

## Design Guide for Hazloc / Industrial



### **Design guide**

Self-regulating trace heating systems  
for pipes and tanks in hazardous locations  
with BARTEC self-regulating trace heaters



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## Overview

This manual introduces the design, installation and operation of BARTEC Self regulating trace heating systems for use in hazardous locations using the following self-regulating trace heaters:

- BARTEC PSB
- BARTEC HSB



The self-regulating trace heater features a temperature-dependent resistive element between two parallel copper conductors that regulates and limits the heat output of the trace heater according to the ambient temperature. If the ambient temperature rises, the power output of the trace heater is reduced. This self-regulating property prevents overheating which would cause damage to the trace heater. Even crossing or overlapping with other trace heaters (or other portions of the same trace heater) are possible.

The heating system is set up as a fixed equipment heating system for pipes in ordinary and hazardous areas. Thanks to the parallel design the trace heater can be cut and installed to any required length (mind the maximum heating circuit length as shown on page 12).

Multiple options for connection, splicing and end termination of the heating circuit are available to meet the individual requirements on site. A large variety of accessories allows for easy customization and extensibility.

## Technical data

<b>Maximum exposure temperature</b>	<b>PSB</b>	<i>continuous</i>	150 °F / 65 °C
		<i>intermittent<sup>1</sup></i>	185 °F / 85 °C
	<b>HSB</b>	<i>continuous</i>	250 °F / 120 °C
		<i>intermittent<sup>1</sup></i>	392 °F / 200 °C
<b>Minimum operation temperature</b>	<b>PSB</b>		-40 °F / -40 °C
	<b>HSB</b>		-76 °F / -60 °C
<b>Minimum installation temperature</b>	<b>PSB</b>		-67 °F / -55 °C
	<b>HSB</b>		-76 °F / -60 °C
<b>Power supply</b>			110 to 120 V <sub>AC</sub> / 208 to 240 V <sub>AC</sub>
<b>Heat output<sup>2</sup></b>	<b>PSB</b>		3 to 10 W/ft (10 to 33 W/m)
	<b>HSB</b>		5 to 20 W/ft (15 to 60 W/m)
<b>Resistance of the grounding braid</b>			< 18.2 Ω/km
<b>Protection classification</b>			Class I, Div 2 Group A, B, C, D Class II, Div 2 Group E, F, G Class III
<b>Temperature classes<sup>3</sup></b>	<b>PSB</b>		T5, T6
	<b>HSB</b>		T2d, T3, T4
<b>Heater dimensions</b>	<b>PSB</b>	<i>fluoropolymer outer jacket</i>	0.46" x 0.22" (11.6 x 5.6 mm)
		<i>polyolefin outer jacket</i>	0.46" x 0.23" (11.6 x 5.8 mm)
		<b>HSB</b>	0.46" x 0.23" (11.6 x 5.8 mm)
<b>Minimum bending radius</b>			1" (25 mm) Do not bend on the narrow axis.

<sup>1</sup> intermittent exposure temperature when turned off, max. 48 h in a time interval of 4 weeks, max. 1000 h cumulated  
<sup>2</sup> nominal heat output at 50 °F (10 °C)  
<sup>3</sup> according to NEC Article 500, refer to page 7 for further information

## Certifications / Approvals



Class I, Div 2 Group A, B, C, D  
 Class II, Div 2 Group E, F, G  
 Class III

Self-regulating trace heater for use in hazardous locations  
 BARTEC PSB / HSB

## Safety

For safe installation and operation of BARTEC Self regulating trace heating systems the technical requirements and instructions given in this manual must be followed.

## WARNING

**Risk of fire or electrical shock. Follow these guidelines to avoid personal injury or material damage.**

- All electrical systems and installations must comply with BARTEC GmbH requirements and be installed in accordance with the relevant electrical codes and any other applicable national and local codes.
- BARTEC GmbH, the US and Canadian electrical codes require ground fault protection to be provided for all trace heating circuits.
- Install the trace heater circuit carefully.
- Use the trace heater in accordance with the intended purpose and strictly comply with the operational data specified in section *Technical Data*.
- The bending radius of the trace heater must be at least 1" (25 mm). Do not bend on the narrow axis.
- To avoid short circuits, do not connect the trace heater bus wires together.
- Keep all components and the trace heaters dry before and during installation.
- Each heating circuit must be marked with electrical warning labels (see section *Accessories* on page 16).
- Keep these instructions for future reference. If applicable, leave them with the end user.
- De-energize before installation or servicing.
- Use only original BARTEC accessories.

## Personnel requirements

The personnel executing installation and maintenance tasks must have acquired the skills and specialized knowledge relating to the types of protection and types of devices concerned. At least, the personnel must have:

- a general understanding of the relevant electrical engineering
- a practical understanding of the principles and techniques of explosion protection
- a working knowledge and understanding of the relevant standards of explosion protection
- a basic knowledge of quality assurance, including the principles of auditing documentation, traceability of measurements and calibration of measurement instruments.

## System design

For the design of trace heating systems with BARTEC self-regulating trace heaters, the following steps are necessary:

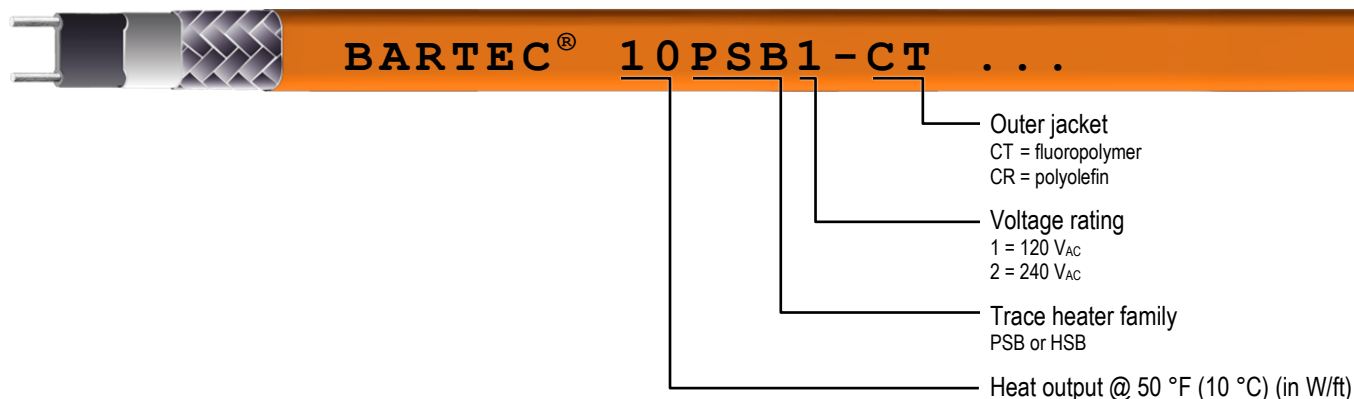
- Trace heater selection
- Determination of the total required trace heater length
- Determination of the required number of heating circuits
- Selection of the required components for power connection, end termination etc.

The following sections provide step-by-step instructions on how to proceed with each step.

## Trace heater selection

### Step 1: Familiarize yourself with the trace heater types and their properties

BARTEC self-regulating trace heaters are available in various types to suit different applications. Each trace heater is marked with a product code that contains all relevant information as shown in the following example:



#### → Example

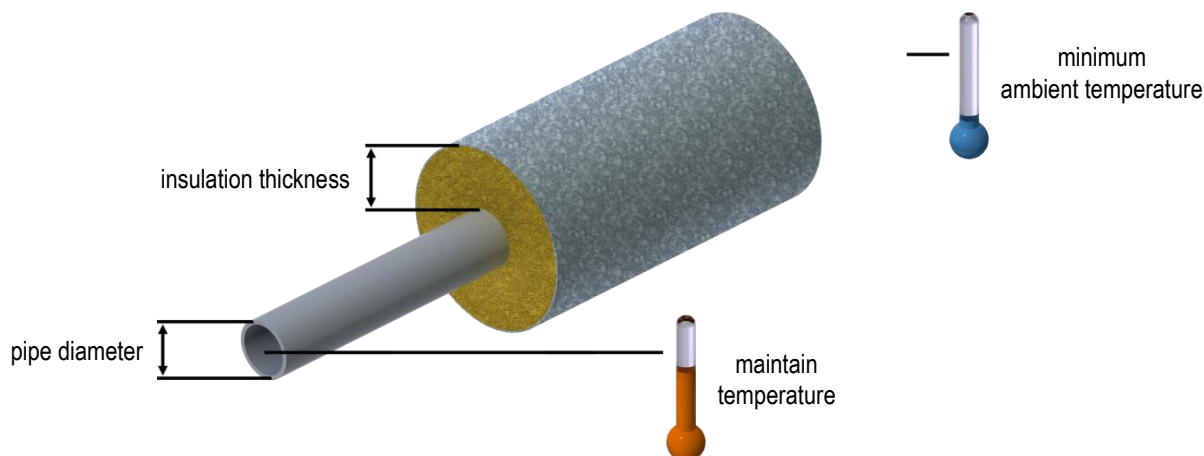
A trace heater that bears the marking **10PSB1-CT** has the following specifications:

- Heat output @ 50 °F (10 °C): **10 W/ft**
- Trace heater family: **PSB**
- Voltage rating: **120 V<sub>AC</sub>**
- Outer jacket: **fluoropolymer**

### Step 2: Determine the heat loss of your pipe setup

For proper system design it is essential to know the effective heat loss of your pipe setup. To determine it, the following data will be required:

- Pipe diameter
- Insulation thickness
- Insulation material
- Maintain temperature
- Minimum ambient temperature
- Temperature differential  $\Delta T$ :  $\Delta T = \text{maintain temperature} - \text{minimum ambient temperature}$



# Self regulating trace heating systems Design Guide for Hazloc / Industrial

Next, obtain the basic heat loss in W/ft using the following table<sup>4</sup>:

Pipe diameter in inch (DN)		Basic heat loss in W/ft																				
		1/4" (DN8)	1/2" (DN15)	3/4" (DN20)	1" (DN25)	1 1/4" (DN32)	1 1/2" (DN40)	2" (DN50)	2 1/2" (DN65)	3" (DN80)	3 1/2" -	4" (DN100)	6" (DN150)	8" (DN200)	10" (DN250)	12" (DN300)	14" (DN350)	16" (DN400)	18" (DN450)	20" (DN500)	24" (DN600)	
ΔT in °F (°C)																						
Insulation thickness in inch (mm)	1/2" (12.7)	50 (28)	1.9	2.5	3.0	3.5	4.2	4.7	5.6	6.8	7.8	8.8	9.8	14.0	17.9	22.1	26.0	28.5	32.4	36.4	40.3	48.2
		100 (56)	3.9	5.2	6.2	7.3	8.7	9.7	11.6	14.1	16.3	18.3	20.4	29.1	37.3	46.0	54.2	59.3	67.5	75.7	83.9	100.4
		150 (83)	6.0	8.1	9.6	11.4	13.6	15.1	18.2	22.0	25.4	28.7	31.9	45.5	58.3	71.9	84.7	92.7	105.5	118.3	131.0	156.7
		200 (111)	8.4	11.3	13.3	15.8	18.9	21.0	25.2	30.5	35.3	39.8	44.2	63.1	80.9	99.8	117.6	128.6	146.4	164.2	181.9	217.6
	1" (25.4)	50 (28)	1.3	1.6	1.9	2.1	2.5	2.7	3.2	3.8	4.4	4.8	5.3	7.5	9.4	11.5	13.5	14.7	16.7	18.7	20.6	24.6
		100 (56)	2.6	3.4	3.9	4.5	5.2	5.7	6.7	7.9	9.1	10.1	11.1	15.5	19.6	24.0	28.1	30.7	34.8	38.9	43.0	51.2
		150 (83)	4.1	5.2	6.0	7.0	8.1	8.9	10.5	12.4	14.1	15.8	17.4	24.2	30.7	37.5	43.9	47.9	54.3	60.7	67.1	79.9
		200 (111)	5.7	7.3	8.4	9.7	11.3	12.3	14.5	17.2	19.6	21.9	24.1	33.6	42.6	52.0	60.9	66.5	75.4	84.2	93.1	111.0
		250 (139)	7.4	9.5	10.9	12.6	14.7	16.1	18.9	22.4	25.6	28.5	31.4	43.8	55.4	67.7	79.3	86.5	98.1	109.6	121.2	144.4
	1 1/2" (38.1)	50 (28)	1.0	1.3	1.5	1.7	1.9	2.1	2.4	2.8	3.2	3.5	3.8	5.3	6.6	8.0	9.3	10.1	11.4	12.8	14.1	16.7
		100 (56)	2.2	2.7	3.0	3.5	4.0	4.3	5.0	5.9	6.6	7.3	8.0	11.0	13.7	16.6	19.4	21.1	23.8	26.6	29.3	34.8
		150 (83)	3.4	4.2	4.8	5.4	6.2	6.8	7.8	9.1	10.3	11.4	12.5	17.1	21.4	26.0	30.3	32.9	37.2	41.5	45.7	54.3
		200 (111)	4.7	5.8	6.6	7.5	8.6	9.4	10.9	12.7	14.3	15.9	17.4	23.8	29.7	36.1	42.0	45.7	51.6	57.6	63.5	75.4
		250 (139)	6.1	7.6	8.6	9.8	11.2	12.2	14.1	16.5	18.7	20.6	22.6	30.9	38.7	46.9	54.7	59.5	67.2	74.9	82.6	98.1
		300 (167)	7.6	9.5	10.7	12.2	14.0	15.2	17.7	20.6	23.3	25.8	28.2	38.6	48.3	58.6	68.3	74.3	84.0	93.6	103.2	122.6
	350 (194)	9.3	11.5	13.0	14.8	17.0	18.5	21.5	25.1	28.3	31.3	34.3	46.9	58.7	71.2	83.0	90.3	102.0	113.7	125.4	148.9	
	2" (50.8)	50 (28)	0.9	1.1	1.3	1.4	1.6	1.7	2.0	2.3	2.6	2.8	3.1	4.2	5.2	6.2	7.2	7.8	8.8	9.8	10.8	12.8
		100 (56)	1.9	2.3	2.6	2.9	3.3	3.6	4.1	4.8	5.4	5.9	6.4	8.7	10.7	12.9	15.0	16.3	18.3	20.4	22.5	26.6
		150 (83)	3.0	3.6	4.1	4.6	5.2	5.6	6.5	7.5	8.4	9.2	10.1	13.5	16.8	20.2	23.4	25.4	28.7	31.9	35.1	41.5
		200 (111)	4.1	5.1	5.7	6.4	7.3	7.8	9.0	10.4	11.6	12.8	14.0	18.8	23.3	28.1	32.5	35.3	39.8	44.2	48.7	57.6
		250 (139)	5.4	6.6	7.4	8.3	9.4	10.2	11.7	13.5	15.2	16.7	18.2	24.5	30.3	36.5	42.3	46.0	51.8	57.6	63.4	75.0
		300 (167)	6.7	8.2	9.2	10.4	11.8	12.7	14.6	16.9	18.9	20.8	22.7	30.6	37.9	45.6	52.9	57.4	64.7	71.9	79.1	93.7
	350 (194)	8.2	10.0	11.2	12.6	14.3	15.5	17.7	20.5	23.0	25.3	27.6	37.1	46.0	55.4	64.2	69.7	78.5	87.3	96.1	113.8	
	2.5" (63.5)	50 (28)	0.8	1.0	1.1	1.3	1.4	1.5	1.7	2.0	2.2	2.4	2.6	3.5	4.3	5.1	5.9	6.4	7.2	8.0	8.8	10.4
		100 (56)	1.7	2.1	2.3	2.6	3.0	3.2	3.6	4.1	4.6	5.0	5.5	7.3	9.0	10.7	12.4	13.4	15.1	16.7	18.3	21.6
		150 (83)	2.7	3.3	3.7	4.1	4.6	5.0	5.6	6.5	7.2	7.9	8.6	11.4	14.0	16.7	19.3	20.9	23.5	26.1	28.7	33.8
		200 (111)	3.8	4.6	5.1	5.7	6.4	6.9	7.8	9.0	10.0	10.9	11.9	15.8	19.4	23.2	26.8	29.1	32.6	36.2	39.8	46.9
		250 (139)	4.9	6.0	6.6	7.4	8.3	9.0	10.2	11.7	13.0	14.2	15.5	20.5	25.3	30.2	34.9	37.8	42.5	47.1	51.8	61.1
300 (167)		6.2	7.4	8.3	9.2	10.4	11.2	12.7	14.6	16.3	17.8	19.3	25.7	31.6	37.8	43.6	47.3	53.1	58.9	64.7	76.3	
350 (194)	7.5	9.0	10.0	11.2	12.7	13.6	15.5	17.7	19.8	21.6	23.5	31.2	38.3	45.9	53.0	57.4	64.5	71.5	78.5	92.7		
3" (76.2)	50 (28)	0.8	0.9	1.0	1.2	1.3	1.4	1.6	1.8	2.0	2.1	2.3	3.0	3.7	4.4	5.1	5.5	6.2	6.8	7.5	8.8	
	100 (56)	1.6	2.0	2.2	2.4	2.7	2.9	3.2	3.7	4.1	4.5	4.8	6.3	7.8	9.2	10.6	11.5	12.9	14.2	15.6	18.4	
	150 (83)	2.5	3.0	3.4	3.7	4.2	4.5	5.1	5.8	6.4	7.0	7.5	9.9	12.1	14.4	16.6	17.9	20.1	22.2	24.4	28.7	
	200 (111)	3.5	4.2	4.7	5.2	5.8	6.2	7.0	8.0	8.9	9.7	10.5	13.8	16.8	20.0	23.0	24.9	27.9	30.9	33.8	39.8	
	250 (139)	4.6	5.5	6.1	6.8	7.6	8.1	9.2	10.4	11.6	12.6	13.6	17.9	21.9	26.0	30.0	32.4	36.3	40.1	44.0	51.8	
	300 (167)	5.8	6.9	7.6	8.4	9.5	10.1	11.4	13.0	14.5	15.7	17.0	22.4	27.3	32.5	37.4	40.5	45.3	50.2	55.0	64.7	
350 (194)	7.0	8.4	9.2	10.3	11.5	12.3	13.9	15.8	17.6	19.1	20.7	27.2	33.2	39.5	45.5	49.1	55.0	60.9	66.8	78.6		
4" (101.6)	50 (28)	0.7	0.8	0.9	1.0	1.1	1.2	1.3	1.5	1.7	1.8	1.9	2.5	3.0	3.5	4.0	4.4	4.8	5.3	5.8	6.8	
	100 (56)	1.5	1.7	1.9	2.1	2.3	2.5	2.8	3.1	3.4	3.7	4.0	5.2	6.2	7.4	8.4	9.1	10.1	11.1	12.2	14.2	
	150 (83)	2.3	2.7	3.0	3.3	3.6	3.9	4.3	4.9	5.4	5.8	6.3	8.1	9.7	11.5	13.1	14.1	15.8	17.4	19.0	22.2	
	200 (111)	3.2	3.8	4.1	4.6	5.1	5.4	6.0	6.8	7.5	8.1	8.7	11.2	13.5	16.0	18.2	19.6	21.9	24.1	26.4	30.9	
	250 (139)	4.2	4.9	5.4	5.9	6.6	7.0	7.8	8.8	9.7	10.5	11.3	14.6	17.6	20.8	23.7	25.6	28.5	31.4	34.3	40.2	
	300 (167)	5.2	6.1	6.7	7.4	8.2	8.7	9.8	11.0	12.1	13.1	14.1	18.2	22.0	25.9	29.6	31.9	35.6	39.2	42.9	50.2	
350 (194)	6.3	7.4	8.2	9.0	10.0	10.6	11.9	13.4	14.7	16.0	17.2	22.1	26.7	31.5	36.0	38.8	43.2	47.7	52.1	61.0		

<sup>4</sup> Heat loss calculations are based on IEC/IEEE 60079-30-1:2015 Annex C and IEC/IEEE 60079-30-2:2015 Annex E. The following assumptions have been made:

- Medium not in motion
- Single layer insulation
- No gap between pipe and insulation layer
- No gap between insulation layer and weather shielding
- Outdoor installation, wind speed: 20 m/s
- Application of a safety factor of +10 %

Finally, you must apply the following correction factors depending on your insulation material:

Insulation material		Correction Factor	thermal conductivity at 68 °F (20 °C) in BTU/hr - °F - ft <sup>2</sup> /in(W/m×K)
		Fiberglass (ASTM C547 Type II)	1.00*
Mineral wool (ASTM C1393)	1.05*	0.27 (0.039)	
Calcium silicate (ASTM C533 Type I)	1.48*	0.36 (0.052)	
Cellular glass (ASTM C552 Grade 2)	1.56*	0.38 (0.055)	
Rigid cellular urethane (ASTM C591 Type I)	0.82*	0.22 (0.032)	
Foamed elastomer (ASTM C534)	1.22*	0.31 (0.045)	
Expanded perlite (ASTM C610)	1.90*	0.48 (0.069)	

\*applies for -13 to 158°F (-25 to 70°C), for further information contact your local BARTEC distributor

→ **Example**

- Pipe diameter: 1 1/4"
  - Insulation thickness: 1"
  - Insulation material: **calcium silicate**
  - Minimum ambient temperature: -20 °F
  - Maintain temperature: 80 °F
- }  $\Delta T = 80\text{ °F} - (-20\text{ °F}) = 100\text{ °F}$

We obtain the basic heat loss in W/ft from the table on page 4:

		Basic heat loss in W/ft										
		Pipe diameter in inch (DN)		1/4" (DN8)	1/2" (DN15)	3/4" (DN20)	1" (DN25)	1 1/4" (DN32)	1 1/2" (DN40)	2" (DN50)	2 1/2" (DN65)	3" (DN75)
Insulation thickness in inch (mm)		$\Delta T$ in °F (°C)										
1/2" (12.7)	50 (28)	50	1.9	2.5	3.0	3.5	4.2	4.7	5.6	6.8	7.8	
	100 (56)	100	3.9	5.2	6.2	7.3	8.7	9.7	11.6	14.1	16.1	
	150 (83)	150	6.0	8.1	9.6	11.4	13.6	15.1	18.2	22.0	25.2	
	200 (111)	200	8.4	11.3	13.3	15.8	18.9	21.0	25.2	30.5	35.8	
	250 (139)	250	11.0	14.7	17.2	20.3	23.9	27.0	32.4	38.7	45.0	
	300 (152)	300	13.6	18.2	21.3	25.4	29.5	33.6	40.8	48.9	57.0	
1 (25.4)	50 (28)	50	1.3	1.6	1.9	2.1	2.5	2.7	3.2	3.8	4.4	
	100 (56)	100	2.6	3.4	3.9	4.3	5.2	5.7	6.7	7.7	8.8	
	150 (83)	150	4.1	5.2	6.0	7.0	8.1	8.9	10.5	12.2	14.0	
	200 (111)	200	5.7	7.3	8.4	9.7	11.3	12.3	14.5	17.0	19.6	
	250 (139)	250	7.4	9.5	10.9	12.6	14.7	16.1	18.9	22.2	25.6	
	300 (152)	300	9.2	11.7	13.4	15.4	17.9	19.3	23.1	27.4	31.8	

basic heat loss: 5.2 W/ft

Now, the correction factors from the table on page 5 must be applied:

Insulation material		Correction Factor
		Fiberglass (ASTM C547 Type II)
Mineral wool (ASTM C335-89)	0.95*	
Calcium silicate (ASTM C533 Type I)	1.48*	
Cellular glass (ASTM C552 Grade 2)	1.56*	
Rigid cellular urethane (ASTM C591 Type I)	0.82*	
Foamed elastomer (ASTM C534)	1.22*	

correction factor insulation: 1.48

The effective heat loss of the setup is determined as follows:

**effective heat loss** = basic heat loss × correction factor insulation  
 = 5.2 W/ft × 1.48  
 = 7.7 W/ft

## Step 3: Choose a trace heater family

At first, recap the requirements for your trace heating application:

- Maximum exposure temperature (continuous / intermittent)
- Minimum operation / start-up temperature (continuous / intermittent)
- Required heat output to compensate the effective heat loss as calculated in Step 2
- Required temperature class ("T-Rating")

Then pick the trace heater family that meets your requirements using the following table:

Maximum exposure temperature	<b>PSB</b>	<i>continuous</i>	150 °F / 65 °C			
		<i>intermittent<sup>5</sup></i>	185 °F / 85 °C			
	<b>HSB</b>	<i>continuous</i>	250 °F / 120 °C			
		<i>intermittent<sup>5</sup></i>	392 °F / 200 °C			
Minimum operation temperature	<b>PSB</b>		-40 °F / -40 °C			
	<b>HSB</b>		-76 °F / -60 °C			
Heat output	<b>PSB</b>		3 to 10 W/ft (10 to 33 W/m)			
	<b>HSB</b>		5 to 20 W/ft (15 to 60 W/m)			
Temperature classes <sup>6</sup>	<b>PSB</b>		<b>Rated voltage</b>	<b>Power output</b>	<b>Temperature class</b>	
		<b>208 to 240 V<sub>AC</sub></b>			3, 5 W/ft	T6
					8, 10 W/ft	T5
		<b>110 to 120 V<sub>AC</sub></b>			3, 5, 8, 10 W/ft	T5
		<b>HSB</b>	<b>208 to 240 V<sub>AC</sub></b>			5, 10, 15 W/ft
					20 W/ft	T2d
	<b>110 to 120 V<sub>AC</sub></b>				5, 10 W/ft	T3
					15, 20 W/ft	T2d

## NOTICE

If you want to use plastic piping within your installation, contact your local BARTEC distributor for verification that the design does not exceed the maximum withstand temperature of the pipe material. Also, adjustments in heat loss calculations may be required.

### → Example

- Maximum exposure temperature: **80 °F (continuous), 100 °F (intermittent)**
- Minimum operation temperature: **-20 °F**
- Required heat output: **7.7 W/ft**
- Required temperature class: **T5**

Trace heater family that meets the requirements: **PSB**

<sup>5</sup> intermittent exposure temperature when turned off, max. 48 h in a time interval of 4 weeks, max. 1000 h cumulated

<sup>6</sup> temperature classes according to NEC Article 500 (max. surface temperature):

- T6 : 185 °F (85 °C)
- T5 : 212 °F (100 °C)
- T4 : 275 °F (135 °C)
- T3 : 392 °F (200 °C)
- T2d : 419 °F (215 °C)



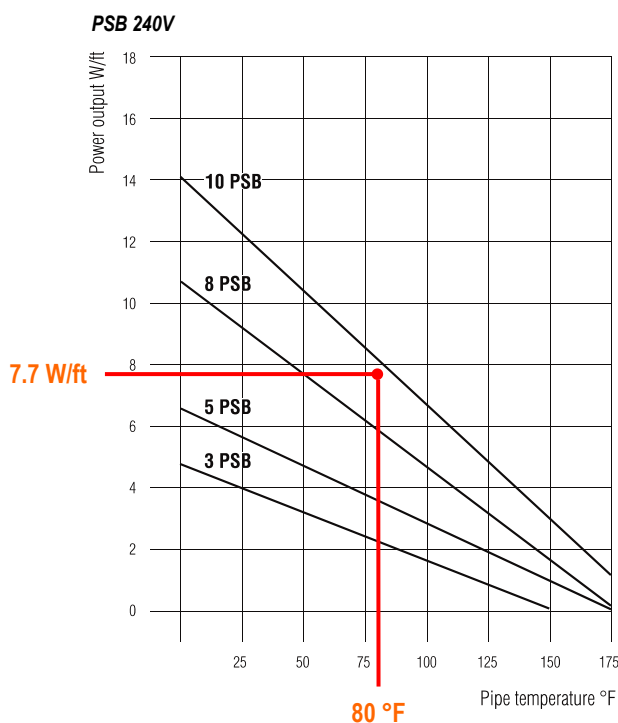
## Step 4: Determine the required power rating

Since the power output of self-regulating trace heaters depends on the pipe temperature, the conditions within your application must be considered when choosing a power rating:

- Recap the maintain temperature (= pipe temperature) of your setup and the effective heat loss as calculated in Step 2.
- Read the required power output in the diagram that contains the trace heater type and voltage you use (see diagrams on pages 8 to 9).
- If the required power output is between 2 trace heater types, choose the one with the higher rating.
- If the required power output exceeds the output of the trace heater with the highest rating, you may:
  - Use 2 or more trace heaters on the same pipe.
  - Use a thicker insulation or insulation material with a lower thermal conductivity.
  - Contact your local BARTEC distributor for further assistance.

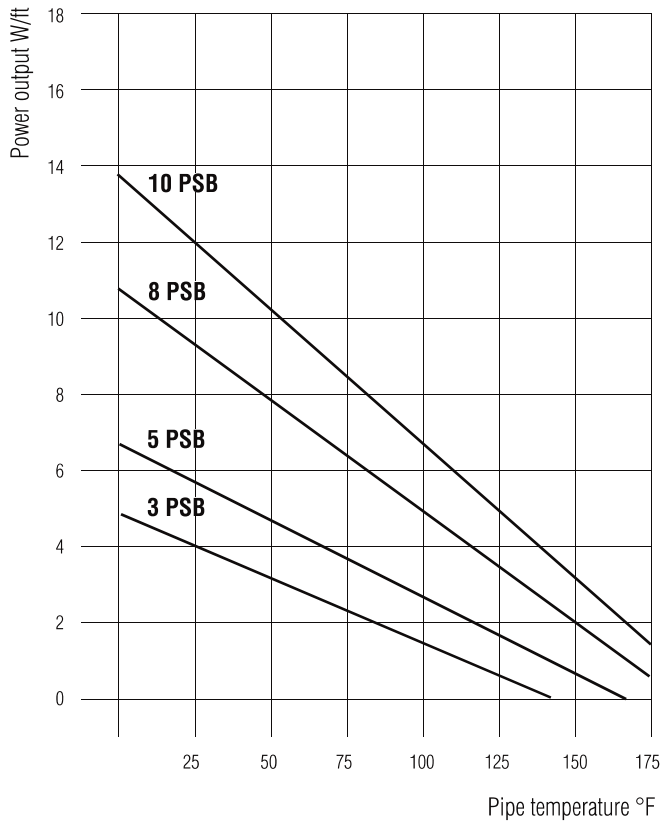
### → Example

- Maintain temperature: **80 °F**
- Effective heat loss: **7.7 W/ft**
- Trace heater family as determined in Step 3: **PSB**
- Power supply voltage: **240 V**

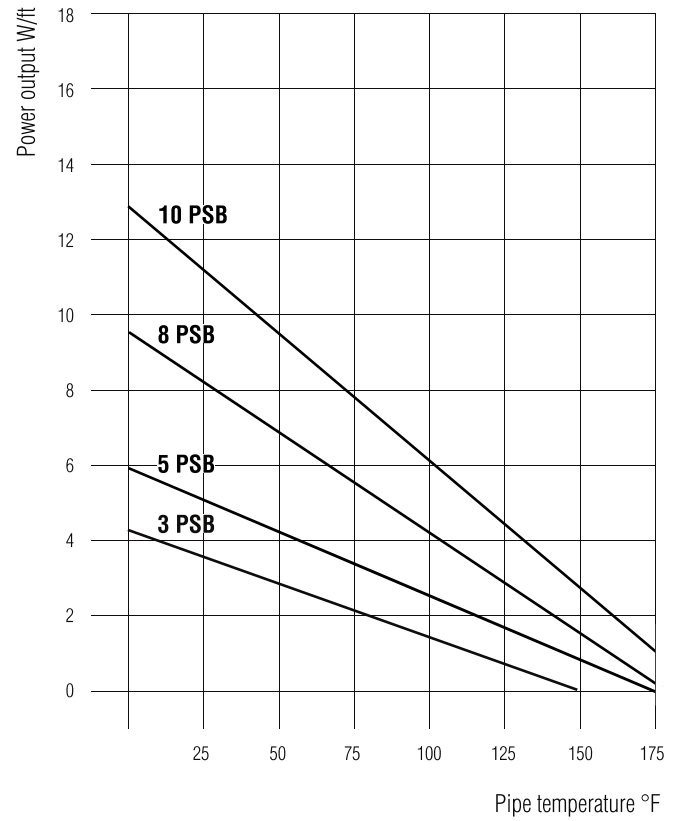


Trace heater that meets the required power output: **10 PSB**

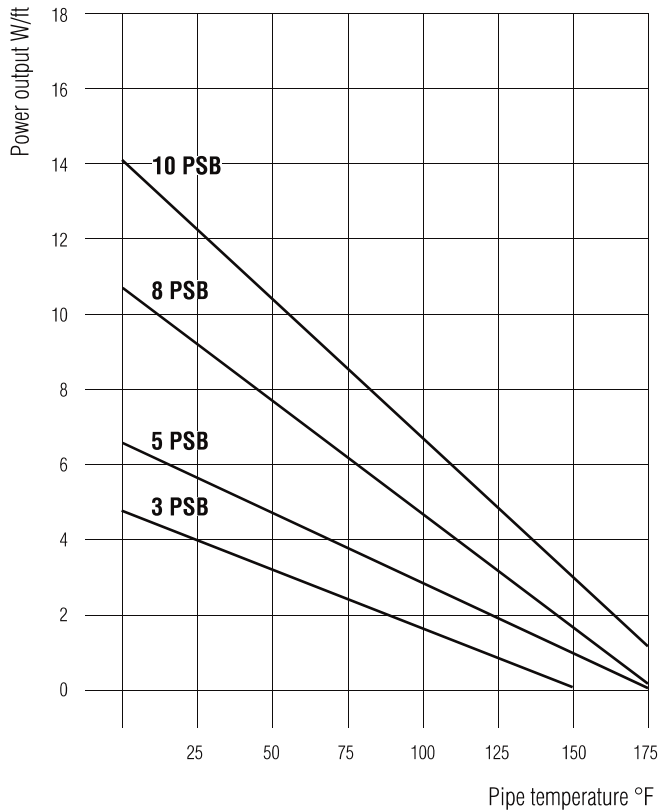
**PSB 120V**



**PSB 208V**

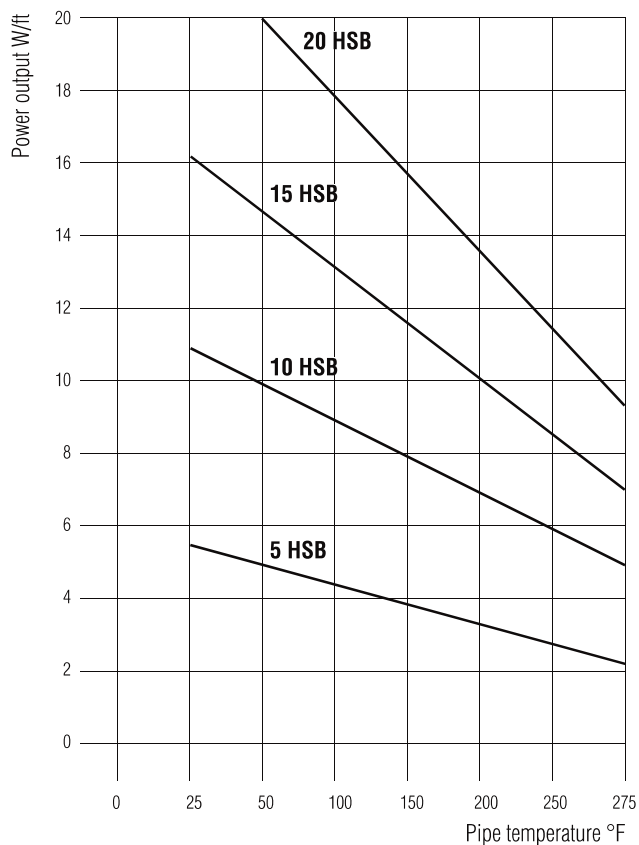


**PSB 240V**

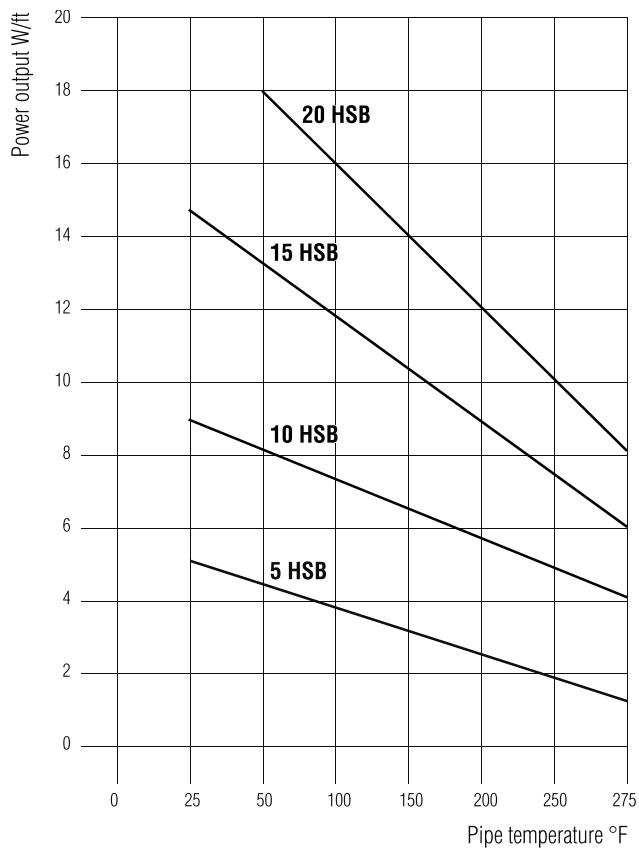


For HSB trace heaters see page 9.

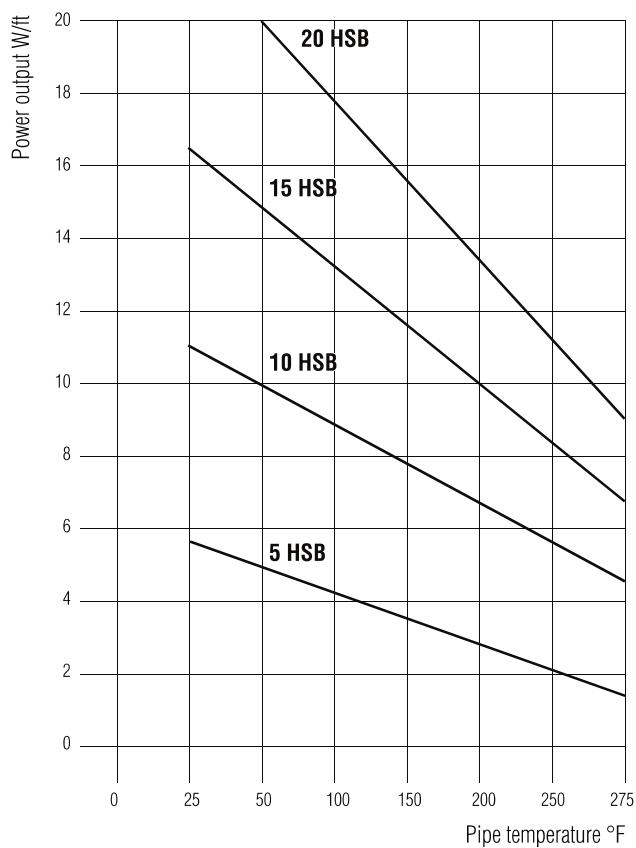
## HSB 120V



## HSB 208V



## HSB 240V



For PSB trace heaters see page 8.

## Step 5: Select the appropriate outer jacket material

BARTEC self-regulating trace heaters are available with 2 different types of outer jackets. Choose the outer jacket that suits the chemical environment it will be exposed to. For questions regarding the chemical resistance please contact your local BARTEC distributor.

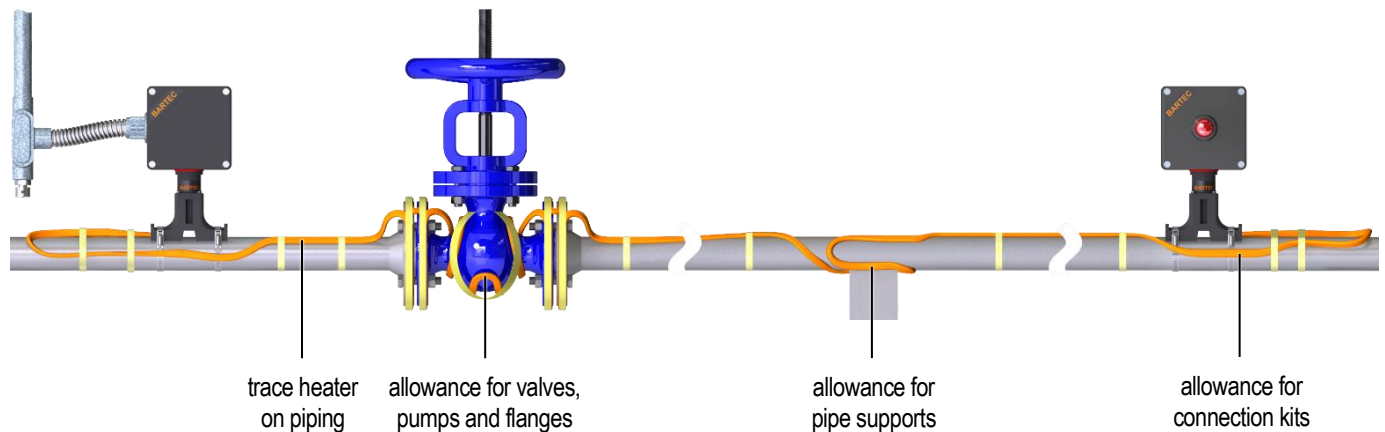
	Application	Catalog No.
Fluoropolymer outer jacket	exposure to organic chemicals	...-CT
Polyolefin outer jacket	exposure to aqueous, inorganic chemicals	...-CR

### → Example

- Trace heating systems for process applications in the oil industry: **fluoropolymer outer jacket**
- Trace heating system for frost protection of water supply lines: **polyolefin outer jacket**

## Determination of the required trace heater length

The total required trace heater length is determined by taking into account the trace heater length for piping as well as allowances for valves, pumps, flanges, pipe supports and connection kits.



### Step 1: Determine the required trace heater length for the piping:

The required trace heater length for piping corresponds to the pipe length.

### → Example

100 ft. of piping = **100 ft. of trace heater**

### Step 2: Determine the required allowance for connection kits:

The required allowance for connection kits is 1.6 ft (0.5 m) for each kit.

### → Example

- Heating circuit with 1 power connection kit, 1 splice kit and 1 end of line lamp

The total required allowance is calculated as follows:

$$\begin{aligned}
 \text{total required allowance} &= \text{no. of connection kits} \times 1.6 \text{ ft} \\
 &= 3 \times 1.6 \text{ ft} \\
 &= \underline{4.8 \text{ ft}}
 \end{aligned}$$

### Step 3: Determine the required allowance for pumps, valves, flanges and pipe supports:

Determine the required allowances for pumps, valves, flanges and pipe supports using the following table:

Pipe diameter in inch (DN)	1/4" (DN8)	1/2" (DN15)	3/4" (DN20)	1" (DN25)	1 1/4" (DN32)	1 1/2" (DN40)	2" (DN50)	2 1/2" (DN65)	3" (DN80)	4" (DN100)	6" (DN150)	8" (DN200)	10" (DN250)	12" (DN300)	14" (DN350)	16" (DN400)	18" (DN450)	20" (DN500)	24" (DN600)
Allowance for pumps in ft (m)	4.9 (1.5)	6.6 (2.0)	6.6 (2.0)	6.9 (2.1)	7.5 (2.3)	7.5 (2.3)	7.9 (2.4)	7.9 (2.4)	7.9 (2.4)	8.5 (2.6)	9.8 (3.0)	11.5 (3.5)	13.1 (4.0)	13.1 (4.0)	13.1 (4.0)	13.8 (4.2)	14.8 (4.5)	16.4 (5.0)	23 (7.0)
Allowance for valves in ft (m)	1.6 (0.5)	1.6 (0.5)	1.6 (0.5)	2.0 (0.6)	2.0 (0.6)	2.3 (0.7)	2.3 (0.7)	3.3 (1.0)	3.3 (1.0)	4.3 (1.3)	4.9 (1.5)	5.2 (1.6)	5.9 (1.8)	6.6 (2.0)	6.6 (2.0)	7.2 (2.2)	8.2 (2.5)	8.9 (2.7)	9.5 (2.9)
Allowance for flanges in ft (m)	0.7 (0.2)	0.7 (0.2)	1.0 (0.3)	1.0 (0.3)	1.0 (0.3)	1.0 (0.3)	1.3 (0.4)	1.3 (0.4)	1.6 (0.5)	2.3 (0.7)	3.0 (0.9)	3.3 (1.0)	3.9 (1.2)	3.9 (1.2)	3.9 (1.2)	4.3 (1.3)	4.3 (1.3)	4.6 (1.4)	5.9 (1.8)
Allowance for pipe supports in ft (m)	0.7 (0.2)	0.7 (0.2)	1.0 (0.3)	1.0 (0.3)	1.0 (0.3)	1.0 (0.3)	1.3 (0.4)	1.3 (0.4)	1.6 (0.5)	2.3 (0.7)	3.0 (0.9)	3.3 (1.0)	3.9 (1.2)	3.9 (1.2)	3.9 (1.2)	4.3 (1.3)	4.3 (1.3)	4.6 (1.4)	5.9 (1.8)

#### → Example

- Pipe diameter: 2"
- 1 pump
- 2 valves
- 6 flanges
- 4 pipe supports

The total required allowance is calculated as follows:

$$\begin{aligned}
 \text{total required allowance} &= \text{no. of pumps} \times \text{pump allowance value} + \\
 &\quad \text{no. of valves} \times \text{valve allowance value} + \\
 &\quad \text{no. of flanges} \times \text{flange allowance value} \\
 &\quad \text{no. of pipe supports} \times \text{pipe support allowance value} \\
 &= 1 \times 7.9 \text{ ft} + 2 \times 2.3 \text{ ft} + 6 \times 1.3 \text{ ft} + 4 \times 1.3 \text{ ft} \\
 &= \underline{25.5 \text{ ft}}
 \end{aligned}$$

### Step 4: Add all lengths / allowances together:

Add the lengths for piping (as determined in Step 1) and allowances (as determined in Step 2 and Step 3) together to obtain total required trace heater length.

#### → Example

- required trace heater length for piping (Step 1): **100 ft**
- required allowances for connection kits (Step 2): **4.8 ft**
- required allowances for pumps, valves, flanges and pipe supports (Step 3): **25.5 ft**

$$\begin{aligned}
 \text{total required trace heater length} &= \text{required trace heater length for piping} + \text{required allowances} \\
 &= 100 \text{ ft} + 4.8 \text{ ft} + 25.5 \text{ ft} \\
 &= \underline{130.3 \text{ ft}}
 \end{aligned}$$

**Maximum heating circuit length**

The following table shows the maximum circuit lengths in ft (m) for the different PSB and HSB trace heater types with standard circuit breaker amperages. Breaker sizing should be based on the National Electrical Code, Canadian Electrical Code or any other local or applicable code. Use only circuit breakers with type C tripping characteristics.

**⚠ WARNING**  
 Risk of fire, electrical shock or dysfunction. Observe the maximum amperage of all components of the trace heating circuit. If the required trace heater length exceeds the maximum heating circuit length you must install multiple heating circuits.

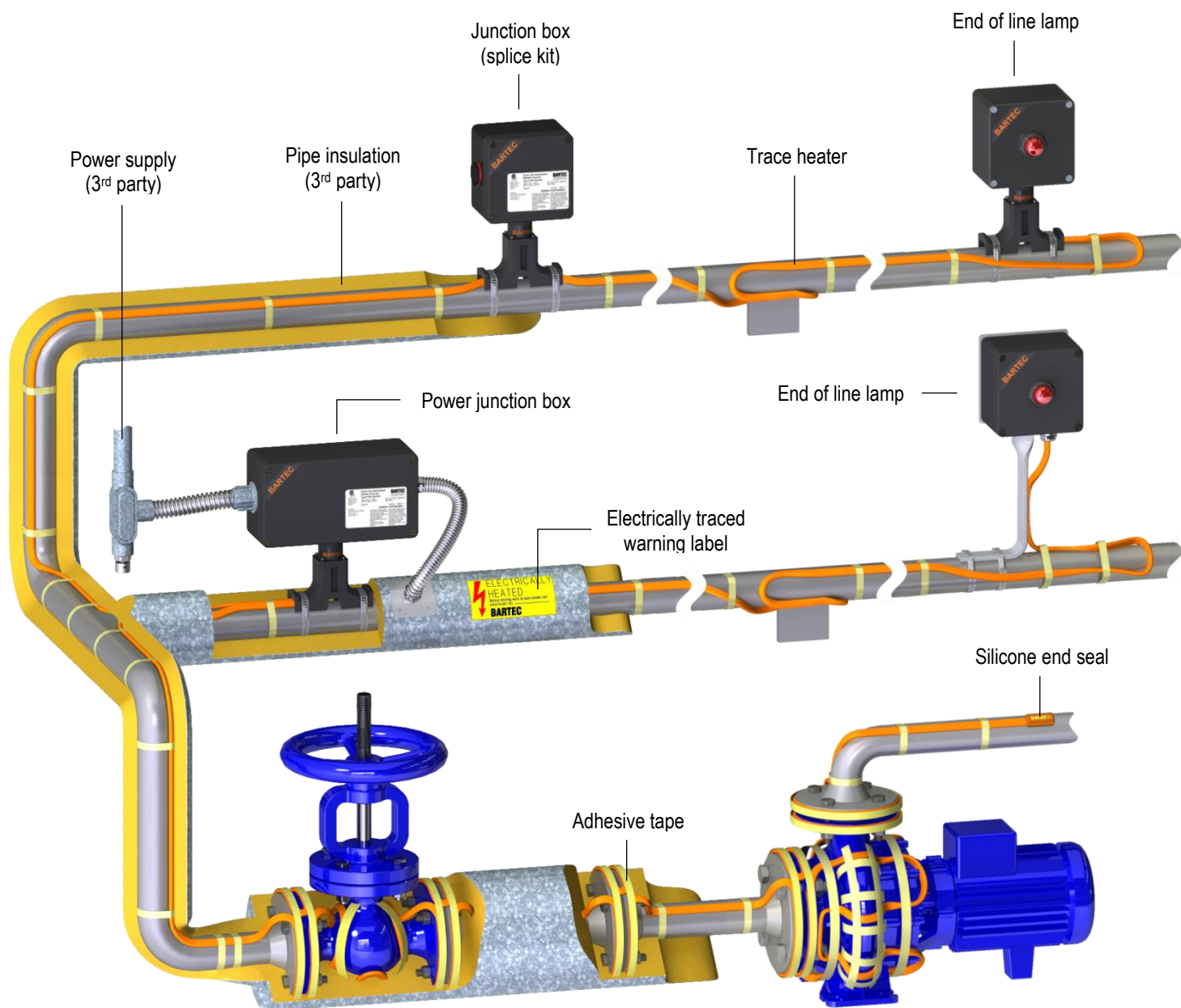
Trace heater type	Start-up temperature °F (°C)	Maximum heating circuit length in ft. (m)									
		Operating Voltage: 120 V <sub>AC</sub>			Operating Voltage: 208 V <sub>AC</sub>			Operating Voltage: 240 V <sub>AC</sub>			
		20 A	30 A	40 A	20 A	30 A	40 A	20 A	30 A	40 A	
PSB	3 PSB 07-5801-.10.	+50 (+10)	312 (95)	312 (95)	312 (95)	591 (180)	591 (180)	591 (180)	673 (205)	673 (205)	673 (205)
		0 (-18)	295 (90)	312 (95)	312 (95)	551 (168)	591 (180)	591 (180)	597 (182)	640 (195)	640 (195)
		-20 (-29)	246 (75)	312 (95)	312 (95)	476 (145)	591 (180)	591 (180)	505 (154)	623 (190)	640 (195)
		-40 (-40)	240 (73)	312 (95)	312 (95)	420 (128)	558 (170)	591 (180)	479 (146)	623 (190)	640 (195)
	5 PSB 07-5801-.15.	+50 (+10)	262 (80)	262 (80)	262 (80)	486 (148)	492 (150)	492 (150)	525 (160)	525 (160)	525 (160)
		0 (-18)	197 (60)	262 (80)	262 (80)	394 (120)	492 (150)	492 (150)	394 (120)	525 (160)	525 (160)
		-20 (-29)	161 (49)	262 (80)	262 (80)	328 (100)	443 (135)	476 (145)	328 (100)	525 (160)	525 (160)
		-40 (-40)	157 (48)	256 (78)	262 (80)	312 (95)	394 (120)	476 (145)	315 (96)	512 (156)	525 (160)
	8 PSB 07-5801-.26.	+50 (+10)	190 (58)	207 (63)	207 (63)	344 (105)	377 (115)	377 (115)	381 (116)	413 (126)	413 (126)
		0 (-18)	125 (38)	184 (56)	207 (63)	246 (75)	312 (95)	344 (105)	246 (75)	374 (114)	413 (126)
		-20 (-29)	105 (32)	177 (54)	207 (63)	203 (62)	289 (88)	322 (98)	210 (64)	348 (106)	404 (123)
		-40 (-40)	98 (30)	164 (50)	207 (63)	190 (58)	272 (83)	302 (92)	197 (60)	328 (100)	387 (118)
	10 PSB 07-5801-.33.	+50 (+10)	148 (45)	167 (51)	180 (55)	262 (80)	312 (95)	312 (95)	295 (90)	335 (102)	361 (110)
		0 (-18)	98 (30)	138 (42)	148 (45)	190 (58)	256 (78)	295 (90)	197 (60)	276 (84)	295 (90)
		-20 (-29)	85 (26)	125 (38)	131 (40)	164 (50)	230 (70)	269 (82)	171 (52)	236 (72)	262 (80)
		-40 (-40)	72 (22)	115 (35)	118 (36)	131 (40)	180 (55)	230 (70)	131 (40)	197 (60)	230 (70)
HSB	5 HSB 07-5803-.15.	+50 (+10)	312 (95)	312 (95)	312 (95)	541 (165)	541 (165)	541 (165)	620 (189)	620 (189)	620 (189)
		0 (-18)	262 (80)	312 (95)	312 (95)	492 (150)	541 (165)	541 (165)	502 (153)	620 (189)	620 (189)
		-20 (-29)	246 (75)	312 (95)	312 (95)	443 (135)	541 (165)	541 (165)	489 (149)	620 (189)	620 (189)
		-40 (-40)	246 (75)	312 (95)	312 (95)	427 (130)	541 (165)	541 (165)	472 (144)	620 (189)	620 (189)
	10 HSB 07-5803-.30.	+50 (+10)	184 (56)	190 (58)	190 (58)	315 (96)	374 (114)	374 (114)	361 (110)	374 (114)	374 (114)
		0 (-18)	154 (47)	190 (58)	190 (58)	279 (85)	374 (114)	374 (114)	312 (95)	374 (114)	374 (114)
		-20 (-29)	148 (45)	190 (58)	190 (58)	262 (80)	374 (114)	374 (114)	302 (92)	374 (114)	374 (114)
		-40 (-40)	141 (43)	190 (58)	190 (58)	256 (78)	367 (112)	374 (114)	279 (85)	367 (112)	374 (114)
	15 HSB 07-5803-.45.	+50 (+10)	131 (40)	135 (41)	135 (41)	230 (70)	269 (82)	269 (82)	262 (80)	269 (82)	269 (82)
		0 (-18)	112 (34)	135 (41)	135 (41)	203 (62)	269 (82)	269 (82)	223 (68)	269 (82)	269 (82)
		-20 (-29)	108 (33)	135 (41)	135 (41)	190 (58)	269 (82)	269 (82)	217 (66)	269 (82)	269 (82)
		-40 (-40)	98 (30)	135 (41)	135 (41)	187 (57)	262 (80)	269 (82)	210 (64)	262 (80)	269 (82)
	20 HSB 07-5803-.60.	+50 (+10)	98 (30)	105 (32)	105 (32)	177 (54)	210 (64)	210 (64)	197 (60)	210 (64)	210 (64)
		0 (-18)	89 (27)	105 (32)	105 (32)	154 (47)	210 (64)	210 (64)	174 (53)	210 (64)	210 (64)
		-20 (-29)	82 (25)	105 (32)	105 (32)	148 (45)	210 (64)	210 (64)	164 (50)	210 (64)	210 (64)
		-40 (-40)	75 (23)	105 (32)	105 (32)	141 (43)	203 (62)	210 (64)	157 (48)	203 (62)	210 (64)

## System overview

A typical heating circuit with self-regulating trace heaters consists of:

- Power supply / cold lead cable connection
- Trace heater splices / junctions (optional)
- Control and monitoring units (optional)
- End termination


The following figure shows a sample heating circuit including typical components:





The following pages list all compatible components for BARTEC Self regulating trace heating systems in hazardous locations. The respective installation instructions are included in the scope of delivery.

**Power connection, splice and junction components**

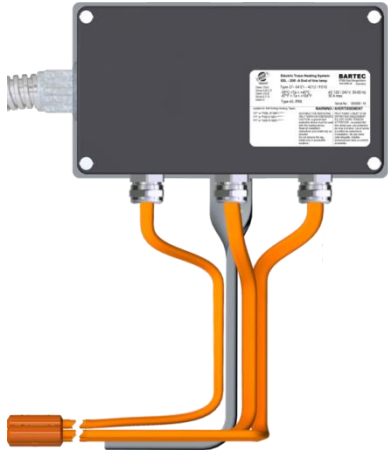
The following components can be used for power connection with BARTEC Self regulating trace heating systems in hazardous locations.

 <p>The image shows a square, grey, single-entry power junction box mounted on a black T-shaped stand. A grey cable enters from the left side. An orange silicone end seal is attached to the bottom of the stand.</p>	<p><b>PBS-200-A Single entry power junction box</b></p> <p>For connection of a trace heater inside a junction box. Includes a mounting stand for on-pipe installation and a silicone end seal.</p>	<p>Catalog No.: PBS-200-A</p> <p>Order No.: 407400</p> <p>Part No.: 27-54P1-4212/1610</p>
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 <p>The image shows a square, grey, single-entry power junction box mounted on a black T-shaped stand. A grey cable enters from the left side. An orange silicone end seal is attached to the bottom of the stand.</p>	<p><b>PBS-300-A Single entry power junction box</b></p> <p>For connection of a trace heater inside a junction box. Includes a mounting stand for off-pipe installation and a silicone end seal.</p>	<p>Catalog No.: PBS-300-A</p> <p>Order No.: 407401</p> <p>Part No.: 27-54P1-4211-1670</p>
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 <p>The image shows a square, grey, multiple-entry power junction box mounted on a black T-shaped stand. A grey cable enters from the left side. Two orange silicone end seals are attached to the bottom of the stand.</p>	<p><b>PBM-200-A Multiple entry power junction box</b></p> <p>For connection of up to 3 trace heaters inside a junction box. Includes a mounting stand for on-pipe installation and 3 silicone end seals.</p>	<p>Catalog No.: PBM-200-A</p> <p>Order No.: 407402</p> <p>Part No.: 27-54P1-4433/1610</p>
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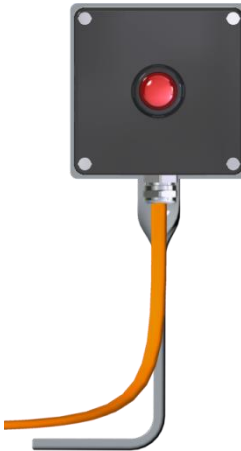



	<p><b>PBM-300-A Multiple entry power junction box</b></p> <p>For connection of up to 3 trace heaters inside a junction box. Includes a mounting stand for off-pipe installation and 3 silicone end seals.</p>	<p>Catalog No.: PBM-300-A</p> <p>Order No.: 407404</p> <p>Part No.: 27-54P1-4431/1610</p>
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**End termination**

The following components can be used for end termination with BARTEC Self regulating trace heating systems in hazardous locations.

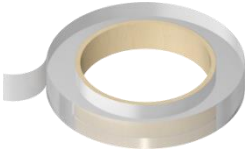
	<p><b>ELL-200-A End of line lamp</b></p> <p>End of line lamp for connection of a trace heater. Includes a mounting stand for on-pipe installation.</p>	<p>Catalog No.: ELL-200-A</p> <p>Order No.: 407405</p> <p>Part No.: 27-54E1-4212/F010</p>
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	<p><b>ELL-300-A End of line lamp</b></p> <p>End of line lamp for connection of a trace heater. Includes a mounting stand for off-pipe installation.</p>	<p>Catalog No.: ELL-300-A</p> <p>Order No.: 407406</p> <p>Part No.: 27-54E1-4211/F010</p>
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	<p><b>Cold applied end seal</b></p> <p>Silicone end seal for insulation of the end of the trace heater <i>(package of 10 pieces)</i></p>	<p>Catalog No.: CAK-E10-A</p> <p>Order No.: 404128</p> <p>Part No.: 27-59CZ-9000-0010</p>
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**Accessories**

The following original BARTEC accessories are available for BARTEC Self regulating trace heating systems in hazardous locations.

	<p><b>Polyester adhesive tape</b>                  for use on pipes other than stainless steel                  3/4" x 164 ft (50 m) per roll                  Minimum installation temperature (dry surface): 40 °F (5 °C)                  Maximum withstand temperature: 212 °F (100 °C)</p>	<p>Catalog No.: PT-164                  Order No.: 100706                  Part No.: 02-5500-0005</p>
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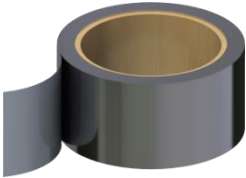
Tip: Refer to the following table to estimate the required number of tape rolls for your installation:

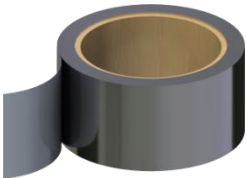
Pipe diameter in inch (DN)	1/4" (DN8)	1/2" (DN15)	3/4" (DN20)	1" (DN25)	1 1/4" (DN32)	1 1/2" (DN40)	2" (DN50)	2 1/2" (DN65)	3" (DN80)	4" (DN100)	6" (DN150)	8" (DN200)	10" (DN250)	12" (DN300)	14" (DN350)	16" (DN400)	18" (DN450)	20" (DN500)	24" (DN600)
Required no. of tape rolls per 100 ft (30 m) of piping	1	1	1	1	1	1	2	2	2	3	4	5	6	7	7	8	9	10	12

	<p><b>Glass cloth tape</b>                  for use on all pipes including stainless steel                  1/2" x 108 ft (33 m) per roll                  Minimum installation temperature (dry surface): 40 °F (5 °C)                  Maximum withstand temperature: 392 °F (200 °C)</p>	<p>Catalog No.: GT-108                  Order No.: 392328                  Part No.: 02-5500-0047</p>
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Tip: Refer to the following table to estimate the required number of tape rolls for your installation:

Pipe diameter in inch (DN)	1/4" (DN8)	1/2" (DN15)	3/4" (DN20)	1" (DN25)	1 1/4" (DN32)	1 1/2" (DN40)	2" (DN50)	2 1/2" (DN65)	3" (DN80)	4" (DN100)	6" (DN150)	8" (DN200)	10" (DN250)	12" (DN300)	14" (DN350)	16" (DN400)	18" (DN450)	20" (DN500)	24" (DN600)
Required no. of tape rolls per 100 ft (30 m) of piping	1	1	1	1	2	2	2	3	3	4	5	7	9	10	11	12	14	15	18

	<p><b>Aluminum adhesive tape</b>                  for use on all pipe materials                  2" x 164 ft (50 m) per roll                  Minimum installation temperature (dry surface): 40 °F (5 °C)                  Maximum withstand temperature: 176 °F (80 °C)</p> <p>Tip: The required number of tape rolls per 100 ft (30 m) of pipe is 0.6.</p>	<p>Catalog No.: AT80-164                  Order No.: 100506                  Part No.: 02-5500-0003</p>
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	<p><b>High temperature aluminum adhesive tape</b>                  for use on all pipe materials                  2" x 164 ft (50 m) per roll                  Minimum installation temperature (dry surface): 40 °F (5 °C)                  Maximum withstand temperature: 302 °F (150 °C)</p> <p>Tip: The required number of tape rolls per 100 ft (30 m) of pipe is 0.6.</p>	<p>Catalog No.: AT150-164                  Order No.: 101606                  Part No.: 02-5500-0014</p>
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### Cable ties

for trace heater installation on pipes etc.

*Package of 1000 pieces*

*Length: 8" (200 mm)*

*Maximum withstand temperature: 221 °F (105 °C)*

Catalog No.: CT-200

Order No.: 126225

Part No.: 03-6500-0015



### Pipe clamps for small pipes

stainless steel, for fixation of mounting stands on pipes etc.

*for pipe diameters up to 3"*

Catalog No.: PC-1

Order No.: 710144

Part No.: *Contact your local BARTEC distributor.*



### Pipe clamps for big pipes

stainless steel, for fixation of mounting stands on pipes etc.

*for pipe diameters up to 10"*

Catalog No.: PC-2

Order No.: 710145

Part No.: *Contact your local BARTEC distributor.*



### Polyester fixing straps

for installation of trace heaters on tanks and vessels

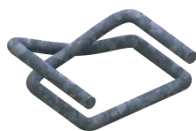
*for pipe diameters up to 10"*

*3/4" x 2790 ft. (850 m) on full roll*

Catalog No.: PFS-850

Order No.: 117932

Part No.: 03-6500-0100




### Tensioning buckle

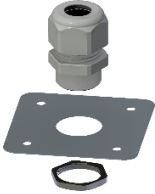
for use with the PFS-850 polyester fixing straps


Catalog No.: TB-075

Order No.: 117939

Part No.: 03-6515-0203

	<p><b>Insulation entry bushing for PSB trace heaters</b></p> <p>for protection of the trace heater on the point where it passes through the thermal insulation outer cladding</p>	<p>Catalog No.: IEB-P</p> <p>Order No.: 234006</p> <p>Part No.: 05-0020-0472</p>
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	<p><b>Insulation entry bushing for HSB trace heaters</b></p> <p>for protection of the trace heater on the point where it passes through the thermal insulation outer cladding</p>	<p>Catalog No.: IEB-H</p> <p>Order No.: 106730</p> <p>Part No.: 05-0020-0091</p>
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	<p><b>Electrically traced warning label</b></p> <p>Warning label for trace heater circuits</p>	<p>Catalog No.: HTWL-DE (<i>German</i>) HTWL-US (<i>English</i>) HTWL-FR (<i>French</i>) HTWL-RU (<i>Russian</i>)</p> <p>Order No.: 113450 (<i>German</i>) 113550 (<i>English</i>) 120300 (<i>French</i>) 207439 (<i>Russian</i>)</p> <p>Part No.: 05-2144-0046 (<i>German</i>) 05-2144-0047 (<i>English</i>) 05-2144-0703 (<i>French</i>) 05-2144-0860 (<i>Russian</i>)</p>
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## Installation

### Preparation

Before installing any electric trace heating, the person installing must check if the trace heating has been designed and planned correctly. It is particularly essential to verify the following points:

- complete project planning documentation, operating instructions and installation instructions.
- correct selection of the trace heater and accessories with respect to:
  - calculation of heat losses
  - max. permissible operating temperature
  - max. permissible ambient temperature
  - temperature class
  - heating circuit length

Before installing, make sure that all piping and equipment is properly installed and pressure tested.

### Required tools / equipment

The following tools are required for installation of the BARTEC Self regulating trace heating systems:

- Wire cutters
- Insulation resistance meter with a minimum testing voltage of 500 V<sub>DC</sub> and a maximum testing voltage of 2500 V<sub>DC</sub>



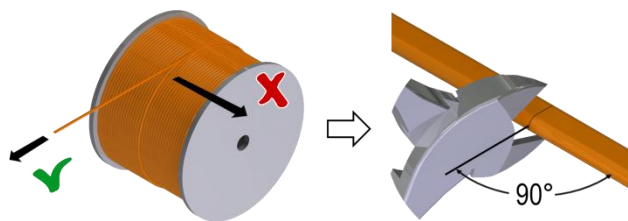
1

### Unrolling the trace heater

#### ⚠ WARNING

Risk of short cuts and/or material damage. Keep the trace heater ends dry before and during installation.

- Unroll the required trace heater in a straight line and cut to the correct length. Cut off the trace heater ensuring a straight cut.
- Do not bend or pinch the trace heater, or pull it over sharp edges.



2

### Installation on pipes

This step is necessary for plastic pipes only since plastic pipes conduct heat less efficiently than metal pipes do. For metal pipes continue with step 4.

- Place aluminium tape (see section *Accessories* on page 16) where the trace heater will be attached for better heat distribution.



3

#### ⚠ CAUTION

Risk of injury and/or material damage. Never tread on or drive over the trace heater. Do not use it as a loop for stepping on.

- Install the trace heater in a straight line along the pipe. This saves time, helps to avoid installation mistakes and prevents damage to the trace heater during the thermal insulation work. Furthermore the trace heater can be easily located later on.



4

- Preferably install the trace heater in the lower half of the pipe, **but not on the lowest point**. This prevents mechanical damage and allows for better heat distribution.
- If you use multiple trace heaters, position them with an offset of 90°.



5

**Fastening**

Select the correct fastening material:

- Always use polyester adhesive tape or glass cloth tape that suits the expected temperatures.
- Preferably use BARTEC adhesive tapes.
- Never use PVC insulating tape or self-adhesive tapes containing PVC or VC.
- Do not use metal wire or banding.



6

**Trace heater routing**

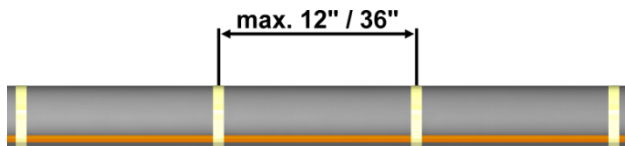
- Always install the trace heater on fittings, valves etc. in such a way, that these are easily accessible and replaceable and heating circuits do not have to be cut up. Therefore, always leave a sufficiently large trace heater loop.
- Through the higher heat losses from fittings, valves, flanges etc. a greater length of trace heater is required. This additional requirement is specified in the project planning documents.
- The following illustrations show typical types of installation.

**NOTICE**

The bending radius of the trace heater must always be at least 1" (25 mm). Do not bend on the narrow axis.

9

- Fasten the trace heater with the adhesive tape or zip ties at intervals of at least 12" (300 mm) on plastic pipes or 36" (900 mm) on steel pipes.

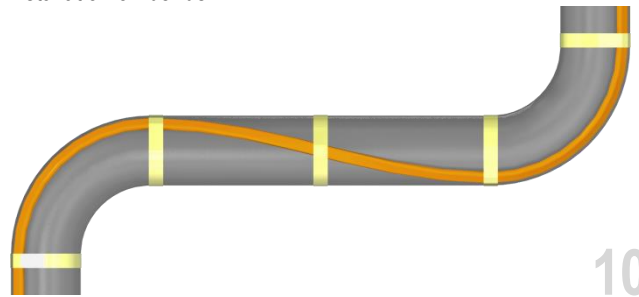


**NOTICE**

In order to ensure good heat transmission the trace heater must have a flat, flush fit over the whole length. If necessary, reduce the distances between the fixing points.

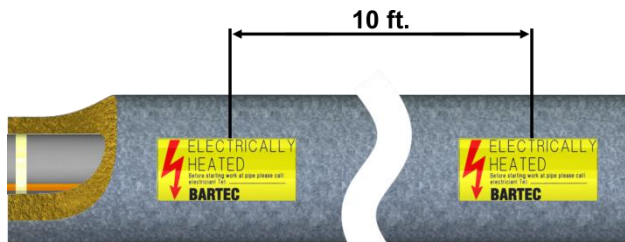
7

- Installation on bends:



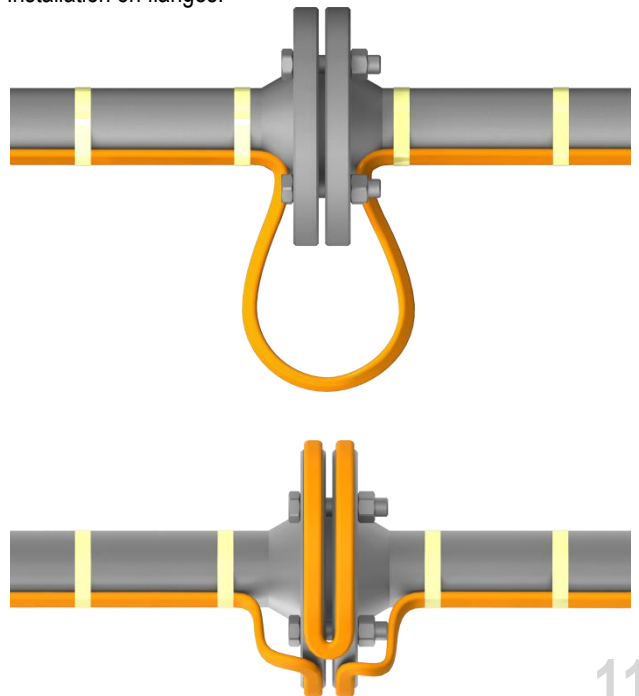
10

- Apply the pipe's insulation according to the manufacturer's installation instructions.
- Apply an electrical warning label every 10 ft. (3 m) on a clearly visible place.



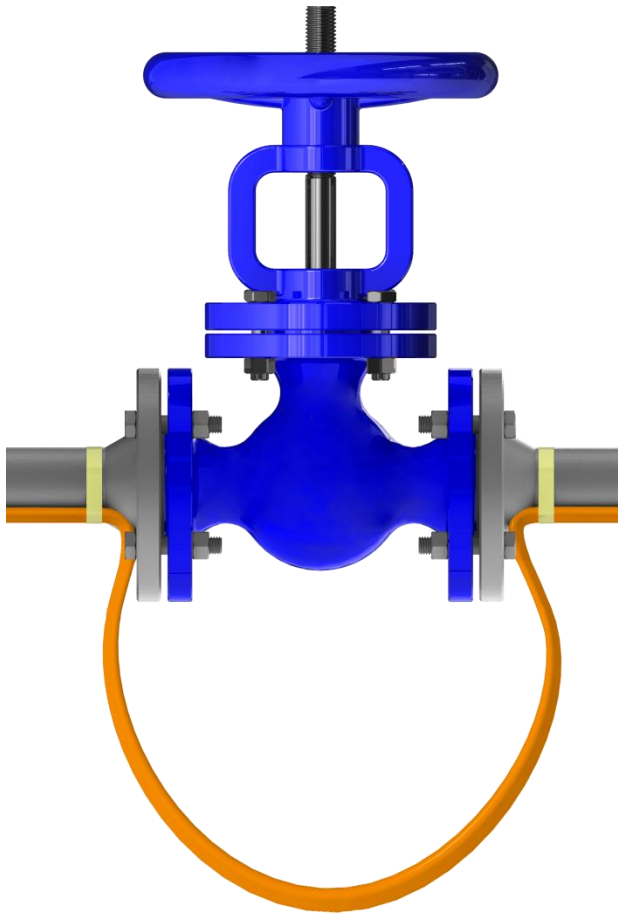
8

- Installation on flanges:



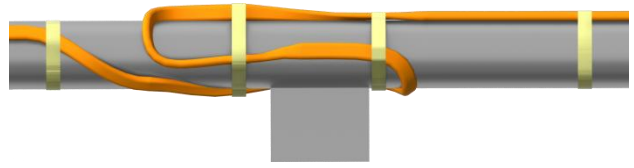
11

- Installation on valves:



12

- Installation on pipe supports:



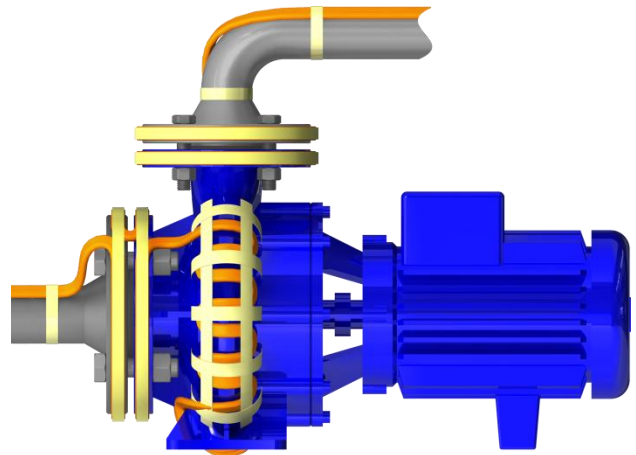
13

- Installation on pressure gauges:



14

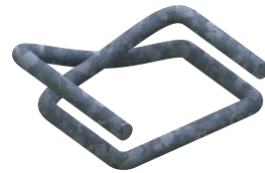
- Installation on pumps:



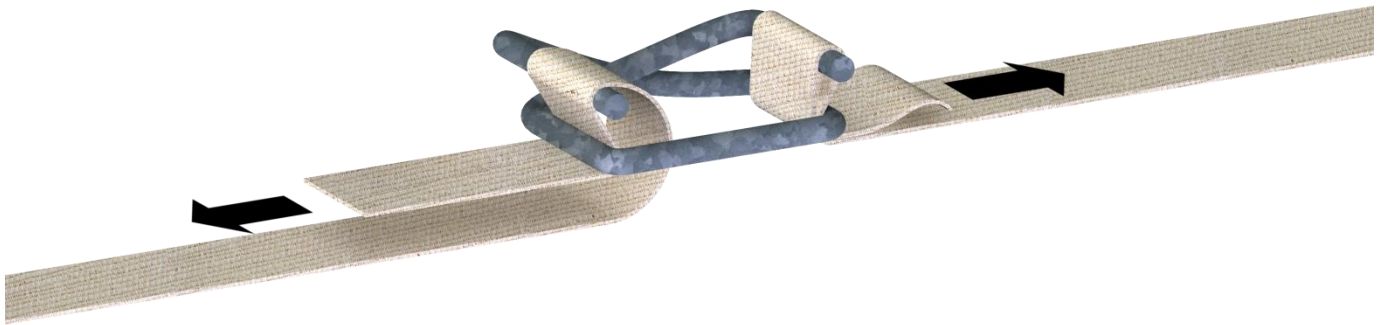
15

**Installation on tanks and vessels**

- For tank diameters of up to 6.5 ft (2 m) the trace heater is attached using polyester fixing straps and tensioning buckles (see section *Accessories* on page 16).



- To fasten the fixing straps thread the polyester straps through the tensioning buckle as shown and pull the ends of the straps.



16

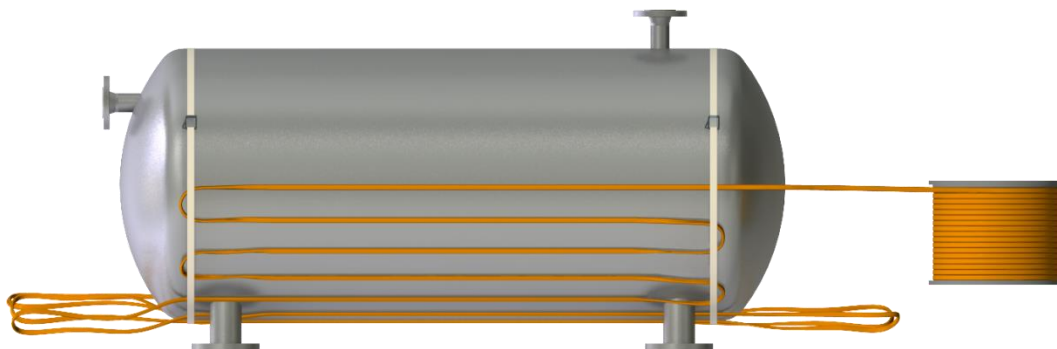
- At first, install fixing straps around the beginning and end of the tank and fasten them with slight tension.

**Upright tank****Horizontal tank**

17

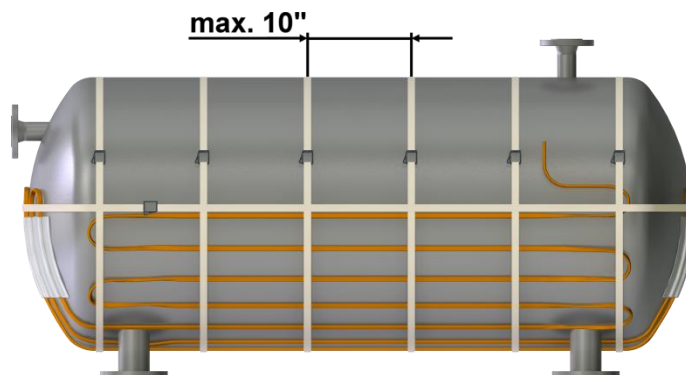


- Install the trace heater beginning at the supply point.
- Fix it at the distances specified in the project planning documentation. To do so, use the premounted fixing straps.
- Allow for material addition for the bases.



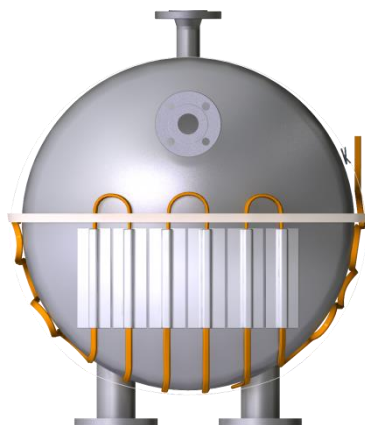
18

- Align the trace heater exactly and fix it firmly to the bases and the cylinder using further fixing straps.
- To avoid damage to the trace heater, make sure that the fixing straps are not tightened too firmly. It should be possible to move the trace heater slightly under the fixing straps.
- The distances between the fixing straps should not exceed 10" (250 mm).



19

- Finally, place aluminium tape on areas of loose contact of the trace heater.
- This step improves heat transmission and prevents the penetration of insulating material between the trace heater and the tank surface.



20

**Tests and commissioning**

**Measurement of the insulation resistance**

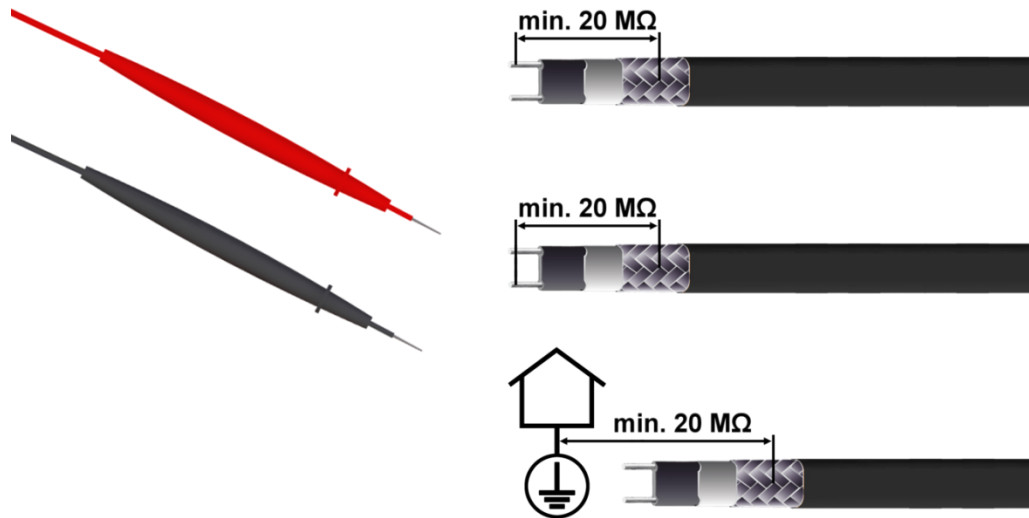
The measurement of the insulation resistance is used to determine damage to the trace heater and possible installation faults. It must be carried out at the following times:

- Preliminary test (shortly before beginning installation of the trace heater on the construction site; refer to section *Acceptance Report* on page 27)
- Acceptance test (after the complete installation of the heating circuit or fitting of the thermal insulation; refer to section *Acceptance Report* on page 27)
- Final inspection (immediately after completion of work on the thermal insulation)
- Upon commissioning
- Before switching on the installation

To do the measurement, proceed as follows:

- Use an insulation resistance meter with a minimum testing voltage of 500 V<sub>DC</sub> and a maximum testing voltage of 2500 V<sub>DC</sub> (recommended testing voltage: 1500 V<sub>DC</sub>, required insulation resistance: > 20 MΩ).
- Measure the resistance between each bus wire of the trace heater and the grounding braid.
- Measure the resistance between the grounding braid and the earth potential (for this measurement the heating circuit **must not** be grounded yet).

**⚠ WARNING**  
 Risk of fire or electrical shock. If the insulation resistance is insufficient you must fix the heating circuit before putting it into operation.



**Acceptance test and acceptance test report**

- After completion of the installation work (before fitting the thermal insulation) each heating circuit must be accepted, if possible in the presence of the client.
- All further tests must also be documented in an acceptance test report (refer to section *Acceptance report / Record of inspection* on page 27).

**NOTICE**  
 Claims under warranty will not be considered if the acceptance report is not filled in completely.

- After completion of work on the thermal insulation final inspection and acceptance of the individual heating circuits is recommended. Usually, this is the task of the client or the final customer (= final inspection).

**Commissioning**

Each heat tracing system can only be put into operation if the following conditions are fulfilled:

- The acceptance test reports for each heating circuit are available and the perfect state of the trace heating system has been confirmed.
- All components of the heating circuit are completely installed and are in working order.
- It has been ensured that the heating circuit is operated in conformance with the technical data specified by BARTEC.

**NOTICE**  
 Upon a cold start, additional heating power is required for heating up tanks and pipes. When starting the system you should allow sufficient time for heat up. For further information on heat up calculations contact your local BARTEC representative.

## Operation

During operation of the electric trace heating system you must ensure that all components of the system are operated within the operating data specified by BARTEC.

This applies particularly to observation of the maximum temperature. Operation within these operating data is a precondition for possible later warranty claims.

## System documentation

Complete documentation must be carried out for each system, from the project planning stage, through installation and commissioning up to periodic maintenance of the trace heating system.

This documentation should include the following:

- Project planning documents
- Manuals of all of the components of the heating system
- Heat loss calculation
- Selection of the trace heater
- Layout plans with division of heating circuits
- Circuit diagrams
- Acceptance reports
- Reports on repairwork and any operations carried out on the tank/pipe system, trace heating system and thermal insulation
- Inspection reports

## Maintenance

### Visual and functional inspection

- Regularly check the thermal insulation for possible damage, missing seals, cracks, damage to the outer jacket, missing thermal insulation bushings for trace heaters and cables, penetrated water or chemicals. If the thermal insulation is damaged the trace heater should be checked for possible damage.
- Damaged trace heaters must be replaced.
- Parts subject to wear must be replaced (e.g. seals, locking plates etc).
- Check junction boxes, splices, end terminations etc. for corrosion and possible mechanical damage. Make sure that all enclosure covers are properly in place.
- If present, check the temperature regulator connecting cables and capillary tube systems for damage and that their installation is protected against mechanical damage.

### Electrical inspection

- Measurement of the insulation resistance should be seen as a permanent part of regular maintenance. For instructions on how to perform the test refer to section *Measurement of the insulation resistance* on page 24.

### Inspection intervals

- For frost protection installations inspections should be carried out annually before the heating period begins.
- For plants designed to maintain process temperatures, inspections should be carried out at regular intervals, but at least twice a year.

### Personnel training courses

- Regular maintenance should be carried out by trained, experienced maintenance personnel.
- It is recommended that maintenance personnel is supported in learning new developments in application technology and maintenance by regular service.

### Repairwork on piping or thermal insulation

- Make sure that the plant is isolated for safety before all repairwork.
- Take care that the heat tracing system is not damaged during repairwork on the pipes or insulation.
- After completion of the repairwork:
  - Make sure that the heating circuits are properly installed anew according to the project planning documentation.

## WARNING

**Risk of fire or electrical shock due to damaged components. Remember that self-regulating trace heaters are designed to be installed only once.**

- Carry out a visual, functional and electrical test (refer to section *Tests and commissioning* on page 24).

**Troubleshooting**

<b>Problem</b>	<b>Possible cause</b>	<b>Remedy</b>
Trace heater remains cold	No power supply	Check the supply line
	Trace heater or cold lead cable not properly connected	Connect the trace heater and cold lead cable according to the installation instructions
	Control unit adjusted incorrectly	Adjust the control unit according to the installation instructions
Automatic circuit breaker disengages	Automatic circuit breaker defective	Replace the automatic circuit breaker
	Automatic circuit breaker has wrong tripping characteristics, e. g. "B" instead of "C"	Install an automatic circuit breaker with Type-C tripping characteristics
	Nominal circuit breaker size is insufficient	Install an automatic circuit breaker with higher capacity (Observe the maximum amperage of all components of the trace heating circuit!)
	Maximum heating circuit length has been exceeded	Split the heating circuit into separate circuits
	End seal has not been installed	Install the end seal according to the installation instructions
	Short circuit	Identify the cause and remedy the fault (e. g. ensure that tape tails are not twisted)
	Humidity inside the connection system or end seal	Replace the connection system / end seal
Ground fault protection is disengaged	Trace heater damaged	Replace the trace heater at the point where it is damaged
	Moisture in the junction box	Dry the junction box Be sure that the conduit drain is installed and breathing properly.
	Ground fault protection defective	Replace the ground fault protection device(s)

**Acceptance report / Record of inspection**
**Protocol type**

Inspection before commissioning <input type="checkbox"/>	Inspection after modification <input type="checkbox"/>	Periodic inspection <input type="checkbox"/>
Visual inspection <input type="checkbox"/>	Close inspection <input type="checkbox"/>	Detailed inspection <input type="checkbox"/>

**Project information**

Project / Customer	
Order Comm. No. / BARTEC Order No.	
Date	

**Installation details**

Heating circuit type	Electric Trace Heating of Pipes <input type="checkbox"/>	Electric Trace Heating of Tanks/Vessels <input type="checkbox"/>
Ex version	yes <input type="checkbox"/> no <input type="checkbox"/> Zone <input style="width: 50px;" type="text"/>	Temperature class T <input type="checkbox"/> Ex group <input style="width: 50px;" type="text"/>
Switchgear / Distribution panel	Included in the scope of delivery	UV Name ESS/LDP
	yes <input type="checkbox"/> no <input type="checkbox"/>	Test report <input type="checkbox"/>
Thermal insulation	Thermal insulation material	Thermal insulation thickness in inch <input style="width: 50px;" type="text"/>
	Check <b>before</b> installation of the insulation Date / Name / Signature	Check <b>after</b> installation of the insulation Date / Name / Signature

**Heating circuit data**

Heating Circuit No.									
Sub-Heating circuit	yes <input type="checkbox"/>	no <input type="checkbox"/>	yes <input type="checkbox"/>	no <input type="checkbox"/>	yes <input type="checkbox"/>	no <input type="checkbox"/>	yes <input type="checkbox"/>	no <input type="checkbox"/>	
Pipe-/Vessel No.									
Building									
Product									
Trace heater type									
Lot No. of trace heater									
Trace heater length	_____ ft. (m)		_____ ft. (m)		_____ ft. (m)		_____ ft. (m)		
Serial No. connection kit									
Serial No. junction box									
Voltage	_____ V		_____ V		_____ V		_____ V		
Current (Switch on / operation)	_____ / _____ A		_____ / _____ A		_____ / _____ A		_____ / _____ A		
Output power trace heater	_____ W/ft. (W/m)		_____ W/ft. (W/m)		_____ W/ft. (W/m)		_____ W/ft. (W/m)		
Trace heater resistance	_____ Ω		_____ Ω		_____ Ω		_____ Ω		
Insulation resistance at ..... V	> _____ MΩ		> _____ MΩ		> _____ MΩ		> _____ MΩ		
<b>Temperature settings</b>	°F (°C)	yes	no	°F (°C)	yes	no	°F (°C)	yes	no
Controller	_____	<input type="checkbox"/>	<input type="checkbox"/>	_____	<input type="checkbox"/>	<input type="checkbox"/>	_____	<input type="checkbox"/>	<input type="checkbox"/>
Limiter	_____	<input type="checkbox"/>	<input type="checkbox"/>	_____	<input type="checkbox"/>	<input type="checkbox"/>	_____	<input type="checkbox"/>	<input type="checkbox"/>
Low temperature	_____	<input type="checkbox"/>	<input type="checkbox"/>	_____	<input type="checkbox"/>	<input type="checkbox"/>	_____	<input type="checkbox"/>	<input type="checkbox"/>

Remarks: \_\_\_\_\_  
 \_\_\_\_\_

 \_\_\_\_\_  
 City/Date

 \_\_\_\_\_  
 BARTEC Contractor  
 Name / Signature

 \_\_\_\_\_  
 Customer  
 Name / Signature

## NOTICE

Claims under warranty will not be considered if the acceptance report is not filled in completely.

## Limited product warranty

### Scope

The term of this limited product warranty begins on the date of purchase and continues for a period of 2 years. It applies for all BARTEC products and accessories that are subject of this manual, against:

- faulty components, and
- faulty manufacturing.

**Not covered** are any damages caused by:

- accidents,
- misuse, improper installation, operation, maintenance or repairs,
- neglect, or
- alteration.

Furthermore BARTEC cannot be held liable under this warranty for:

- installation or removal costs,
- loss or damage to property,
- loss of revenue or anticipated profits, or
- any other damages or costs directly or indirectly related to the warranty issue.

If all warranty conditions are met, BARTEC will, at its sole discretion:

- repair the concerning product,
- replace the concerning product, or
- refund the purchasing price.

This warranty gives you specific legal rights, and you may also have other rights which vary from State to State.

### Conditions

The limited product warranty is subject to the following conditions:

- proper installation, operation and maintenance in compliance with the state of the technology and the product documentation
- presence of completely filled in acceptance reports for all installation, maintenance and repairwork operations

### How to claim the warranty

To claim the limited product warranty, you have to:

- Notify BARTEC or your local BARTEC representative by written correspondence or email within 30 days after identification of a possible warranty issue.
- If requested, you must provide any warranty related information to BARTEC, such as:
  - project planning documents
  - acceptance reports for installation, operation, maintenance or repairwork
  - etc.

### Applicability of implied warranties, state or provincial laws

BARTEC HEREBY DISCLAIMS ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING WITHOUT LIMITATION ANY IMPLIED WARRANTY OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR NONINFRINGEMENT, AND OF ANY OTHER OBLIGATION OR LIABILITY ON THE PART OF BARTEC MANAGEMENT, WHETHER BY STATUTE, CONTRACT, STRICT LIABILITY, TORT OR OTHERWISE. Some States do not allow the exclusion or limitation of incidental or consequential damages, so the above limitations may not apply to Buyer.

Buyer and successors of Buyer are limited to the remedies specified in this agreement and shall have no others for a nonconformity in the products and accessories. If the goods are a consumer product in Buyer's jurisdiction, Buyer may have additional legal rights under the applicable national/state/provincial legislation governing the sale of consumer goods. As a result, the above exclusions and/or limitations on the warranty may or may not apply.



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