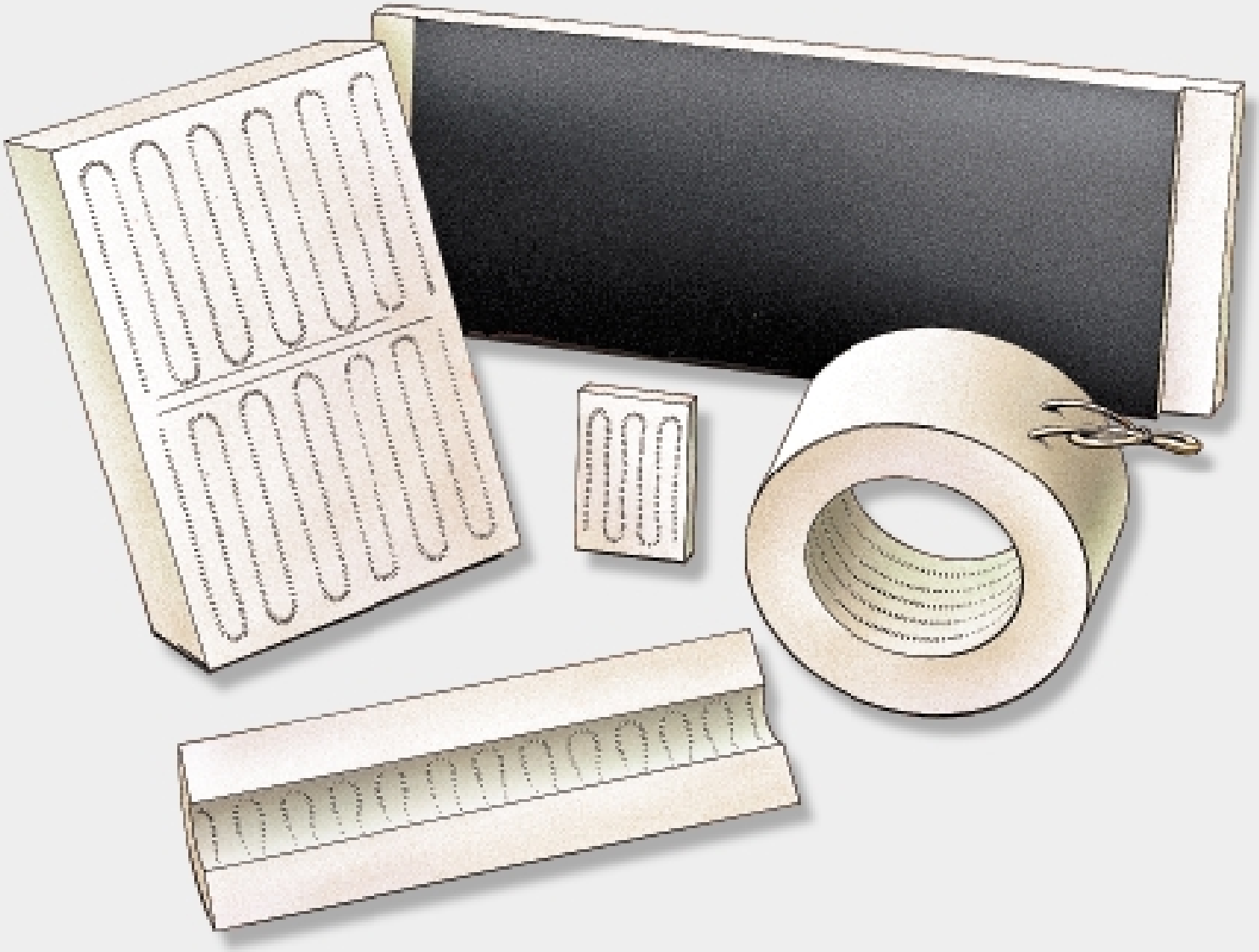
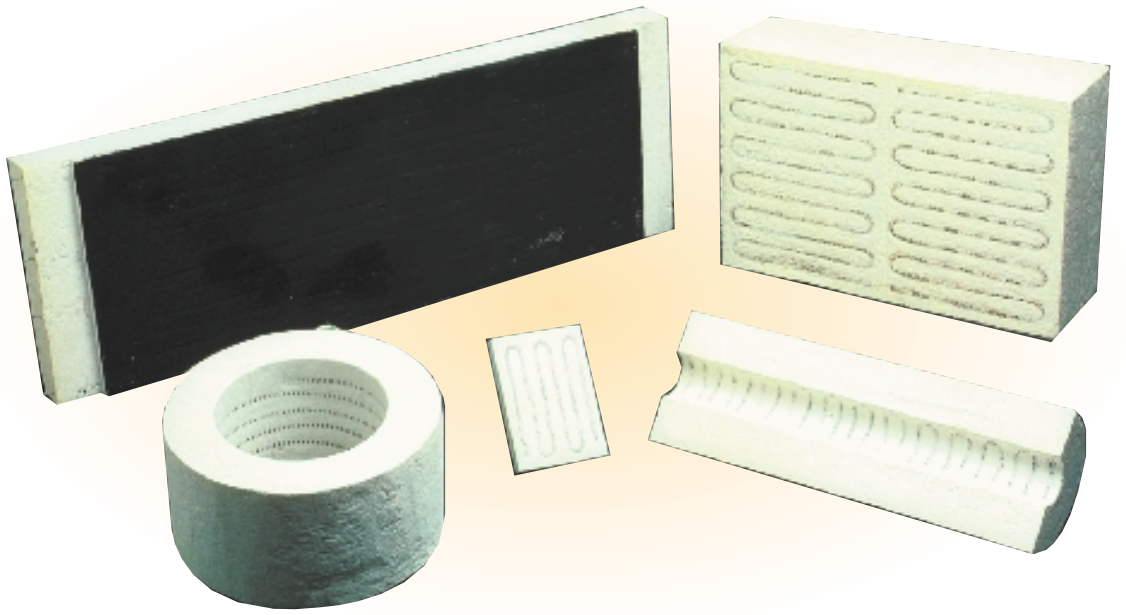
MAIN



SECTION 4

CERAMIC FIBER HEATERS

High Temperature Ceramic Fiber Heaters



Design Features

- Temperatures to 1100°C (2012°F)
- Low Thermally Conductive Built-In Insulation
- Standard Flat Panel, Full Cylindrical, and Semi-Cylindrical Shapes
- Fe-Cr-Al Alloy Resistance Wire Elements
- 100% Organic Free/No Asbestos
- Thermal Shock Immunity
- Excellent Resistance to Chemical Attack

Industrial Uses

Industry	Application
Aerospace	Crystal Growth R & D Tensile and Creep Testing
Dental	Manufacture of Crowns and Bridges
Metals	Heat Treat and Temper
Plastics	Sealers and Formers
Automotive	Metal Heat Treating and Paint Curing
Petroleum	Apply Tensile Test Gauges to Drill Bits Remove Unwanted Products
Chemical	Remove By-products & Catalyst Materials
Crystals	Preheat & Manufacturing of Optical and Gemstone Crystals
Glass	Annealing Process & Preheat Of Glass Manufacturing
Ceramic	Extrusion Dies
Semiconductor	Diffusion Furnaces & Annealing Wafers

Designed For High Temperatures and Efficiency

Tempco Ceramic Fiber Insulated Heaters combine a heat source with superior high temperature insulation— an ideal solution for an unlimited number of industrial heating applications. Tempco Ceramic Fiber Insulated Heaters produce fast, efficient, and reliable uniform heat to temperatures of 1100°C (2012°F). Higher temperature ratings, up to 1300°C (2372°F), are available with custom designs.

Flat Panel, Full Cylindrical and Semi-Cylindrical Shaped Ceramic Fiber Insulated Heaters — *Tempco Standard*

These heaters are comprised of high quality helically wound Fe-Cr-Al alloy resistance wire elements embedded in a rigid body of vacuum-formed high temperature refractory fiber. This ceramic fiber insulation has very low weight, thermal mass and thermal conductivity and thus can handle extremely rapid cycling.

All Tempco Ceramic Fiber Insulated Heaters are organic free and will not smoke or outgas.

The elements are typically mounted flush with the heated surface. The diameter of the helically wound element coil is kept to a minimum, reducing the difference between the element and chamber temperature, thus ensuring long heater life. This feature enables the design and manufacture of responsive heating systems and significantly reduces the risk of overheating the element.

At 1100°C (2012°F), power (watts) and current (amps) are 3.8% less and resistance (ohms) is 3.8% more than the rated values.

Standard Essentials:

- Available in flat panel, full cylindrical and semi-cylindrical shapes with several lead styles as standard.
- Standard heaters are supplied with 9" long double-twisted wire leads.
- Type “A” leads are supplied unless otherwise specified.
- Custom shapes are available on request.

Characteristics and Properties

Composition of Insulation

Al_2O_3 (Alumina) 38%
SiO_2 (Silica) 62%
Organics 0%

Bond . . . . . Silica

Bulk Density gm/cm³, (pcf) . . 0.28 (18)

Thermal Conductivity
W/m°K (Btu/hr°F ft²/in)
400°C (752°F) 0.10 (0.8)
1100°C (2012°F) 0.22 (1.5)

Flexural Strength MPa (Psi)
As received 0.17 (26)
After 24 hrs. at 1000°C 0.354 (53.6)

Compressive Strength MPa (Psi)
10% Deflection 0.054 (8.1)

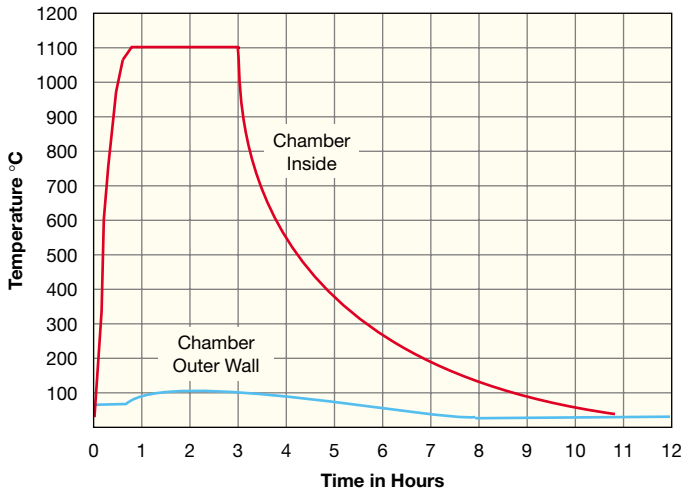
Stability— Linear Shrinkage
24 hrs. at temperature
800°C (1472°F) 0.3%
1000°C (1832°F) 1.8%
1200°C (2192°F) 2.5%

Performance Characteristics

Typical Full Round High Temperature Ceramic Fiber Heater 5.5" I.D. × 12" H × 11" O.D.

The performance data represented in the chart was obtained by combining a Fiber Insulated Heater with 3" disks of insulation top and bottom. This assembly, which can be representative of many industrial and laboratory heating applications, was cycled with no load. Cool down rates were determined by turning the power off. Assembly was left intact. The "outside wall" temperature was measured on the external surface of the sidewall.

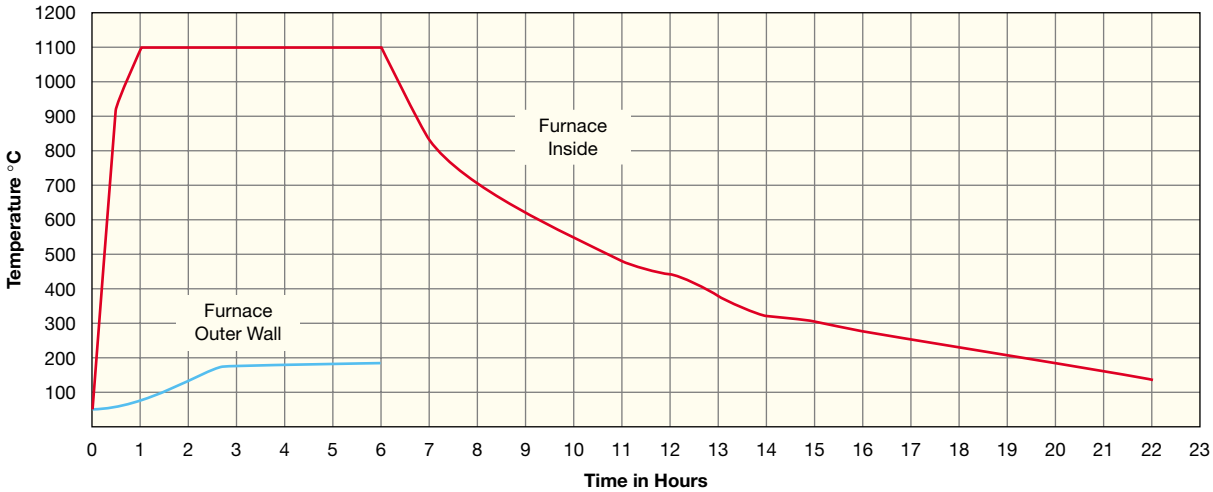
Time vs. Temperature



Performance of a Typical Rectangular Furnace

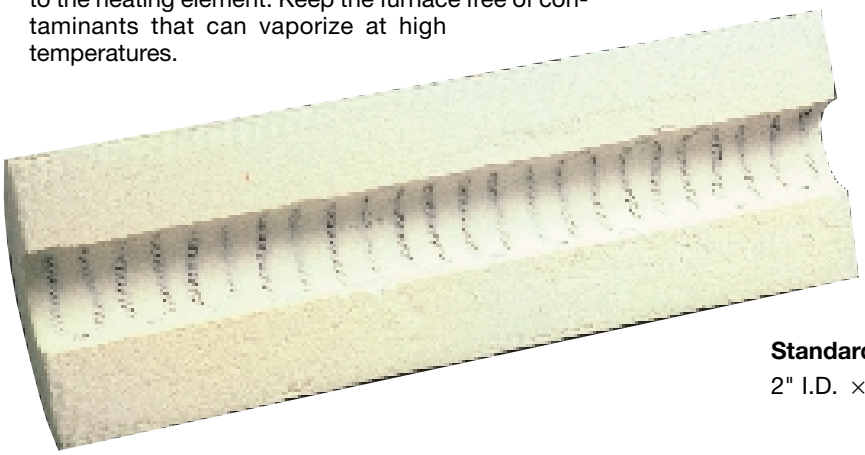
Test chamber left and right walls fabricated from Standard Fiber Insulated Heaters (24" × 36" × 5") and insulation boards. This size chamber, approximately 10 cubic feet, was chosen to best reflect performance characteristics of flat panel heaters as used in a broad section of industrial applications. Chamber walls, roof and floor are 5" thick insulation. Cool down rate was plotted with data generated after element power was turned off. Chamber door remained closed. Chamber contained no load.

Time vs. Temperature of an (approx.) 10 cubic foot furnace chamber incorporating High Temperature Ceramic Fiber Heaters



Application Guidelines

1. High Temperature Ceramic Fiber heaters are ***designed for radiant heat transfer*** only. They are not intended for contact heating. They do not have the physical strength found in band, cartridge, strip or cast-in heaters.
2. ***Mounting methods*** such as washers, pins, screws, overlapping edge clamps, and interlocking edges work well with Ceramic Fiber heaters. Cementing is not recommended because it will not allow expansion or contraction.
3. Ceramic Fiber Heaters have a ***very high porosity factor*** and cannot be sealed against contamination and possible damage to the heating element. Keep the furnace free of contaminants that can vaporize at high temperatures.
4. Use ***temperature controllers with low mass thermocouples*** that respond rapidly. Position your low mass thermocouple close to the element such that the element chamber Delta T can be minimized and thereby promote longer element life.
5. Thermocouples should be ***mounted directly above*** the element to closely monitor the heater face temperature.
6. ***Be careful with any electrical connections*** made in the heated portion of the application. The connections must be rated for the expected operating temperature and current flow.
7. ***Use only inorganic fibers and binders*** to avoid corrosive fumes that could damage the heater.
8. Ceramic Fiber Heaters are easily damaged from ***careless mechanical handling***, so handle the units and leads carefully.



Standard Semi-Cylindrical Shaped Heater
2" I.D. × 6" O.D. × 18" Long

Dimensional Tolerances

Flat Panels

Width:	4", 6", 8"	± ⅛"
	10" thru 32"	± ¼"
Length:	6"	± ⅛"
	12" thru 44"	± ¼"
Thickness:	1"	± ⅛"
	2" thru 4"	± ¼"

Full Cylindrical

I.D.:	0.75" thru 4"	± ⅛"
	5" thru 18"	± ¼"
O.D.:	3" and 3.5"	± ⅛"
	5" thru 24"	± ¼"
Length:	6"	± ⅛"
	12" and 18"	± ¼"

Semi-Cylindrical

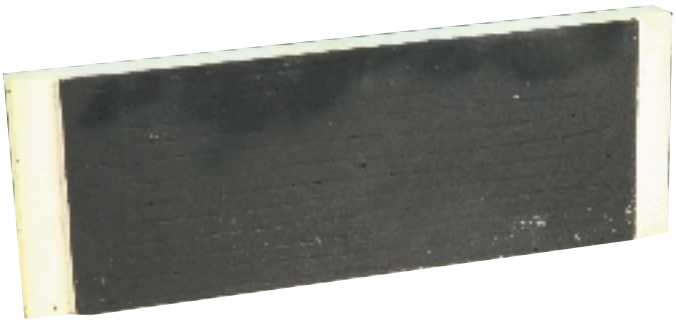
I.D.:	1", 2" and 3.5"	± ⅛"
	5" thru 18"	± ¼"
O.D.:	5" thru 22"	± ¼"
Length:	6"	± ⅛"
	12" thru 36"	± ¼"

Options and Accessories

High Emissivity Black Coating

Can be added to flat panel ceramic fiber heaters for use as pure infrared style heaters. Factory installation only.

Consult Tempco with your requirements.



Rigidizer

The external surface of ceramic fiber heaters is treated with a chemical rigidizer to give the heater the hardened shell typical of this type of heater. When the ceramic heater is cut in the field prior to installation for any purpose, or repairs are required, rigidizer should be used to recoat the surface.

Part Number: CFR00010 **Quantity:** 1 Gal.

Ceramic Fiber Cement

The cement has many general purposes such as bonding ceramic fiber heaters together, or adding additional external insulation.

Part Number: CFR00020 **Quantity:** 1 Gal.

Ceramic Putty

Made from high purity "Asbestos Free" Aluminum Oxide based ceramics with a melting point in excess of 3200°F (1760°C) and formulated with special ceramic binders that, on drying, produce a strong ceramic body.

- ✓ **Resistant** to molten metals. most chemicals, oxidizing and reducing atmospheres.
- ✓ **Use for instant repairs** to brick, mortar, burner blocks, insulation furnace holders, thermocouples, etc.
- ✓ **Applications include** molding and bonding ceramic fiber components, high temp. insulation, insulation of pipes, supports, burners, turbines, etc.

Size: 4 oz. Squeeze Tube **Part Number:** CFR00030
Size: 11 oz. Caulking Tube **Part Number:** CFR00032

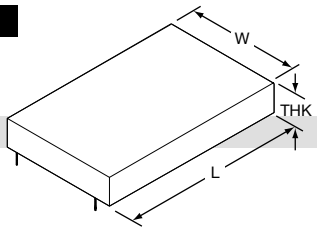
Specifications

Melting Point	3200°F (1760°C)
Continuous Service	2300°F (1260°C)
Base Material	Al_2O_3
Density	40-50#/Sq. ft.
Specific Heat	0.25 BTU/# °F
Dielectric Constant at 10^8 cps	1.61
Loss Factor	0.017
Dielectric Strength	100 Volts/mil.
Thermal Conductivity at 500°F (260°C)	065

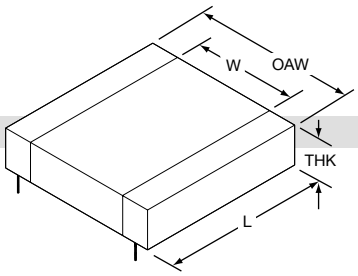
Flat Panels

Panel Styles

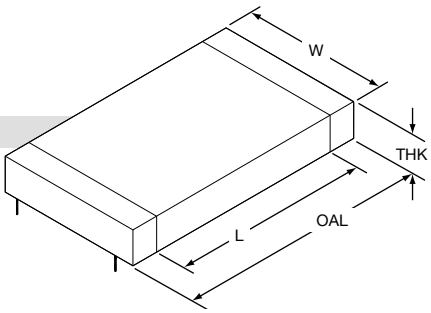
(shown with Type 1 Leads)



Style 1— Entire Panel Heated

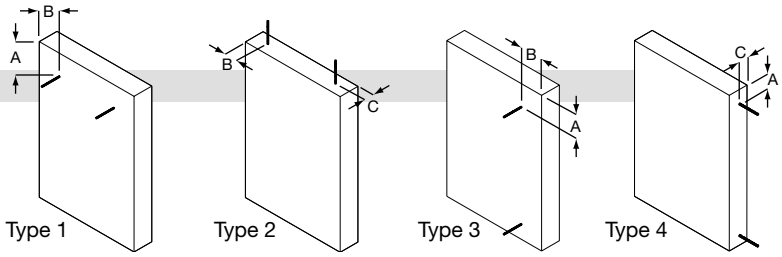


Style 2— Unheated Ends in Width



Style 3— Unheated Ends in Length

Lead Locations



Standard Panel Heater
18"W × 24"L × 3" Thick

How to Order

Standard Units

Select a **Flat Panel Heater** by size, electrical rating and style from the table below. To complete the part number add the required lead location number.

For example

CFR1001[2] has Type 2 Leads.

Standard leads are double twist 9" long high temperature bare wire.

Custom Designed/Manufactured Flat Panel Heaters

Custom manufactured Flat Panel Ceramic Fiber Heaters are available; consult **Tempco** with your requirements. ***Standard lead time is 4 weeks.***

Please Specify the following:

- ❑ Length
- ❑ Width
- ❑ Voltage
- ❑ Wattage
- ❑ Lead Location and Type
- ❑ Special Features

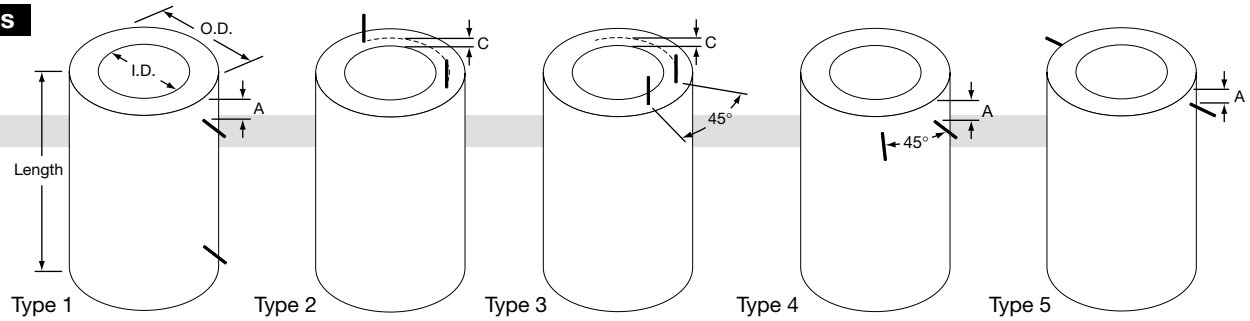
Standard Flat Panel High Temperature Ceramic Fiber Heaters

Heated					Style 1				Style 2					Style 3				
W	L	Thk	Watts	Volts	Part Number	Lead Location A	B	C	Part Number	OAW	Lead Location A	B	C	Part Number	OAL	Lead Location A	B	C
4	6	1	250	60	CFR1001☐	1.0	1.0	0.5	CFR1019☐	6	1.0	2.0	0.5	CFR1037☐	8	2.0	1.0	0.5
4	12	1	500	60	CFR1002☐	1.0	1.0	0.5	CFR1020☐	6	1.0	2.0	0.5	CFR1038☐	14	2.0	1.0	0.5
6	6	2	375	60	CFR1003☐	1.5	1.5	1.0	CFR1021☐	10	1.5	3.5	1.0	CFR1039☐	10	3.5	1.5	1.0
6	12	2	750	120	CFR1004☐	1.5	1.5	1.0	CFR1022☐	10	1.5	3.5	1.0	CFR1040☐	16	3.5	1.5	1.0
6	18	2	1125	120	CFR1005☐	1.5	1.5	1.0	CFR1023☐	10	1.5	3.5	1.0	CFR1041☐	22	3.5	1.5	1.0
6	24	2	1500	120	CFR1006☐	1.5	1.5	1.0	CFR1024☐	10	1.5	3.5	1.0	CFR1042☐	28	3.5	1.5	1.0
8	12	2	1000	120	CFR1007☐	2.0	2.0	1.0	CFR1025☐	12	2.0	4.0	1.0	CFR1043☐	16	4.0	2.0	1.0
8	18	2	1500	120	CFR1008☐	2.0	2.0	1.0	CFR1026☐	12	2.0	4.0	1.0	CFR1044☐	22	4.0	2.0	1.0
8	24	2	2000	120	CFR1009☐	2.0	2.0	1.0	CFR1027☐	12	2.0	4.0	1.0	CFR1045☐	28	4.0	2.0	1.0
12	12	2	1500	120	CFR1010☐	2.0	2.0	1.0	CFR1028☐	16	2.0	4.0	1.0	CFR1046☐	16	4.0	2.0	1.0
12	18	2	2250	120	CFR1011☐	2.0	2.0	1.0	CFR1029☐	16	2.0	4.0	1.0	CFR1047☐	22	4.0	2.0	1.0
12	24	2	3000	240	CFR1012☐	2.0	2.0	1.0	CFR1030☐	16	2.0	4.0	1.0	CFR1048☐	28	4.0	2.0	1.0
12	36	2	4500	240	CFR1013☐	2.0	2.0	1.0	CFR1031☐	16	2.0	4.0	1.0	CFR1049☐	40	4.0	2.0	1.0
18	18	3	3375	240	CFR1014☐	2.5	2.5	1.5	CFR1032☐	24	2.5	5.5	1.5	CFR1050☐	24	5.5	2.5	1.5
18	24	3	4500	240	CFR1015☐	2.5	2.5	1.5	CFR1033☐	24	2.5	5.5	1.5	CFR1051☐	30	5.5	2.5	1.5
18	36	3	6750	480	CFR1016☐	2.5	2.5	1.5	CFR1034☐	24	2.5	5.5	1.5	CFR1052☐	42	5.5	2.5	1.5
24	24	4	6000	480	CFR1017☐	3.0	3.0	2.0	CFR1035☐	32	3.0	7.0	2.0	CFR1053☐	32	7.0	3.0	2.0
24	36	4	9000	480	CFR1018☐	3.0	3.0	2.0	CFR1036☐	32	3.0	7.0	2.0	CFR1054☐	44	7.0	3.0	2.0

All Dimensions are in inches

Full Cylindrical Shapes

Lead Locations



Standard Full Cylindrical Shaped High Temperature Ceramic Fiber Heaters

I.D.	O.D.	Length	Watts	Volts	A	C	Part Number
0.75	3.0	6	150	60	1.0	0.6	CFR3001☐
1.00	3.0	6	200	60	1.0	0.5	CFR3002☐
1.00	3.0	12	400	120	1.5	0.5	CFR3003☐
1.50	3.5	12	600	120	1.5	0.5	CFR3004☐
2.00	5.0	6	400	60	1.0	0.8	CFR3005☐
2.00	5.0	12	800	120	1.5	0.8	CFR3006☐
3.00	6.0	6	600	120	1.0	0.8	CFR3007☐
3.00	6.0	12	1200	120	1.5	0.8	CFR3008☐
4.00	8.0	6	800	120	1.0	1.0	CFR3009☐
4.00	8.0	12	1600	120	1.5	1.0	CFR3010☐
5.00	9.0	6	1000	120	1.0	1.0	CFR3011☐
5.00	9.0	12	2000	120	1.5	1.0	CFR3012☐
6.00	10.0	6	1200	120	1.0	1.0	CFR3013☐
6.00	10.0	12	2400	120	1.5	1.0	CFR3014☐
6.00	10.0	18	3500	240	2.0	1.0	CFR3015☐
8.00	12.0	6	1600	120	1.0	1.0	CFR3016☐
8.00	12.0	12	3100	240	1.5	1.0	CFR3017☐
8.00	12.0	18	4700	240	2.0	1.0	CFR3018☐
10.00	16.0	6	2000	120	1.0	1.5	CFR3019☐
10.00	16.0	12	3900	240	1.5	1.5	CFR3020☐
10.00	16.0	18	5900	240	2.0	1.5	CFR3021☐
12.00	18.0	6	2400	120	1.0	1.5	CFR3022☐
12.00	18.0	12	4700	240	1.5	1.5	CFR3023☐
12.00	18.0	18	7100	240	2.0	1.5	CFR3024☐
14.00	20.0	12	5500	240	1.5	1.5	CFR3025☐
14.00	20.0	18	8200	240	2.0	1.5	CFR3026☐
16.00	24.0	12	6000	240	1.5	2.0	CFR3027☐
18.00	24.0	12	7100	240	1.5	2.0	CFR3028☐
18.00	24.0	18	10600	240	2.0	2.0	CFR3029☐

All Dimensions are in inches

Standard Full Cylindrical Shaped Heater
(12" O.D. × 8" I.D. × 6"L)

How to Order

Standard Units

Select a **Full Cylindrical Shaped Heater** by size and electrical rating from the table above. To complete the part number add the required lead location number.

For example

CFR3001[2] has Type 2 Leads.

Standard leads are double twist 9" long high temperature bare wire.

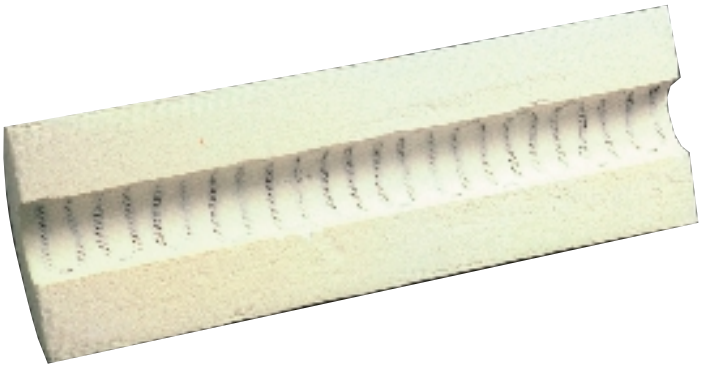
Custom Designed/Manufactured Full Cylindrical Shaped Heaters

Custom manufactured Full Cylindrical Shaped Ceramic Fiber Heaters are available; consult **Tempco** with your requirements. ***Standard lead time is 4 weeks.***

Please Specify the following:

- ❑ Length
- ❑ Inner Diameter
- ❑ Outer Diameter
- ❑ Wattage
- ❑ Voltage
- ❑ Lead Location and Type

Standard Semi-Cylindrical Shaped High Temperature Ceramic Fiber Heaters

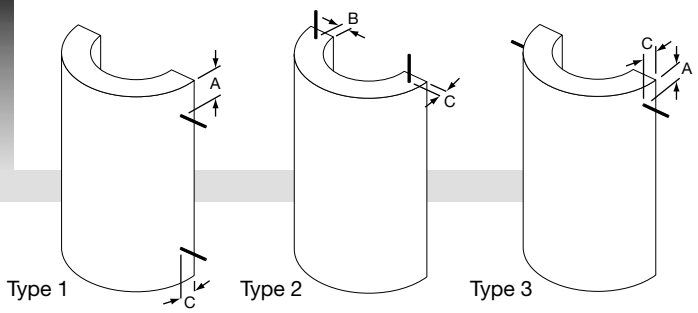


Standard Semi-Cylindrical Shaped Heater
(6" O.D. × 2" I.D. × 18"L)

I.D.	O.D.	L	Watts	Volts	A	B	C	Part Number
1	5	6	100	30	1.0	1.0	1.0	CFR5001☐
1	5	12	200	60	1.5	1.0	1.0	CFR5002☐
2	6	6	200	60	1.0	1.0	1.0	CFR5003☐
2	6	12	400	120	1.5	1.0	1.0	CFR5004☐
2	6	18	600	120	2.0	1.0	1.0	CFR5005☐
2	6	24	800	240	2.0	1.0	1.0	CFR5006☐
3.5	7.5	6	350	60	1.0	1.5	1.0	CFR5007☐
3.5	7.5	12	700	120	1.5	1.5	1.0	CFR5008☐
3.5	7.5	18	1050	120	2.0	1.5	1.0	CFR5009☐
3.5	7.5	24	1400	240	2.0	1.5	1.0	CFR5010☐
5	9	6	500	60	1.0	1.5	1.0	CFR5011☐
5	9	12	1000	120	1.5	1.5	1.0	CFR5012☐
5	9	18	1500	240	2.0	1.5	1.0	CFR5013☐
5	9	24	2000	240	2.0	1.5	1.0	CFR5014☐
5	9	30	2500	240	2.5	1.5	1.0	CFR5015☐
5	9	36	3000	240	2.5	1.5	1.0	CFR5016☐
6.5	10.5	6	650	120	1.0	2.0	1.0	CFR5017☐
6.5	10.5	12	1300	240	1.5	2.0	1.0	CFR5018☐
6.5	10.5	18	1950	240	2.0	2.0	1.0	CFR5019☐
6.5	10.5	24	2600	240	2.0	2.0	1.0	CFR5020☐
6.5	10.5	30	3250	240	2.5	2.0	1.0	CFR5021☐
6.5	10.5	36	3900	240	2.5	2.0	1.0	CFR5022☐
8	12	12	1600	240	1.5	2.0	1.0	CFR5023☐
8	12	18	2400	240	2.0	2.0	1.0	CFR5024☐
8	12	24	3200	240	2.0	2.0	1.0	CFR5025☐
8	12	30	4000	240	2.5	2.0	1.0	CFR5026☐
8	12	36	4800	240	2.5	2.0	1.0	CFR5027☐
10	14	12	2000	240	1.5	2.0	1.0	CFR5028☐
10	14	18	3000	240	2.0	2.0	1.0	CFR5029☐
10	14	24	4000	240	2.0	2.0	1.0	CFR5030☐
10	14	30	5000	240	2.5	2.0	1.0	CFR5031☐
10	14	36	6000	240	2.5	2.0	1.0	CFR5032☐
12	16	12	2400	240	1.5	2.0	1.0	CFR5033☐
12	16	18	3600	240	2.0	2.0	1.0	CFR5034☐
12	16	24	4800	240	2.0	2.0	1.0	CFR5035☐
12	16	30	6000	240	2.5	2.0	1.0	CFR5036☐
12	16	36	7200	240	2.5	2.0	1.0	CFR5037☐
15	19	12	3000	240	1.5	2.0	1.0	CFR5038☐
15	19	18	4500	240	2.0	2.0	1.0	CFR5039☐
15	19	24	6000	240	2.0	2.0	1.0	CFR5040☐
15	19	30	7500	240	2.5	2.0	1.0	CFR5041☐
15	19	36	9000	240	2.5	2.0	1.0	CFR5042☐
18	22	12	3600	240	1.5	2.0	1.0	CFR5043☐
18	22	18	5400	240	2.0	2.0	1.0	CFR5044☐
18	22	24	7200	240	2.0	2.0	1.0	CFR5045☐

All Dimensions are in inches

Lead Locations



How to Order

Standard Units

Select a **Semi-Cylindrical Shaped Heater** by size and electrical rating from the table above. To complete the part number add the required lead location number.

For example

CFR5001[2] has Type 2 Leads.

Standard leads are double twist 9" long high temperature bare wire.

Custom Designed/Manufactured Semi-Cylindrical Shaped Heaters

Custom manufactured Semi-Cylindrical Shaped Ceramic Fiber Heaters are available; consult **Tempco** with your requirements. ***Standard lead time is 4 weeks.***

Please Specify the following:

- ❑ Length
- ❑ Inner Diameter
- ❑ Outer Diameter
- ❑ Wattage
- ❑ Voltage
- ❑ Lead Location and Type