

**Raychem**<sup>®</sup>

# Selection guide for self-regulating heat-tracing systems



**tyco**

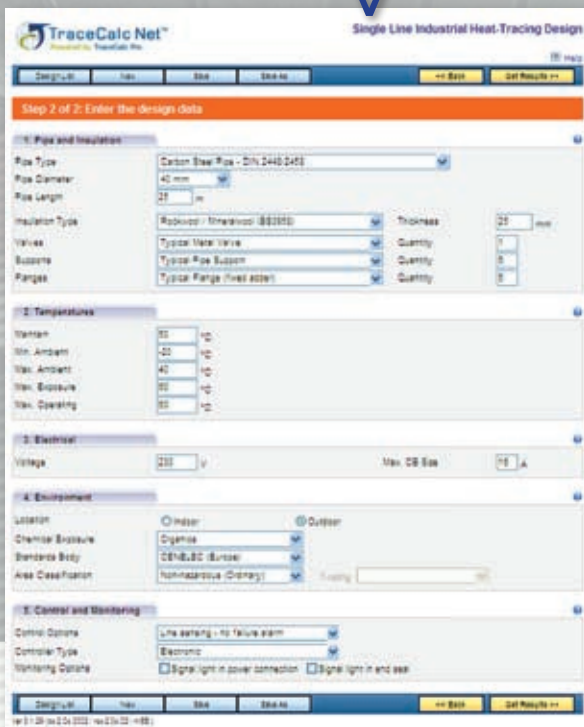
Thermal Controls

## TraceCalc Net, software design in three easy steps:

### 1. Select your heat-tracing design



### 2. Enter the design data



### 3. Get a bill of materials and request a quotation



# We manage the heat you need...

## ... with easy project design

1 >>

### Follow this design guide

to get to the right solution for your application. This paper guide offers the benefit that it is fast and easy to use at any location where you may need it. First select the correct heating cable, then take care of the electrical design and select the components and accessories to complete your heat-tracing system.



2 >>

### Or use our software design tools

TraceCalc Net or TraceCalc Pro to generate a complete bill of materials, design summary and line list for your heat-tracing system. Both offer the possibility to do designs for use in hazardous or non-hazardous areas and for frost protection or temperature maintenance. With TraceCalc Net selecting the appropriate industrial pipe heat-tracing products is easy.

The simple 3-step design process consists of:

1. Select your heat-tracing design
2. Enter the design data
3. Get a bill of materials and request a quotation

Register for this online design tool at:

[www.tycothermal.com/TraceCalc/](http://www.tycothermal.com/TraceCalc/)

For heat-tracing in industrial applications, TraceCalc Pro provides design calculations such as pipe heat loss, number of circuits, electrical loads and maximum temperatures, automated heating cable and component selection, recommendations for control and monitoring selection, and much more.

It provides easy-to-use standard reports and last but not least, its powerful features help you obtain the best heat-tracing solution for your particular project.

With TraceCalc Pro, Tyco Thermal Controls provides you with an unprecedented design tool giving you an optimal heat-tracing solution.

Please contact your Tyco Thermal Controls representative for more information.



3 >>

### Or let us do the design for you

Simply complete the project information sheet provided at the end of this guide and email or fax it back to your Tyco Thermal Controls representative who will quickly provide you with a most appropriate design, a bill of materials and pricing.





# ... with a 'high performance' heat-tracing system

**Our Raychem self-regulating heat-tracing system is ...**



## ... Super Safe

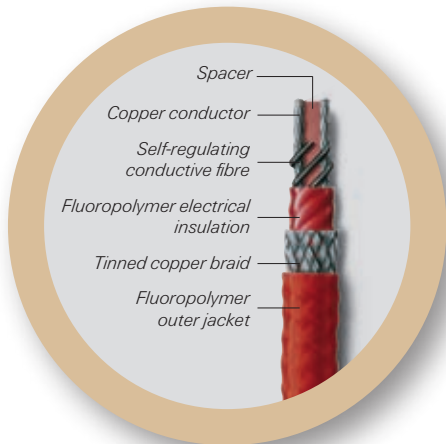
- Raychem self-regulating heat-tracing cables are certified for unconditional T-rating in accordance with European Standard EN 60079-30-1. The surface temperature of the heating cable will never exceed its T-class temperature.
- The self-regulating principle ensures that the cable senses overlaps. It regulates its heat accordingly and prevents any heat build-up or burn out. Furthermore, complex shapes like valves, flanges or pipe supports are easily traced with this system.

## ... Cost Saving

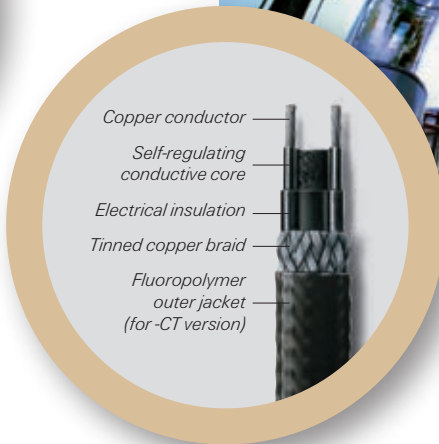
- The cable is easy to tee, splice, install and repair. No special skills are required, resulting in reduced installation time.
- Due to its self-regulating principle, this system saves energy and thus operational costs.
- The system requires a minimum of maintenance and is fully resistant to all pipe maintenance procedures.
- To easily accommodate design changes on site, the cable can be cut-to-length when being installed.

500.00 km ca





Fiber construction



Monolithic construction

## ... Reliable

- Toughness is a major attribute of self-regulating heat-tracing cables. An outer jacket of fluoropolymer offers mechanical strength as well as chemical resistance. Both XTV and KTV type heating cables have a unique fiber construction and are manufactured using high performance polymers.
- The cable compensates for variations in heat loss and voltage. It can be fine-tuned to control your pipe temperature to a tolerance of 3°C by installing a pipe sensor and feeding the input to a control unit.

- Even variations in ambient temperature are automatically compensated for by the self-regulating heating cable.
- Our company can build on more than 30 years of experience in the heat-tracing business.
- With Tyco Thermal Controls, customers can rely on a company that has shipped over a billion feet (> 300.000 km) of self-regulating heat-tracing cables.

**Cold Pipe:** In response to cold, the core or fiber contracts microscopically opening up electrical paths.

**Warm Pipe:** In response to warmth, the core or fiber begins to expand microscopically disrupting the electrical paths.

**Hot Pipe:** The core or fiber expands enough to disrupt almost all of the electrical paths.



# Heat-Tracing Design Guide

## How to select and design the heat-tracing system for pipes

This Design Guide outlines a simple procedure for designing and selecting a complete heat-tracing system using BTV, QTVR, XTV or KTV heating cables.

By following the design steps in the 3 sections, a bill of materials can be easily produced which includes the heating cable type, length, components and accessories needed to install the heat-tracing system correctly.

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### Installation

Tyco Thermal Controls heat-tracing systems must be installed following Tyco Thermal Controls guidelines. Contact your Tyco Thermal Controls representative for a copy of the installation manual. All components are supplied with easy-to-follow instructions.

### Additional information

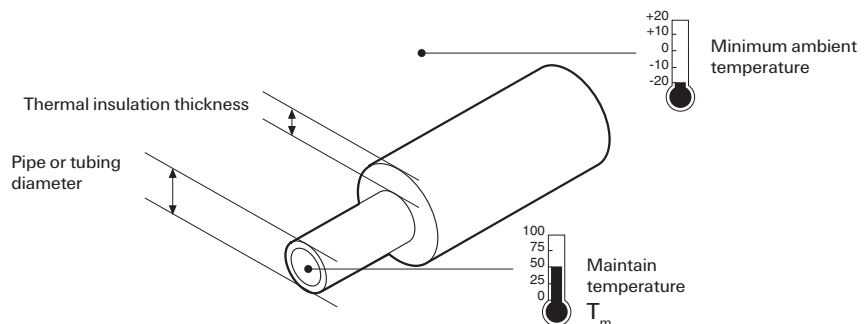
Full technical information on components and heating cables can be found in our Technical Databook. Combined with the installation instructions this supplements the information in this guide. These documents are available from your local Tyco Thermal Controls representative and from the Tyco Thermal Controls website ([www.tycothermal.com](http://www.tycothermal.com)).

## 1.0 Heating cable selection

Heating Cable Selection
1. Determine heat loss
2. Select heating cable family
3. Select heating cable
4. Determine heating cable length

To select the correct heating cable determine

- Pipe or tubing diameter
- Thermal insulation thickness
- $T_m$ : Maintain Temperature (desired fluid temperature)



### Example:

Fluid: Process liquid, steam-cleaned  
Line size: NB 50 mm  
Insulation thickness: 50 mm  
 $T_m$ : 50°C

## Step 1.1 Determine heat loss

### Heating Cable Selection

1. Determine heat loss
2. Select heating cable family
3. Select heating cable
4. Determine heating cable length

Table 1 Heat Loss Table

The table is based on the following parameters:

- Mineral wool insulation
- Minimum expected ambient temperature:  $-20^{\circ}\text{C}$
- Pipes located outdoors
- Steel pipes
- Safety factor 10%

For other configurations (dimensions, temperatures, etc.), please use TraceCalc Pro or TraceCalc Net software or consult your Tyco Thermal Controls representative.

1. Select the pipe diameter and insulation thickness
2. Select the desired maintain temperature
3. Note the heat loss result

Example: NB 50 mm,  
50 mm insulation  
thickness  
 $T_m: 50^{\circ}\text{C}$   
18.8 W/m

DN= $\varnothing$ pipe (NB)	Insulation thickness (mm)	Maintain temperature ( $^{\circ}\text{C}$ )						
		5	10	20	30	40	50	60
8	25	3.9	4.7	6.4	8.1	9.9	11.8	13.7
	30	3.5	4.3	5.8	7.5	9.1	10.8	12.6
	40	3.1	3.8	5.1	6.5	8.0	9.5	11.0
15	25	4.9	6.0	8.2	10.4	12.7	15.1	17.6
	30	4.5	5.4	7.4	9.4	11.5	13.7	15.9
	40	3.9	4.7	6.4	8.1	9.9	11.8	13.7
20	25	5.7	6.9	9.4	11.9	14.6	17.4	20.2
	30	5.1	6.2	8.4	10.7	13.1	15.6	18.1
	40	4.4	5.3	7.2	9.2	11.2	13.3	15.5
25	25	6.6	7.9	10.8	13.8	16.9	20.0	23.3
	30	5.9	7.1	9.6	12.3	15.0	17.9	20.8
	40	4.9	6.0	8.1	10.4	12.7	15.1	17.5
32	25	7.6	9.3	12.6	16.1	19.7	23.3	27.1
	30	6.8	8.2	11.2	14.2	17.4	20.7	24.1
	40	5.7	6.9	9.3	11.9	14.6	17.3	20.1
40	25	8.4	10.2	13.8	17.6	21.5	25.6	29.7
	30	7.4	9.0	12.2	15.5	19.0	22.6	26.2
	40	6.1	7.4	10.1	12.9	15.8	18.7	21.8
50	30	8.6	10.5	14.2	18.2	22.2	26.4	30.6
	40	7.1	8.6	11.7	14.9	18.2	21.7	25.2
	50	6.1	7.5	10.1	12.9	15.8	18.8	21.8
65	30	10.2	12.4	16.9	21.5	26.4	31.3	36.4
	40	8.3	10.1	13.7	17.5	21.4	25.4	29.6
	50	7.2	8.7	11.8	15.0	18.4	21.8	25.4
80	40	9.3	11.3	15.4	19.6	24.0	28.5	33.1
	50	8.0	9.7	13.1	16.7	20.5	24.3	28.3
	80	5.9	7.1	9.7	12.3	15.1	17.9	20.8
100	50	9.5	11.6	15.7	20.1	24.5	29.1	33.9
	80	6.9	8.3	11.3	14.5	17.7	21.0	24.4
	100	6.0	7.2	9.8	12.5	15.3	18.2	21.2
150	50	12.8	15.6	21.2	27.0	33.0	39.2	45.6
	80	9.0	10.9	14.9	18.9	23.2	27.5	32.0
	100	7.7	9.3	12.7	16.2	19.8	23.5	27.3

## Step 1.2 Select heating cable family

### Heating Cable Selection

1. Determine heat loss
2. Select heating cable family
3. Select heating cable
4. Determine heating cable length

#### Example:

- Verify that maximum exposure temperatures of heating cable are sufficient
- Select correct heating cable according to temperature classification

Steam-cleaned: System is cleaned for 6 hours per year using 20 bar saturated steam (215°C)  
 Normal operating temperature is 50°C  
 Temperature classification is T3  
 Correct family is XTV2-CT-T3

Cable type	Temperature classification	Max. exposure temperatures	
		continuous	intermittent (1000 hours cumulated)
BTV2-CT	T6	65°C	85°C
QTVR2-CT	T4	110°C	110°C
XTV2-CT-T3	T3	120°C	215°C
20XTV2-CT-T2	T2	120°C	215°C
KTV2-CT	T2	150°C	215°C

## Step 1.3 Select heating cable

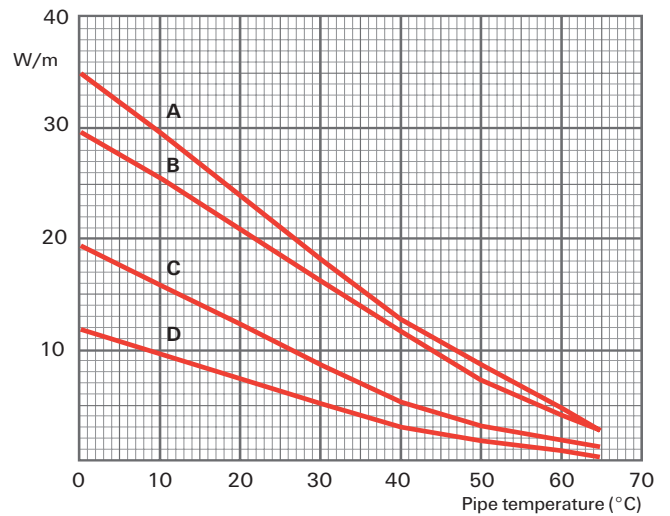
### Heating Cable Selection

1. Determine heat loss
2. Select heating cable family
3. Select heating cable
4. Determine heating cable length

- Select graph below based on the heating cable family
- Draw a vertical line at the maintain temperature
- Draw a horizontal line for the heat loss
- Select nearest cable above crossover of these two lines

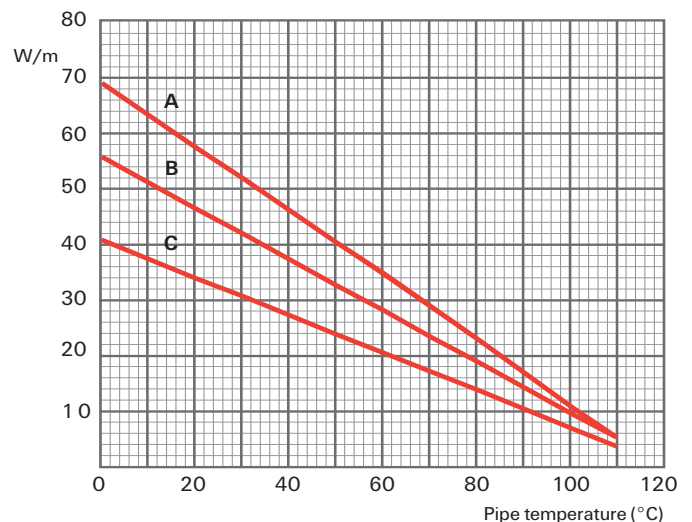
#### BTV2-CT

- A 10BTV2-CT
- B 8BTV2-CT
- C 5BTV2-CT
- D 3BTV2-CT



#### QTVR2-CT

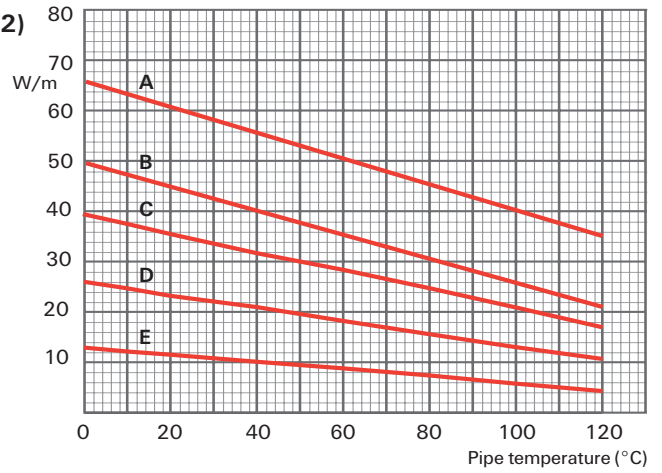
- A 20QTVR2-CT
- B 15QTVR2-CT
- C 10QTVR2-CT





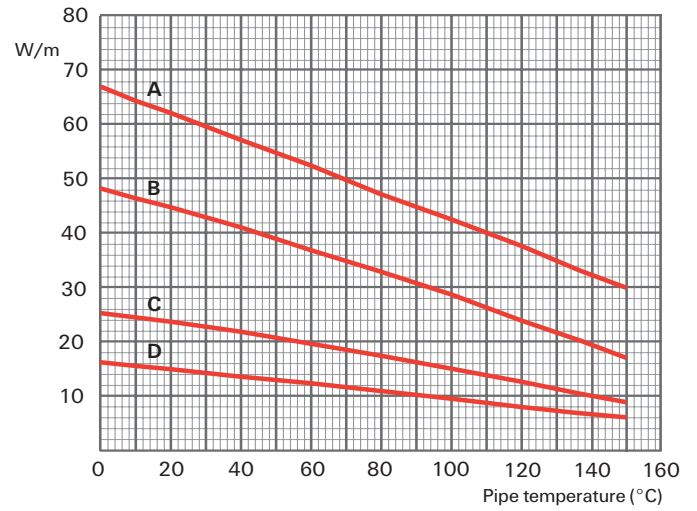
**XTV2-CT-T\* (\*=3 or 2)**

- A 20XTV2-CT-T2
- B 15XTV2-CT-T3
- C 12XTV2-CT-T3
- D 8XTV2-CT-T3
- E 4XTV2-CT-T3



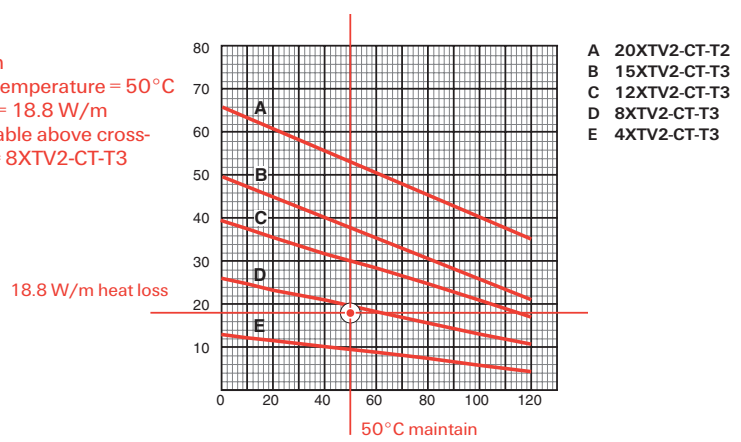
**KTV2-CT**

- A 20KTV2-CT
- B 15KTV2-CT
- C 8KTV2-CT
- D 5KTV2-CT



**Example:**

XTV graph  
 Maintain temperature = 50°C  
 Heat loss = 18.8 W/m  
 Nearest cable above cross-over is D = 8XTV2-CT-T3



## Step 1.4 Determine heating cable length

### Heating Cable Selection

1. Determine heat loss
2. Select heating cable family
3. Select heating cable
4. Determine heating cable length

Determine the total length of the heating cable by combining lengths from each component in the piping system.

#### For the piping

Calculate the amount of heating cable required for the pipe length. In the case of a straight heating cable run, this quantity is equal to the total length of the piping. Add at least one metre to allow for the entry into a junction box and the end seal. Add a heating cable length of 5-10% for bends, flanges, elbows etc.

#### For each valve

Add the following heating cable lengths:

Valve type	Heating cable length (m) per valve
Gate	1.0
Butterfly	0.4
Ball	0.5
Globe	0.9

#### Pipe supports

Add the following heating cable lengths:

Pipe size (mm)	Support Type	Heating cable length (m) per support
8 - 25	Pipe hangers	0
32 - 50	Small shoe (100 mm x 5 mm)	1.0
65 - 150	Medium shoe (150 mm x 8 mm)	2.0

#### Other fittings and fixtures

Consult your local Tyco Thermal Controls representative.

#### Example:

Heating cable length =	
Pipe: 30 m =	30.0 m
Junction Box entry + end seal =	1.0 m
Flanges: 5% =	1.5 m
Valves: 3 ball valves x 0.5 =	1.5 m
Supports: 5 small shoes x 1 =	5.0 m
Total length of 8XTV2-CT-T3 =	39.0 m

## 2.0 Electrical Design

### Electrical design

1. Determine minimum pipe start-up temperature °C
2. Select protection rating

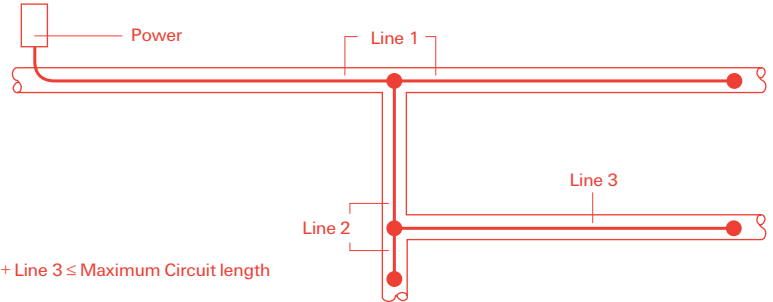
All Raychem heating cables must be installed with electrical protection in accordance with local codes and practices.

#### Circuit definition

For ease of system design and use, only one type of heating cable should be connected in each circuit.

Each heat-tracing circuit should have its own electrical protection.

A circuit may be composed of several branches (see figure below) but the sum of all heating cable lengths should not exceed the maximum circuit length determined in section 2.2.



#### Example:

#### Electrical protection sizing

Raychem heating cables are self-regulating: power output and current draw decrease as temperature increases. This current draw must be co-ordinated with the electrical protection. Table 2 on page 12 shows maximum circuit lengths for use with commonly available protection devices (Type C to EN 60898 circuit breaker) and applies for Raychem heating cables installed on thermally insulated surfaces without the use of heat transfer aids. The table was generated in accordance with European practices for heating cables powered at 230 Vac.

For other supply voltages, applications, protection devices, start-up temperatures or products, consult your Tyco Thermal Controls representative.

#### Earth leakage protection

Tyco Thermal Controls requires the use of a 30 mA residual current device to provide maximum safety and protection from fire.

To select the circuit breaker sizing, determine:

- minimum start-up temperature
- total length of heating cable

### Step 2.1 Determine minimum pipe start-up temperature (°C)

#### Electrical design

1. Determine minimum pipe start-up temperature °C
2. Select protection rating

#### Example:

The power output and current draw of a Raychem heating cable depend on its temperature. Electrical protection sizing must be based on the minimum pipe start-up temperature.

0°C

### Step 2.2 Select protection rating

#### Electrical design

1. Determine minimum pipe start-up temperature °C
2. Select protection rating

From table 2 on page 12, match the heating cable catalogue number (see step 1-3) at the expected minimum start-up temperature with the total heating cable length (see step 1.4).

Select protection rating (A) for which the length of the heating cable is less or equal than the maximum recommended heating cable length ( $L \leq L_{max}$ ).

#### Power cable sizing

Power supply cables from the electrical protection to the Raychem connection system should be sized to meet appropriate codes of practice, protection rating and voltage drop considerations.

Table 2

1. Select heating cable
2. Select min. start-up temperature
3. Match the total heating cable length

Example: 8XTV2-CT-T3  
 0°C,  
 39 m, 10 A Type C  
 circuit breaker  
 Max. heating cable  
 length = 60 m

**L max (m) - Maximum recommended heating cable length**

Start-up temperature	Circuit breaker size (type C)	3BTV2-CT	5BTV2-CT	8BTV2-CT	10BTV2-CT	100TVR2-CT	150TVR2-CT	200TVR2-CT	4XTV2-CT-T3	8XTV2-CT-T3	12XTV2-CT-T3	15XTV2-CT-T3	20XTV2-CT-T2	5KTV2-CT	8KTV2-CT	15KTV2-CT	20KTV2-CT
5°C	6A	90	60	35	20	25	20	15	60	40	30	20	15	55	40	25	15
	10A	150	100	60	40	45	35	25	100	65	45	35	25	90	65	40	25
	13A	195	135	80	50	60	45	35	130	85	60	50	35	115	85	50	35
	16A	200	160	100	60	75	60	45	165	100	75	60	45	145	105	65	45
	20A	-	-	125	75	95	75	55	205	130	95	75	55	180	130	80	55
	25A	-	-	-	95	115	95	70	245	160	120	95	70	225	160	100	70
	32A	-	-	-	110	-	100	90	-	175	140	120	90	230	180	130	90
	40A	NA	NA	NA	NA	-	-	110	-	-	-	130	110	-	-	-	110
0°C	6A	80	55	35	20	25	20	15	60	35	25	20	15	50	35	20	15
	10A	135	95	55	35	45	35	25	100	60	45	35	25	85	60	40	25
	13A	175	120	75	45	60	45	35	130	80	60	45	35	115	80	50	35
	16A	200	150	90	55	70	55	40	160	100	75	55	45	140	100	60	45
	20A	-	160	115	70	90	70	55	200	125	90	70	55	175	125	80	55
	25A	-	-	125	90	115	90	65	245	155	115	90	70	220	160	100	70
	32A	-	-	-	110	-	100	85	-	175	140	115	90	230	180	125	90
	40A	NA	NA	NA	NA	-	-	105	-	-	-	130	110	-	-	130	110
-10°C	6A	65	45	30	15	25	20	15	55	35	25	20	15	50	35	20	15
	10A	110	80	50	30	40	30	25	95	60	45	35	25	85	60	35	25
	13A	145	100	65	40	55	40	30	120	75	55	45	35	110	80	50	35
	16A	180	125	80	50	65	50	40	150	95	70	55	40	135	95	60	45
	20A	200	160	100	60	85	65	50	190	120	85	70	50	170	120	75	55
	25A	-	-	125	80	105	80	60	235	150	110	85	65	210	150	95	65
	32A	-	-	-	100	115	100	80	245	175	140	110	85	230	180	120	85
	40A	NA	NA	NA	NA	-	-	100	-	-	-	130	105	-	-	130	110
-20°C	6A	55	40	25	15	20	15	15	50	35	25	20	15	45	35	20	15
	10A	95	70	45	25	40	30	20	90	55	40	30	25	80	60	35	25
	13A	125	90	55	35	50	40	30	115	75	55	40	30	105	75	45	35
	16A	155	110	70	45	60	50	35	145	90	65	55	40	130	95	60	40
	20A	195	140	90	55	75	60	45	180	115	85	65	50	165	120	70	50
	25A	200	160	110	70	95	75	60	225	145	105	85	65	205	150	90	65
	32A	-	-	125	90	115	100	75	245	175	135	105	80	230	180	115	85
	40A	NA	NA	NA	NA	-	-	95	-	-	140	135	105	-	-	130	105

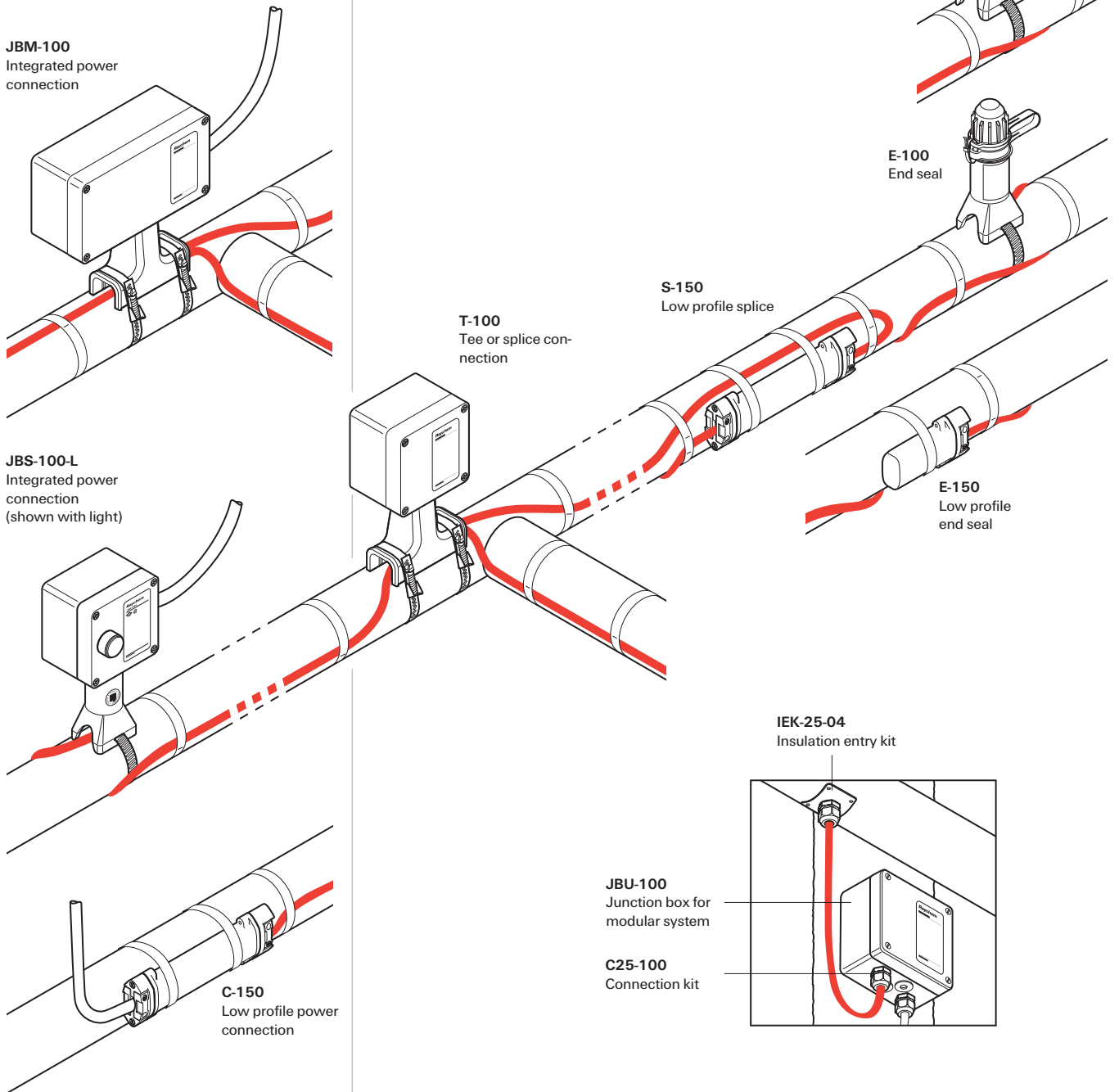
\* NA: Not allowed

## 3.0 Components and accessories selection

### Components and accessories

1. Power connections
2. Splices and Tees
3. End seals
4. Thermostats
5. Accessories

A complete range of cold applied components and accessories is available for all BTV, QTVR, XTV and KTV heating cable types. All of the components work together to provide a safe and reliable heat-tracing system that is easy to install and maintain. Raychem components must be used to ensure proper functioning of the product and compliance with relevant standards and regulations. A heat-tracing system consists of at least one power connection and one end seal. Additional components such as splices and tees are used as required.



## Power connections

### Components and accessories

1. Power connections
2. Splices and Tees
3. End seals
4. Thermostats
5. Accessories

Power connections may be mounted on or off the pipe. For pipe mounted applications, select one of the integrated components below. For mounting off the pipe, select a separate junction box and the necessary connection kits and insulation entry kits from the modular components table on the next page. The kits can be used with Raychem industrial heating cables: BTV, QTVR, XTV and KTV.

The power connections JBS, JBM and JBU can also be ordered with a green light for simple indication if power is on.

### Integrated components

Integrated components combine the functions of the junction box, connection, insulation entry, and support bracket. These components provide full protection of the heating cable for safe operation. The cold-applied core sealing and innovative WAGO cage clamp terminals ensure reliable connections and significantly reduce installation time. The integrated components are designed for industrial applications and are approved for use in hazardous areas.

Threads are metric (M25).

### Above the insulation

**JBS-100-E** Integrated power connection for 1 heating cable. Cold applied. One power cable gland included. Requires 1 pipe strap, to be ordered separately. Part number P/N: 829939-000 With green light, order reference: JBS-100-L-E (P/N 054363-000)

**JBS-100-EP** Integrated power connection for 1 heating cable. Includes earth plate and earth stud for use with armoured cables. Cold applied. Requires 1 pipe strap and 1 metal power cable gland to be ordered separately. Part number P/N: 158251-000 With green light, order reference: JBS-100-L-EP (P/N 075249-000)

**JBM-100-E** Integrated power connection for up to 3 heating cables. May also be used for tee and splice connections. Cold applied. One power cable gland included. Requires 2 pipe straps, to be ordered separately. Part number P/N: 831519-000 With green light, order reference: JBM-100-L-E (P/N 395855-000)

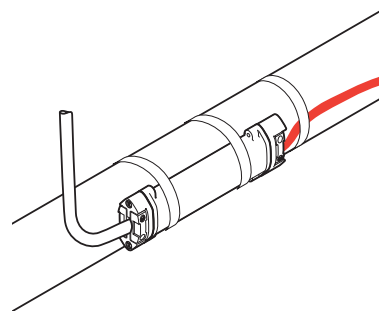
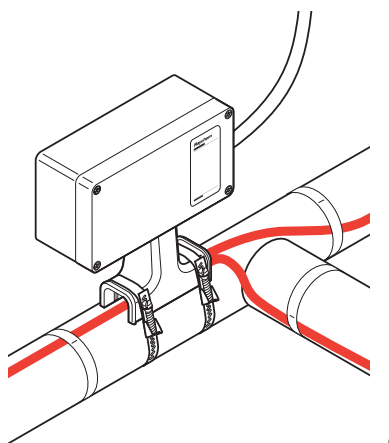
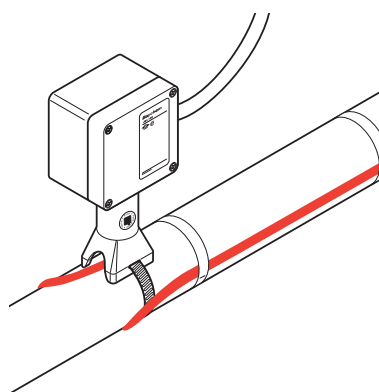
**JBM-100-EP** Integrated power connection for up to 3 heating cables. Includes earth plate and earth stud for use with armoured cables. May also be used for tee and splice connections. Cold applied. Requires 2 pipe straps and 1 metal power cable gland to be ordered separately. Part number P/N: 986415-000 With green light, order reference: JBM-100-L-EP (P/N 300273-000)

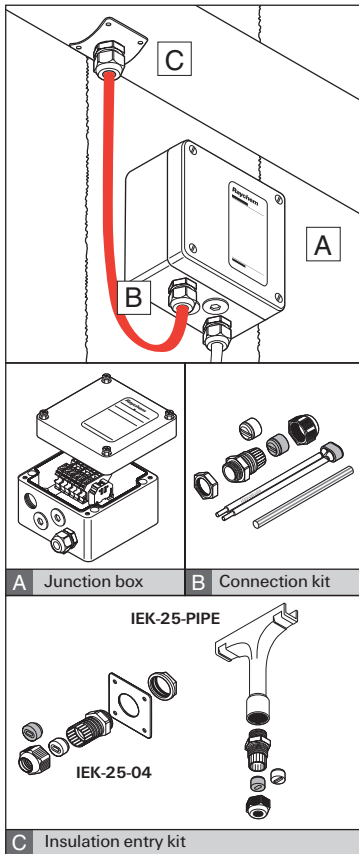
### Under the insulation

**C-150-E** Low profile power connection for 1 heating cable. Maximum load of 25A Cold applied Suitable for non-armoured power cables up to 2.5 mm<sup>2</sup> with stranded copper conductors C-150-E is used as a connector:

- where connection to a junction box is difficult e.g. because of space limitations
- on instrument lines or loading arms
- where installation of under insulation components is preferred
- as a cost effective alternative for JBS-100-E on short lines

Part number P/N: 073704-000





## Modular components

Modular components are used for making power connections for up to 3 heating cables. The junction boxes are designed for surface mounting, and versions for both hazardous and non-hazardous areas are available. The JBU-100 includes the innovative cage clamp terminals from WAGO. The connection kits and insulation entry kits are cold applied and have to be ordered separately. Select one junction box for each circuit. Select one connection kit and one insulation entry kit for each heating cable terminated in the junction box. Optionally a conduit system for mechanical protection of the heating cable where it transitions from the junction box to the pipe can be selected.

### Metric system (M25)

	Hazardous	Non-Hazardous
<b>A Junction boxes</b>		
For non-armoured power cable	JBU-100-E <sup>(1)</sup>	JB-82
For armoured power cable	JBU-100-EP <sup>(1)(2)</sup>	–
<b>B Connection kits</b>		
	C25-100	C25-100
<b>C Insulation entry kit</b>		
For pipes, vessels, pumps and instruments	IEK-25-04	IEK-25-04
For pipes	IEK-25-PIPE <sup>(3)</sup>	IEK-25-PIPE <sup>(3)</sup>
<b>D Conduit system</b>		
For medium temperature applications	CCON25-100 + CCON-CMT-2M	CCON25-100 + CCON-CMT-2M
For high temperature applications	CCON25-100 + CCON-CHT-2M	CCON25-100 + CCON-CHT-2M

<sup>(1)</sup> with green light, order reference: JBU-100-L-E or JBU-100-L-EP

<sup>(2)</sup> includes internal earth plate and earth stud; requires metal power cable gland, to be ordered separately.

<sup>(3)</sup> requires 2 pipe straps, to be ordered separately

## Splices and Tees

### Components and accessories

1. Power connections
2. Splices and Tees
3. End seals
4. Thermostats
5. Accessories

For in-line joining or making T-connections of the heating cables. Approved for use in hazardous areas (Ex e).

### Above the insulation

#### JBM-100-E

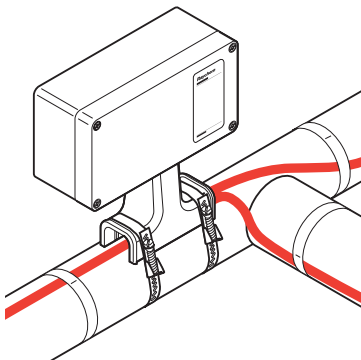
For making splice or tee connections with terminals above the insulation.

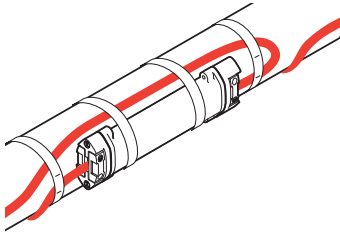
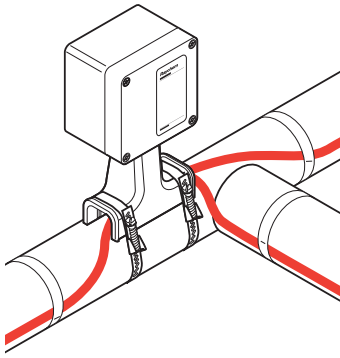
Cold applied.

Requires 2 pipe straps, to be ordered separately.

Part number P/N: 83 15 19-000

With internal earth plate and earth stud, order reference: JBM-100-EP (P/N 9864 15-000)





T-100

For making tee or splice connections with crimps above the insulation.  
Cold applied.  
Requires 2 pipe straps, to be ordered separately.  
Part number P/N: 447379-000  
Required crimp tool, reference: T-100-CT (P/N 954799-000)  
(Panduit: CT-1570)

**Under the insulation**

S-150

For making splice connections with terminals under the insulation.  
Cold applied.  
Part number: 497537-000

**End seals**

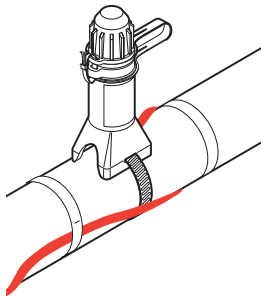
<b>Components and accessories</b>
1. Power connections
2. Splices and Tees
3. End seals
4. Thermostats
5. Accessories

End seals are used for terminating the heating cable. Approved for use in hazardous areas. Select 1 end seal for each remote heating cable end.

**Above the insulation**

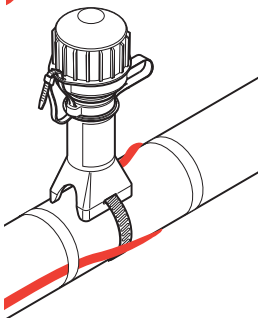
E-100-E

Mechanical end seal (Ex e).  
Cold applied.  
Requires 1 pipe strap, to be ordered separately.  
Part number: 101255-000



E-100-L2-E

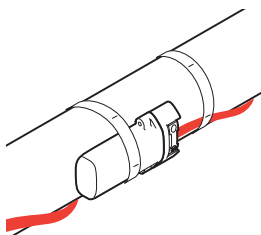
Mechanical end seal with green LED light module (Ex em).  
Cold applied.  
Requires 1 pipe strap, to be ordered separately.  
Part number: 726985-000



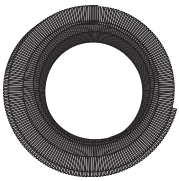
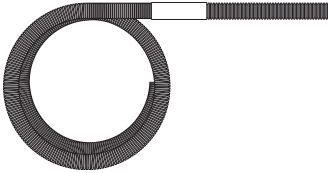
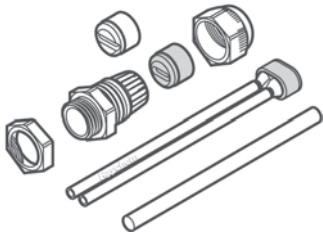
**Under the insulation**

E-150-E

Low profile end seal (Ex e).  
Cold applied.  
Part number: 979099-000







CCON25-100	Conduit connection kit for parallel heating cables. Part number: 1244-003272
CCON25-CMT-2M	Medium temperature conduit for parallel heating cables, 2m pre-cut length. Part number: 1244-003281
CCON25-CHT-2M	High temperature conduit for parallel heating cables, 2m pre-cut length. part number: 1244-003284
CCON25-CMT-25M	Medium temperature conduit for parallel heating cables, 25m spool. Part number: 1244-003280
CCON25-CHT-25M	High temperature conduit for parallel heating cables, 25m spool. part number: 1244-003284
CCON25-CMT/ HT-1.67/0.33M	Mixed medium temperature conduit (1.67m) with high temperature conduit (0.33m) joined with a heat shrink sleeve Part number: 1244-003474

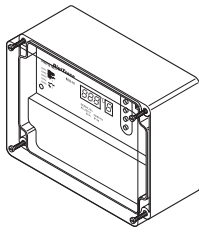
## Thermostats

<b>Components and accessories</b>
1. Power connections
2. Splices and Tees
3. End seals
4. Thermostats
5. Accessories

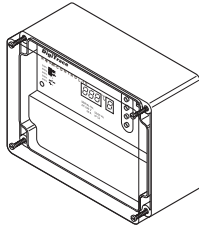
Thermostats may be required for process temperature maintenance (surface sensing) or freeze protection (ambient sensing) applications. Use the table below to select the appropriate thermostat. For surface sensing, select one thermostat per circuit. For ambient sensing, select one thermostat per site.

For significant reductions in energy consumption in freeze protection applications, select the RAYSTAT-ECO-10. This electronic thermostat continuously matches the heat-tracing output to the pipe heat loss based on the ambient temperature.

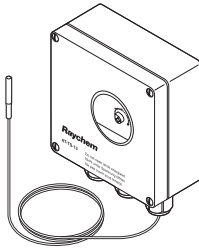
Area	Type	Catalogue number
Non-hazardous	Ambient sensing	AT-TS-13
	Proportional Ambient sensing	RAYSTAT-ECO-10
	Surface sensing	AT-TS-14 RAYSTAT-CONTROL-10
Hazardous	Ambient sensing	RAYSTAT-EX-04 (electronic)
	Surface sensing	RAYSTAT-EX-02 (mechanical) RAYSTAT-EX-03 (electronic)



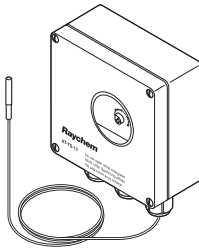
**RAYSTAT-ECO-10** Proportional ambient sensing controller for use in non-hazardous areas  
 Sensor type: 3-wire RTD (Pt 100)  
 Mounting: surface mounted  
 Setpoint range: 0°C to +30°C  
 Switching capacity: 25A  
 Includes an alarm relay to allow remote indication of system status  
 Part number: 145232-000



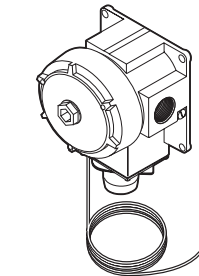
**RAYSTAT-CONTROL-10** Electronic surface sensing thermostat for use in non-hazardous areas  
 Sensor type: 3-wire RTD (Pt 100)  
 Mounting: surface mounted, or pipe mounted using SB-100 or SB-101(option)  
 Setpoint range: 0°C to +150°C  
 Switching capacity: 25A  
 Includes an alarm relay to allow remote indication of system status  
 Part number: 828810-000



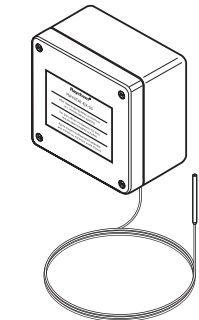
**AT-TS-13** Electronic ambient sensing thermostat for use in non-hazardous areas  
 Sensor type: PTC KTY 83-110  
 Mounting: wall mounted, or pipe mounted using SB-110 or SB-111(option)  
 Setpoint range: -5°C to +15°C  
 Switching capacity: 16A  
 Part number: 728129-000



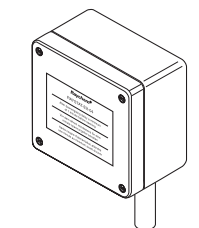
**AT-TS-14** Electronic surface sensing thermostat for use in non-hazardous areas  
 Sensor type: PTC KTY 83-110  
 Mounting: surface mounted, or pipe mounted using SB-110 or SB-111 (option)  
 Setpoint range: 0°C to +120°C  
 Switching capacity: 16A  
 Part number: 648945-000



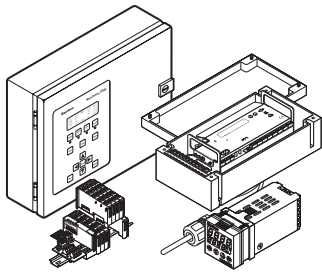
**RAYSTAT-EX-02** Mechanical surface sensing thermostat for use in hazardous areas  
 Sensor type: bulb and capillary  
 Sensor length: 3 m  
 Approval:  $\text{Ex}$  II 2GD Ex d IIC T6 (Ta -40°C to +60°C)  
 Ex tD A21 IP6X T80°C (-40°C ≤ Tamb ≤ +60°C)  
 Mounting: on pipe with SB-100 or SB-101 (option) or surface mounted  
 Setpoint range: -4 to +163°C  
 Switching capacity: 22 A  
 Cable gland (3/4" NPT) to be ordered separately: for armoured cable use GL-33; for non-armoured cable use GL-34  
 Part number: 404385-000



**RAYSTAT-EX-03** Electronic surface sensing thermostat for use in hazardous areas  
 Sensor type: 2 wire RTD (Pt 100)  
 Sensor length: 2 m  
 Approval:  $\text{Ex}$  II 2 GD T=85°C Ex emia IIC T6 (-50°C ≤ Ta ≤ 55°C)  
 Mounting: on pipe with SB-100 or SB-101 (option) or surface mounted  
 Setpoint range: 0 to +499°C  
 Switching capacity: 16 A  
 Part number: 333472-000



**RAYSTAT-EX-04** Electronic ambient sensing thermostat for use in hazardous areas  
 Approval:  $\text{Ex}$  II 2 GD T=85°C Ex emia IIC T6 (-50°C ≤ Ta ≤ 55°C)  
 Mounting: on pipe with SB-100 or SB-101 (option) or surface mounted  
 Setpoint range: 0 to +49°C  
 Switching capacity: 16 A  
 Part number: 462834-000



## Control and Monitoring products

In addition to products in this document, Tyco Thermal Controls also offers control & monitoring units ranging from single up to hundreds of circuits. For further information, refer to the Product Catalogue for Industrial Heat-Tracing Systems, visit our website ([www.tycothermal.com](http://www.tycothermal.com)) or contact your Tyco Thermal Controls representative.

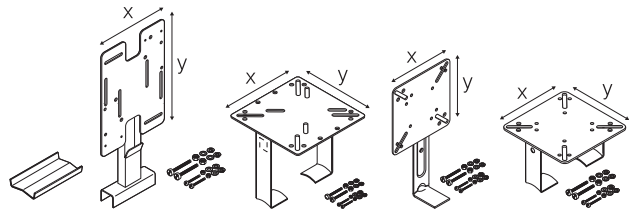
## Accessories

### Components and accessories

1. Power connections
2. Splices and Tees
3. End seals
4. Thermostats
5. Accessories

## Stainless steel support brackets

Support brackets are used to fix equipment such as thermostats or junction boxes on pipes. Support brackets require additional pipe straps which are to be ordered separately. They include a set of M6 and/or M4 fixing screws, nuts, washers and spring lock washers for the fixation of one junction box or thermostat. The table below outlines the typical compatibility of each bracket with relevant equipment, for other equipment please contact your Tyco Thermal Controls representative.



	SB-100	SB-101	SB-110	SB-111
AT-TS-13	x	x	x	x
AT-TS-14	x	x	x	x
JBU-100-E	x	x		
JBU-100-EP	x	x		
RAYSTAT-CONTROL-10	x	x		
RAYSTAT-ECO-10	x	x		
RAYSTAT-EX-02	x	x	x	x
RAYSTAT-EX-03	x	x		
RAYSTAT-EX-04	x	x		
Technical data				
plate size (mm) X x Y	160 x 230	160 x 160	130 x 130	130 x 130
distance pipe-plate (mm)	100	160	100	100
number of pipe straps required	2	2	1	2
Part number	192932-000	990944-000	707366-0000	579796-000

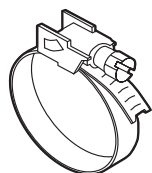


## Warning labels

Warning labels indicate the presence of electrical heat-tracing under the insulation of the pipe or other equipment. (min. of 1 label per 5 m of heat-tracing line).

Language	Label reference	PN
Croatian	LAB-ETL-HR	938764-000
Czech	LAB-ETL-CZ	731605-000
Danish	LAB-ETL-DK	C97690-000
Dutch	LAB-I-23	749153-000
English	LAB-I-01	938-947-000
Finnish	LAB-ETL-SF	756479-000
French	LAB-ETL-F	883061-000
German / French / Italian	LAB-ETL-CH	148648-000
German	LAB-ETL-G	597779-000
Hungarian	LAB-ETL-H	623725-000
Italian	LAB-ETL-I	C97688-000
Latvian	LAB-I-32	841822-000
Lithuanian	LAB-ETL-LIT	105300-000
Norwegian	LAB-ETL-N	C97689-000
Norwegian / English	LAB-ETL-NE	165899-000
Polish	LAB-ETL-PL	258203-000
Portugese	LAB-ETL-POR	945960-000
Romanian	LAB-ETL-RO	902104-000
Russian	LAB-ETL-R	574738-000
Slovenian	LAB-ETL-SLO	538156-000
Spanish	LAB-ETL-SPANISH	C97686-000
Swedish	LAB-ETL-S	691703-000

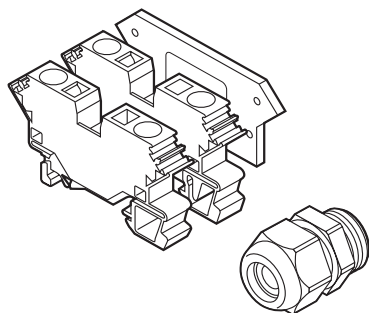
## Pipe straps



Are used for fixing components. Select the appropriate pipe strap (stainless steel) according to the pipe diameter. For JBS-100, JBM-100, E-100, E-100-L, T-100 and IEK-25-PIPE, add 25 mm to the pipe diameter.

Pipe outer diameter in mm	(inches)	Pipe strap	Part number
20-47	(1/2" - 1 1/4")	PSE-047	700333-000
40-90	(1 1/4" - 3")	PSE-090	976935-000
60-288	(2" - 10")	PSE-280	664775-000
60-540	(2" - 20")	PSE-540	364489-000

## Thermostat kit



HWA-WAGO-TSTAT-KIT

Kit with supplementary terminals to connect thermostat type RAYSTAT-EX-02 to the junction boxes JBS, JBM and JBU.

The kit includes 2 terminals WAGO 284 series (1 x L, 1 x PE) and 1 power cable gland GL-36-M25. Part number: 966659-000



## Fixing tape

Select the tape according to the pipe material.  
Applied in 3 turns every 300 mm across heating cable.  
Determine the quantity from the table below.

$$\text{Number of rolls} = \frac{\text{Total pipe length}}{\text{m of pipe per roll}}$$

Add another 20% to allow for fixing the heating cable on valves, flanges, etc. if appropriate.

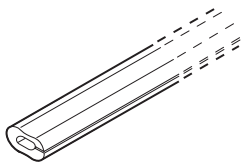
GT-66 Standard glass cloth tape.  
For carbon steel pipes.  
20 m per roll.  
Part number: C77220-000

GS-54 Glass cloth tape with low halogen content.  
For carbon and stainless steel pipes.  
16 m per roll.  
Part number: C77221-000

For the use of aluminium tape as heat transfer aid, use TraceCalc Pro or TraceCalc Net or consult your Tyco Thermal Controls representative.

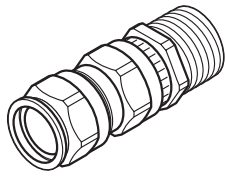
Pipe size Ø mm	Ø inches	GT-66 m of pipe per roll	GS-54 m of pipe per roll
8	1/4"	46.5	37.2
15	1/2"	29.9	23.9
20	3/4"	23.8	19.1
25	1"	19.1	15.2
32	1 1/4"	15.1	12.1
40	1 1/2"	13.2	10.5
50	2"	10.6	8.4
65	2 1/2"	8.7	7.0
80	3"	7.2	5.7
100	4"	5.6	4.5
150	6"	3.8	3.0

## Protective grommet



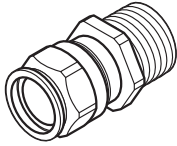
G-02 Protective grommet to protect the heating cable from mechanical damage (e.g. at a sharp edge).  
Supplied in 1 m sections, to be cut to length.  
Part number: 412549-000

## Glands



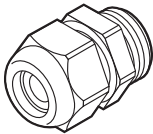
GL-33

3/4" NPT cable gland (Ex d II C) for RAYSTAT-EX-02.  
Nickel plated brass.  
For use with armoured power cables.  
Part number: 493217-000



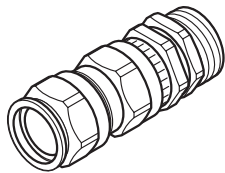
GL-34

3/4" NPT cable gland (Ex d II C) for RAYSTAT-EX-02.  
Nickel plated brass.  
For use with non-armoured power cables.  
Part number: 931945-000



GL-36-M25

M25 power cable gland (Ex e).  
Polyamide.  
For use with non-armoured power cables with outer diameter range 8–17 mm.  
Spare part for JBS-100, JBM-100 and JBU-100.  
Part number: 774424-000

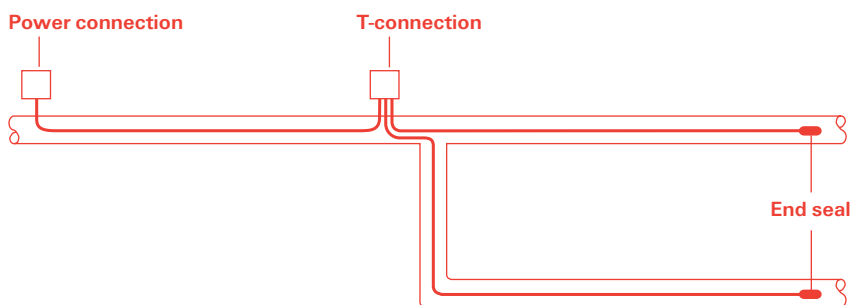


GL-38-M25-METAL

M25 cable gland (Ex e II and Exd II C) for boxes with earth plate (-EP).  
Nickel plated brass.  
For use with armoured power cables.  
Part number: 056622-000

## Example

Example:



Area classification: Hazardous  
Power cables, non-armoured  
Pipe Ø: 50 mm  
Heating cable type: 8XTV2-CT-T3  
Heating cable length: 39 m

**Bill of materials**  
1 x JBS-100-E integrated power connection  
1 x T-100 T-connection  
2 x E-100 end seal kit  
8 x LAB-I-01 warning label  
5 x PSE-090 pipe strap  
4 x GT-66 fixing tape

Fax/email to: .....

**Fax from**

Name .....

Company .....

Fax n° ..... Date .....

**Project parameters**

Project name and location .....

Done for .....

Done by .....

Tel ..... Fax .....

**Design parameters**

Application  Frost protection  Temperature maintenance

Condensation prevention

---

Temperatures

Maintain temperature ..... °C

Ambient temperature min. .... °C max. .... °C

Process temperature continuous: ..... °C  
intermittent (upset) max.: ..... °C

Max. pipe temperature ..... °C

Max. allowed pipe temperature ..... °C

Start-up temperature ..... °C

Pipes are steam-cleaned  yes  no max. temp. .... °C

Voltage  230 Vac  Other ..... Vac

Indoors  Outdoors

---

Insulation type  Mineral wool (Rockwool)

Other ..... Insulation k-factor @ 10°C ..... W/(m · K)

---

Area Classification  Zone 1  Zone 2  Zone 11  Zone 21  Non-Hazardous

---

Temperature Classification  T1  T2  T3  T4  T5  T6  Non-Hazardous

---

Pipe material  Steel  Stainless steel  PE  PVC  Other .....

**Lines**


	Ref. No	Diameter (mm)	Insulation thickness (mm)	Pipe length (m)	Pipe supports		Valves /Pumps etc...		Flanges
					Type	N°	Type	N°	N°
1									
2									
3									
4									
5									
6									
7									
8									

# Raychem®

## Raychem Heat-Tracing Systems

- Safe and reliable
- Easy project design
- Self-regulating technology
- Steam-cleanable systems
- Unique and safe construction
- Cold applied components
- Support by a quality organisation



 Our products satisfy the requirements of the relevant European Directives.

[www.tycothermal.com](http://www.tycothermal.com)

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**tyco**  
Thermal Controls

We manage the heat you need

**AMERICAS**  
**Worldwide Headquarters**  
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**Tyco Thermal Controls**  
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Fax: 610-993-1226

**Tyco Thermal Controls**  
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Fax: 708-824-3030

**Tyco Thermal Controls**  
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Fax: 650-474-7761

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Fax: 800-527-5703  
Tel: 613-392-6571  
Fax: 613-392-3999

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Tel: 780-455-8111  
Fax: 780-455-8115

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Fax: 519-894-11011

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