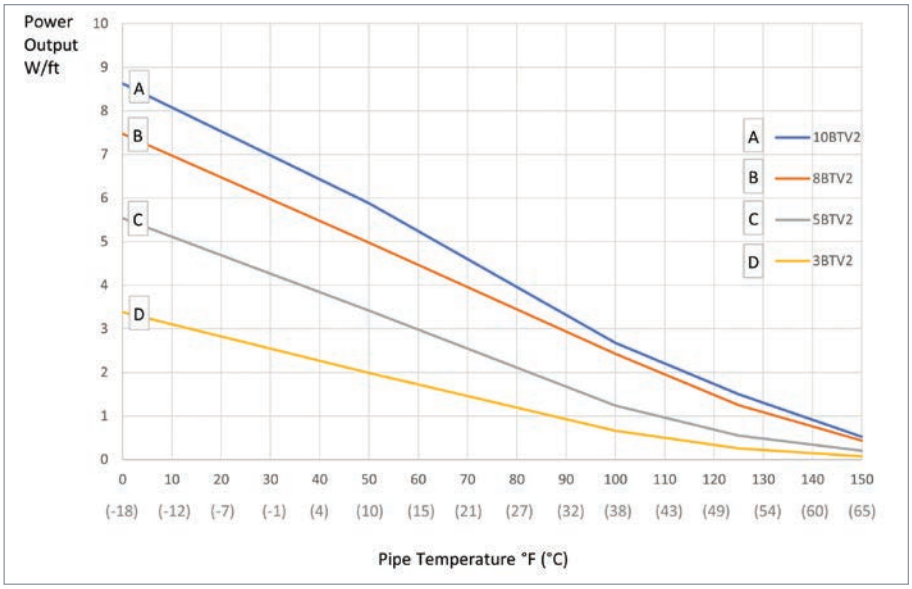
Graph 7 XTVR – Nominal power output on metal pipes at 240 volts



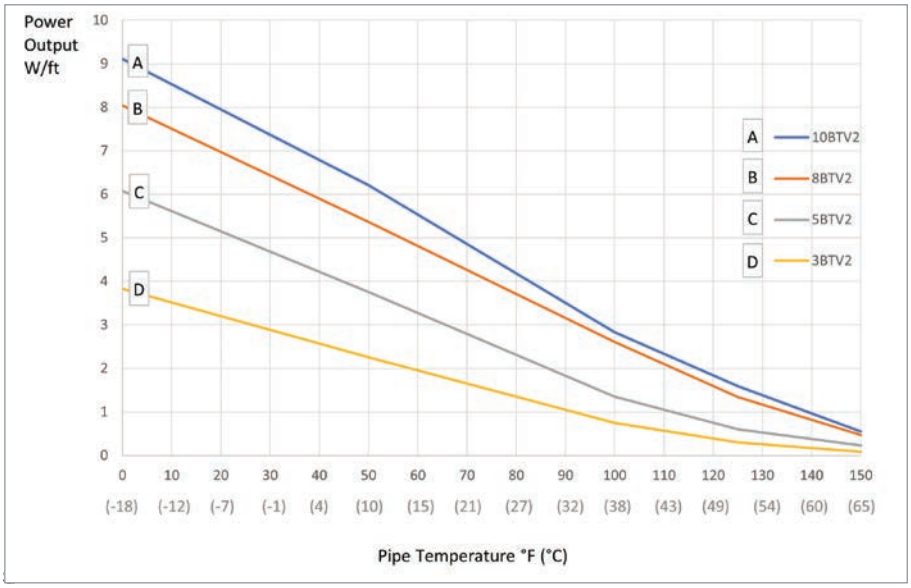
Graph 8 XTVR – Nominal power output on metal pipes at 277 volts



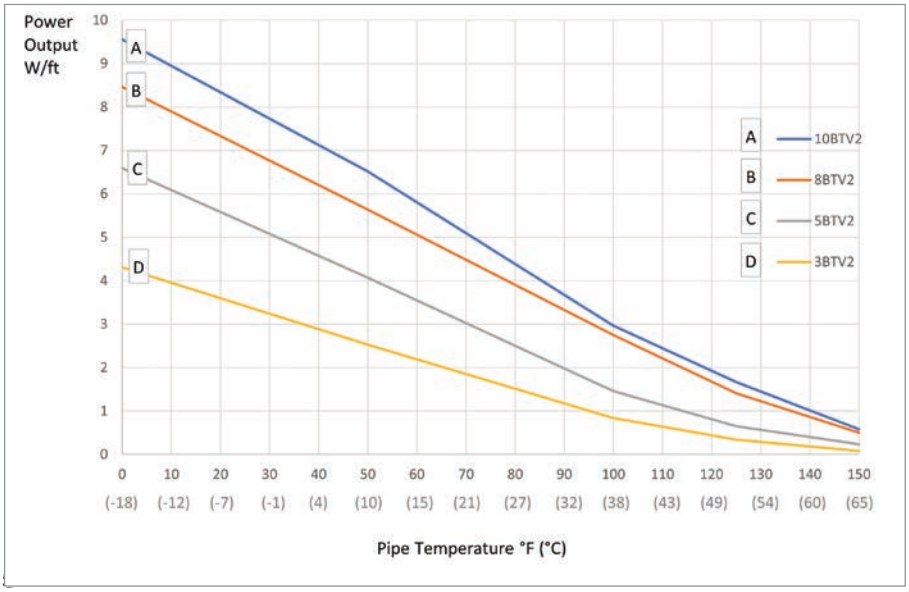
Graph 9 BTV – Nominal power output on plastic pipes at 120 volts



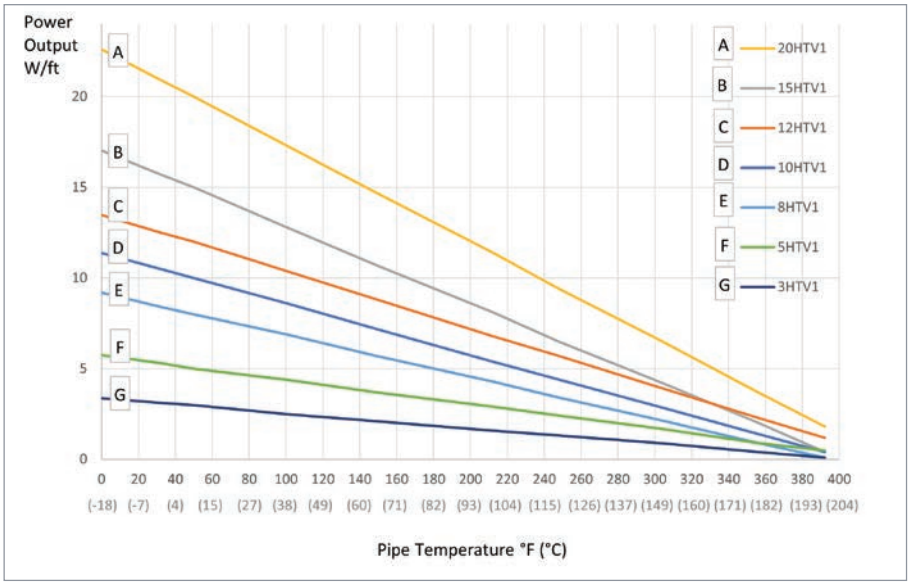
Graph 10 BTV – Nominal power output on plastic pipes at 208



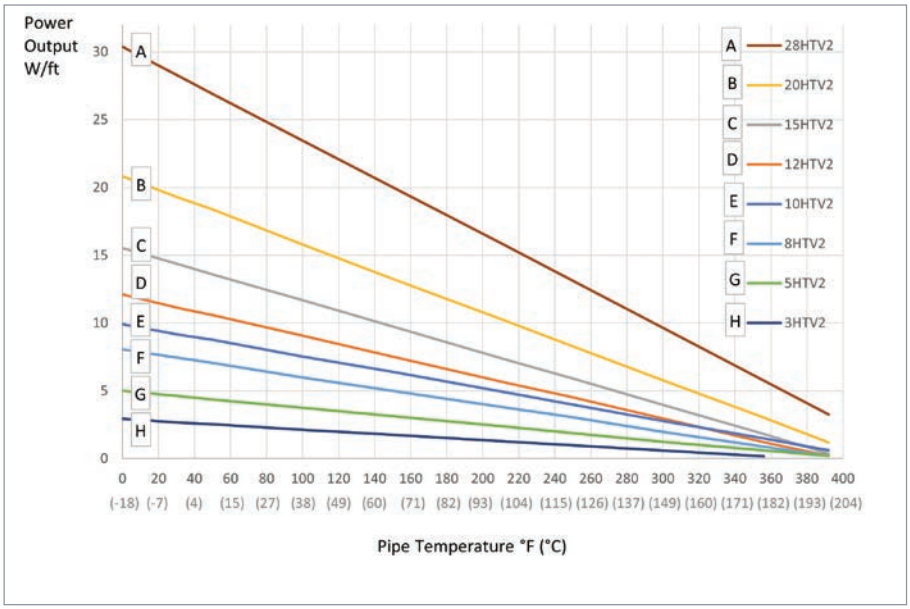
Graph 11 BTV – Nominal power output on plastic pipes at 240



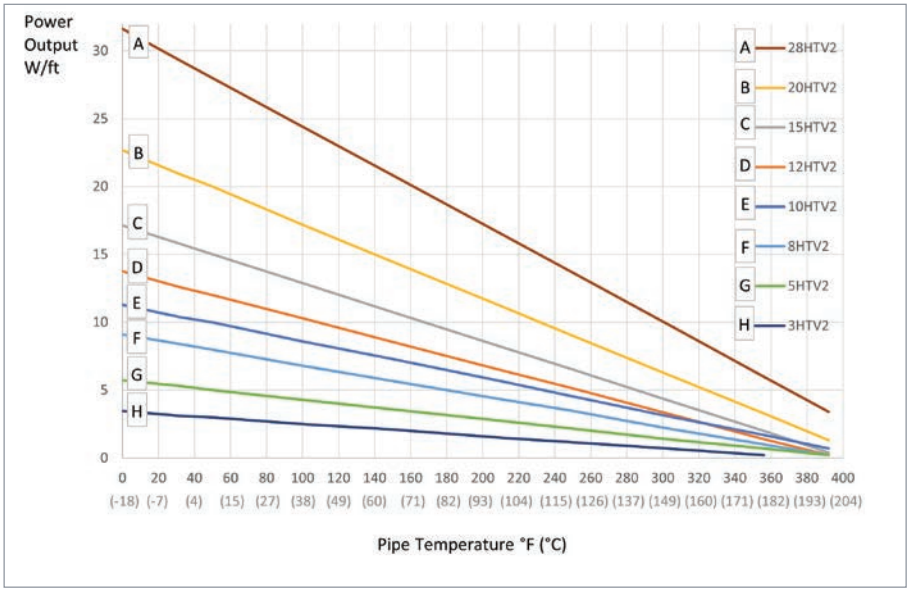
Graph 12 BTV – Nominal power output on plastic pipes at 277 volts



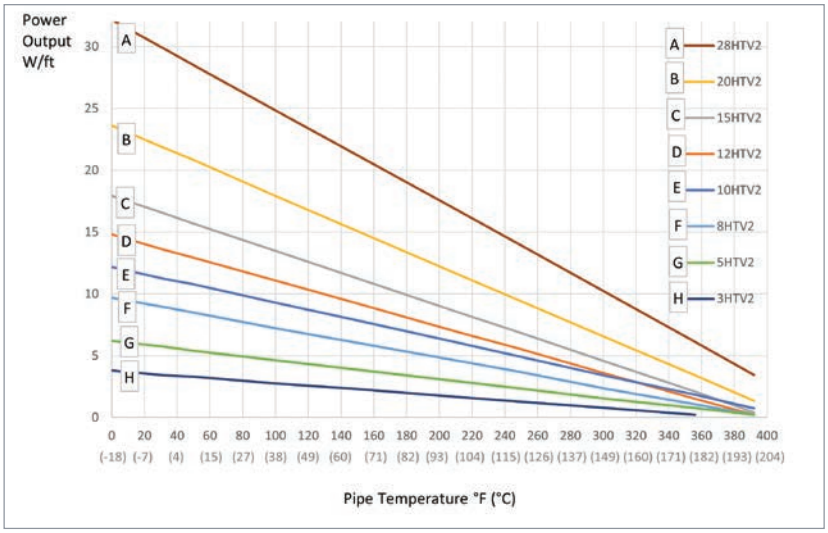
Graph 13 HTV – Nominal power output on metal pipes at 120 volts



Graph 14 HTV – Nominal power output on metal pipes at 208



Graph 15 HTV – Nominal power output on metal pipes at 240 volts



Graph 16 HTV – Nominal power output on metal pipes at 277 volts

Heating Cable Selection
1. Gather information
2. Select heating cable family
3. Select service voltage
4. Determine power output rating
5. Select jacket type

Step 5. Select the jacket type

While nVent RAYCHEM QTVR, XTVR and HTV heating cables are only available with a CT outer jacket, the BTV heating cables are also available in a CR version.

TABLE 5 HEATING CABLE OUTER JACKET OPTIONS

Option	Material	Application
CT	Fluoropolymer	Exposure to organic chemicals or corrosives
CR	Modified polyolefin	Exposure to aqueous inorganic chemicals

If you are unsure about the correct jacket for your application, select the CT version or contact your nVent representative for assistance.

Example: Jacket type selection

Input	10XTVR1-xx heating cable (from Step 4)
Input	Organic chemicals
Jacket type	CT
Catalog number	10XTVR1-CT

BILL OF MATERIALS

Now that you have selected the correct heating cable for your application, this section helps you to determine:

- Total length of heating cable required
- Electrical design, including circuit breaker sizing and selection
- Quantity and type of connection kits and accessories

Determining the Total Length of Heating Cable

To determine the total length of heating cable, follow these six steps:

1. Gather the necessary information:
   - Pipe length and diameter
   - Type and number of valves
   - Type and number of pipe supports
   - Start-up temperature
   - Number of circuits and tees in the piping
2. Calculate the total length of heating cable for the piping.
3. Calculate the total length of heating cable for the valves.
4. Calculate the total length of heating cable for the pipe supports.
5. Calculate additional heating cable for connection kit installation.
6. Add all the lengths together.

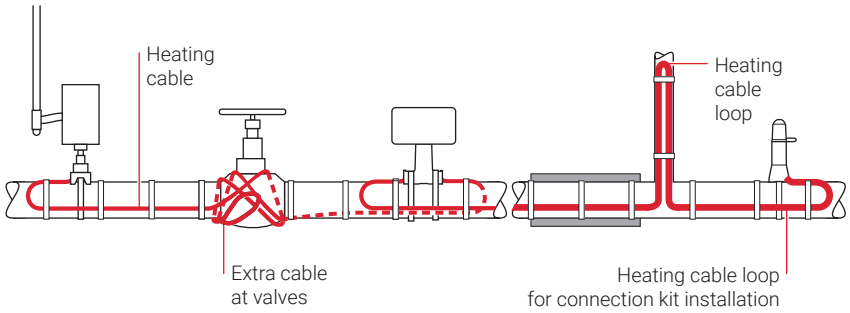


Fig. 5 Typical heating cable layout

Heating Cable Length
1. Gather information
2. Calculate cable length for piping
3. Calculate cable length for valves
4. Calculate cable length for supports
5. Calculate cable length for connection kits
6. Add all lengths

Step 1. Gather the necessary information

To determine the total length of heating cable, gather and record the following information:

- Pipe length and diameter
- Type and number of valves
- Type and number of pipe supports
- Start-up temperature
- Number of circuits and tees in piping

Example: Gather necessary information

Pipe length and diameter	95 feet of 6-inch pipe
Type and number of valves	Three 6-inch gate valves
Type and number of pipe supports	Support shoes, 10 each, 1-foot length
Start-up temperature	0°F
Number of circuits and tees in piping	Power connections: 1
	End seals: 3
	Pipe tees: 2

Heating Cable Length
1. Gather information
2. Calculate cable length for piping
3. Calculate cable length for valves
4. Calculate cable length for supports
5. Calculate cable length for connection kits
6. Add all lengths

Step 2. Calculate the total length of heating cable for the piping

Example: Total length of cable for piping calculation

95 ft of pipe (from Step 1) = 95 ft of cable for single tracing

Heating Cable Length
1. Gather information
2. Calculate cable length for piping
3. Calculate cable length for valves
4. Calculate cable length for supports
5. Calculate cable length for connection kits
6. Add all lengths

Step 3. Calculate the total length of heating cable for the valves

Table 6 contains guidelines to determine the amount of additional heating cable required to compensate for heat loss on valves. For a more detailed analysis, use TraceCalc Pro design software or consult nVent.

Multiply the number of valves to arrive at the total additional footage of heating cable.

TABLE 6 RECOMMENDED VALVE ALLOWANCE

Pipe diameter (IPS) (inches)	Heating cable feet (meters)	Comments*
¼	0.3 (0.09)	These recommendations are limited by the amount of heating cable that can physically be installed on small valves. Heat loss may not be fully compensated under extreme conditions.
½	0.8 (0.24)	
¾	1.3 (0.4)	
1	2.0 (0.6)	
1-¼	3.3 (1.1)	
1-½	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)	These numbers represent the minimum amount of heating cable required for a service loop. Additional cable may be required to compensate for total heat loss.
14	7.3 (2.2)	
18	9.4 (2.9)	
24	12.6 (3.8)	

* Use TraceCalc Pro design software to calculate the exact quantity required for the valve.

Example: Heating cable length for valves calculation

From Table 6 for a 6-inch diameter pipe,

Each valve requires: 5.0 ft

Cable needed for three valves: 3 x 5.0 ft

Total cable length needed for valves: 15.0 ft

Heating Cable Length
1. Gather information
2. Calculate cable length for piping
3. Calculate cable length for valves
4. Calculate cable length for supports
5. Calculate cable length for connection kits
6. Add all lengths

Step 4. Calculate the total length of heating cable for the pipe supports

Support Shoes

For each pipe support shoe, calculate the additional heating cable required as follows:

Determine the heat loss for one support.

- Formula: Qsupport = 0.7L x (T_M – T_A), where L = Support length (ft) (assumes a 0.25-inch steel welded shoe partially shielded from winds)
- Multiply that heat loss by the total number of supports.
- Add 10 percent to the total heat loss for added safety.
- Obtain the heating cable power output per foot from Graph 5.
- Divide the total support heat loss by the heating cable power output per foot to get the number of feet of heating cable needed.

Example: Total length of cable for pipe supports calculation

Input	10XTVR1-CT heating cable (from Cable Selection, Step 5)
Input	10 one-foot welded steel shoe supports (from Step 1)
Heat loss for one support	0.7 x 1 x (40–(–40)) = 56 W
Heat loss for all supports	10 x 56 W = 560 W
Add safety factor	560 W + 10% = 616 W
Heating cable power output	10.2 W/ft (from Step 3 of Cable Selection)
Heating cable required	616 W/10.2 W/ft = 60 ft of heating cable

Heating Cable Length
1. Gather information
2. Calculate cable length for piping
3. Calculate cable length for valves
4. Calculate cable length for supports
5. Calculate cable length for connection kits
6. Add all lengths

Step 5. Calculate additional heating cable for connection kit installation

Estimate the number of power connections, tees, and splices for the system. Allow an additional three feet for each connection kit.

Example: Include additional cable

Input	1 power connection, 3 end seals, 2 tees (from Step 1)
Total number of connection kits	6 (from Step 1)
Cable needed for 6 connection kits	6 x 3 ft of additional cable
Total cable length for 6 connection kits	18 ft of cable

Heating Cable Length
1. Gather information
2. Calculate cable length for piping
3. Calculate cable length for valves
4. Calculate cable length for supports
5. Calculate cable length for connection kits
6. Add all lengths

Step 6. Add all lengths together

Example: Final addition

Cable for piping	95 ft (from Step 1)
Cable for valves	15 ft (from Step 3)
Cable for supports	60 ft (from Step 4)
Cable for connection kits	18 ft (from Step 5)
Sum of all lengths	95 + 15 + 60 + 18 = 188 ft
Total length of heating cable	188 ft

Now that you have the total length of heating cable, you can determine the number of electrical circuits you will need.

Electrical Design

⚠ WARNING: Fire hazard
There is a danger of fire from sustained electrical arcing if the heating cable is damaged or improperly installed. To comply with nVent requirements, certifications, and national electrical codes, and to protect against the risk of fire, ground-fault equipment protection must be used on each heating cable circuit. Arcing may not be stopped by conventional circuit breakers.

DETERMINING MAXIMUM LENGTH OF HEATING CABLE ON ONE CIRCUIT BREAKER

Using Table 7 and Table 8, match the heating cable catalog number at the expected minimum start-up temperature with the total heating cable length and select a circuit breaker trip rating. The circuit breaker trip rating should not exceed the maximum trip rating shown for heating cables of that product family. For example, the trip rating of a circuit breaker protecting several 10XTVR circuits should not exceed 50 amps. To maximize fault current protection, use the lowest allowable circuit breaker.

Maximum circuit length per breaker depends on four factors:

1. Heating cable family and catalog number
2. Minimum start-up temperature
3. Service voltage
4. Circuit breaker trip rating

TABLE 7 MAXIMUM CIRCUIT LENGTH (FEET) VS. CIRCUIT BREAKER TRIP RATING (AMPS)

120- and 240-volt heating cables applied to metal pipe with glass tape												
nVent RAYCHEM Heating cable	Ambient temperature at start-up		120-volt cable					240-volt cable				
	°F	°C	15 A	20 A	30 A	40 A	50 A	15 A	20 A	30 A	40 A	50 A
3BTV	50	10	330	330	330	330	†	660	660	660	660	†
	0	−18	200	265	330	330	†	395	530	660	660	†
	−20	−29	175	235	330	330	†	350	465	660	660	†
	−40	−40	155	205	310	330	†	310	410	620	660	†
5BTV	50	10	230	270	270	270	†	460	540	540	540	†
	0	−18	140	190	270	270	†	285	380	540	540	†
	−20	−29	125	165	250	270	†	250	330	500	540	†
	−40	−40	110	145	220	270	†	220	295	440	540	†
8BTV	50	10	150	200	210	210	†	300	400	420	420	†
	0	−18	100	130	200	210	†	200	265	400	420	†
	−20	−29	85	115	175	210	†	175	235	350	420	†
	−40	−40	80	105	155	210	†	155	210	315	420	†
10BTV	50	10	120	160	180	180	†	240	315	360	360	†
	0	−18	80	110	160	180	†	160	215	325	360	†
	−20	−29	70	95	140	180	†	145	190	285	360	†
	−40	−40	65	85	125	170	†	125	170	255	340	†
10QTVR	50	10	100	130	195	195	†	200	265	390	390	†
	0	−18	80	105	160	195	†	160	210	320	390	†
	−20	−29	70	95	145	195	†	145	195	295	390	†
	−40	−40	65	90	135	180	†	135	180	275	365	†
15QTVR	50	10	75	100	150	200	220	160	210	320	340	†
	0	−18	60	80	120	160	200	125	170	255	340	†
	−20	−29	55	70	110	145	185	115	155	235	315	†
	−40	−40	50	65	100	135	170	110	145	220	290	†
20QTVR	50	10	60	80	120	160	195	120	160	240	320	390
	0	−18	45	60	95	125	160	95	125	190	255	320
	−20	−29	40	55	85	115	145	85	115	175	235	295
	−40	−40	40	55	80	110	135	80	110	165	220	275
3XTVR2-CT	50	10	N/A					480	640	960	979	979
	0	−18						415	553	830	979	979
	−20	−29						394	526	789	979	979
	−40	−40						376	501	751	979	979
5XTVR1-CT 5XTVR2-CT	50	10	180	240	360	373	373	360	480	720	744	744
	0	−18	155	207	310	373	373	311	414	621	744	744
	−20	−29	147	196	294	373	373	295	393	589	744	744
	−40	−40	139	186	279	372	373	280	374	561	744	744
8XTVR2-CT	50	10	N/A					261	348	522	578	578
	0	−18						227	302	453	578	578
	−20	−29						216	287	431	575	578
	−40	−40						205	274	411	548	578
10XTVR1-CT 10XTVR2-CT	50	10	111	148	221	256	256	221	295	443	509	509
	0	−18	96	128	192	256	256	192	256	383	509	509
	−20	−29	91	121	182	242	256	182	243	364	485	509
	−40	−40	87	115	173	231	256	173	231	346	462	509
12XTVR2-CT	50	10	N/A					192	256	384	456	456
	0	−18						166	222	332	443	456
	−20	−29						158	211	316	421	456
	−40	−40						150	200	301	401	456

120- and 240-volt heating cables applied to metal pipe with glass tape												
nVent RAYCHEM Heating cable	Ambient temperature at start-up		120-volt cable					240-volt cable				
	°F	°C	15 A	20 A	30 A	40 A	50 A	15 A	20 A	30 A	40 A	50 A
15XTVR1-CT	50	10	72	96	144	193	200	144	193	289	385	407
15XTVR2-CT	0	–18	63	84	127	169	200	125	167	251	334	407
	–20	–29	60	81	121	161	195	119	159	238	318	392
	–40	–40	58	77	115	154	189	114	151	227	302	378
20XTVR1-CT	50	10	58	77	115	154	169	115	154	230	307	339
20XTVR2-CT	0	–18	51	68	102	135	151	100	134	200	267	301
	–20	–29	49	65	97	130	146	95	127	191	255	289
	–40	–40	47	62	93	124	141	91	121	182	243	279
3HTV	50	10	241	322	482	485	485	482	643	964	978	978
	0	–18	213	284	426	485	485	415	554	831	978	978
	–20	–29	203	271	407	485	485	395	527	791	978	978
	–40	–40	195	260	390	485	485	378	504	756	978	978
5HTV	50	10	180	240	360	372	372	360	480	720	751	751
	0	–18	157	209	314	372	372	314	418	627	751	751
	–20	–29	151	201	302	372	372	299	398	598	751	751
	–40	–40	145	194	291	372	372	285	380	571	751	751
8HTV	50	10	131	174	261	289	289	261	348	523	581	581
	0	–18	113	151	227	289	289	229	305	457	581	581
	–20	–29	108	144	216	288	289	218	291	437	581	581
	–40	–40	103	138	207	276	289	209	278	418	557	581
10HTV	50	10	111	148	221	254	254	221	296	443	508	508
	0	–18	97	130	195	254	254	196	261	392	508	508
	–20	–29	93	124	185	247	254	187	249	374	498	508
	–40	–40	89	118	177	236	254	178	238	357	476	508
12HTV	50	10	96	128	192	226	226	192	256	384	462	462
	0	–18	85	114	171	226	226	167	223	335	446	462
	–20	–29	81	109	163	217	226	160	213	319	426	462
	–40	–40	78	104	156	207	226	153	204	305	407	462
15HTV	50	10	75	101	151	198	198	151	202	302	400	400
	0	–18	67	89	133	177	198	132	176	264	352	400
	–20	–29	63	84	127	169	198	126	168	252	336	397
	–40	–40	60	80	121	161	190	120	160	240	320	381
28HTV2-CT	50	10	N/A					86	114	172	229	231
	0	–18						76	101	152	202	208
	–20	–29						73	97	145	194	200
	–40	–40						70	93	139	185	193

† Not permitted

For a fully optimized design, use TraceCalc Pro design software or contact your nVent representative.

Note: nVent and the U.S. National Electrical Code require both ground-fault protection of equipment and agrounded metallic covering (usually braid) on all heating cables. All nVent RAYCHEM products meet the metallic covering requirement.

TABLE 8 MAXIMUM CIRCUIT LENGTH (FEET) VS. CIRCUIT BREAKER TRIP RATING (AMPS)

208- and 277-volt heating cables applied to metal pipe with glass tape												
nVent RAYCHEM Heating cable	Ambient temperature at start-up		208-volt cable					277-volt cable				
	°F	°C	15 A	20 A	30 A	40 A	50 A	15 A	20 A	30 A	40 A	50 A
3BTV	50	10	635	635	635	635	†	710	710	710	710	†
	0	−18	380	510	635	635	†	425	570	710	710	†
	−20	−29	335	445	635	635	†	360	500	710	710	†
	−40	−40	300	395	595	635	†	335	440	670	710	†
5BTV	50	10	430	505	505	505	†	500	590	590	590	†
	0	−18	270	355	505	505	†	310	415	590	590	†
	−20	−29	235	310	470	505	†	270	360	545	590	†
	−40	−40	210	275	415	505	†	240	320	480	590	†
8BTV	50	10	275	370	385	385	†	330	445	465	465	†
	0	−18	185	245	370	385	†	220	295	445	465	†
	−20	−29	160	215	320	385	†	195	260	390	465	†
	−40	−40	145	190	290	385	†	170	230	350	465	†
10BTV	50	10	220	290	330	330	†	265	350	400	400	†
	0	−18	145	200	300	330	†	180	240	360	400	†
	−20	−29	130	175	260	330	†	160	210	315	400	†
	−40	−40	115	155	235	310	†	140	190	280	375	†
10QTVR	50	10	190	250	365	365	†	210	280	415	415	†
	0°F	−18	150	195	300	365	†	170	225	340	415	†
	−20	−29	135	180	275	365	†	155	205	315	415	†
	−40	−40	125	170	260	345	†	140	190	290	385	†
15QTVR	50	10	145	190	290	310	†	175	230	350	375	†
	0	−18	115	155	230	310	†	140	185	280	375	†
	−20	−29	105	140	215	285	†	125	170	260	345	†
	−40	−40	100	130	200	265	†	120	160	240	320	†
20QTVR	50	10	110	145	220	290	355	135	180	265	355	430
	0	−18	85	115	175	230	290	105	140	210	280	355
	−20	−29	80	105	160	215	270	95	130	195	260	325
	−40	−40	75	100	150	200	250	90	120	180	245	305
3XTVR2	50	10	466	622	902	902	902	519	692	1039	1093	1093
	0	−18	404	538	808	902	902	450	600	900	1093	1093
	−20	−29	386	514	772	902	902	429	572	858	1093	1093
	−40	−40	369	492	737	902	902	410	547	821	1093	1093
5XTVR2	50	10	346	462	682	682	682	395	527	790	836	836
	0	−18	297	396	594	682	682	339	452	678	836	836
	−20	−29	283	377	565	682	682	323	430	645	836	836
	−40	−40	270	361	541	682	682	309	412	618	824	836
8XTVR2	50	10	247	329	493	526	526	285	380	570	648	648
	0	−18	214	286	429	526	526	248	330	496	648	648
	−20	−29	203	271	407	526	526	235	313	470	627	648
	−40	−40	193	258	387	516	526	224	298	447	596	648
10XTVR2	50	10	213	284	425	468	468	240	321	481	567	567
	0	−18	184	245	367	468	468	208	277	416	554	567
	−20	−29	174	233	349	465	468	197	263	395	526	567
	−40	−40	166	221	332	443	468	188	250	376	501	567
12XTVR2	50	10	181	242	362	415	415	210	281	421	511	511
	0	−18	157	209	314	415	415	182	243	364	486	511
	−20	−29	149	199	298	397	415	173	231	346	462	511
	−40	−40	142	189	284	379	415	165	220	330	440	511

208- and 277-volt heating cables applied to metal pipe with glass tape												
nVent RAYCHEM Heating cable	Ambient temperature at start-up		208-volt cable					277-volt cable				
	°F	°C	15 A	20 A	30 A	40 A	50 A	15 A	20 A	30 A	40 A	50 A
15XTVR2	50	10	135	180	270	360	369	158	211	316	422	456
	0	–18	118	157	235	314	369	138	184	276	368	443
	–20	–29	112	149	223	297	369	131	174	261	349	425
	–40	–40	106	141	212	283	353	124	166	248	331	409
20XTVR2	50	10	107	142	214	285	309	126	167	251	335	365
	0	–18	93	124	186	248	283	109	146	219	292	324
	–20	–29	88	118	177	236	272	104	139	208	277	311
	–40	–40	84	112	169	225	262	99	132	198	265	300
3HTV2-CT	50	10	490	654	924	924	924	502	670	1004	1072	1072
	0	–18	426	568	852	924	924	436	581	871	1072	1072
	–20	–29	405	540	810	924	924	414	553	829	1072	1072
	–40	–40	388	517	775	924	924	396	528	792	1056	1072
5HTV2-CT	50	10	358	477	700	700	700	385	513	769	832	832
	0	–18	312	416	623	700	700	335	446	670	832	832
	–20	–29	297	396	594	700	700	319	426	639	832	832
	–40	–40	284	379	568	700	700	305	407	610	814	832
8HTV2-CT	50	10	256	341	512	539	539	283	378	566	648	648
	0	–18	225	300	450	539	539	249	332	497	648	648
	–20	–29	214	286	429	539	539	237	316	474	632	648
	–40	–40	205	273	410	539	539	227	302	453	604	648
10HTV2-CT	50	10	219	292	438	474	474	237	316	474	561	561
	0	–18	194	259	388	474	474	210	280	420	560	561
	–20	–29	185	246	370	474	474	200	267	400	534	561
	–40	–40	176	235	353	471	474	191	255	382	510	561
12HTV2-CT	50	10	189	252	378	430	430	206	275	412	511	511
	0	–18	165	220	330	430	430	180	240	359	479	511
	–20	–29	157	209	314	419	430	171	228	342	457	511
	–40	–40	150	200	300	400	430	164	218	327	436	511
15HTV2-CT	50	10	144	193	289	368	368	167	222	334	445	449
	0	–18	126	169	253	337	368	146	195	292	390	449
	–20	–29	120	160	241	321	368	139	185	278	370	433
	–40	–40	115	153	229	306	368	132	176	265	353	416
20HTV2-CT	50	10	109	145	217	290	305	128	170	255	340	362
	0	–18	96	128	192	256	284	112	150	225	300	323
	–20	–29	92	122	183	244	273	108	143	215	287	310
	–40	–40	88	117	175	234	263	103	137	206	274	299
28HTV2-CT	50	10	77	103	155	206	210	97	130	194	259	261
	0	–18	68	91	137	183	189	86	115	172	230	234
	–20	–29	66	87	131	175	182	82	110	165	220	226
	–40	–40	63	84	126	167	176	79	105	158	210	217

† Not permitted

⚠ **Note:** nVent and the U.S. National Electrical Code require both ground-fault protection of equipment and agrounded metallic covering (usually braid) on all heating cables. All nVent RAYCHEM products meet the metallic covering requirement.

Example: Determine maximum length of heating cable on one circuit breaker

Input 10XTVR1 heating cable (from Cable Selection, Step 3)

Input 120 volts (from Cable Selection Step 1)

Input 0°F start-up temperature (from Cable Selection, Step 1)

Input Maximum circuit length = 192 feet on a 30-amp breaker (from Table 7)

If the total length of cable exceeds 192 feet, you must use a 40-amp circuit breaker, which allows up to 256 feet.

DETERMINE MINIMUM NUMBER OF CIRCUITS

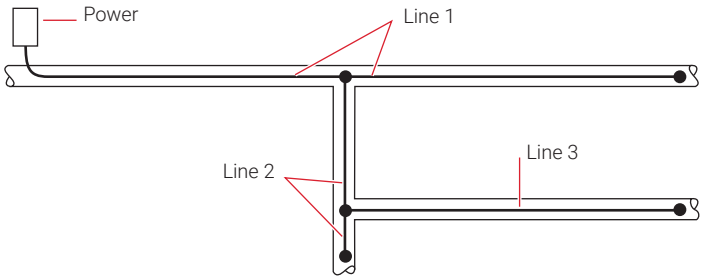
Example: Minimum number of circuits calculation

Input 192 ft allowed per 30-amp circuit (from Table 7)

Input Total circuit length = 188 ft (from Bill of Materials, Step 6)

Number of circuits 1 circuit

If the total length of heating cable required exceeded 192 ft, you would need to split the total length into two separate circuits or use a larger circuit breaker size.



Line 1 + Line 2 + Line 3 ≤ Maximum circuit length

Fig. 6 Maximum heating cable circuit length

Ground-fault protection

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. Many nVent RAYCHEM control and monitoring systems meet the ground-fault protection requirement.

Connection Kit Selection and Accessories

⚠ **WARNING: Fire hazard**
To prevent fire or shock, nVent RAYCHEM brand specified connection kits must be used. Do not substitute parts or use vinyl electrical tape.

OVERVIEW

nVent offers a full range of connection kits for power connections, splices, and end seals on self-regulating cable systems. These connection kits must be used to ensure proper functioning of the product and compliance with warranty, code, and approvals requirements.

Different power connection, end seal, splice, and tee kits are required depending on the area classification. The data sheets for these connection kits are included in the Technical Data section.

Data sheets can be found on nVent.com/RAYCHEM or the Technical data sheet section of the Industrial Heat Tracing Products & Services Catalog (H56550).

NONHAZARDOUS AND HAZARDOUS LOCATION CONNECTION KITS

Fig. 7 shows the connection kits and accessories available for self-regulating heating systems.

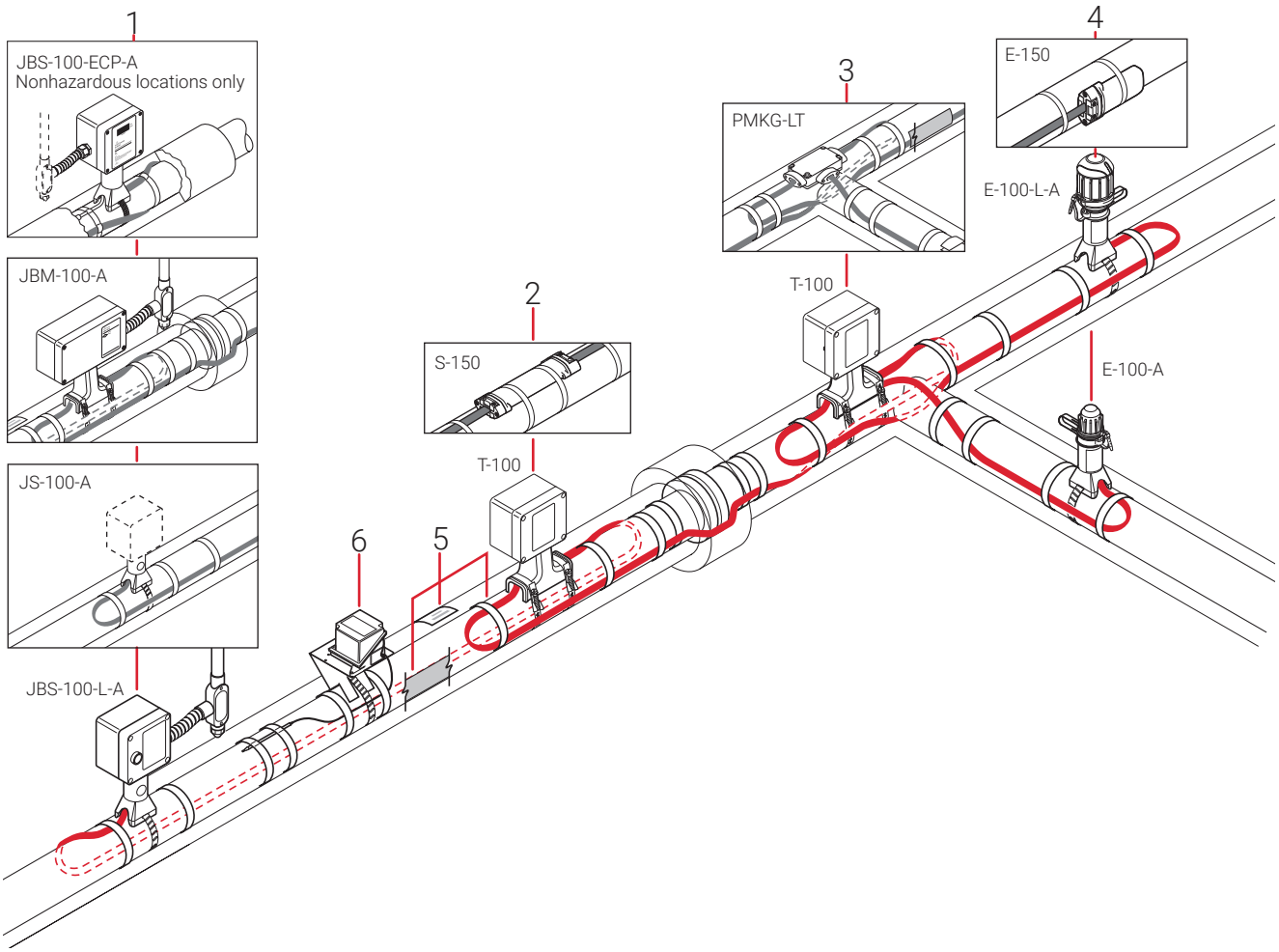


Fig. 7 nVent RAYCHEM Self-regulating heating system connection kits and accessories

Note: PMKG-LE, PMKG-LT, PMKG-LS are only approved for use with BTV and QTVR heating cables. S-150, E-150 are only approved with BTV, QTVR, XTVR heating cables.

TABLE 9 NONHAZARDOUS AND HAZARDOUS NVENT RAYCHEM HEATING CABLE FAMILY CONNECTION KITS AND ACCESSORY SELECTION

Description Connection Kits	Catalog number	Quantity
		1 per circuit
1. Power connection Single heating cable Single heating cable with light Single heating cable with digital electronic controller	JBS-100-A JBS-100-L-A JBS-100-ECP-A (nonhazardous locations only)	
Single heating cable (user-supplied junction box)	JS-100-A	
Multiple heating cables (1, 2, or 3)	JBM-100-A	
Multiple heating cable with light	JBM-100-L-A	
2. Splice connection		1 per splice
Above insulation	T-100	
Below insulation	S-150	
3. Tee connection		1 per tee
Above insulation	T-100	
Below insulation	PMKG-LT (BTV and QTVR only)	
4. End seal		1 per power connection plus 1 per tee
Above insulation	E-100-A	
Above insulation with light	E-100-L-A	
Below insulation	E-150	
Accessories		
5. Attachment tape, labels, and pipe straps		
Controls (optional)		
6. Thermostat — Control and Monitoring design guide (H56889)		

CID1 GROUPS B, C, D HAZARDOUS LOCATION CONNECTION KITS

All power connections, splices, tees, and end seals in a Division 1 location must use the nVent RAYCHEM HAK-C-100 connection kit and an HAK-JB3-100 or a Division 1 Nationally Recognized Testing Lab (NRTL) approved junction box.

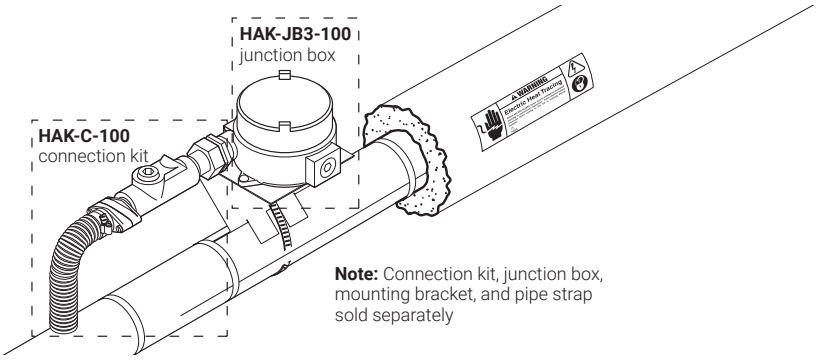


Fig. 8 CID1 hazardous location connection kits

TABLE 10 CID1 CONNECTION KIT SELECTION

Connection type	Number of HAK-C-100 kits required	Number of holes required on the junction box	Junction box catalog number	Additional materials required	
				Mounting brackets*	Pipe straps
Power	1	2	HAK-JB3-100	1	1
Splice	2	2	HAK-JB3-100	1	1
Tee	3	3	HAK-JB3-100	1	1
End seal	1	1	HAK-JB3-100	1	1

* Catalog number UMB

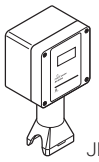
The nVent RAYCHEM HAK-C-100 kit is FM approved and CSA certified to be used for all power connections, splices, tees, and end seals in Division 1 locations.

SYSTEM CONNECTION KITS

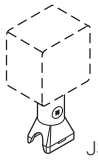

JBS-100-A

nVent RAYCHEM JBS-100-A Power connection for one heating cable in nonhazardous and hazardous locations. Includes cold-applied heating cable core seal. Requires one pipe strap to be ordered separately.

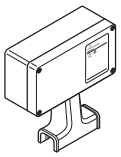
With LED indicator light, order JBS-100-L-A


JBS-100-ECP-A

nVent RAYCHEM JBS-100-ECP-A Power connection and digital electronic controller. Requires one pipe strap to be ordered separately. nonhazardous locations only.

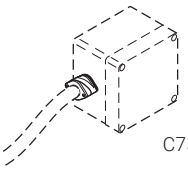

JS-100-A

nVent RAYCHEM JS-100-A Junction box stand for one heating cable in nonhazardous and hazardous locations. A separate customer-supplied NEMA 4X junction box is required. Includes cold-applied heating cable core seal. Requires one pipe strap to be ordered separately.

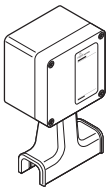

JBM-100-A

nVent RAYCHEM JBM-100-A Multiple-entry power connection for up to three heating cables. Can also be used as a splice or tee connection. For use in nonhazardous and hazardous locations. Includes cold-applied heating cable core seal. Requires two pipe straps to be ordered separately.

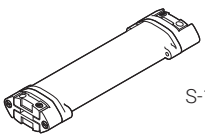
With LED indicator light, order JBM-100-L-A.


C75-100-A

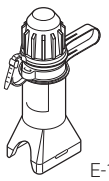
nVent RAYCHEM C75-100-A A NEMA 4X-rated gland kit (¾" NPT) used to transition heating cables into a junction box in nonhazardous and hazardous locations. Includes cold-applied heating cable core seal. A terminal block (3 x 12 AWG) is included. This kit does not include the junction box or the conduit.


T-100

nVent RAYCHEM T-100 Tee or splice connection for up to three heating cables in nonhazardous and hazardous locations. Includes cold-applied heating cable core seal. Requires two pipe straps to be ordered separately.

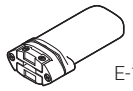

S-150

nVent RAYCHEM S-150 Splice kit for heating cables in nonhazardous and hazardous locations. Includes cold-applied heating cable core seal.


E-100-A

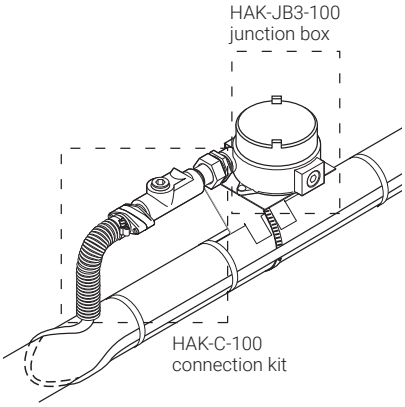
nVent RAYCHEM E-100-A End seal for heating cable in nonhazardous and hazardous locations. Reenterable. Includes cold-applied heating cable core seal. Requires one pipe strap to be ordered separately.

With LED indicator light, order E-100-L-A



E-150

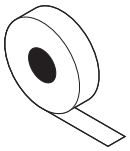
nVent RAYCHEM E-150 Low-profile end seal for heating cable in nonhazardous and hazardous locations. Includes cold-applied heating cable core seal.



nVent RAYCHEM HAK-C-100 CID1 hazardous location connection kit for one heating cable. Junction box ordered separately.

nVent RAYCHEM HAK-JB3-100 CID1 hazardous location junction box for up to three entries. Requires one pipe strap and a universal mounting bracket (UMB) to be ordered separately.

ACCESSORIES



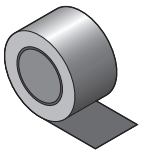
GT-66
GS-54

nVent RAYCHEM GT-66 Glass Installation Tape

- For use on pipes other than stainless steel
- ½" x 66' roll
- Strap at 1-foot intervals at minimum application temperature of 40°F (5°C)

nVent RAYCHEM GS-54 Glass Installation Tape

- For use on all pipes, particularly stainless steel
- ½" x 54' roll
- Strap at 1-foot intervals at minimum application temperature of –40°F (–40°C)



AT-180

nVent RAYCHEM AT-180 Aluminum Tape

- For use on all pipe materials
- 2-½" x 180' roll
- Temperature class: 300°F (150°C)
- Minimum installation temperature: 32°F (0°C)

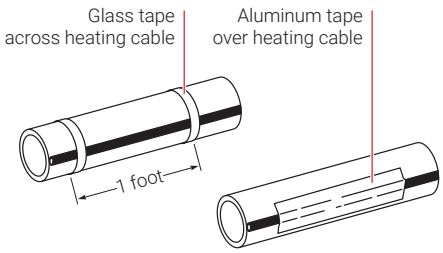


Fig. 9 Tape installation

TABLE 11 ATTACHMENT TAPE REQUIREMENTS

	Rolls needed per 100 ft of cable						
	Pipe diameter (IPS) in inches						
Tape type	½	1	2	3	4	6	8
GT-66	0.6	1.2	4	4	6	8	10
GS-54	0.6	1.2	4	6	6	10	12
AT-180	Use one foot of tape per foot of heating cable						

ETL

ETL (Electric Traced Label)
Attach the label to the outside of the thermal insulation weather barrier to indicate presence of electrical heat tracing. Use one label for every 10 feet (3 m) of pipe, alternating on either side of the pipe.

Pipe strap

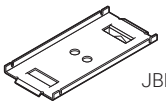
Pipe Straps

Stainless steel pipe straps to attach connection kit to the heat-traced pipe.
Use Table 13 below to assist with pipe strap selection.

TABLE 12 PIPE STRAP SELECTION

Catalog number	Pipe size
PS-01	For conduit ≤1"
PS-03	For connection kits on pipes with dimensions <2"
PS-10	For connection kits on pipes with dimensions 2"–10"
PS-20	For connection kits on pipes with dimensions 10"–19.5"

JBS-SPA

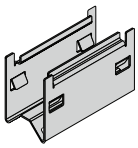


JBM-SPA

Small Pipe Adapters

JBS-SPA Adapter for mounting nVent RAYCHEM E-100, JBS-100, and JS-100-A to small pipe. (≤1" diameter)

JBM-SPA Adapter for mounting JBM-100 and T-100 to small pipe. (≤1" diameter)



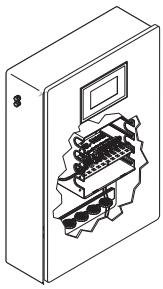
Junction Box Stand Off

For insulation thickness 4½" to 7" (120–180 mm)
JBM-100-STANDOFF
JBS-100-STANDOFF

JB-DRAIN-PLUG-3/4IN

Conduit Drain

JB-DRAIN-PLUG-3/4IN Conduit drain for JBS-100, JBM-100, and JS-100-A.



nVent RAYCHEM Control
& Monitoring Systems

Controls

For a complete selection of control and monitoring products, including thermostats, see Control and Monitoring design guide (H56889)

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