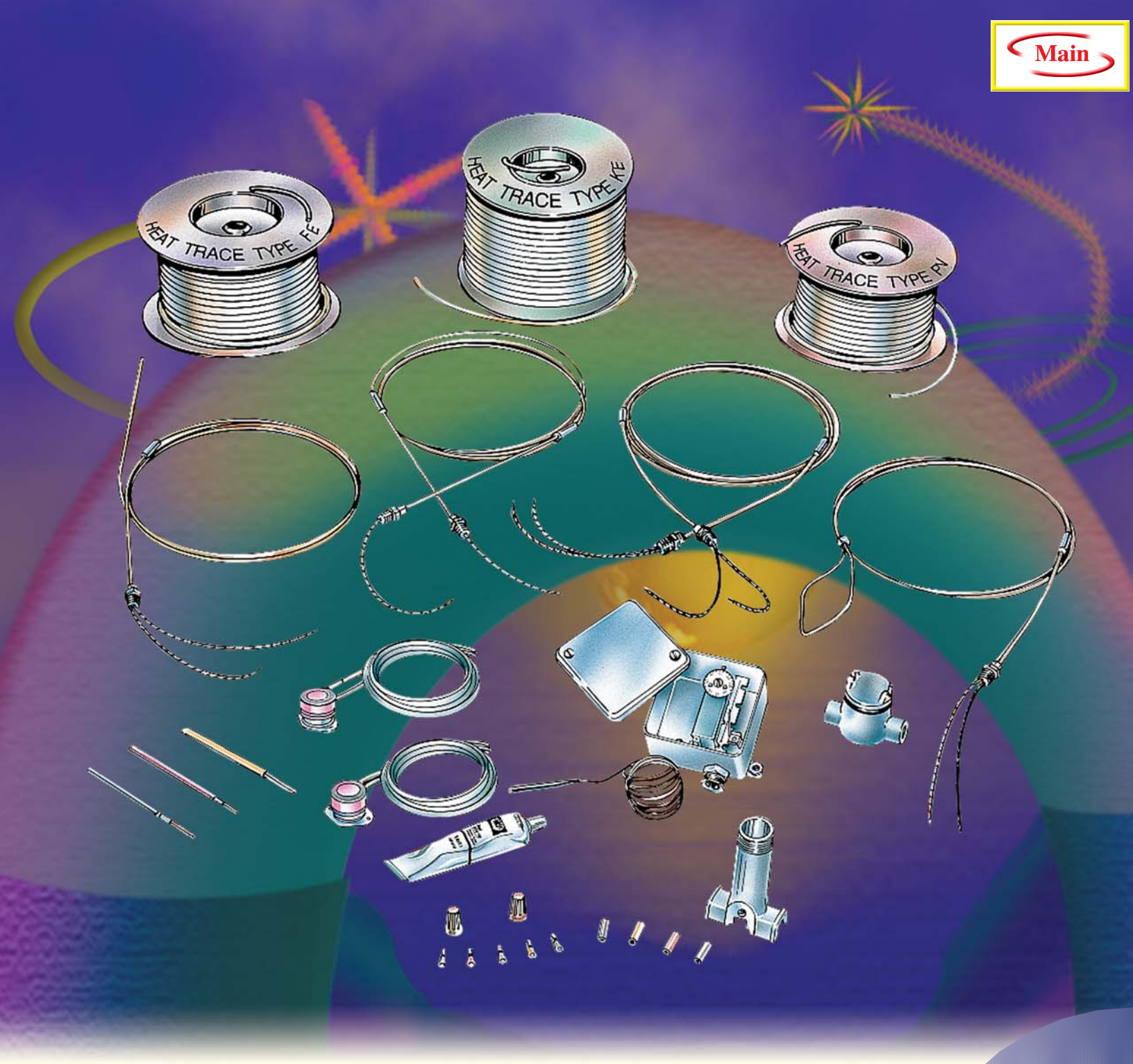

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6 section

Heat Trace Cable

Introduction to Heat Trace Cable Systems

Tempco's Heat Trace Cables are used to counteract the effects of heat dissipation from process pipe and equipment through its insulation (if any). This heat loss allows a drop in temperature, bringing about unacceptable consequences such as frozen pipes, reduced fluid viscosity, etc.

The use of heat trace cable replaces the heat lost, maintaining the desired temperature through the application of the required wattage.

There are two general categories of Electrical Heat Trace Cable:
Constant Wattage and
Self-Limiting, or **Self-Regulating** cable
Each style of heat trace cable serves different applications.

The Most Commonly Asked Questions About Heat Trace Cables

Which cable do I need?

Selecting the proper cable depends on many different variables. The pipe size, exposure temperatures, ambient conditions, insulation type and thickness, maintenance temperatures, heat-up rate, flow rate, and type of material involved all play a part in determining which cable is best for your application.

Consult pages 6-2 through 6-14 and/or contact **Tempco** to assist you in making the correct choice.

What are the requirements for metal overbraid and outer jackets?

Metal overbraid is required on all heat trace cabling to meet NEC code for grounding. The braid provides mechanical protection, as well as a low-resistance grounding path.

On SL self-limiting cable, in addition to the standard metal overbraid, an optional thermoplastic elastomer or fluoropolymer outer jacket is recommended when exposure to organic chemicals or corrosives is expected.

Can the cable be cut in the field without changing the resistance?

Tempco's Constant Wattage and Self-Limiting style cable is designed to be a certain wattage per foot within a certain circuit length. All Constant Wattage cables have modules cut out of the bus wire jacket, exposing the bare wire at alternating points at predetermined lengths. The cable is designed to be a certain wattage within this circuit length. These circuits run the length of the spool, similar to short runs of cable run in series to make one long cable. If a circuit is interrupted (cut), the cable will be cold up until the next complete circuit.

Types of Heat Trace Cable

Constant Wattage Cable This style of heat trace cable is designed to put out a certain amount of wattage per linear foot at a particular voltage. It is always putting out the designed watts per foot, no matter what the surface or ambient temperature is.

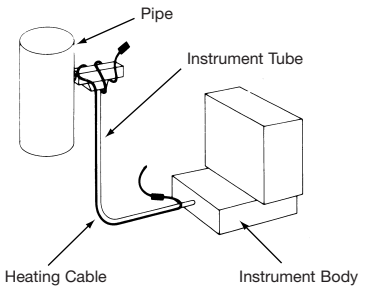
This means that in most situations the heating cable is continually pumping heat into the vessel or pipe being maintained or heated. If the heat trace cable is not attached to some kind of control device, it has the potential to overheat itself and burn out. This would not only ruin the cable, but could cause damage to whatever it is being used on. Therefore, constant wattage cable must be controlled by some means.

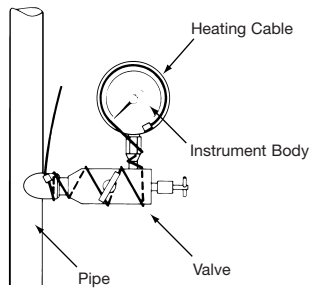
Self-Limiting, or Self-Regulating Cable This cable will self-adjust its power output in relation to the surface temperature as well as ambient conditions. In other words, the hotter the conditions get, the lower the wattage output becomes. This characteristic allows this type of cable to be used without a control device. However, if a particular temperature is required, then a control device must be used.

Both cables are used by all types of industry. It is the user's requirements that dictate which design to use. Higher temperature maintenance applications will use the constant wattage cables due to the higher maximum exposure temperatures that they allow. Lower temperature maintenance applications, such as freeze protection, can use the self-limiting cable, although constant wattage cable can be used just as effectively as long as it is controlled properly.

Heat Trace Cable Application/Installation Examples

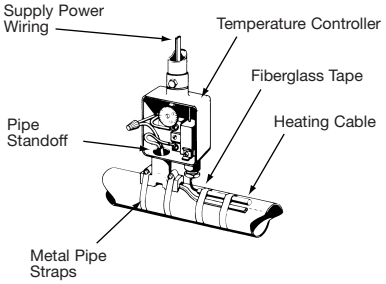
Installation of Heating Cable on a Pressure Transmitter

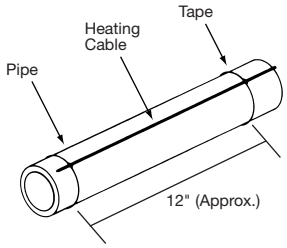




Installation of Heating Cable on a Pressure Indicator

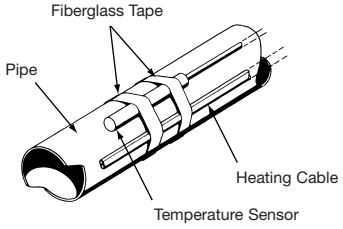
Installation of Heating Cable System in Non-Hazardous Area

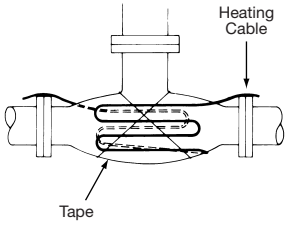




Installation of Heating Cable on a Straight Pipe Run

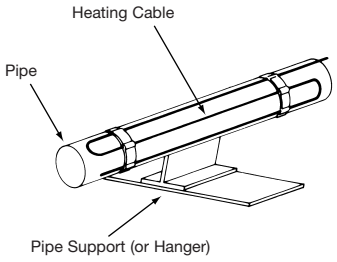
Installation of Temperature Sensor

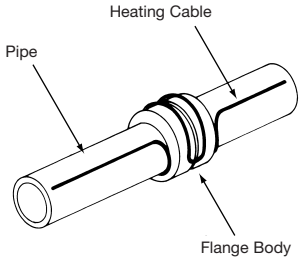




Installation of Heating Cable at a Blind Tee

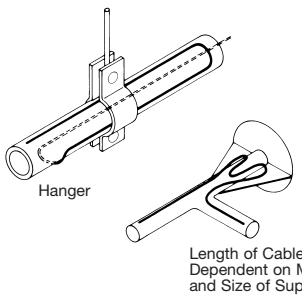
Installation of Heating Cable at a Pipe Support

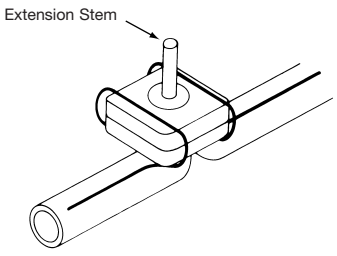




Installation of Heating Cable at a Flange Body

Typical Installation of Heating Cable for Supports





Installation of Heater on Diaphragm Valve (when surface area is sufficient)

How to Determine Heat Trace Cable Requirements

Heat Loss

Heat loss is the amount of heat given up to the surrounding atmosphere through a combination of conduction, convection, and radiation. The parameters required to determine total heat losses on a given pipe or vessel include several of the following:

- Temperature to be maintained
- Lowest expected ambient temperature
- Type, size, and run-length of pipe or tubing
- Type and thickness of thermal insulation to be used
- Heat loss from the surface of the material or vessel
- Losses through the vessel wall and the insulation
- Thermal properties (specific heat) of the materials being heated
- Flow rate
- Dimensions and weight of the material being heated
- Heat carried away by products being processed through the heated area
- Specified heat-up time
- Type and number of valves and supports

Calculating Heat Loss from Insulated Pipe

1. Calculate the ΔT, or temperature difference. Subtract the lowest ambient temperature from the operating temperature.
2. Using the ΔT calculated in step 1, and the insulation thickness, refer to **Tables 1-A through 1-E—Heat Loss for Pipes (pages 6-6 and 6-7)**, to determine the heat loss in watts per linear foot of pipe.
3. Depending on the type of insulation used in the application, multiply result from step 2 by the appropriate factor from **Table 2—Insulation Factor (page 6-7)**. The resulting number is the heat loss expressed in watts per linear foot of pipe to be made up by the heat tracer.

Determine the Correct Heat Trace Cable

1. Determine the cable most appropriate for your system based on the temperature to be maintained, environment, length of the run, and the voltages available. There are **Tempco** heating cables available for most heat tracing applications.
2. If the watts per foot rating of the cable selected is more than the heat loss per foot, then a straight run may be used.

   If the watts per foot rating of the cable selected is less than the heat loss per foot, your options are:

   a. Use a higher wattage cable
   b. Use multiple straight runs
   c. Spiral wrap the cable on the pipe
   d. Use insulation with a higher insulation factor or thickness.
3. Multiple or straight runs are preferred over spiraling in most applications because fewer power points along the pipe are required and installation is easier.
4. If spiraling is used, determine the wrapping factor by dividing the watts per linear foot of heat loss by the wattage rating of the selected heat tracer. A wrap factor of less than 1.0 indicates that a straight run of cable will provide adequate heat. For ease of installation, it is also recommended that multiple straight runs be used for wrapping factors of more than 2.0.
5. Determine the pitch distance for the pipe size being used by finding the wrapping factor in **Table 3—Spiral Pitch (page 6-8)** that is closest to the the one calculated.

Calculating Heat Loss for Valves and Supports

1. To determine the heat loss multiplication factor for valves, refer to **Table 4—Heat Loss Multiplication Factors for Valves (page 6-8)**. Multiply the watts per linear foot of heat loss of the pipe feeding to and from the valve by the multiplication factor for the corresponding pipe size from the table. This heat loss factor is based on a typical gate valve with insulation coverage to include the body, flange, and bonnet of the valve. If pipe supports are part of the system, the heat loss calculation for each support should be made in the same manner as for a valve.

   To determine adjusted multiplication factors for other types of valves and supports, use the following conversion factors:

Gate valve	1.0
Ball valve	.7
Globe valve	.95
Butterfly valve	.60
Pipe supports	.50

2. Determine the length of cable required for each valve and/or support by dividing the heat loss in watts per foot by the wattage rating of the selected cable.

Determine the Total Amount of Heat Trace Required

1. Add the length of cable required for each valve and support to the length of cable required for the total pipe within your system.
2. Take the total length of cable and round it upward to the nearest figure divisible by the module length of 4 feet. Then add 4 feet for cold lead.
3. This final figure is the total amount required for the length of pipe, valves, and supports in the system.

Tables...
Please see the corresponding tables on pages 6-6 through 6-8.

Engineering Sample Problem

System Specifications

Operating Temperature: 55°F
Low Ambient Temperature: -20°F
Pipe Size: 4" steel pipe
Pipe Length: 200 ft.
Valve: 1 Gate Valve
Insulation Thickness and Type: 1" of Calcium Silicate
Voltage: 120 or 240 volts

PROCEDURE

1. Determine the heat loss.

a. Difference between low ambient and operating temperature:
55°F − (-20°F) = ΔT
ΔT = 75°F

b. Determine the heat loss by referring to Table 1-A—**Heat Loss for Pipes** for ΔT = 75°F, 4" diameter pipe, with 1" thick insulation. Heat loss factor using 1" thick fiberglass insulation = 7.6 W/ft.

2. Determine the adjusted heat loss for calcium silicate insulation (heat loss chart is based on fiberglass).
Refer to Table 2—**Insulation Factor**
Adjustment = 7.6W × 1.47 adjustment factor = 11.17W/ft

3. Select correct heating cable (by voltage and wattage) required to replace a heat loss of 11.17 W/ft. Use one straight run of 12 W/ft. or three straight runs of 4 W/ft.

4. Determine the heat loss of the valve gate and supports.
Refer to Table 4—**Heat Loss Factor for Valves** for a 4" diameter pipe. The heat loss multiplication factor is 2.92.
Valve heat loss factor = 11.17 W/ft. × 2.92 = 32.62 W

5. Determine the cable requirements for the valve.
Divide valve heat loss by W/ft. of selected cable. Length of cable for valve:
32.62 W/ft. ÷ 12 W = 2.72 ft.

6. Determine total cable requirements.

a. Cable required for pipe:
1 run × 200 ft. = 200 ft.

b. Cable required for valve = 2.72 ft.

c. Total: 200 ft. + 2.72 ft. = 203 ft.
Round this number (203) up to the nearest number evenly divisible by the module (module length = 4 ft.), i.e. 204 ft.

d. Add module length (4 ft.) for cold leads for termination:
204 ft. + 4 ft. = 208 ft.
Total feet of cable required = 208 ft. of 12 W/ft. heating cable.

Table...
Please see the corresponding table on page 6-10 through 6-12

Heat Loss Tables

Table 1-A Heat Loss for Pipes *(Watts Per Foot)* Insulation Thickness 1"

	NPS Pipe Size																		
ΔT	0.25	0.5	0.75	1	1.5	2	2.5	3	4	6	8	10	12	14	16	18	20	24	30
25	0.6	0.7	0.8	1.0	1.2	1.5	1.7	2.0	2.4	3.3	4.2	5.2	6.0	6.6	7.5	8.4	9.2	11.0	13.6
50	1.2	1.5	1.7	2.0	2.5	3.0	3.4	4.0	4.9	7.0	8.7	10.6	12.4	13.5	15.3	17.1	18.9	22.5	28.0
75	1.8	2.3	2.6	3.0	3.9	4.6	5.3	6.2	7.6	10.6	13.3	16.3	19.1	20.8	23.6	26.3	29.1	34.7	43.0
100	2.5	3.2	3.6	4.2	5.3	6.3	7.2	8.4	10.4	14.4	18.2	22.2	26.0	28.4	32.2	36.0	39.8	47.3	58.7
125	3.2	4.0	4.6	5.3	6.8	8.0	9.3	10.8	13.3	18.5	23.3	28.5	33.3	36.4	41.2	46.0	50.9	60.6	75.1
150	3.9	5.0	5.7	6.5	8.4	9.8	11.4	13.3	16.3	22.7	28.6	35.0	40.9	44.6	50.6	56.5	62.5	74.4	92.2
175	4.7	5.9	6.8	7.8	10.0	11.7	13.6	15.8	19.4	27.0	34.2	41.7	48.8	53.3	60.4	67.5	74.6	88.7	110.0
200	5.5	6.9	7.9	9.1	11.7	13.7	15.9	18.5	22.7	31.6	39.9	48.7	57.0	62.2	70.5	78.8	87.1	103.7	128.5
225	6.3	8.0	9.1	10.5	13.4	15.8	18.2	21.2	26.1	36.3	45.9	56.0	65.5	71.5	81.0	90.6	100.1	119.1	147.7
250	7.1	9.0	10.3	11.9	15.2	17.9	20.7	24.1	29.6	41.2	52.0	63.5	74.3	81.1	91.9	102.7	113.5	135.2	167.6
275	8.0	10.1	11.6	13.3	17.1	20.1	23.2	27.1	33.2	46.2	58.4	71.3	83.5	91.1	103.2	115.3	127.5	151.7	188.1
300	8.9	11.3	12.9	14.9	19.0	22.4	25.8	30.1	37.0	51.5	65.0	79.4	92.9	101.3	114.8	128.4	141.9	168.9	209.4
325	9.8	12.5	14.2	16.4	21.0	24.7	28.6	33.3	40.8	56.8	71.8	87.7	102.6	111.9	126.9	141.8	156.7	186.5	231.3
350	10.8	13.7	15.6	18.0	23.1	27.1	31.3	36.5	44.8	62.4	78.8	96.2	112.6	122.9	139.3	155.7	172.0	204.8	253.9
375	11.8	15.0	17.1	19.7	25.2	29.6	34.2	39.9	48.9	68.1	86.1	105.1	123.0	134.2	152.0	169.9	187.8	223.5	277.1
400	12.8	16.3	18.5	21.4	27.4	32.2	37.2	43.3	53.2	74.0	93.5	114.2	133.6	145.8	165.2	184.6	204.0	242.9	301.1

Table 1-B Heat Loss for Pipes *(Watts Per Foot)* Insulation Thickness 1.5"

	NPS Pipe Size																		
ΔT	0.25	0.5	0.75	1	1.5	2	2.5	3	4	6	8	10	12	14	16	18	20	24	30
25	0.5	0.6	0.7	0.8	0.9	1.1	1.3	1.4	1.7	2.4	3.0	3.6	4.2	4.6	5.2	5.8	6.4	7.5	9.3
50	1.0	1.2	1.4	1.6	1.9	2.2	2.6	3.0	3.6	4.9	6.1	7.4	8.6	9.4	10.6	11.8	13.0	15.5	19.1
75	1.5	1.9	2.1	2.4	3.0	3.5	3.9	4.5	5.5	7.5	9.4	11.4	13.3	14.1	16.3	18.2	20.0	23.8	29.4
100	2.1	2.5	2.9	3.3	4.1	4.7	5.4	6.2	7.5	10.3	12.8	15.5	18.1	19.7	22.2	24.8	27.3	32.4	40.1
125	2.6	3.3	3.7	4.2	5.2	6.0	6.9	7.9	9.6	13.1	16.4	19.9	23.2	25.2	28.5	31.7	35.0	41.5	51.3
150	3.2	4.0	4.5	5.1	6.4	7.4	8.5	9.7	11.8	16.1	20.1	24.4	28.4	30.9	34.9	38.9	42.9	50.9	62.9
175	3.9	4.8	5.4	6.1	7.6	8.8	10.1	11.6	14.1	19.2	24.0	29.1	33.9	36.9	41.6	46.4	51.2	60.7	75.0
200	4.5	5.6	6.3	7.1	8.9	10.3	11.8	13.6	16.4	22.4	28.0	34.0	39.6	43.0	48.6	54.2	59.7	70.9	87.6
225	5.2	6.4	7.2	8.2	10.2	11.8	13.5	15.6	18.9	25.8	32.2	39.0	45.4	49.4	55.8	62.2	68.6	81.4	100.6
250	5.9	7.2	8.1	9.3	11.6	13.4	15.3	17.7	21.4	29.2	36.5	44.3	51.5	56.1	63.3	70.6	77.8	92.3	114.1
275	6.6	8.1	9.1	10.4	13.0	15.1	17.2	19.8	24.0	32.8	41.0	49.7	57.8	62.9	71.1	79.2	87.3	103.6	128.0
300	7.3	9.0	10.2	11.6	14.5	16.8	19.2	22.1	26.7	36.5	45.6	55.3	64.3	70.0	79.1	88.1	97.2	115.3	142.4
325	8.1	10.0	11.2	12.8	16.0	18.5	21.2	24.4	29.5	40.3	50.4	61.0	71.0	77.3	87.3	97.3	107.3	127.3	157.2
350	8.9	11.0	12.3	14.0	17.5	20.3	23.2	26.7	32.4	44.2	55.3	67.0	78.0	84.8	95.8	106.8	117.7	139.7	172.6
375	9.7	12.0	13.5	15.3	19.1	22.2	25.3	29.2	35.3	48.3	60.3	73.1	85.1	92.6	104.6	116.5	128.5	152.4	188.3
400	10.5	13.0	14.6	16.6	20.8	24.1	27.5	31.7	38.4	52.4	65.5	79.4	92.4	100.5	113.6	126.6	139.6	165.6	204.5

Table 1-C Heat Loss for Pipes *(Watts Per Foot)* Insulation Thickness 2"

	NPS Pipe Size																		
ΔT	0.25	0.5	0.75	1	1.5	2	2.5	3	4	6	8	10	12	14	16	18	20	24	30
25	0.4	0.5	0.6	0.6	0.8	0.9	1.0	1.2	1.4	1.9	2.4	2.8	3.3	3.6	4.0	4.5	4.9	5.8	7.1
50	0.9	1.1	1.2	1.3	1.6	1.9	2.1	2.4	2.9	3.9	4.8	5.8	6.7	7.3	8.2	9.1	10.1	11.9	14.6
75	1.3	1.6	1.8	2.0	2.5	2.9	3.3	3.7	4.4	6.0	7.4	8.9	10.3	11.2	12.6	14.0	15.5	18.3	22.5
100	1.8	2.2	2.5	2.8	3.4	3.9	4.4	5.1	6.1	8.2	10.1	12.2	14.1	15.3	17.2	19.2	21.1	24.9	30.7
125	2.3	2.8	3.2	3.6	4.4	5.0	5.7	6.5	7.8	10.4	12.9	15.6	18.0	19.6	22.1	24.5	27.0	31.9	39.3
150	2.9	3.5	3.9	4.4	5.4	6.2	7.0	8.0	9.5	12.8	15.9	19.1	22.1	24.0	27.1	30.1	33.1	39.2	48.2
175	3.4	4.1	4.6	5.2	6.4	7.3	8.3	9.5	11.4	15.3	18.9	22.8	26.4	28.7	32.3	35.9	39.5	46.7	57.5
200	4.0	4.8	5.4	6.1	7.5	8.6	9.7	11.1	13.3	17.9	22.1	26.6	30.8	33.5	37.7	41.9	46.1	54.5	67.1
225	4.6	5.6	6.2	7.0	8.6	9.9	11.2	12.7	15.2	20.5	25.4	30.6	35.4	38.5	43.3	48.1	53.0	62.6	77.1
250	5.2	6.3	7.0	7.9	9.7	11.2	12.6	14.4	17.3	23.3	28.8	34.7	40.2	43.6	49.1	54.6	60.1	71.1	87.5
275	5.8	7.1	7.9	8.9	10.9	12.5	14.2	16.2	19.4	26.1	32.3	38.9	45.1	49.0	55.1	61.3	67.4	79.7	98.2
300	6.5	7.9	8.8	9.9	12.2	14.0	15.8	18.0	21.6	29.1	36.0	43.3	50.2	54.5	61.3	68.2	75.0	88.7	109.2
325	7.2	8.7	9.7	10.9	13.4	15.4	17.5	19.9	23.9	32.1	39.8	47.8	55.4	60.2	67.7	75.3	82.9	98.0	120.7
350	7.9	9.6	10.7	12.0	14.7	16.9	19.2	21.9	26.2	35.2	43.6	52.5	60.8	66.0	74.4	82.7	91.0	107.6	132.4
375	8.6	10.4	11.6	13.1	16.1	18.5	20.9	23.9	28.6	38.5	47.6	57.3	66.4	72.1	81.2	90.2	99.3	117.4	144.5
400	9.3	11.3	12.6	14.2	17.5	20.1	22.7	25.9	31.0	41.8	51.7	62.2	72.1	78.3	88.2	98.0	107.8	127.5	157.0

Heat Loss Tables

Table 1-D Heat Loss for Pipes *(Watts Per Foot)* Insulation Thickness 2.5"

ΔT	NPS Pipe Size 0.25	0.5	0.75	1	1.5	2	2.5	3	4	6	8	10	12	14	16	18	20	24	30
25	0.4	0.5	0.5	0.6	0.7	0.8	0.9	1.0	1.2	1.6	2.0	2.4	2.7	2.9	3.3	3.7	4.0	4.7	5.8
50	0.8	1.0	1.1	1.2	1.4	1.6	1.8	2.1	2.5	3.3	4.0	4.8	5.6	6.0	6.8	7.5	8.2	9.7	11.9
75	1.2	1.5	1.6	1.8	2.2	2.5	2.8	3.2	3.8	5.0	6.2	7.4	8.5	9.2	10.4	11.5	12.6	14.9	18.3
100	1.7	2.0	2.2	2.5	3.0	3.4	3.8	4.4	5.2	6.9	8.4	10.1	11.6	12.6	14.2	15.7	17.3	20.3	25.0
125	2.1	2.6	2.8	3.2	3.8	4.4	4.9	5.6	6.6	8.8	10.8	12.9	14.9	16.1	18.1	20.1	22.1	26.0	31.9
150	2.6	3.1	3.5	3.9	4.7	5.4	6.0	6.8	8.1	10.8	13.2	15.8	18.3	19.8	22.2	24.6	27.1	31.9	39.2
175	3.1	3.7	4.1	4.6	5.6	6.4	7.2	8.1	9.7	12.8	15.8	18.9	21.8	23.6	26.5	29.4	32.3	38.0	46.7
200	3.6	4.4	4.8	5.4	6.6	7.5	8.4	9.5	11.3	15.0	18.4	22.0	25.4	27.5	30.9	34.3	37.7	44.4	54.5
225	4.2	5.0	5.6	6.2	7.5	8.6	9.6	10.9	13.0	17.2	21.1	25.3	29.2	31.6	35.5	39.4	43.2	51.0	62.6
250	4.7	5.7	6.3	7.0	8.5	9.7	10.9	12.4	14.7	19.5	24.0	28.7	33.1	35.8	40.2	44.6	49.0	57.8	70.9
275	5.3	6.4	7.1	7.9	9.6	10.9	12.3	13.9	16.5	21.9	26.9	32.2	37.1	40.2	45.2	50.1	55.0	64.9	79.6
300	5.9	7.1	7.9	8.8	10.7	12.1	13.6	15.5	18.3	24.4	29.9	35.8	41.3	44.7	50.2	55.7	61.2	72.1	88.5
325	6.5	7.8	8.7	9.7	11.8	13.4	15.1	17.1	20.2	26.9	33.0	39.5	45.6	49.4	55.5	61.5	67.6	79.6	97.7
350	7.2	8.6	9.5	10.6	12.9	14.7	16.5	18.7	22.2	29.5	36.3	43.4	50.0	54.2	60.9	67.5	74.1	87.4	107.2
375	7.8	9.4	10.4	11.6	14.1	16.0	18.0	20.4	24.2	32.2	39.6	47.3	54.6	59.1	66.4	73.6	80.9	95.4	117.0
400	8.5	10.2	11.3	12.6	15.3	17.4	19.6	22.2	26.3	35.0	43.0	51.4	59.3	64.2	72.1	80.0	87.8	103.5	127.1

Table 1-E Heat Loss for Pipes *(Watts Per Foot)* Insulation Thickness 3"

ΔT	NPS Pipe Size 0.25	0.5	0.75	1	1.5	2	2.5	3	4	6	8	10	12	14	16	18	20	24	30
25	0.4	0.4	0.5	0.5	0.6	0.7	0.8	0.9	1.1	1.4	1.7	2.0	2.3	2.5	2.8	3.1	3.4	4.0	4.9
50	0.7	0.9	1.0	1.1	1.3	1.5	1.6	1.9	2.2	2.9	3.5	4.2	4.8	5.2	5.8	6.4	7.0	8.3	10.1
75	1.1	1.4	1.5	1.7	2.0	2.3	2.5	2.8	3.3	4.4	5.4	6.4	7.3	7.9	8.9	9.8	10.8	12.7	15.5
100	1.6	1.9	2.0	2.3	2.7	3.1	3.4	3.9	4.6	6.0	7.3	8.7	10.0	10.8	12.1	13.4	14.7	17.3	21.2
125	2.0	2.4	2.6	2.9	3.5	3.9	4.4	5.0	5.8	7.7	9.4	11.1	12.8	13.8	15.5	17.2	18.8	22.1	27.1
150	2.4	2.9	3.2	3.6	4.3	4.8	5.4	6.1	7.2	9.4	11.5	13.7	15.7	17.0	19.0	21.1	23.1	27.1	33.2
175	2.9	3.5	3.8	4.2	5.1	5.8	6.4	7.3	8.5	11.2	13.7	16.3	18.7	20.2	22.7	25.1	27.5	32.3	39.6
200	3.4	4.0	4.5	4.9	5.9	6.7	7.5	8.5	10.0	13.1	16.0	19.0	21.9	23.6	26.5	29.3	32.1	37.8	46.2
225	3.9	4.6	5.1	5.7	6.8	7.7	8.6	9.7	11.5	15.0	18.4	21.8	25.1	27.1	30.4	33.6	36.9	43.4	53.1
250	4.4	5.3	5.8	6.4	7.7	8.8	9.8	11.0	13.0	17.1	20.8	24.8	28.5	30.8	34.5	38.1	41.8	49.2	60.2
275	5.0	5.9	6.5	7.2	8.7	9.8	11.0	12.4	14.6	19.1	23.4	27.8	31.9	34.5	38.7	42.8	46.9	55.2	67.5
300	5.5	6.6	7.2	8.0	9.7	10.9	12.2	13.8	16.2	21.3	26.0	30.9	35.5	38.4	43.0	47.6	52.2	61.4	75.1
325	6.1	7.3	8.0	8.9	10.7	12.1	13.5	15.2	17.9	23.5	28.7	34.1	39.2	42.4	47.5	52.6	57.6	67.7	82.9
350	6.7	8.0	8.8	9.7	11.7	13.2	14.8	16.7	19.6	25.8	31.5	37.5	43.1	46.5	52.1	57.7	63.2	74.3	91.0
375	7.3	8.7	9.6	10.6	12.8	14.5	16.2	18.2	21.4	28.2	34.4	40.9	47.0	50.8	56.9	62.9	69.0	81.1	99.3
400	7.9	9.4	10.4	11.6	13.9	15.7	17.5	19.8	23.3	30.6	37.3	44.4	51.0	55.2	61.8	68.4	74.9	88.1	107.8

Table 2 Insulation Factor

Insulation Material	Temperature (°F) to be Maintained 50	100	150	200	250	300	400	500	600
Fiberglass	1	1	1	1	1	1	1	1	1
Cellular Glass	1.53	1.50	1.48	1.44	1.42	1.40	1.36	1.34	1.32
Calcium Silicate	1.47	1.47	1.45	1.44	1.41	1.39	1.34	1.32	1.30
Polyurethane	0.60	0.60	0.58	0.57	*	*	*	*	*

* Temperature (°F) exceeds the recommended values for foam.

Note: All insulation factors were determined based on leading insulation manufacturers' specifications.

CONTINUED

Heat Loss Tables

Continued from previous page…

Table 3 Spiral Pitch *(Feet of Heat Trace Cable Per Foot of Pipe)*

Pitch	NPS Pipe Size 0.50	0.75	1.00	1.50	2.00	2.5	3	4	6	8	10	12	14	16	18	20	24	30
2"	1.98	2.27	2.66	3.52	4.25	5.01	5.97	7.52	10.85	13.98	17.30	20.43	22.39	25.53	28.67	31.81	38.09	47.50
3"	1.52	1.69	1.92	2.46	2.93	3.43	4.05	5.07	7.27	9.35	11.56	13.64	14.95	17.04	19.13	21.22	25.40	31.68
4"	1.32	1.43	1.59	1.96	2.29	2.65	3.11	3.86	5.49	7.04	8.69	10.25	11.23	12.80	14.36	15.93	19.06	23.77
5"	1.21	1.29	1.40	1.68	1.93	2.21	2.56	3.15	4.43	5.67	6.98	8.23	9.00	10.25	11.50	12.76	15.26	19.02
6"	1.15	1.21	1.29	1.51	1.70	1.92	2.20	2.68	3.74	4.75	5.84	6.88	7.52	8.56	9.60	10.64	12.73	15.86
7"	1.11	1.16	1.22	1.39	1.55	1.72	1.96	2.35	3.24	4.11	5.03	5.92	6.47	7.36	8.25	9.14	10.92	13.61
8"	1.09	1.12	1.17	1.31	1.44	1.58	1.78	2.12	2.88	3.63	4.43	5.20	5.68	6.46	7.23	8.01	9.57	11.92
9"	1.07	1.10	1.14	1.25	1.36	1.48	1.65	1.94	2.60	3.26	3.97	4.64	5.07	5.76	6.45	7.14	8.52	10.60
10"	1.06	1.08	1.11	1.21	1.30	1.40	1.54	1.80	2.38	2.96	3.60	4.20	4.58	5.20	5.82	6.44	7.68	9.55
11"	1.05	1.07	1.10	1.17	1.25	1.34	1.46	1.68	2.20	2.72	3.30	3.84	4.19	4.75	5.30	5.87	6.99	8.69
12"	SR	1.06	1.08	1.15	1.21	1.29	1.40	1.60	2.06	2.53	3.05	3.55	3.86	4.37	4.88	5.39	6.42	7.98
14"	SR	SR	1.06	1.11	1.16	1.22	1.31	1.46	1.84	2.23	2.66	3.08	3.35	3.78	4.21	4.65	5.53	6.86
16"	SR	SR	1.05	1.09	1.13	1.17	1.24	1.37	1.68	2.01	2.38	2.74	2.97	3.34	3.72	4.10	4.86	6.02
18"	SR	SR	SR	1.07	1.10	1.14	1.19	1.30	1.56	1.84	2.16	2.48	2.68	3.01	3.34	3.67	4.35	5.37
24"	SR	SR	SR	SR	1.06	1.08	1.11	1.18	1.35	1.53	1.75	1.97	2.12	2.35	2.59	2.83	3.33	4.08
30"	SR	SR	SR	SR	SR	1.05	1.07	1.12	1.23	1.37	1.52	1.69	1.80	1.97	2.16	2.34	2.73	3.32
36"	SR	SR	SR	SR	SR	SR	1.05	1.08	1.17	1.26	1.39	1.51	1.60	1.73	1.88	2.03	2.34	2.82
42"	SR	SR	SR	SR	SR	SR	SR	1.06	1.12	1.20	1.29	1.39	1.46	1.57	1.69	1.81	2.07	2.47
48"	SR	SR	SR	SR	SR	SR	SR	1.05	1.10	1.16	1.23	1.31	1.37	1.46	1.56	1.66	1.88	2.22
60"	SR	SR	SR	SR	SR	SR	SR	SR	1.05	1.10	1.15	1.21	1.25	1.31	1.38	1.46	1.62	1.87
72"	SR	SR	SR	SR	SR	SR	SR	SR	SR	1.07	1.11	1.15	1.18	1.23	1.28	1.33	1.46	1.66

SR = Straight Run

Table 4 Heat Loss Multiplication Factors for Valves

NPS Pipe Size	Multi. Factor	NPS Pipe Size	Multi. Factor	NPS Pipe Size	Multi. Factor	NPS Pipe Size	Multi. Factor
0.5	0.52	2	1.92	6	3.84	16	7.91
0.75	0.78	2.5	2.00	8	4.66	18	8.84
1	1.00	3	2.40	10	5.51	20	9.57
1.25	1.33	3.5	2.62	12	6.25	24	11.09
1.5	1.70	4	2.92	14	7.07		

Constant Wattage Heat Trace Cable

Tempco's Constant Wattage Heating Cables are all parallel resistance, low watt density electrical heaters designed to be cut to the desired lengths in the field, eliminating the need for prefabrications and reducing or eliminating many design and installation costs. No special training is required.

All Tempco Heating Cables are parallel circuit designed. The multi-stranded bus wires are covered in a high dielectric insulation. Spirally wrapped resistance wire maintains circuit continuity by connecting short, alternately spaced sections of exposed conductor bus wire. Cables feature moisture and chemical resistance and are classed for hazardous locations when properly cut and spliced using the correct lead termination kit.

Metal Overbraid is provided on all heat tracing as standard to meet NEC code for grounding. The braid provides mechanical protection as well as a low resistance grounding path.

Tempco constant wattage heating cables are designed for a full range of applications. Whether your need is freeze protection or process temperature control of pipelines, water lines, oil lines or asphalt lines, Tempco has the cable for your special needs.

KE Style Heating Cables *Maximum Temperature:* 500°F (260°C)

The KE Style cable heating element is tension wrapped and covered with two layers of Kapton® film applied in reverse directions, then heat fused for moisture protection. A tinned copper overbraid is then added for additional abrasion protection and for a ground return path. The overbraid is further enclosed in a covering of 20 mm extruded Teflon® PFA for further chemical and abrasion resistance.

Design Features

- ***Temperature exposure rating 500°F (260°C)***
- ***Continuous electrical ground***
- ***Excellent moisture and chemical resistance***
- ***Hazardous location rating***
- ***FM approved***

Typical Applications

- *Oil Refineries*
- *Asphalt Plants*
- *Severe Arctic Cold*
- *Mines*
- *Pulp and Paper Mills*
- *Corrosive Environments*
- *Explosive Environments*

Specifications

Voltages Available: 120, 208, 240, 480
Wattages: 4, 8, 12 (W/ft.)
Outside Dimensions: Nom. .330" × .225"
Exposure Rating: 500°F (260°C)
De-Energized: 550°F (302°C)
Standard Metal Overbraid: Tinned Copper
Extruded Jacket: Teflon®
Moisture and Chemical Resistance: Excellent
Flame Resistance: Outstanding
Radiation Resistance: Fair to Good

Agency Approvals

- **IEEE Std 515**
- **Factory Mutual**
  Ordinary Locations
  Hazardous Locations:
  Class I, Division 2, Groups B, C & D
  Class II, Division 2
  Class III, Division 2

Ordering Information

Tempco's KE Constant Wattage Heat Trace Cable is sold by part number and length. The cable part number is put together as follows:

H T P 0 1

Wattage—watts/ft.
4 W/ft. = 4
8 W/ft. = 8
12 W/ft. = 2

Voltage
120 VAC = 1
240 VAC = 2
208 VAC = 3
480 VAC = 4

Outer Layer
0 = Standard Tinned Copper Braid

Note: Due to code requirements, KE cable has a metal overbraid.

Constant Wattage Heat Trace Cable

FE Style Heating Cable Maximum Temperature: 400°F (204°C)

The FE Style cable heating element is tension wrapped and covered with a fluorocarbon film and enclosed in a minimum 20 mm Teflon® FEP abrasion resistant extruded jacket. This tough outer cover provides moisture and dielectric protection as well as resistance to abrasion. A layer of tinned copper braid is then applied to meet NEC code and to provide mechanical protection as well as a low resistance to ground.

Design Features

- ***Temperature Exposure Rating 400°F (204°C)***
- ***Ease of installation—cut to length at the job site***
- ***Moisture and chemical resistant***
- ***Stands up to repeated handling and flexing***
- ***Field proven industrial grade construction***
- ***Single end power connection***

Agency Approvals

- **Factory Mutual**
  Ordinary Locations
  Hazardous Locations;
  Class I, Division 2, Groups B, C & D
  Class II, Division 2, Groups E, F & G
  Class III, Division 2
- **CSA (120 and 240 VAC only)**
  Ordinary Locations
  Hazardous Locations;
  Class I, Division 2, Groups B, C & D
  Class II, Division 2, Groups F & G
  Class III, Division 2

Applications

- *Mid-Temperature Control*
- *Food Processing Plants*
- *Freeze Protection*
- *Chemical Processing Plants*
- *Hazardous Locations*
- *Water Lines/Condensate Return Lines*

Specifications

Voltages Available: 120, 208, 240, 480V
Wattages: 3, 5, 8, 12 (W/ft.)
Outside Dimensions: Nom. .300" × .200"
Exposure Rating: 400°F (204°C)
De-Energized: 450°F (232°C)
Standard Metal Overbraid: Tinned Copper (Optional Stainless Steel)
Moisture and Chemical Resistance: Excellent
Flame Resistance: Outstanding
Radiation Resistance: Fair to Good

Ordering Information

Tempco's FE Constant Wattage Heat Trace Cable is sold by part number and length. The cable part number is put together as follows:

H T P 0 2

Wattage—watts/ft.
3 W/ft. = 3
5 W/ft. = 5
8 W/ft. = 8
12 W/ft. = 2

Voltage
120 VAC = 1
240 VAC = 2
208 VAC = 3
480 VAC = 4

Outer Layer
0 = Standard Tinned Copper Braid
3 = Stainless Steel Braid

Note: Due to code requirements, FE cable has a metal overbraid.

Lead Termination and Cable Kits for Constant Wattage Cables

In order to maintain the integrity of the insulation, termination kits must be used to add leads or splice the heating cables. **Both ends must be terminated to use the heat trace cable properly.** The termination kits are designed to fully seal using a general purpose silicone RTV sealant, such as GE RTV108, on the final connections.

Termination Kit Type	"KE" Cable	"FE" Cable
Universal Connection/ Termination Kit	HTP90001	HTP90006
Lead and End Kit	HTP90002	HTP90007
Single Lead Term.	HTP90003	HTP90008
Single End Term.	HTP90004	HTP90009
Cable Splice Kit	HTP90005	HTP90010

The **Universal Kit** is mainly used to terminate the heat trace cable for pipe trace heating when the heating cable needs to terminate in an NPT pipe standoff for attaching a wiring junction box. The kit includes the 1" NPT pipe standoff and materials to make one power input connection, and two end terminations or one power input splice. The junction box is ordered separately; see page 6-14. These assemblies are watertight and suitable for use in Division II hazardous locations.

The **Lead and End Kit**, **Single Lead Termination Kit** and **Single End Termination Kits** are used when only simple cold power leads are required. The lead wire is customer supplied. The non-lead end must also be terminated and sealed.

The **Lead and End Kit** contains enough material for 5 lead and 5 end terminations.

The **Single Termination Lead Kit** and the **Single End Termination Kit** contain enough material for 1 lead or 1 end termination.

The **Splice Kit** is used to create one in-line splice or one "T" splice between two heat cables. May require pipe standoff, straps, junction box, and RTV (ordered separately, see page 6-14).

Self-Limiting Heat Trace Cable

Tempco's Self-Limiting Heating Cables are all parallel resistance, low watt density electrical heaters designed to be cut to the desired lengths in the field, eliminating the need for prefabrications and reducing or eliminating many design and installation costs. No special training is required.

Self-limiting heating cables are designed and built to regulate their output. As the process temperature drops, the cable's output increases; conversely, as the temperature rises, the cable's output decreases.

The self-limiting core is in essence an infinite number of parallel resistors that permit the cable to be cut to any length without creating cold sections. Because it is self-regulating and infinitely parallel, the output varies along the length of the cable, depending upon local process temperature.

Metal overbraid is provided on all heat trace cabling to meet NEC code for grounding. The braid provides mechanical protection, as well as a low resistance grounding path.

On SL self-limiting cable, in addition to the standard metal overbraid, an optional thermoplastic elastomer or fluoropolymer outer jacket is recommended when exposure to organic chemicals or corrosives is expected.

Self-limiting heating cable provides safe, reliable heat tracing for process temperature maintenance and freeze protection of pipes, valves and similar applications.

Design Features

- ***Efficient, Safe, Easy to Install***
- ***Maintenance Temperatures up to 150°F (65°C)***
- ***Can Be Overlapped***
- ***Cut to Length at the Job Site***

Applications

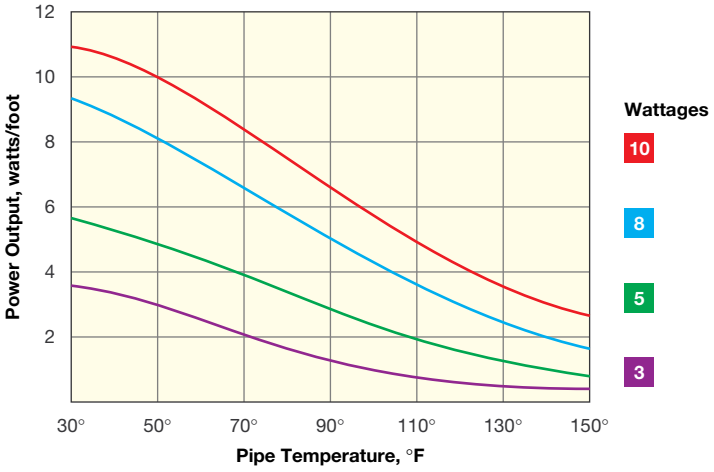
- *Pipelines*
- *Drains*
- *Water Lines*
- *Safety Showers*
- *Sprinkler Systems*

Specifications

Voltages Available: 120, 240
Wattages: 3, 5, 8, 10 (W/ft.)
Outside Dimensions: Nom. .450"×.130"
Exposure Rating: 150°F (65°C)
De-Energized: 185°F (85°C)
Standard Metal Overbraid: Tinned Copper or optional Stainless Steel
Moisture Resistance: Excellent
Chemical Resistance: Good
Flame Resistance: Good
Radiation Resistance: Fair

Agency Approvals

- **CSA**
- **IEEE Std 515 RU**
- **Factory Mutual**
  Ordinary Locations
  Hazardous Locations;
  Class I, Division 2, Groups B, C & D
  Class II, Division 2, Groups F & D
  Class III, Division 1 and Division 2



SL Style Heating Cable

The SL Style cable heating element is a low watt density parallel circuit electrical heater. The multi-stranded bus wires are extruded in an irradiated self-regulating conductive polyolefin that increases and decreases its heat output with changes in the ambient temperature. A flame retardant thermoplastic elastomer jacket is added for abrasion and impact resistance.

A metal braided shield is then applied to meet NEC code for grounding. Metal overbraid heaters are FM approved for use in hazardous areas.

An optional fluoropolymer outer jacket is also available. This outer jacket should be specified when the metal braided cable is installed in corrosive environments.

Self-Limiting Heat Trace Cable

Ordering Information

Tempco's Self-Limiting Heat Trace Cable is sold by part number and length. The cable part number is put together as follows:

H T P

Cable Style
SL Style = 03

Wattage—watts/ft.
3 W/ft. = 3
5 W/ft. = 5
8 W/ft. = 8
10 W/ft. = 1

Voltage
120 VAC = 1
240 VAC = 2

Outer Layer
0 = Standard tinned copper braid
1 = Tinned copper braid and thermoplastic jacket
2 = Tinned copper braid and fluoropolymer jacket
3 = Stainless Steel overbraid

Lead Termination and Cable Kits for Self-Limiting Cable

In order to maintain the integrity of the insulation, termination kits must be used to add leads or splice the heating cables. **Both ends must be terminated to use the heat trace cable properly.** The termination kits are designed to fully seal using a general purpose silicone RTV sealant, such as GE RTV108, on the final connections.

Termination Kit Type	"SL" Cable
Universal Connection/ Termination Kit	HTP90021
Splice or Lead End Kit	HTP90022
End Seal Kit	HTP90023

The **Universal Kit** is mainly used to terminate the heat trace cable for pipe trace heating when the heating cable needs to terminate in an NPT pipe standoff for attaching a wiring junction box. The SL kit includes the 1" NPT pipe standoff and materials to make one power input connection, and two end terminations or one power input splice. The junction box is ordered separately; see page 6-14. These assemblies are watertight and suitable for use in Division II hazardous locations.

The **Splice or Lead End Kit** is used for tee splices or cold lead end terminations. Enough material is supplied for 10 tee splices or 10 cold lead end terminations.

The **End Seal Kit** is used to cap off and seal the end of the cable where the bus wires are exposed. Enough material is supplied for 10 end seal terminations.

Temperature Controls and Accessories for Heat Trace Cables

Choosing the proper control depends first on the system requirements and second on the desired features and cost. Since Tempco's heat trace products are used primarily for freeze protection and to offset system heat loss, PID controls are generally not required.

The most economical is the pipe-mounted direct acting preset thermostat. Tempco offers a normally open/normally closed three wire model.

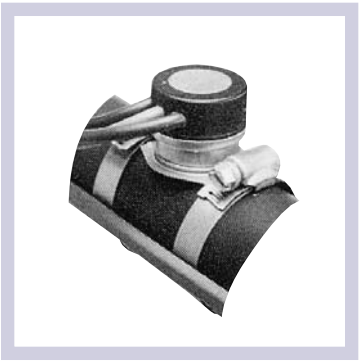
Where greater accuracy, faster response and larger ranges with adjustment capability are required, a bulb and capillary style thermostat fills the need. Tempco offers two types with NEMA 3R for general purpose and NEMA 4X where a fully sealed housing is required.

If the heat trace is used for process control and very accurate control is needed along with additional features, a thermocouple-based electronic PID controller is required.

See Section 13 – "Temperature Controllers" for more information.

Heating Cable Accessories		
Part Number	Accessory	Usage
HTP90028	Junction Box	For use with NPT pipe standoff Single hub - 1" NPT
HTP90029	Reducer	Adapts .75" NPT male to 1" NPT female
HTP90030	Aluminum Adhesive Tape 2" x 180 ft. 350°F/176°C	Helps to isolate the cable from insulation and aids in securing the cable to pipes and tanks.
HTP90031	Aluminum Adhesive Tape 2" x 180 ft. 600°F/315°C	Same as above

Action		
Closes	Opens	Part No.
35°F (2°C)	50°F (10°C)	HTP90104
45°F (7°C)	60°F (16°C)	HTP90105
60°F (16°C)	75°F (24°C)	HTP90106
90°F (32°C)	105°F (41°C)	HTP90107
185°F (85°C)	200°F (93°C)	HTP90108



This control is a preset, epoxy-sealed thermostat containing a hermetically sealed single pole, double throw switch with normally open and normally closed connections

Specifications

Voltage: Up to 277 VAC

Current: FM approved to 240 VAC at 25 amps

Leads: 36" long, 600 VAC 14 ga., 105°C PVC insulation

This control is an adjustable Stainless Steel bulb and capillary thermostat. It is enclosed in a NEMA 4X enclosure with a clear cover.

Specifications

Voltage: 120 or 240 VAC

Contacts: 120V SPST, 240V DPST

Current: 50 amps at either voltage

Leads: Hard wired directly to terminals

Dimensions: 6"H × 6"L × 5.87"W

Range		Part No.	
°F	°C	120V	240V
0 - 150	–18 - 66	HTP90113	HTP90116
50 - 300	10 - 149	HTP90114	HTP90117
150 - 650	66 - 343	HTP90115	HTP90118

Range		
°F	°C	Part No.
0 - 150	–18 - 66	HTP90109
100 - 250	38 - 121	HTP90110
200 - 350	93 - 177	HTP90111

This control is an adjustable bulb and capillary thermostat with single pole double throw contacts with NO and NC connections. It is enclosed in a NEMA 3R general purpose enclosure.

Specifications

Voltage: Up to 277 VAC

Current: 277 VAC at 22 amps

Leads: Hard wired directly to terminals

Dimensions: 3.30"H × 4.08"L × 4.08"W