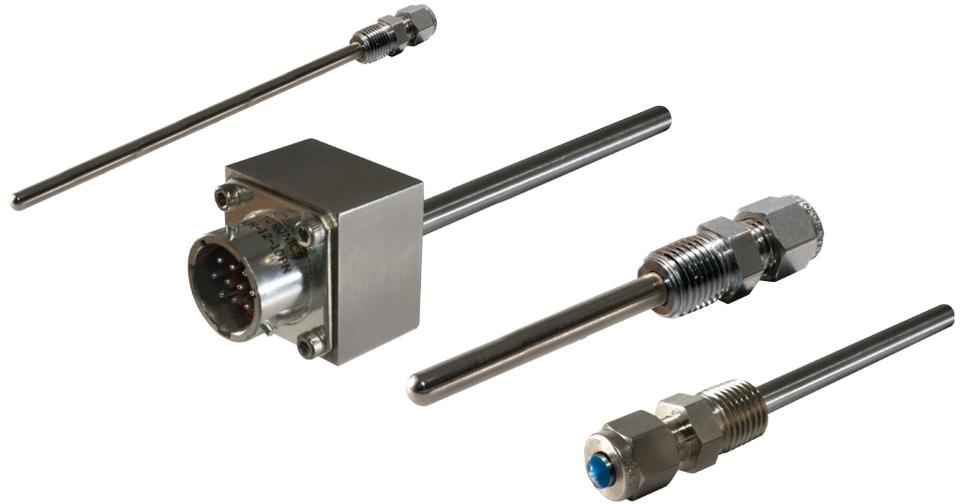




# Temperature Probes

## Temperature probe features

- Stainless steel-encased probes that provide highly reliable sensor performance in a thermowell or direct cryogen contact
- Highly customizable to suit your particular application
- May be configured with many sensor types, including Cernox™ for superior temperature performance from room temperature down to 4 K (-269.15 °C) and below
- Thin-walled probe tubing reduces thermal lag and heat leak from outside the measurement space
- Ideal for temperature measurements in fluid containers and tanks
- Full 3 year standard warranty



Lake Shore offers a variety of temperature sensors in packages that enable mounting in very tight areas. But for some applications (especially if the sensors have to be immersed in liquid) you need to do more to protect the sensor circuitry. For these applications, a cryogenic temperature probe is the optimum choice. Encased in one of these stainless steel thermowell fixtures, the sensor can perform as designed, unaffected by high pressure and sealed to keep electrical components and wiring protected from fluids and other elements.

## Typical applications

Lake Shore temperature probes are ideal for thermometry applications where you need to measure inside:

- fluid containers, tanks, and pipes
- cryostats and cryogenic liquid flow meters
- other liquid storage systems.

They can be used in a number of industrial measurement and monitoring environments, as well as for LH2 and liquefied natural gas (LNG) storage applications. Also, because the rod provides extra length, the probe makes it easier to place a sensor at the precise location required. They also contain a hermetic wiring feedthrough and temperature-resistant epoxy at their end, ensuring reliable end-to-end protection.

## Highly customizable

Lake Shore temperature probes are made-to-order with a wide range of configuration options available. These include:

- Multiple sensor types including our extremely popular Cernox™ RTDs and DT-670 diodes
- Either 1/8 in or 1/4 in stem diameter in lengths up to 0.71 m (28 in) are standard
- Various mounting adapters suited for either positive or negative pressures, if required
- Numerous connectivity options including wire types and lengths as well as various terminating connectors for direct connection to Lake Shore temperature instruments or third party equipment

If you do not see an option available as part of our standard offerings, please contact Lake Shore to discuss further customization options.

## Specifications

### Probe construction

#### Stem

**Material:** 316 stainless steel (non-magnetic)

	Wall thickness	Maximum length
1/4 in stem	0.028 in $\pm 0.003$ in	28 in*
1/8 in stem	0.010 in $\pm 0.001$ in	20 in

\*Longer lengths may be possible depending on the overall configuration. Please contact Lake Shore to discuss.

#### Internal components

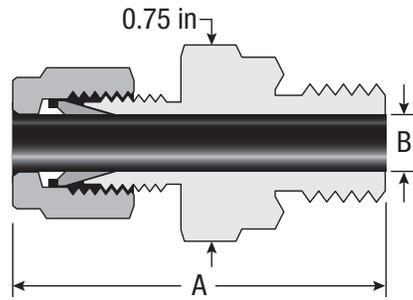
**Internal atmosphere:** Air

**Internal atmosphere pressure:** 98 kPa (14.2 psia)

**Internal sensor wire:** Quad-Twist™ 4-lead 36 AWG phosphor bronze wire with polyimide insulation

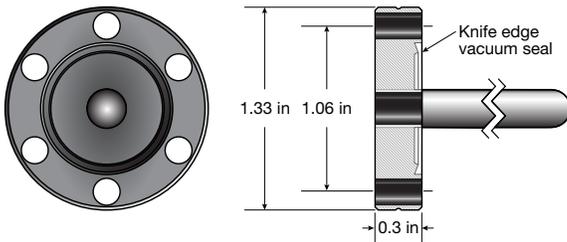
#### Probe mount

##### Swagelok® fittings



	1/4 in probe	1/8 in probe
<b>Swagelok® part number:</b>	SS-400-1-4BT	SS-200-1-2BT
<b>Material</b>	316 stainless steel	
<b>Thread</b>	0.25 in NPT male	0.125 in NPT male
<b>A</b>	1.59 in	1.5 in
<b>B</b>	0.25 in	0.125 in

##### CF flange



**Material:** 304L stainless steel

**Flange size:** 1 1/3 in (DN16)

**Vacuum rating:**  $1 \times 10^{-13}$  torr ( $< 1.3 \times 10^{-13}$  mbar)\*

\*Requires the use of appropriate bolts, gasket and mating surface.

### Connectors

#### BNC connector

Standard male BNC connector. When ordering with 4-lead wire, two separate BNC connectors will be provided to maintain the 4-lead measurement.

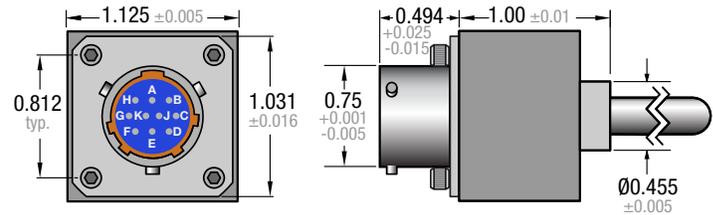
##### Configuration:

	BNC 1		BNC 2	
	Center pin	Shield	Center pin	Shield
2-lead cable	I/V+ (anode)	I/V- (cathode)	—	—
4-lead cable	I+	I-	V+	V-

#### 10-pin Detorionics® connector

The Detorionics connector is o-ring sealed to the temperature probe.

**Note:** This connector is mounted directly to the probe, meaning that no external cable can be selected with this option. It also eliminates the CF flange probe mount option.



##### General specifications

**Air leakage:**  $1 \times 10^{-6}$  cm<sup>3</sup>/s at 15 psi

**Insulation resistance:** 5,000 MΩ at 500 VDC

**Operating temperature:** -55 °C to +125 °C (-67 °F to +257 °F)

Finish is tin-plated shell and pins.

##### Materials

**Shell, bayonet and flange:** Carbon steel

**Pins:** 52 nickel alloy

**Insulator:** Glass

#### 25-pin D-sub connector



The 25-pin D-sub is required to connect directly to particular Lake Shore temperature monitors.

##### Supported instruments:

- Model 211
- Model 218

#### 6-pin DIN connector



The 6-pin DIN is required to connect directly to particular Lake Shore temperature controllers and monitors.

##### Supported current instruments:

- Model 350
- Model 336
- Model 335
- Model 224

##### Supported discontinued instruments:

- Model 340
- Model 331/332
- Model 330 (diodes only)
- Model 321 (silicon diodes only)



### Connector configurations

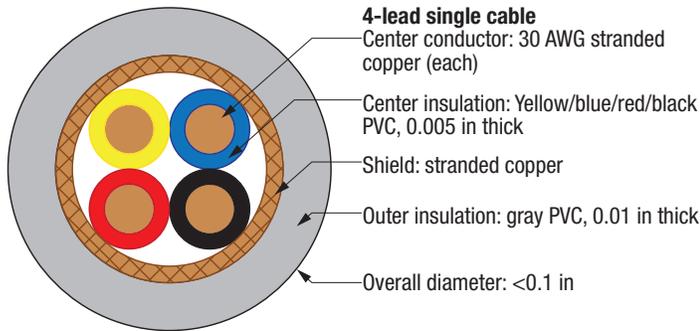
Connector type	I+	V+	I-	V-	Shield*
2-lead BNC (1 connector)	Center pin		Outer cup (shield)		Not connected
4-lead BNC (2 connectors)	Center pin of 'I' BNC	Center pin of 'V' BNC	Outer cup of 'I' BNC	Outer cup of 'V' BNC	Not connected
10-pin probe-mounted Detronics connector®	Pin A	Pin C	Pin B	Pin D	NA
6-pin DIN	Pin 5	Pin 4	Pin 1	Pin 2	Pin 6
25-pin D-sub	Pin 3	Pin 4	Pin 15	Pin 16	Pin 2

\*Shield connection is only used in conjunction with external cable choices that include a braided shield (Cryocable™ and instrument cable)

### Wire

#### Instrument cable

Robust 4-lead cable best for wiring to instrument where both the wire and instrument are at room temperature. The 30 AWG signal wires make these wires easier to work with than traditional cryogenic wire.



**Rated temperature:** -20 °C to 80 °C  
**Thermal conductivity (300 K):** 400 W/(m·K)  
**Resistance (300 K):** 0.32 Ω/m  
**Supported sensor types:** Cernox® RTD, silicon diode, GaAlAs diode, platinum RTD  
**Maximum rated temperature:** 378 K

### Cryogenic wire

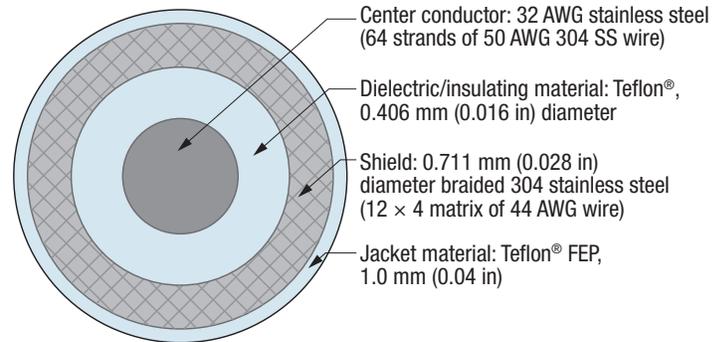
Phosphor-bronze wire combinations that limit heat transfer into the temperature probe and are themselves rated for use in cryogenic environments.

	Quad-Twist™ 36 AWG*	Quad-Twist™ 32 AWG	Quad-Lead™ 32 AWG	Duo-Twist™ 32 AWG
Configuration	4-lead		2-lead	
Wire	Phosphor bronze			
Gauge	36 AWG	32 AWG		
Insulation	Formvar	Polyimide		
Structure	Two twisted pairs		Four wires formed into a ribbon using Bond Coat 999 bonding film	One twisted pair
Thermal conductivity (300 K)	48 W/(m·K)			
Resistance (300 K)	10.3 Ω/m	4.02 Ω/m		
Supported sensors	Cernox® RTD, silicon diode, GaAlAs diode, platinum RTD			Diodes only

\*Also used for internal probe wiring. Ordering this cable will result in a continuous length of wire from the sensor through to the outside environment.

### SS (stainless steel) coaxial cable

2-lead cabling solution that is extremely robust and limits heat transfer into the probe. Due to the 2-lead configuration, this cable is only compatible with diode sensors and will cause a predictable (potentially insignificant) offset in any temperature readings.



#### Electrical properties

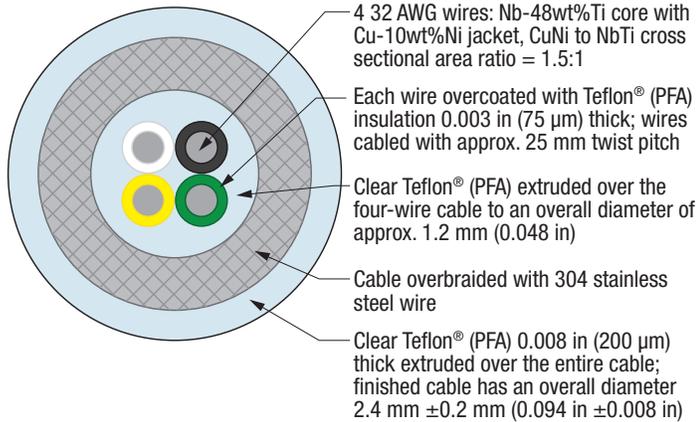
**Resistance—center conductor at 295 K (22 °C):** 23.62 Ω/m (7.2 Ω/ft)  
**Resistance—shield at 295 K (22 °C):** 3.61 Ω/m (1.1 Ω/ft)  
**Insulation temperature range:** 10 mK to 473 K  
**Supported sensor types:** Silicon diode, GaAlAs diode, platinum RTD

### Cryocable™

A robust, 4-wire cable for use in cryogenic environments to room temperature for the

## Cryocable™

A robust, 4-wire cable for use in cryogenic environments to room temperature for the ultimate in thermal isolation from external heat sources. This cable is designed around 32 AWG (203 µm) diameter superconductive wires consisting of a NbTi core (128 µm diameter) and a Cu-10% Ni jacket. The wire is LTS, requiring very low temperatures for it to become superconducting.



**Minimum bend radius:** 15 mm (0.6 in)

**Superconducting critical temperature:** 9.8 K

**Superconducting critical magnetic field:** 10 T

**Supported sensor types:** Cernox™ RTD, silicon diode, GaAlAs diode, platinum RTD

Magnetic field	Critical current (per wire)
3 T	35 A
5 T	25 A
7 T	15 A
9 T	6 A

	Temperature (K)		
	295	77	4.2
Wire resistance (Ω/m)	9.2	8.4	0*
Overbraid resistance (Ω/m)	0.90	0.64	0.62
Thermal conductivity—entire cable assembly (W/(m-K))	7.6	2.8	0.17

\*Superconducting

## Wire configurations

Wire type	I+	V+	I-	V-	Shield
Instrument cable	Black	Yellow	Red	Blue	Copper braid
Quad-Twist™ 36 AWG	Green (from red/green pair)	Green (from clear/green pair)	Red	Clear	None
Quad-Twist™ 32 AWG	Red	Black	Green	Clear	None
Quad-Lead™ 32 AWG	Clear	Black	Red	Green	None
Duo-Twist™ 32 AWG	Clear		Green		None
Stainless steel coaxial	Center conductor		Shield		None
Cryocable™	Black	Yellow	White	Green	Stainless steel braid

### Instrument cable



### Quad-Twist™ 36 AWG



### Quad-Twist™ 32 AWG



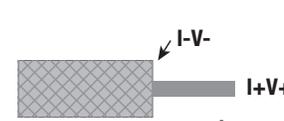
### Quad-Lead™ 32 AWG



### Duo-Twist™ 32 AWG



### Stainless steel coaxial



### Cryocable™



## Temperature sensors

See the individual Cernox, DT-670, and platinum sensor pages for specifications:

Sensor type	Installed sensor package
Cernox™	SD
DT-670	SD
Platinum	Standard PT-100 Series packages

All temperature sensor calibrations are performed before the device is installed into the probe. At this time, Lake Shore does not perform recalibrations on finished probes.



## Temperature probe ordering information

The easiest way to request a quote for a temperature probe is to use the online configurator at [www.lakeshore.com](http://www.lakeshore.com). Otherwise contact our Sales department at [sales@lakeshore.com](mailto:sales@lakeshore.com) and we can assist you.

## Specify TP-a-bcd-e-f-g, where:

**a = probe length in inches**—offered in whole inch increments from 1 to 28 inches

**b = tube diameter<sup>1</sup>**

<b>2</b>	1/8 in
<b>4</b>	1/4 in

<sup>1</sup> Probes over 20 inches long are only available in 1/4-inch diameter

**c = probe mount**

<b>N</b>	no probe mount adapter
<b>S</b>	Swagelok® fitting <sup>2</sup>
<b>F</b>	CF™ flange mount <sup>3</sup>

<sup>2</sup> For 1/8 in diameter probe, Swagelok® fitting uses a 1/8 in NPT male thread; for 1/4 in diameter probe, Swagelok® fitting uses a 1/4 in NPT male thread

<sup>3</sup> The CF™ flange is welded to the probe

**d = external cable/wire type<sup>4</sup>**

<b>N</b>	no external cable (usually used with Detronics connector)
<b>S</b>	S1 coaxial cable (2-lead)
<b>I</b>	30 AWG instrument cable (4-lead)
<b>T</b>	DT-32 (twisted pair of 32 AWG phosphor bronze wire)
<b>F</b>	QT-32 (two twisted pairs of 32 AWG phosphor bronze wire)
<b>Q</b>	QT-36 (two twisted pairs of 36 AWG phosphor bronze wire)
<b>L</b>	QL-32 (four 32 AWG wires in a ribbon configuration)
<b>C</b>	CryoCable™ (4-lead cryogenic coaxial cable)

<sup>4</sup> Lake Shore strongly recommends that all RTD temperature sensors use a 4-lead cable/wire type

**e = terminator**

<b>N</b>	no connector (leads stripped and tinned)
<b>B</b>	BNC connector
<b>D</b>	10-pin Detronics connector <sup>5</sup>
<b>Y</b>	25-pin D-shell connector for temperature monitors
<b>R</b>	connector wired for temperature instruments (6-pin round)

<sup>5</sup> Selecting a Detronics connector limits the following selections: **d** = N and **f** = 0; the Detronics connector is o-ring sealed to the probe

**f = external cable length**—offered in whole meter increments from 1 to 10 m (enter '0' for no external cable)

**g = temperature sensor type<sup>6</sup>**—specify sensor model number with calibration range, if applicable

<sup>6</sup> Due to indium solder use, all SD sensors have an upper temperature usage limit of 400 K

### Ordering example

**TP- 06 - 2FS - B - 03 - S27**

(6 in probe, 1/8 in diameter, flange, S1 coaxial cable, BNC connector, 3 m cable length, DT-670-SD calibrated 1.4 K to 325 K)

### Calibration range suffix codes

Numeric figure is the low end of the calibration Letters represent the high end: B = 40 K, D = 100 K, L = 325 K, H = 500 K

### Cernox™ RTDs

<b>Uncalibrated</b>	<b>C01</b>	CX-1010-SD
	<b>C02</b>	CX-1030-SD
	<b>C03</b>	CX-1050-SD
	<b>C04</b>	CX-1070-SD
	<b>C05</b>	CX-1080-SD
<b>Calibrated</b>	<b>C07</b>	CX-1010-SD-0.1L
	<b>C16</b>	CX-1030-SD-0.3L
	<b>C25</b>	CX-1050-SD-1.4L
	<b>C31</b>	CX-1070-SD-4L
	<b>C32</b>	CX-1080-SD-20L
	<b>C13</b>	CX-1010-SD-1.4L

### Platinum RTDs

<b>Uncalibrated</b>	<b>P01</b>	PT-102
	<b>P02</b>	PT-103
	<b>P03</b>	PT-111
<b>Calibrated</b>	<b>P04</b>	PT-102-2S
	<b>P05</b>	PT-102-3S
	<b>P07</b>	PT-102-14L
	<b>P08</b>	PT-102-14H
	<b>P11</b>	PT-103-2S
	<b>P12</b>	PT-103-3S
	<b>P14</b>	PT-103-14L
	<b>P15</b>	PT-103-14H
	<b>P18</b>	PT-111-2S
	<b>P19</b>	PT-111-3S
	<b>P21</b>	PT-111-14L
	<b>P22</b>	PT-111-14H

### Silicon diodes

<b>Uncalibrated</b>	<b>S07</b>	DT-670A-SD	
	<b>S08</b>	DT-670B-SD	
	<b>S09</b>	DT-670C-SD	
	<b>S10</b>	DT-670D-SD	
	<b>S0A</b>	DT-670A1-SD	
	<b>S0B</b>	DT-670B1-SD	
	<b>Calibrated</b>	<b>S27</b>	DT-670-SD-1.4L
		<b>S28</b>	DT-670-SD-1.4H
<b>S32</b>		DT-670-SD-70L	
<b>S33</b>		DT-670-SD-70H	

### GaAIs diodes

<b>Uncalibrated</b>	<b>G01</b>	TG-120-SD
<b>Calibrated</b>	<b>G04</b>	TG-120-SD-1.4L
	<b>G05</b>	TG-120-SD-1.4H
	<b>G10</b>	TG-120-SD-70L
	<b>G11</b>	TG-120-SD-70H