

# Specialty Heaters

## Coil/Cable Heaters

The versatile Watlow cable and coil heater can be formed to a variety of shapes. Cable heaters are small diameter, high-performance units, fully annealed and readily bent to a multitude of configurations.

The heater can be formed into a compact, coiled nozzle heater supplying a full 360° of heat with optional distributed wattage. A straight cable heater can snake through an equipment application. Flat spiral configurations can be used in high-tech manufacturing while a star wound cable can be used for air and gas heating.

Different applications require different construction methods, including one, two or four resistance wires; parallel coil or straight wire; drawn or swaged sheaths; with or without internal thermocouples; leads exiting from one or both ends, and round, rectangular or square cable cross sectionals.

Whatever the application, the Watlow coil and cable heater can be shaped to fit.

### Performance Capabilities

- Continuous operating temperatures to 1200°F (650°C) with intermittent operating periods achieving up to 1500°F (815°C) dependent on the type of element wire used
- Sheath watt densities on the cable to 30 W/in<sup>2</sup> (4.65 W/cm<sup>2</sup>), and as high as 75 W/in<sup>2</sup> (11.62 W/cm<sup>2</sup>) subject to factory approval
- Maximum voltage to 240V

### Features and Benefits

#### High ductility

- Allows the heater to be cold-formed into almost any shape

#### Low mass

- Allows for quick response in both heating and cooling

#### Constructed with no open seams

- Provides the capability of operating in unusual environments, including cryogenic and sub-freezing temperatures, high vacuum, gaseous and liquid immersion heaters

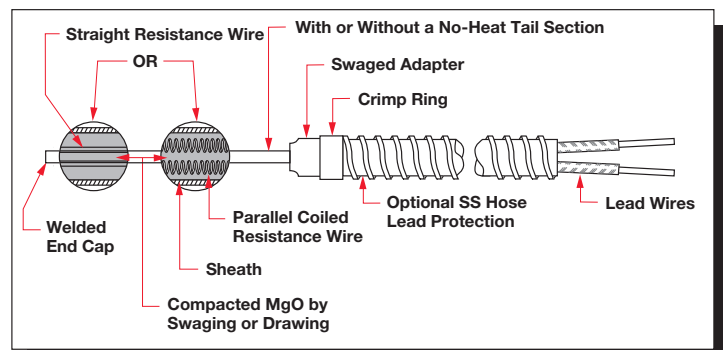
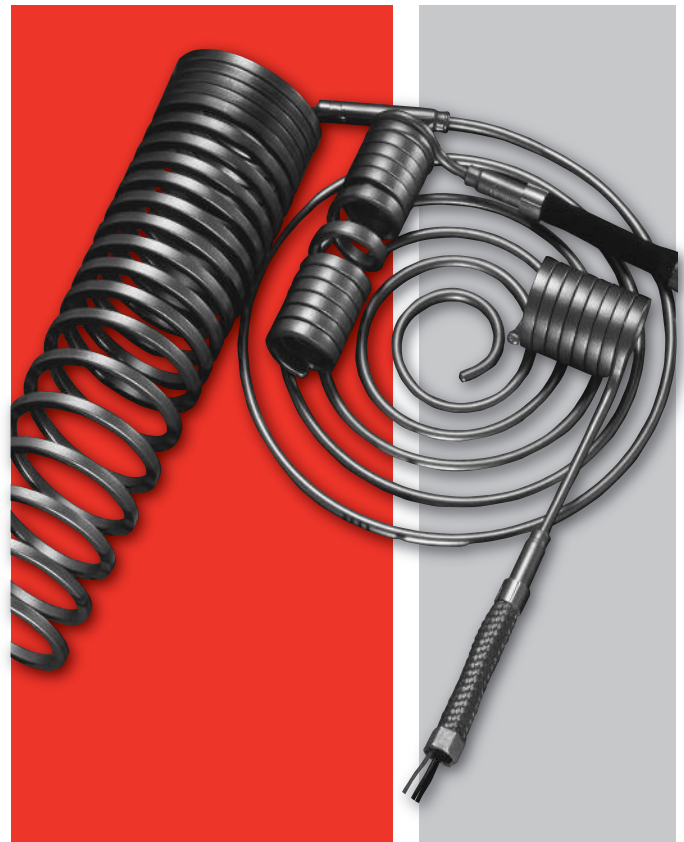
- Decreases opportunity for corrosion

#### Constructed of standard 304 stainless steel or optional 316 stainless steel or Inconel® 600

- Provides high temperature corrosion and oxidation resistance along with ideal expansion properties

#### Heater sheath can be brazed

- Allows the permanent attachment of mounted fittings to the heater, contact your Watlow representative



**Ranging from 0.040 in. (1.02 mm) to 0.188 in. (4.8 mm) diameter**

- Delivers a lot of heat into a tiny space

#### Internal construction options

- Allows for internal thermocouples and no-heat sections (not available in all sizes)

Star Electric

to Order Call 1.800.345.0369

# Specialty Heaters

## Coil/Cable Heaters

### Typical Applications

- Plastic injection molding nozzles
- Semiconductor manufacturing and wafer processing
- Hot metal forming dies and punches
- Sealing and cutting bars
- Medical, analytical and scientific instruments
- Restaurant and food processing equipment
- Cast-in heaters
- Laminating and printing presses
- Air heating
- Textile manufacturing
- Heating in a vacuum environment

### Electrical Data and Coiling Limits

Sheath Diameter		Max. Voltage	Surface Area Per Linear Foot		Min. Bend Radius		Min. Coiled Inside Diameter	
in.	(mm)		in.	(cm)	in.	(mm)	in.	(mm)
0.040 ± 0.002	(1.016 ± 0.051)	48	1.51	(9.740)	1/16	(1.6)	1/8	(3.2)
0.062 ± 0.002	(1.575 ± 0.051)	120	2.34	(15.098)	1/8	(3.2)	1/4	(6.0)
0.058 ± 0.002	(1.473 ± 0.051)	240	2.18	(14.065)	1/8	(3.2)	1/4	(6.0)
0.094 + 0.002 - 0.003	(2.388 + 0.051 - 0.076)	240	3.54	(22.840)	3/16	(4.8)	3/8	(9.5)
0.102 square ± 0.003	(2.591 ± 0.076)	240	4.90	(31.615)	1/4	(6.0)	1/2	(13.0)
0.102 ± 0.003 x 0.156 ± 0.005 rectangular	(2.591 ± 0.076) x (3.962 ± 0.127)	240	6.19	(39.938)	1/4	(6.0)	1/2	(13.0)
0.125 ± 0.003	(3.175 ± 0.076)	240	4.71	(30.389)	1/4	(6.0)	1/2	(13.0)
0.157 ± 0.004	(3.998 ± 0.102)	240	5.92	(38.196)	5/16	(7.9)	5/8	(15.9)
0.188 + 0.003 - 0.006	(4.775 + 0.076 - 0.152)	240	7.09	(45.745)	3/8	(9.5)	3/4	(19.0)
0.128 square ± 0.003	(3.353 ± 0.076)	240	6.31	(40.712)	1/4	(6.0)	1/2	(13.0)

In most cases 30 W/in<sup>2</sup> (4.65 W/cm<sup>2</sup>) is the safe allowable limit for cable watt density. Please contact your Watlow representative before ordering >30 W/in<sup>2</sup> cables.

#### Resistance/Wattage Tolerance ±10%.

Cable heaters can run on both ac and dc, 50 or 60Hz. Contact your Watlow representative for amperage limitations.

### Coiling Tolerances

Cable Diameters	Coiled Width Tolerances		Coiled I.D. Tolerances			
	Coiled Width in. (mm)	Tolerances in. (mm)	Coil I.D. Range in. (mm)		Tolerances in. (mm)	
All Diameters	Below 6 (152)	+ 0 - 1/8 (+0.00 - 3.18)	Below 0.625	(Below 15.88)	+0.000 - 0.015	(+0 - 0.38)
	6 to 10 (152 to 254)	+ 1/8 - 3/8 (+3.18 - 9.53)	0.625 to 0.999	(15.88 to 25.38)	+0.000 - 0.030	(+0 - 0.76)
	Over 10 (Over 254)	+ 1/4 - 1/2 (+6.35 - 6.35)	1.000 to 1.999	(25 to 50.78)	+0.000 - 0.062	(+0 - 1.58)
			2.000 to 2.999	(51 to 76.18)	+0.000 - 0.125	(+0 - 3.18)
			3.000 to 3.999	(76 to 101.58)	+0.000 - 0.250	(+0 - 6.35)
			4.000 to 4.999	(102 to 126.98)	+0.000 - 0.375	(+0 - 9.53)
			5.000 and Over	(127 and Over)	+0.000 - 0.500	(+0 - 13.00)

When the O.D. of the coil is required to be the critical dimension, this fact must be specified at the time of ordering so that proper coiling procedures can be determined. I.D. and O.D. dimensions cannot be held on the same unit. Please contact your Watlow representative before ordering coiled cable heaters requiring other than standard tolerances.

### Cable Straight Length Tolerances

Length	≤ 24 in.	>24 in. ≤ 60 in.	>60 in. ≤ 100 in.	>100 in.
	±1/8 in.	±1/4 in.	±1 in.	±1%

# Specialty Heaters

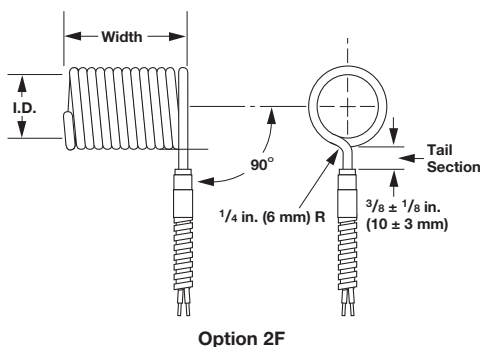
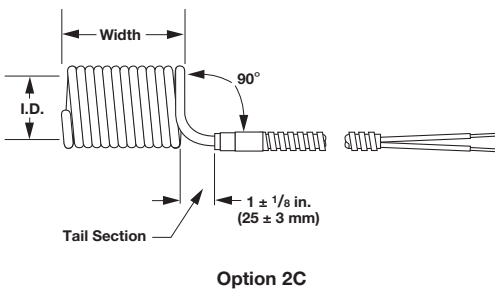
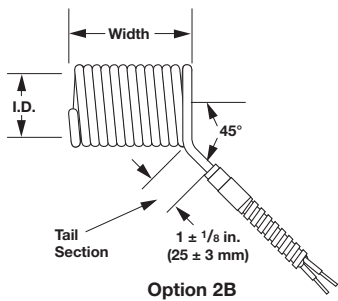
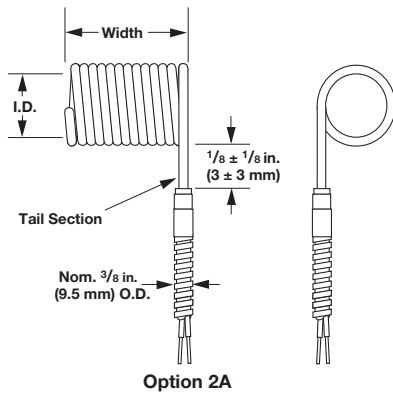
## Coil/Cable Heaters

### Formation Options

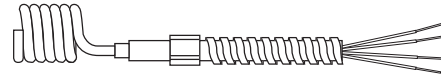
#### Coil Heaters

The coil heater can be tight wound, open pitch or anything in between.

#### Lead Orientation Options for Coiled Cable Heaters



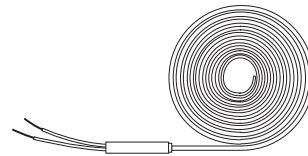
#### Closed Coil without Distributed Wattage



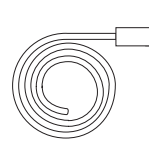
#### Closed Coil with Distributed Wattage



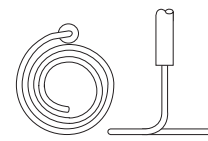
#### Flat Spiral



Flat spiral formations are used to heat flat circular surfaces. This information is often used in semiconductor and medical applications.



Flat Spiral with 2A Type Lead Orientation

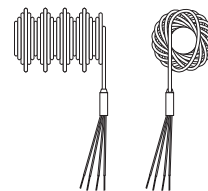


Flat Spiral with 2C Type Lead Orientation



Flat Spiral with 2F Type Lead Orientation

#### Star Wound



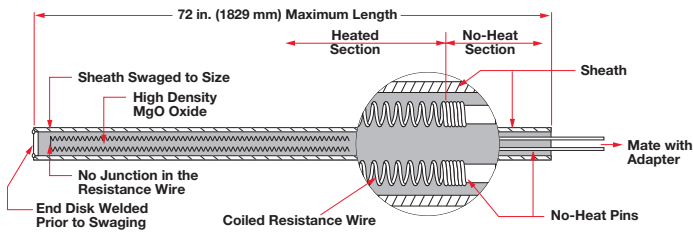
Star wound formations are usually inserted into pipes or ducts and are used to heat moving air or liquids. The offset coils increase/induce turbulent flow. This allows the flowing material to have better contact with the heater surface, resulting in a more efficient heat transfer.

# Specialty Heaters

## Coil/Cable Heaters

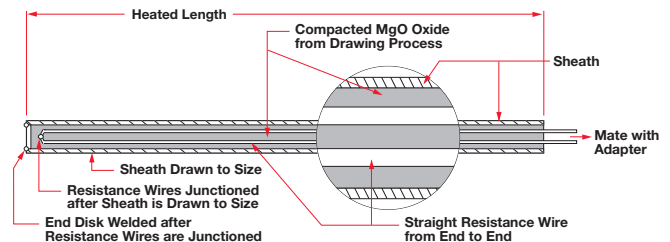
### Internal Construction

#### Sheath with Coiled Internal Resistance Wire



Parallel Coil Construction

#### Sheath with Straight (Uncoiled) Resistance Wire



Drawn Cable Construction

Resistance wire, wound into a small coil, is loaded into insulating cores, then into metal tubing and swaged to final size. This method of construction is called **parallel coil**.

The parallel coil method allows for a no-heat section in the sheath. The length of either the heated section or no-heat section is variable as long as the combined length does not exceed 72 in. (1829 mm). Other features of this construction method include:

- Variable ohms/foot within a minimum and maximum range
- Variable location of the thermocouple junction
- Grounded or ungrounded thermocouple junction
- No-heat sections
- 304 stainless steel
- A variety of diameters and shapes:
  - 0.058 in. (1.5 mm) round
  - 0.094 in. (2.4 mm) round
  - 0.125 in. (3.2 mm) round (minimum diameter with internal thermocouple)
  - 0.102 in. (2.6 mm) square
  - 0.128 in. (3.3 mm) square
  - 0.102 in. X 0.156 in. (2.6 mm X 4 mm) rectangular

Uncoiled resistance wires are positioned inside a large diameter metal tube. The tube assembly is repeatedly pulled through draw dies until the desired diameter is achieved. Though limited to fixed incremental ohms/foot and without no-heat sections, this **drawn cable** construction method does allow:

- Essentially no limit on cable length
- Thermocouple junction only at the disk end of the sheath
- Grounded or ungrounded thermocouple junction
- Sheath heated from end to end
- 304 stainless steel
- A variety of diameters and shapes:
  - 0.040 in. (1.0 mm) round
  - 0.062 in. (1.6 mm) round
  - 0.094 in. (2.4 mm) round
  - 0.125 in. (3.2 mm) round (minimum diameter with internal thermocouple)
  - 0.157 in. (4.0 mm) round
  - 0.188 in. (4.8 mm) round
  - 0.128 in. (3.3 mm) square\*
  - 0.102 in. X 0.156 in.\* (2.6 mm X 4 mm) rectangular

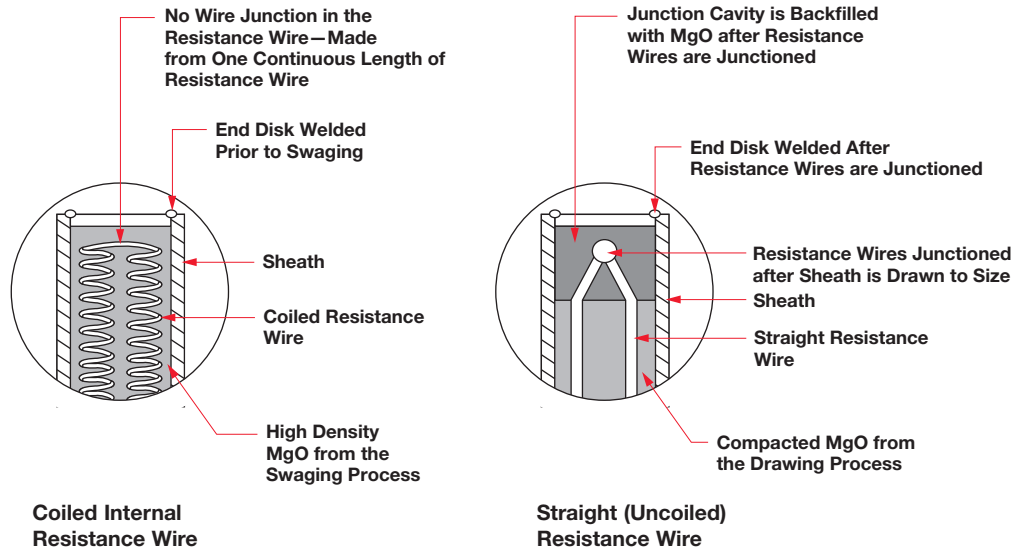
\* Maximum length is 140 in. (3556 mm)

# Specialty Heaters

## Coil/Cable Heaters

### Internal Construction

#### Disk End of Sheath



The end of the heater sheath opposite from the lead end is called the disk end.

With parallel coil construction methods, the internal resistance wires form a 180° bend inside the sheath and, so, do not require a junction. After the end cap has been welded in place, the entire area at the end of the sheath is swaged to provide maximum density of the magnesium oxide.

With drawn cable construction, the internal wires, whether resistance or thermocouple, must be junctioned before the heater sheath can be finished. Magnesium oxide is removed from the tip of the sheath, exposing the wires which are then junctioned by welding. Magnesium oxide powder is backfilled into the cavity surrounding the junctioned wires and lightly compacted. The end cap is inserted and welded into place.

## Thermocouples

Internal thermocouples are available in ASTM Type J or K calibration with both the parallel coil or drawn cable construction methods.

### Parallel coil:

- 0.125 in. (3.2 mm) round
- 0.128 x 0.128 in. (3.3 x 3.3 mm) square
- 0.102 x 0.156 in. (2.6 x 4.0 mm) rectangular

### Drawn cable:

- 0.125 in. (3.2 mm) round
- 0.157 in. (4.0 mm) round
- 0.188 in. (4.8 mm) round
- 0.128 x 0.128 in. (3.3 x 3.3 mm) square
- 0.102 x 0.156 in. (2.6 x 4.0 mm) rectangular

External thermocouples with Type J or K calibration can be brazed to the heater sheath. The sheath size must be a minimum of 0.094 in. (2.4 mm) in diameter.

# Specialty Heaters

## Coil/Cable Heaters

### Options—Internal Construction

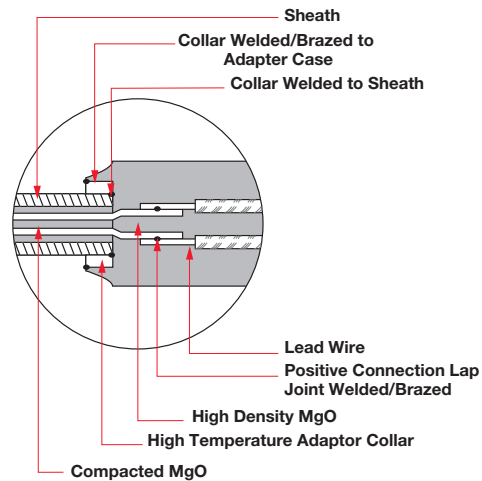
#### Adapters

Adapters are the transition sections where the lead wires are attached to the heater sheaths. The lead wires are connected with the internal wires from the sheath.

The **positive connection** lap joint brazes or welds the wire lap joint before the adapter is swaged. Positive connection is used in all standard applications and provides added protection in high temperature environments and other severe and demanding applications.

An extended length adapter collar, or **high temperature** collar, is used as a heat sink allowing the heater to be operated in high temperature and other demanding applications.

The positive connection and collar are used in conjunction with both power leads and thermocouple leads.



#### External Construction

##### Lead Wire

100 percent nickel, copper, nickel plated copper or silver plated copper.

##### Insulation

Teflon®, fiberglass, or a high temperature variety such as MGT or MGE.

##### Lead Protection

Stainless steel hose, stainless steel braid or fiberglass braid.

Contact your Watlow representative for details.

# Specialty Heaters

## Coil/Cable Heaters

### Cable Heater Units (Internal thermocouple not available)

Straight Cable Length in. (mm)		Volts	Watts	Watt Density W/in <sup>2</sup> W/cm <sup>2</sup>		No-Heat Length in. (mm)		Lead Wire	Lead Protection	Code Number
<b>0.062 in. (1.6 mm) Diameter Round</b> (with ±10% wattage tolerance)										
24 (610)		120	240	51 (7.9)		0 (0)		36 in. (914 mm)	Lead protection is available upon request	<b>62H24A6X-1138</b>
36 (914)		120	400	57 (8.8)		0 (0)	swaged-in	<b>62H36A5X-1015</b>		
56 (1422)		120	330	30 (4.7)		0 (0)	fiberglass	<b>62H56A4X-942</b>		
65 (1651)		120	500	39 (6.0)		0 (0)		<b>62H65A3X-1111</b>		
<b>0.094 in. (2.4 mm) Diameter Round</b> (with ±5% wattage tolerance)										
30 (762)		230	125	17 (2.6)		5 (127)		36 in. (914 mm)	Lead protection not available	<b>94PC30A1X</b>
30 (762)		230	250	34 (5.3)		5 (127)	Teflon® leads only	<b>94PC30A2X</b>		
<b>0.125 in. (3.2 mm) Diameter Round</b> (with ±10% wattage tolerance)										
18 (457)		240	250	35 (5.4)		1.5 (38)		36 in. (914 mm)	Lead protection is available upon request	<b>125CH18A4X-1066</b>
19 (483)		120	165	21 (3.3)		1.5 (38)	swaged-in	<b>125CH19A1X-879</b>		
24 (610)		120	275	29 (4.5)		1.5 (38)	fiberglass	<b>125CH24A1X-1049</b>		
24 (610)		240	275	29 (4.5)		1.5 (38)		<b>125CH24A14X-806</b>		
38 (965)		240	325	21 (3.3)		1.5 (38)			<b>125CH38A1X-631</b>	
38 (965)		120	175	12 (1.9)		1.5 (38)		36 in. (914 mm)	Lead protection is available upon request	<b>125CH38A2X-246</b>
47 (1194)		240	260	14 (2.2)		1.5 (38)	swaged-in	<b>125CH47A1X-108</b>		
47 (1194)		120	235	12 (1.9)		1.5 (38)	fiberglass	<b>125CH47A2X-182</b>		
47 (1194)		120	375	20 (3.1)		1.5 (38)		<b>125CH47A3X-986</b>		
47 (1194)		240	345	19 (2.9)		1.5 (38)		<b>125CH47A4X-1081</b>		
65 (1651)		240	420	16 (2.5)		1.5 (38)		36 in. (914 mm)	Lead protection is available upon request	<b>125CH65A1X-940</b>
65 (1651)		240	675	27 (4.2)		1.5 (38)	swaged-in	<b>125CH65A2X-1115</b>		
95 (2413)		240	1000	28 (4.3)		0.0 (0)	fiberglass	<b>125CH93A1X-1154</b>		
126 (3200)		240	1500	30 (4.7)		0 (0)		<b>125H126A4A-969</b>		
150 (3810)		240	2000	34 (5.3)		0 (0)		<b>125H150A3A-1168</b>		
223 (5664)		240	3000	34 (5.3)		0 (0)		<b>125H223A1A-1057</b>		
<b>0.128 in. (3.3 mm) Square Cross-Section</b> (with ±10% wattage tolerance)										
12 (305)		120	200	36 (5.6)		1.5 (38)		36 in. (914 mm)	Lead protection is available upon request	<b>125PS12A24A-647</b>
12 (305)		240	200	36 (5.6)		1.5 (38)	swaged-in	<b>125PS12A23A-155</b>		
20 (508)		120	300	31 (4.8)		1.5 (38)	fiberglass	<b>125PS20A37A-537</b>		
20 (508)		240	300	31 (4.8)		1.5 (38)		<b>125PS20A38A-142</b>		
30 (762)		120	450	30 (4.7)		1.5 (38)		<b>125PS30A47A-159</b>		
30 (762)		240	450	30 (4.7)		1.5 (38)		<b>125PS30A48A1019</b>		
38 (965)		240	600	31 (4.8)		1.5 (38)		<b>125PS38A23A-562</b>		

# Specialty Heaters

## Coil/Cable Heaters

### Cable Heater Units (Type J internal thermocouple)

Straight Cable Length		Volts	Watts	Watt Density		No-Heat Length		Lead Wire	Lead Protection	Code Number
in.	(mm)			W/in <sup>2</sup>	(W/cm <sup>2</sup> )	in.	(mm)			

**0.125 in. (3.2 mm) Diameter Round** (with ±10% wattage tolerance), thermocouple located in center of heated section.

24	(610)	120	275	29	(4.5)	1.5	(38)	48 in. (1219 mm)	Lead protection is available	<b>125CH24A13X</b>
38	(965)	120	175	12	(1.9)	1.5	(38)	swaged-in	upon request	<b>125CH38A18X</b>
47	(1194)	120	235	13	(2.0)	1.5	(38)	fiberglass		<b>125CH47A21X</b>
65	(1651)	240	675	26	(4.0)	1.5	(38)			<b>125CH65A26X</b>

**0.157 in. (4 mm) Diameter Round** (with ±10% wattage tolerance), thermocouple located at the disk end of the cable.

124	(3150)	240	1500	25	(3.9)	0	(0)	48 in. (1219 mm)	Lead protection is available	<b>157CH124AX</b>
150	(3810)	240	2000	27	(4.2)	0	(0)	swaged-in	upon request	<b>157CH150AX</b>
220	(5588)	240	3000	28	(4.3)	0	(0)	fiberglass		<b>157CH220AX</b>

**0.128 in. (3.3 mm) Square Cross-Section** (with ±10% wattage tolerance), thermocouple located in center of heated section.

12	(305)	240	200	36	(5.6)	1.5	(38)	48 in. (1219 mm)	Lead protection is available	<b>125PS12A22A</b>
20	(508)	120	300	31	(4.8)	1.5	(38)	swaged-in	upon request	<b>125PS20A35A</b>
20	(508)	240	300	31	(4.8)	1.5	(38)	fiberglass		<b>125PS20A36A</b>
30	(762)	240	450	30	(4.7)	1.5	(38)			<b>125PS30A46A</b>
38	(965)	240	600	31	(4.8)	1.5	(38)			<b>125PS38A24A</b>