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Ceramic Fiber Heaters

Introduction



High Temperature Ceramic Fiber Heaters



Design Features

- * Standard Heaters to 1100°C (2012°F)
- * High Temperature Version to 1300°C (2372°F)
- * Low Thermally Conductive Built-In Insulation
- * Standard Flat Panel, Full Cylindrical and Semicylindrical Shapes
- * Fe-Cr-Al Alloy Resistance Wire Elements
- * 100% Inorganic, free of Organics & 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) @ 10W/in². Higher temperature ratings, up to 1300°C (2372°F) @ 15W/in², 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.

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

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

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 bare wire leads
- * Type "A" leads are supplied unless otherwise specified.
- * Custom shapes are available on request.



Introduction

Characteristics and Properties

Composition of Insulation									
Al₂O₃ (Alumina)	8%								
SiO ₂ (Silica)	2%								

Bond.....Silica

Bulk Density gm/cm³, (lb/cu. ft.) 0.28 (18)

Thermal Conductivity W/m°K (Btu/hr°F ft.²/in.)

 Flexural Strength MPa (Psi)

 $\begin{center} \textbf{Compressive Strength} & MPa \ (Psi) \end{center}$

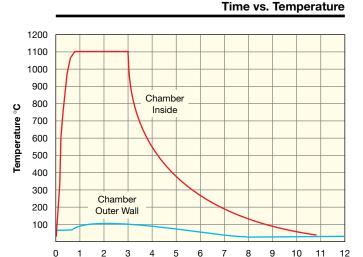
10% Deflection 0.054 (7.83)

Stability-Linear Shrinkage

Performance Characteristics

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

The performance data represented in the chart was obtained by combining a Fiber Insulated Heater with 3" discs 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 in Hours

Time vs. Temperature of an (approx.) 10 cubic

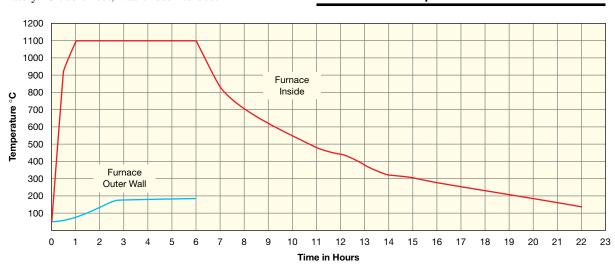
foot furnace chamber incorporating High

Temperature Ceramic Fiber Heaters

Performance of a Typical Rectangular Furnace

Test chamber left and right walls fabricated from Standard Fiber Insulated Heaters $(24" \times 36" \times 5")$ 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.



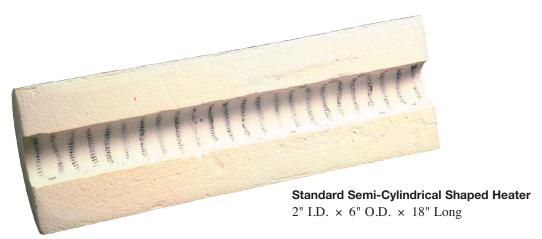
Introduction



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.** The maximum temperatures can only be obtained by trapping the heat generated by the heater coil. If the heaters are used in an open environment the maximum temperatures will not be reached. For example: when using the cylinder style heater, cover the top and bottom opening and insulate; then the internal temperature can approach the maximum.
- **4.** 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.

- **5.** 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.
- **6.** Thermocouples should be *mounted directly above* the element to closely monitor the heater face temperature.
- **7.** *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.
- **8.** *Use only inorganic fibers and binders* to avoid corrosive fumes that could damage the heater.
- **9.** Ceramic Fiber Heaters are easily damaged from *careless mechanical handling*, so handle the units and leads carefully.



Dimensional Tolerances

Flat Panels

Width:	4", 6", 8" 10" through 32"	± ½" ± ½"
Length:	6" 12" through 44"	± ½" ± ½"
Thickness:	1" 2" through 4"	± ½" ± ½"

Full Cylindrical

I.D.:	1.5" through 4" 5" through 18"	± ½" ± ½"
O.D.:	3.5" 5" through 24"	± ½" ± ½"
Length:	6" 12" and 18"	± ½" ± ½"

Semi-Cylindrical

I.D.:	2" and 3.5" 5" through 18"	± 1/8" ± 1/4"
O.D.:	6" through 22"	± 1/4"
Length:	6" 12" through 36"	± ½" ± ½"



Options and Accessories

Ceramic Fiber Heater Features and Options

Higher Temperature Version

Tempco's standard ceramic fiber heaters are designed to go up to 1100°C (2012°F) at a watt density maximum of 10W/in². The particular ceramic fiber and heater resistance wire used determines this temperature limit.

Tempco's Higher Temperature Ceramic Fiber Heaters use a different type of ceramic fiber and heater resistance wire that can withstand 1300°C (2372°F). Also, proprietary manufacturing techniques are used to increase the heat dissipation of the wire coil depending on the particular heater being manufactured.

To order, consult Tempco with your requirements.

Optional Vestibules on Full and Semi-Cylindrical Heaters

Vestibules are used to support full or semi-cylindrical heaters around a pipe to heat the material flowing through the pipe. The vestibule is made from 1" ceramic fiber cut to the correct OD and ID and then cemented to one or both ends of standard size full or semi-cylindrical heaters. The overall length would be the original heater plus 2" for a vestibule on both ends or 1" for a vestibule on one end.

Full cylindrical heaters with (two) vestibules are available with Type 1, 4, or 5 leads.

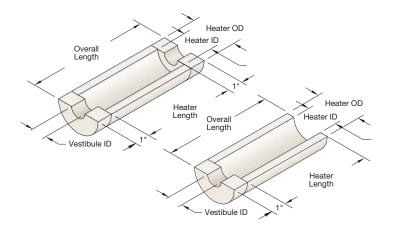
Semi cylindrical heaters with (two) vestibules are available with Type 1 or 3 leads.

To order, consult Tempco with your requirements.

Unheated Molded Ceramic Fiber Panels and Cylinders

Tempco can manufacture unheated fiber panels, full and semicylinders for applications that require additional insulation. For example, flat circles can be made to cover the top or bottom of a cylindrical shaped heater to produce a small furnace. The unheated insulation components are made from the same material as the heaters, so the specifications are identical.

To order, consult Tempco with your requirements.



Mounting / Repair Accessories

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 $3200^{\circ}F (1760^{\circ}C)$

Continuous Service 2300°F (1260°C)

Base Material Al₂O₃ Density 40-50 lbs./cu. ft.

Specific Heat 0.25 BTU/# °F

Thermal Conductivity at 500°F (260°C) . . . 0.65

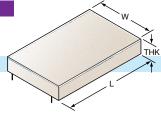
Flat Panels



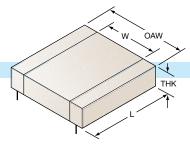
Ceramic Fiber Flat Panel Heaters

Panel Styles

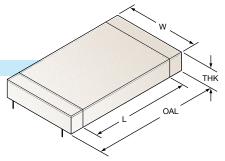
(shown with Type 1 Leads)



Style 1— Entire Panel Heated

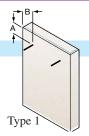


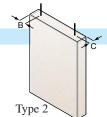
Style 2— Unheated Ends in Width

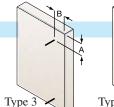


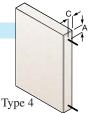
Style 3— Unheated Ends in Length

Lead Locations











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

Ordering Information

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

CFR10012 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
- Wattage
- Width
- ☐ Lead Location and Type
- Voltage
- Special Features

Standard (Non-Stock) Flat Panel High Temperature Ceramic Fiber Heaters

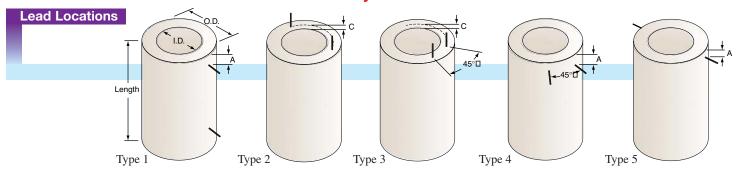
						Style 1			Style 2						Style	e 3			
	Н	leate	b			Part	Part Lead Location		ation	Part	Lead Location		Lead Location		Part		Lead Location		ation
1	W	L	Thk	Watts	Volts	Number	Α	В	С	Number	OAW	Α	В	С	Number	OAL	Α	В	С
	4	6	1	250	60	CFR1001	1.0	1.0	0.5	CFR1019	6	1.0	2.0	0.5	CFR1037	8	2.0	1.0	0.5
	4	12	1	500	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
1	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
1	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
1	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
1	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
1	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
1	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
1	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
2	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
2	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

Ceramic Fiber Cylindrical Heaters



Standard (Non-Stock) Full Cylindrical Shaped High-Temperature Ceramic Fiber Heaters

I.D.	O.D.	Length	Watts	Volts	Α	С	Part Number
1.5	3.5	12.0	600	120	1.5	0.5	CFR3004
2.0	5.0	6.0	400	60	1.0	0.8	CFR3005
2.0	5.0	12.0	800	120	1.5	0.8	CFR3006
3.0	6.0	6.0	600	120	1.0	0.8	CFR3007
3.0	6.0	12.0	1200	120	1.5	0.8	CFR3008
4.0	8.0	6.0	800	120	1.0	1.0	CFR3009
4.0	8.0	12.0	1600	120	1.5	1.0	CFR3010
5.0	9.0	6.0	1000	120	1.0	1.0	CFR3011
5.0	9.0	12.0	2000	120	1.5	1.0	CFR3012
6.0	10.0	6.0	1200	120	1.0	1.0	CFR3013
6.0	10.0	12.0	2400	120	1.5	1.0	CFR3014
6.0	10.0	18.0	3500	240	2.0	1.0	CFR3015
8.0	12.0	6.0	1600	120	1.0	1.0	CFR3016
8.0	12.0	12.0	3100	240	1.5	1.0	CFR3017
8.0	12.0	18.0	4700	240	2.0	1.0	CFR3018
10.0	16.0	6.0	2000	120	1.0	1.5	CFR3019
10.0	16.0	12.0	3900	240	1.5	1.5	CFR3020
10.0	16.0	18.0	5900	240	2.0	1.5	CFR3021
12.0	18.0	6.0	2400	120	1.0	1.5	CFR3022
12.0	18.0	12.0	4700	240	1.5	1.5	CFR3023
12.0	18.0	18.0	7100	240	2.0	1.5	CFR3024
14.0	20.0	12.0	5500	240	1.5	1.5	CFR3025
14.0	20.0	18.0	8200	240	2.0	1.5	CFR3026
16.0	24.0	12.0	6000	240	1.5	2.0	CFR3027
18.0	24.0	12.0	7100	240	1.5	2.0	CFR3028
18.0	24.0	18.0	10600	240	2.0	2.0	CFR3029□



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

All Dimensions are in inches.

Ordering Information

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

CFR30042 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
- Wattage
- ☐ Inner Diameter
- Voltage
- Outer Diameter
- ☐ Lead Location and Type

Semi-Cylindrical Shape



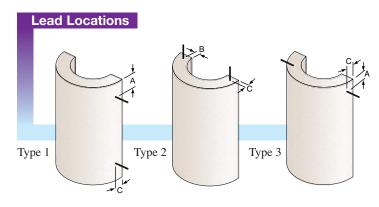
Ceramic Fiber Semi-Cylindrical Heaters

Standard (Non-Stock) Semi-Cylindrical Shaped High Temperature Ceramic Fiber Heaters



Standard Semi-Cylindrical Shaped Heater

(6" O.D. × 2" I.D. × 18" L)





Note: Semi-Cylindrical Heaters are produced individually, but made to fit together in a full circle without a gap.

I.D.	O.D.	L	Watts	Volts	Α	В	С	Part Number
2.0	6.0	6.0	200	60	1.0	1.0	1.0	CFR5003
2.0	6.0	12.0	400	120	1.5	1.0	1.0	CFR5004
2.0	6.0	18.0	600	120	2.0	1.0	1.0	CFR5005
2.0	6.0	24.0	800	240	2.0	1.0	1.0	CFR5006
3.5	7.5	6.0	350	60	1.0	1.5	1.0	CFR5007
3.5	7.5	12.0	700	120	1.5	1.5	1.0	CFR5008
3.5	7.5	18.0	1050	120	2.0	1.5	1.0	CFR5009
3.5	7.5	24.0	1400	240	2.0	1.5	1.0	CFR5010
5.0	9.0	6.0	500	60	1.0	1.5	1.0	CFR5011
5.0	9.0	12.0	1000	120	1.5	1.5	1.0	CFR5012
5.0	9.0	18.0	1500	240	2.0	1.5	1.0	CFR5013
5.0	9.0	24.0	2000	240	2.0	1.5	1.0	CFR5014
5.0	9.0	30.0	2500	240	2.5	1.5	1.0	CFR5015
5.0	9.0	36.0	3000	240	2.5	1.5	1.0	CFR5016
6.5	10.5	6.0	650	120	1.0	2.0	1.0	CFR5017
6.5	10.5	12.0	1300	240	1.5	2.0	1.0	CFR5018
6.5 6.5	10.5	18.0	1950 2600	240	2.0	2.0	1.0	CFR5019
	10.5	24.0	3250	240 240	2.0 2.5	2.0	1.0	CFR5020
6.5 6.5	10.5	30.0	3900	240	2.5	2.0	1.0	CFR5021 CFR5022
8.0	12.0	12.0	1600	240	1.5	2.0	1.0	CFR5022
8.0	12.0	18.0	2400	240	2.0	2.0	1.0	CFR5025
8.0	12.0	24.0	3200	240	2.0	2.0	1.0	CFR5025
8.0	12.0	30.0	4000	240	2.5	2.0	1.0	CFR5025
8.0	12.0	36.0	4800	240	2.5	2.0	1.0	CFR5027
10.0	14.0	12.0	2000	240	1.5	2.0	1.0	CFR5028
10.0	14.0	18.0	3000	240	2.0	2.0	1.0	CFR5029
10.0	14.0	24.0	4000	240	2.0	2.0	1.0	CFR5030
10.0	14.0	30.0	5000	240	2.5	2.0	1.0	CFR5031
10.0	14.0	36.0	6000	240	2.5	2.0	1.0	CFR5032
12.0	16.0	12.0	2400	240	1.5	2.0	1.0	CFR5033
12.0	16.0	18.0	3600	240	2.0	2.0	1.0	CFR5034
12.0	16.0	24.0	4800	240	2.0	2.0	1.0	CFR5035
12.0	16.0	30.0	6000	240	2.5	2.0	1.0	CFR5036
12.0	16.0	36.0	7200	240	2.5	2.0	1.0	CFR5037
15.0	19.0	12.0	3000	240	1.5	2.0	1.0	CFR5038
15.0	19.0	18.0	4500	240	2.0	2.0	1.0	CFR5039
15.0	19.0	24.0	6000	240	2.0	2.0	1.0	CFR5040
15.0	19.0	30.0	7500	240	2.5	2.0	1.0	CFR5041
15.0	19.0	36.0	9000	240	2.5	2.0	1.0	CFR5042
18.0	22.0	12.0	3600	240	1.5	2.0	1.0	CFR5043
18.0	22.0	18.0	5400	240	2.0	2.0	1.0	CFR5044
18.0	22.0	24.0	7200	240	2.0	2.0	1.0	CFR5045□

All Dimensions are in inches.

Ordering Information

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 type by number.

For example

CFR50032 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
- Wattage
- Inner Diameter
- Voltage
- Outer Diameter
- ☐ Lead Location and Type