

PIROWATT - High Power Cartridge Heaters -

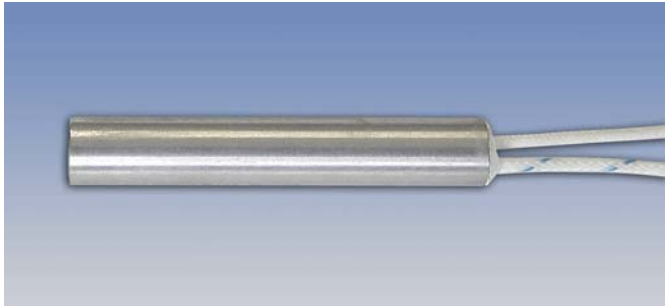
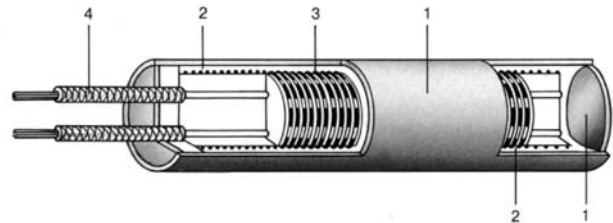


Figure 1



GENERAL CHARACTERISTICS

These heaters are characterised by a **high specific power and a high reliability**: These qualities are essential in the applications for which they have been conceived. These heaters can reach specific powers as high as 50 W/cm² and operating temperatures up to 750 °C. PIROWATT cartridge heaters power supply cables are embedded into the heater head (see Figure 1) without junctions or stiff parts: this manufacturing solution has eliminated all the problems and allows to limit the non-heating ("neutral") section to a 3 ÷ 4 mm.

These heaters undergo final acceptance testing as required by EN 60335-1 specification and are manufactured to comply with VDE 0720 specifications.

APPLICATIONS

These heaters are used in the heating of moulds, plates, injection nozzles and hot-channel injection nozzles. They can be employed, inserted into appropriate slots, in the heating of all metallic masses, provided that the operating temperature does not exceed 750 °C.

TECHNICAL DATA (see Figure 1)

1. **METALLIC SHEATH** made of stainless steel suitable for high temperatures. The sheath surface is ground and the bottom is water-tight and corrosion resistant
2. **ELECTRICAL INSULATION** made of highly concentrated pure magnesium oxide
3. **RESISTIVE WINDING** made of Nickel/Chrome 80/20
4. **POWER SUPPLY** provided by a couple of pure nickel conductors, with a silicone-impregnated fibreglass insulation.

DIMENSIONS

PIROWATT cartridge heaters are available on stock in several dimensions which differ in diameter and/or length (see table below).

For all heaters the dimensional tolerances are $\phi_{-0.02}^{-0.08}$ for the nominal diameter and $\pm 1.5\%$ (with a maximum of 2 mm) for the length. The nominal length is the real cartridge length.

POWER

PIROWATT heaters are normally manufactured with a specific power of about 25 W/cm² but it is possible to manufacture them up to 50 W/cm².

PIROWATT heaters heating power is constant even if they belong to different production lots: the nominal power is guaranteed with a tolerance of $\pm 10\%$. Thanks to this

characteristic it is possible to insure an overall stability of the heating system also after the replacement of several heaters.

COUPLING SLOT

PIROWATT heaters shall be inserted into appropriate slots which have been machined inside the mass to be heated. A Slots surface finishing shall be very good for the coupling to be optimum: the presence of scores or grooves creates stagnant air pockets which, even if very small, insulate thermally the heater causing locally a strong increase of the temperature and a reduction of the heater life (see also Figure 2).

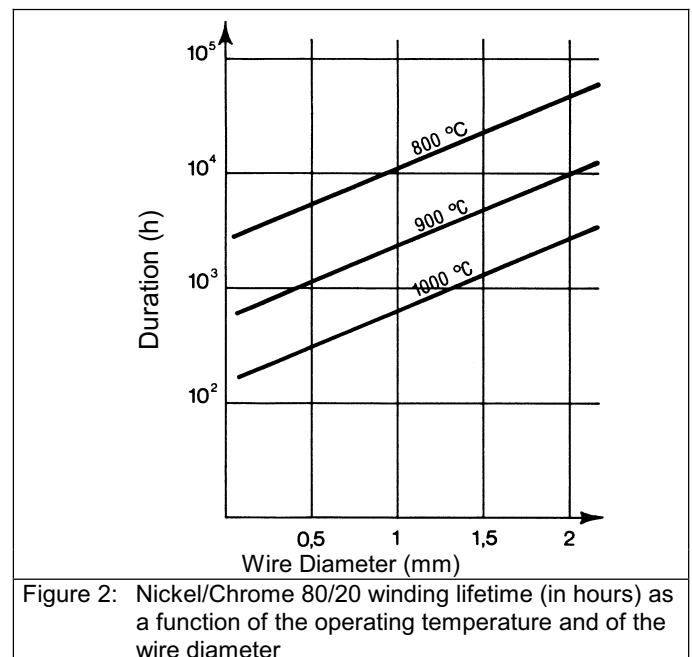


Figure 2: Nickel/Chrome 80/20 winding lifetime (in hours) as a function of the operating temperature and of the wire diameter

The cartridge heater, when hot, expands by few cents of a mm. Hence the tolerances on the slot dimensions is less important than the surface finishing quality. The best result is obtained with an H7 reamer.

ELECTRICAL CONNECTION

The connection to the power supply (monophase) is normally via a couple of nickel cables. Upon request, special cable terminals (see section "Special Constructions") can be provided.

HEATERS WITH EMBEDDED THERMOCOUPLE

When there is not enough room for the separate installation of a thermocouple, heaters with embedded thermocouple can be used.

Standard heaters, available on stock, contain a J-type thermocouple with an Iron/Constantan junction. The thermocouple is located close to the bottom of the heater and is isolated from the metallic sheath.

Other constructions are possible too. Please consult section "Special Constructions"

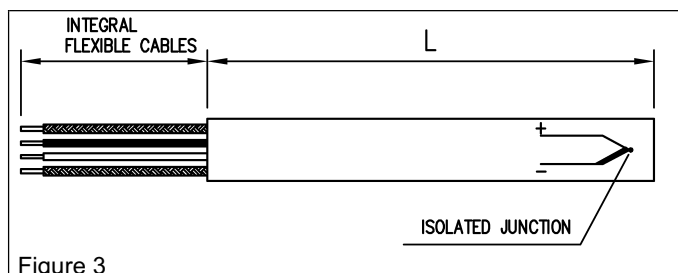


Figure 3

INSTALLATION INSTRUCTIONS

Each heater shall be inserted into its appropriate slot. Please make sure that the surface finishing of the slot is very good (see section "Coupling Slot"). To prevent a blockage of the heater within the slot after a long period of operation, NEVER-SEEZ lubricant (see data sheet in Figure 4) can be used. This product, however, shall not be used to compensate poor finishing conditions of the slots: i.e. it is not possible to use this lubricant to fill scores, grooved, excessive clearance.

Heaters cables shall be installed such that rubbing and pressure points are avoided: this, in fact, is necessary to avoid an early damage of the insulation. Under this respect, it shall be verified that the movements of the heated masses do not damage the electrical connection areas.

Silicone-rubber insulated cables should be used in place of fibreglass-silicone ones (see section "Special Constructions") whenever the environmental temperature allows to do so.

These cables, in fact, can provide the best flexibility, especially if they are spiral-winded



Figure 4: NEVER-SEEZ Lubricant

Very effective against corrosion, makes the heater extraction easier after a long operational period.

Operating Temperature: -180 °C / + 1200 °C

SUGGESTIONS FOR THERMAL CONTROL

The adoption of a proper thermal control system is a key parameter if an efficient heating of the mass to be heated is desired. In addition, such systems allow to insure the longest lifetime to the heaters.

First of all, it is recommended to locate the temperature sensors, as much as possible, at equal distance from the surrounding heaters: this will avoid (see also Figure 5) excessive heating (high thermal inertia due to an excessive distance between sensor and heater - ①) or high-frequency heating cycles (too rapid response caused by a too short distance between sensor and heater - ②).

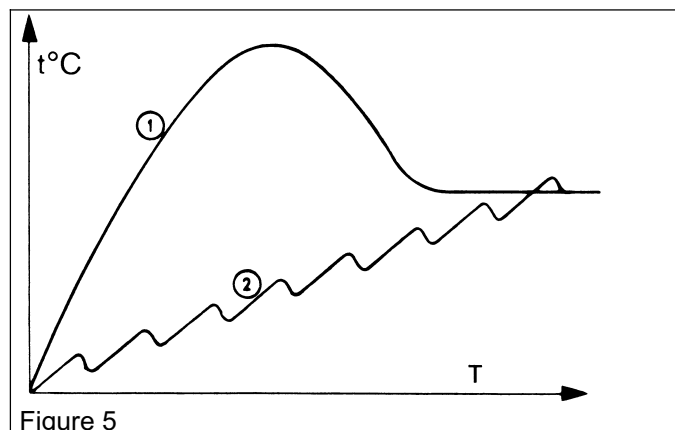


Figure 5

The use of thermo-regulators using SCR components is recommended. These systems, in fact, turn the heaters ON only when the sinusoidal curve crosses the zero ("Zero crossing" activation) thus reducing considerable the thermal shocks on the heater resistive winding (See Figure 6 – point ①)

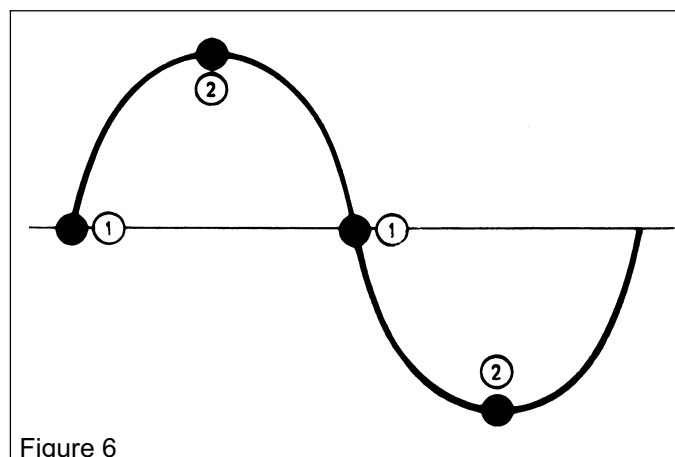


Figure 6

ON/OFF regulators can turn the heaters ON in any point of the sinusoidal curve (see Figure 6 – point ②) causing very high thermal shocks on the heater winding and a consequent reduction of the heater lifetime.

PIROWATT-HLP HEATERS

- Inclusive of flexible cables – Metric sizes -



inclusive of flexible cables L = 500 mm

ØD mm	L mm	Power (Watt at 230V)	Code	ØD mm	L mm	Power (Watt at 230V)	Code	ØD mm	L mm	Power (Watt at 230V)	Code			
6.5 -0,02 -0.08	40	100	100650400100	10 -0,02 -0.08	100	220	101001000220	16 -0,02 -0.08	60	160	101600600160			
		125	100650400125			250	101001000250			250	101600600250			
		160	100650400160			350	101001000350			400	101600600400			
		175	100650400175			560	101001000560			500	101600600500			
	200	100650400200	700			101001000700	630			101600600630				
	100	100650500100	850			101001000850	280			101600800280				
	50	160	100650500160			315	101001300315		400	101600800400				
		200	100650500200			500	101001300500		630	101600800630				
		250	100650500250			800	101001300800		800	101600800800				
		125	100650600125			400	101001600400		1000	101600801000				
	60	200	100650600200			800	101001600800		350	101601000350				
		250	100650600250			1000	101002001000		500	101601000500				
		315	100650600315		100	101250400100	800		101601000800					
		125	100650800125		160	101250400160	1000		101601001000					
	80	180	100650800180		250	101250400250	1250		101601001250					
		280	100650800280		315	101250400315	500		101601300500					
		350	100650800350		400	101250400400	700		101601300700					
		160	100651000160		100	101250500100	1100		101601301100					
	100	220	100651000220		200	101250500200	1400		101601301400					
		350	100651000350		315	101250500315	1800		101601301800					
		100	100800400100		400	101250500400	630		101601600630					
		160	100800400160		500	101250500500	900		101601600900					
	8 -0,02 -0.08	40	200		100800400200	12.5 -0,02 -0.08	60		125	101250600125	20 -0,02 -0.08	160	1600	101601601600
			250		100800400250				200	101250600200			1800	101601601800
125			100800500125	315	101250600315			800	101602000800					
200			100800500200	400	101250600400			1250	101602001250					
250		100800500250	500	101250600500	2000			101602002000						
315		100800500315	200	101250800200	1000			101602501000						
50		100	100800600100	315	101250800315			1600	101602501600					
		140	100800600140	500	101250800500			1250	101603001250					
		220	100800600220	630	101250800630			1800	101603001800					
		280	100800600280	800	101250800800			200	102000600200					
60		350	100800600350	250	101251000250			315	102000600315					
		160	100800800160	400	101251000400			500	102000600500					
		200	100800800200	630	101251000630		630	102000600630						
		315	100800800315	800	101251000800		800	102000600800						
80		400	100800800400	1000	101251001000		350	102000800350						
		180	100801000180	400	101251300400		500	102000800500						
		280	100801000280	630	101251300630		800	102000800800						
		400	100801000400	1000	101251301000		1000	102000801000						
100		250	100801300250	1250	101251301250		1250	102000801250						
		400	100801300400	500	101251600500		450	102001000450						
		100	101000400100	800	101251600800		630	102001000630						
		125	101000400125	1250	101251601250		1000	102001001000						
40		200	101000400200	630	101252000630		1400	102001001400						
		250	101000400250	900	101252000900		1600	102001001600						
	315	101000400315	1500	101252001500	630	102001300630								
	100	101000500100	1250	101252501250	900	102001300900								
50	160	101000500160	1000	101253001000	1400	102001301400								
	250	101000500250	1500	101253001500	1800	102001301800								
	315	101000500315	2000	101253002000	2200	102001302200								
	400	101000500400	100	101600400100	800	102001600800								
60	125	101000600125	250	101600400250	1100	102001601100								
	180	101000600180	315	101600400315	1800	102001601800								
	315	101000600315	400	101600400400	2200	102001602200								
	400	101000600400	160	101600500160	1000	102002001000								
80	500	101000600500	250	101600500250	1600	102002001600								
	160	101000800160	400	101600500400	2500	102002002500								
	250	101000800250	500	101600500500	1250	102002501250								
	400	101000800400	630	101600500630	2000	102002502000								
10	500	101000800500			1600	102003001600								
	630	101000800630			2200	102003002200								

PIROWATT-HLP HEATERS

- Inclusive of flexible cables – Imperial sizes -



inclusive of flexible cables L = 500 mm

ØD	L	Power (Watt at 230V)	Code	ØD	L	Power (Watt at 230V)	Code	ØD	L	Power (Watt at 230V)	Code						
1/4" 6.22 mm +0.05	1" 1/2 38.1 mm	100	100630380100	3/8" 9.4 mm +0.05	4"	220	100951010220	5/8" 15.75 mm +0.05	2"	160	101580500160						
		125	100630380125			350	100951010350			250	101580500250						
		160	100630380160			560	100951010560			400	101580500400						
		175	100630380175			700	100951010700			500	101580500500						
		200	100630380200			850	100951010850			630	101580500630						
	2"	50.8 mm	100		100630500100	5"	500			100951270500	2" 1/2	160	101580630160				
			160		100630500160	6"	750			100951520750		250	101580630250				
			200		100630500200	1" 1/2 38.1 mm	2"			50.8 mm		400	101580630400	400	101580630400		
			250		100630500250							500	101580630500	500	101580630500		
			125		100630630125							630	101580630630	630	101580630630		
	200	100630630200	280	101580820280	280				101580820280								
	250	100630630250	400	101580820400	400				101580820400								
	3"	76.2 mm	300	100630760300	2"		50.8 mm		315	101270380315	3" 1/4	630	101580820630				
			125	100630820125					400	101270380400		800	101580820800				
			180	100630820180					100	101270500100		1000	101580821000				
			280	100630820280					200	101270500200		350	101581010350				
			350	100630820350					315	101270500315		500	101581010500				
	4"	101.6 mm	160	100631010160	2"	50.8 mm	400		101270500400	4"	800	101581010800					
			220	100631010220			500		101270500500		1000	101581011000					
			350	100631010350			125		101270630125		1250	101581011250					
			3" 1/4	82.5 mm			125		100630820125		2" 1/2	63.5 mm	200	101270630200	5" 1/4	500	101581330500
							180		100630820180				315	101270630315		700	101581330700
	280	100630820280			400	101270630400	1100		101581331100								
	350	100630820350			500	101270630500	1400		101581331400								
160	100631010160	100			101270630600	1800	101581331800										
3/8" 9.4 mm +0.05	1" 1/2 38.1 mm	100	100950380100	1/2" 12.57 mm +0.05	3"	200	100950380200	101.6 mm	4"	630	101581650630						
		125	100950380125			500	101270760500			900	101581650900						
		200	100950380200			750	101270760750			1600	101581651600						
		250	100950380250			250	101271010250			1800	101581651800						
		315	100950380315			400	101271010400			800	101582030800						
	2"	50.8 mm	100		100950500100	4"	101.6 mm		630	101271010630	6" 1/2	1250	101582031250				
			160		100950500160				800	101271010800		2000	101582032000				
			250		100950500250				1000	101271011000		1000	101582541000				
			315		100950500315				630	101271330630		1600	101582541600				
			400		100950500400				500	101271650500		1250	101583071250				
	2" 1/2	63.5 mm	125	100950630125	6" 1/2	165.1 mm	800		101271650800	8"	1800	101583071800					
			180	100950630180			1250		101271651250		800	101582030800					
			315	100950630315			630		101272030630		1250	101582031250					
			400	100950630400			900		101272030900		2000	101582032000					
			500	100950630500			1500		101272031500		1000	101582541000					
	3"	76.2 mm	250	100950760250	8"	203.2 mm	1500		101272281500	10"	1600	101582541600					
			400	100950760400			1500		101272541500		1250	101583071250					
			3" 1/4	82.5 mm			82.5 mm		82.5 mm		82.5 mm	82.5 mm	82.5 mm	82.5 mm	82.5 mm	82.5 mm	

PIROWATT-HLPT HEATERS WITH EMBEDDED THERMOCOUPLE

- Inclusive of flexible cables -



inclusive of flexible cables L = 500 mm

METRIC SIZES

ΦD (mm)	L (mm)	Power (Watt at 230V)	Code
6.5 -0.02 -0.08	40	100	110650400100
		175	110650400175
	50	200	110650500200
	60	250	110650600250
	100	350	110651000350
8 -0.02 -0.08	40	200	110800400200
	60	200	110800600200
	80	400	110800800400
10 -0.02 -0.08	40	200	111000400200
	50	250	111000500250
	60	400	111000600400
	80	250	111000800250
	160	400	111001600400

IMPERIAL SIZES

ΦD	L	Power (Watt at 230V)	Code
1/4"	1" 1/2 38.1 mm	100	110630380100
		175	110630380175
6.22 mm +0.05	2" 50.8 mm	200	110630500200
	2" 1/2 63.5 mm	250	110630630250
	3" 76.2 mm	300	110630760300
	4" 101.6 mm	350	110631010350
3/8"	1" 1/2 38.1 mm	200	110950380200
	2" 50.8 mm	250	110950500250
	2" 1/2 63.5 mm	315	110950630315
9.4 mm +0.05	3" 1/4 82.5 mm	400	110950820400
	4" 101.6 mm	350	110951010350

SINGLE-POLE PIROWATT-HLP MICRO-HEATERS

- Inclusive of flexible terminal cable -

Current return on external sheath – suitable for operation voltage up to 24 V



inclusive of flexible cables L = 500 mm

ΦD (mm)	L (mm)	Power (Watt at 24V)	Code
4.5 -0.02 -0.04	40	60	10045040060
		100	10045040100
	50	60	10045050060
		100	10045050100
	60	80	10045060080
		125	10045060125
	80	100	10045080100
		160	10045080160
	100	100	10045100100
		160	10045100160

SPECIAL CONSTRUCTIONS

Special cartridge heaters, additional to those available on stock, can be manufactured following dedicated customer requirements. In these cases, the feasibility shall be assessed case by case by our technical department.

The parameter which can be changed, with respect to the standard heaters, are the following:

DIMENSIONS

PIROWATT heaters can be manufactured in all diameters in the range 4.5 ÷ 25 mm and with lengths ranging from 40 mm to 1000 mm.

SUPPLY VOLTAGE

Supply voltage can vary between 6 and 500 Volt. Depending on the heater diameter, however, some limitations exist for the maximum current and the maximum length that can be manufactured. They are summarised in Table 1.

Table 1: limitations in the choice of PIROWATT heaters as a function of the operational current

Cartridge Diameter	6.5	8	10	12.5	16	20	1/4"	3/8"	1/2"	5/8"
Maximum current (A)	4	5	7	14	18	22	4	7	14	18
Cartridge Maximum Length	100	130	260	300	300	300	100	160	260	310
Wires sect. (mm ²)	0.5	0.75	0.75	1	1.5	2.5	0.5	0.75	1	1.5

These limitations are less stringent if the power supply voltage is low (up to 42V) or if special power supply cables are employed, especially if coupled to a bilateral power supply (see examples ③, ④ and ⑤ in Figure 8).

HEATING POWER DISTRIBUTION

Some applications (e.g. packaging machines) require a non uniform distribution of the heating power. In these cases, constructions with the heating power concentrated at the terminal ends (see Figure 7 – sketch ①) can be made. Constructions with alternating hot and cold zones (see sketch ②) are possible too.

Finally, constructions with separate power stages (see examples ③ and ④) are also possible if Φ 12.5 mm heaters are used.

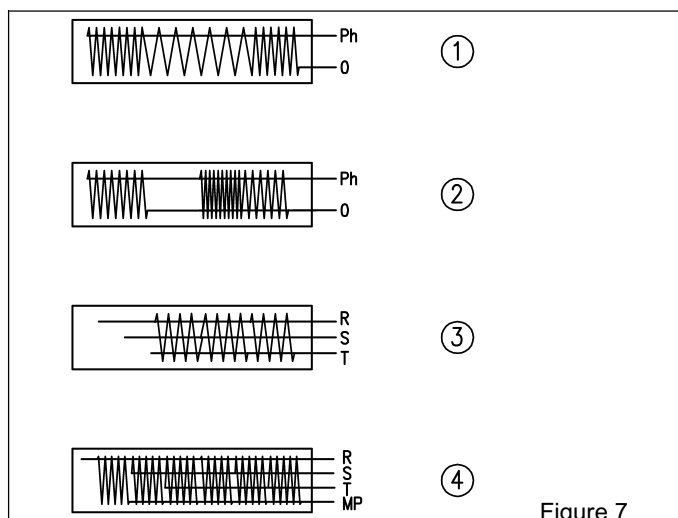


Figure 7

POWER SUPPLY TERMINALS

Upon request, the following power supply terminals can be implemented (see Figure 8):

- ① naked nickel wire type BL or rigid nickel wires type NA
- ② specially insulated cables (this solution is possible if it is requested to increase the length of the neutral section in the terminal area)
- ③④⑤ terminals at both sides (bilateral power supply)
- ⑥⑦⑧ single-pole terminals for low voltage heaters with current return on the external sheath

In all the above cases, supply cables or terminals with lengths different from the standard can be requested.

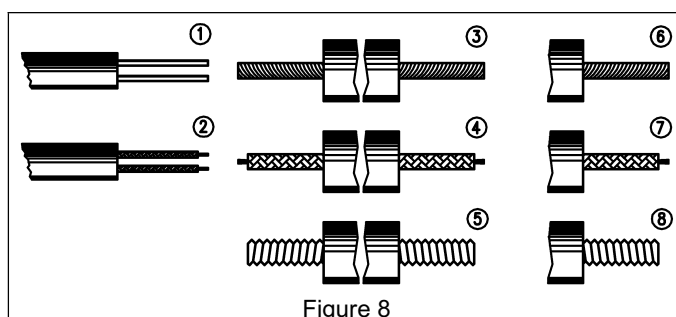


Figure 8

Terminals finishing can also be requested to be different from the standard. The available options are shown in Figure 9.

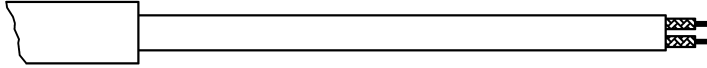
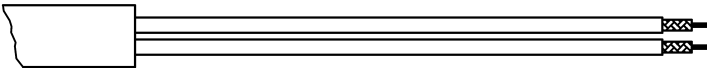
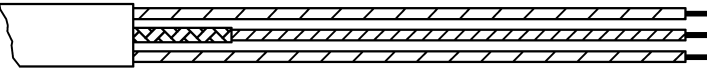
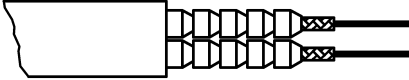



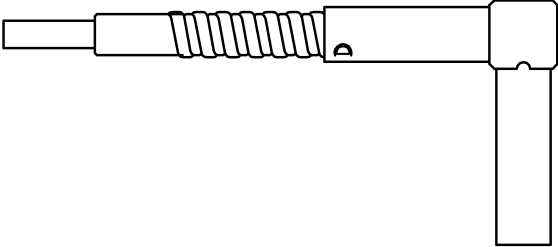
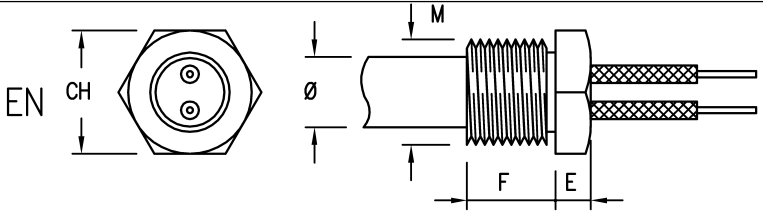
LOW SPECIFIC POWER HEATERS

Several applications require the heating power to be low (see, e.g., the cases of liquids and gases heating).

For these applications, low specific power PIROTERM heaters can be used. These heaters are designed to tailor the customer's requirements and, consequently, are not available on stock.

This specific product line is presented in the last page of this catalogue.

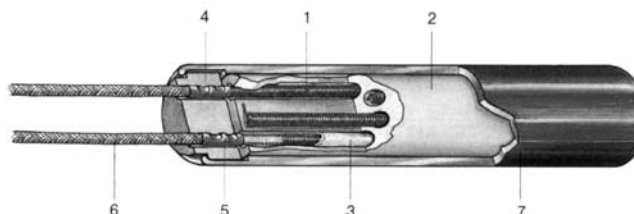
Figure 9: optional solutions for the finishing of the terminals

<p>PROTECTION BY FIBREGLASS SHEATH</p> <p>TYPE S1 – one single sheath incorporated both power supply cables.</p> <p>TYPE S2 – each power supply cable is protected by a dedicated fibreglass sheath.</p>	<p>S1 </p> <p>S2 </p>																																			
<p>WITH GROUNDING CABLE</p> <p>The grounding cable is connected to the heater metallic sheath and is marked to make its identification easier.</p>	<p>E </p>																																			
<p>PROTECTION BY CERAMIC BUSHES</p> <p>For diameters up to Φ 8 mm and operating temperatures above 280 °C.</p>	<p>PA </p>																																			
<p>PROTECTION BY FLEXIBLE METALLIC SHEATH</p> <p>TYPE SSL - protection by a flexible metallic tube made of stainless or zinc plated steel</p> <p>TYPE WSL - protection by a flexible, corrugated, water-tight tube</p> <p>TYPE DRGSL - protection by a zinc plated steel metallic braid</p>	<p>SSL </p> <p>WSL </p> <p>DRGSL </p>																																			
<p>TYPE WAN – SQUARE METALLIC TERMINAL FOR 90° EXIT</p> <p>WAN SSL - with flexible metallic tube</p> <p>WAN WSL -with corrugated, flexible tube</p> <p>WAN DRGSL - with metallic braid</p>	<p>WAN </p>																																			
<p>TYPE EN - THREADED BUSHING WITH HEXAGONAL LEDGE, WATER-TIGHT WELDED</p> <p>EN MS - with brass bushing</p> <p>EN VA - with stainless steel bushing</p>	<p>EN </p> <table border="1"> <thead> <tr> <th>Φ</th> <th>6.5</th> <th>8</th> <th>10</th> <th>12.5</th> <th>16</th> <th>20</th> </tr> </thead> <tbody> <tr> <td>M</td> <td>10 x 1</td> <td>12 x 1.5</td> <td>14 x 1.5</td> <td>16 x 1.5</td> <td>20 x 1.5</td> <td>27 x 1.5</td> </tr> <tr> <td>F</td> <td>7</td> <td>9</td> <td>9</td> <td>10.5</td> <td>13</td> <td>13.5</td> </tr> <tr> <td>E</td> <td>3.5</td> <td>4</td> <td>4</td> <td>4.5</td> <td>5</td> <td>6.5</td> </tr> <tr> <td>CH</td> <td>12</td> <td>14</td> <td>17</td> <td>19</td> <td>24</td> <td>30</td> </tr> </tbody> </table>	Φ	6.5	8	10	12.5	16	20	M	10 x 1	12 x 1.5	14 x 1.5	16 x 1.5	20 x 1.5	27 x 1.5	F	7	9	9	10.5	13	13.5	E	3.5	4	4	4.5	5	6.5	CH	12	14	17	19	24	30
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PIROTERM - Low Specific Power Cartridge Heaters -



Figure 10



GENERAL CHARACTERISTICS

These heaters are characterised by a **low specific power and a high reliability**. These qualities make them suitable for the most different applications.

They consist of a carefully machined stainless steel tube hosting, in intimate contact, a ceramic insulator that is resistant to wide thermal excursions and that provides a good thermal conductivity.

This insulator is drilled to allow the insertion of a nickel/chrome 80/20 spiral whose wire section is defined case by case such that optimum operating conditions can be insured. Magnesium oxide powder surrounds the spiral. The distribution of the powder grain sizes is optimised to fill up any internal volume and guarantee a perfect heat exchange between the spiral and the ceramic insulator.

Power supply is granted by a couple of pure nickel plaits provided with an insulation that is suitable for high temperatures.

APPLICATIONS

These heaters are employed in several applications: in the heating of liquids, gases or metals, in rubber presses, in chills and die-casting moulds, in thermal-welding machines, in footwear moulds, in scientific apparatuses, in freezer or conditioning assemblies, in food processing machines and in packaging plants. More in general these heaters are the best solution whenever a compact, easily adaptable, easily replaceable, extremely safe and long lasting heat source is required.

TECHNICAL DATA (see Figure 10)

- RESISTIVE WINDING** made of Nickel/Chrome 80/20
- MULTI-HOLE TUBE** made of high density steatite characterised by a very high electrical insulation and a very good thermal conductivity
- MAGNESIUM OXIDE** whose granular composition allows high density of the compacted powder, high electrical insulation and optimum heat conduction
- TERMINAL HEAD** made of ceramic material, resistant to thermal shocks, abrasions and vibrations
- CONDUCTOR JUNCTION** made of nickel, joined to the nickel/chrome resistive winding by means of controlled-atmosphere welding
- POWER SUPPLY CABLES** in pure nickel, with silicone-fibreglass insulation.
- METALLIC SHEATH** in stainless steel AISI 304 (or other stainless steel, if required)

DIMENSIONS

PIROTERM cartridge heaters can be manufactured in diameters ranging from Φ 8 to Φ 32 mm e with lengths L up to 2500 mm. The tolerance on the diameter size is a \pm 0.08 mm while for the length it is \pm 1.5 %.

POWER

PIROTERM heaters are manufactured with specific power up to 5 W/cm^2 . The nominal power is granted with a tolerance of \pm 10 %.

Constructions with non uniform power distribution and/or with more heating circuits (see "Heating Power Distribution" section in page 6) are possible as required.

COUPLING SLOT

PIROWATT heaters shall be inserted into appropriate slots which have been machined inside the mass to be heated. A Slots surface finishing shall be very good for the coupling to be optimum: the presence of scores or grooves creates stagnant air pockets which, even if very small, insulate thermally the heater causing locally a strong increase of the temperature and a reduction of the heater life (see also Figure 2).

Under this respect, the considerations made for PIROWATT heaters apply also to PIROTERM.

ELECTRICAL CONNECTION

For the electrical connection (monophase power supply) two nickel cables are normally employed. If requested, the special terminals showed in Figure 11 can be provided.

<p>STANDARD TYPE Incorporated flexible cables length as required</p>	<p>TYPE LCT</p>	
<p>TYPE L</p>	<p>TYPE LS</p>	<ol style="list-style-type: none"> 1) Fibreglass insulated cable with no metal braid 2) Metal braid protected cable 3) Flexible metal tube protected cable
<p>TYPE LC</p>	<p>TYPE LV</p>	<ol style="list-style-type: none"> 1) Fibreglass insulated cable with no metal braid 2) Metal braid protected cable 3) Flexible metal tube protected cable
<p>TYPE LT</p>	<p>TYPE LO</p>	<ol style="list-style-type: none"> 1) Fibreglass insulated cable with no metal braid 2) Metal braid protected cable 3) Flexible metal tube protected cable

To order a PIROTERM heater please specify:

- The diameter D
- The length L
- The power W
- The power supply voltage V
- The length of the power supply cables
- The type of construction