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.

**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

*Note: These probes are not designed to be intrinsically safe. It is the responsibility of the user to operate these probes safely in explosive environments.*

Probe construction

**Stem**

<table>
<thead>
<tr>
<th>Material: 316 stainless steel (non-magnetic)1</th>
<th>Wall thickness</th>
<th>Maximum length</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/4 in stem</td>
<td>0.028 in ±0.003 in</td>
<td>28 in*</td>
</tr>
<tr>
<td>1/8 in stem</td>
<td>0.010 in ±0.001 in</td>
<td>20 in</td>
</tr>
</tbody>
</table>

1Not suitable for direct immersion in liquid oxygen or hydrogen environments.
2Longer 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**

0.75 in

**25-pin D-sub connector**

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

**General specifications**

Air leakage: $1 \times 10^{-6}$ cm$^3$/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

**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)

Lake Shore Cryotronics, Inc. | t. 614.891.2244 | f. 614.818.1600 | e. info@lakeshore.com | www.lakeshore.com
**Connector configurations**

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

*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.

![4-lead single cable](image)

- Center conductor: 30 AWG stranded copper (each)
- Center insulation: Yellow/blue/red/black PVC, 0.005 in thick
- Shield: stranded copper
- Outer insulation: gray PVC, 0.01 in thick
- Overall diameter: <0.1 in

**Cryogenic wire**

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

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

*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.

- Center conductor: 32 AWG stainless steel (64 strands of 50 AWG 304 SS wire)
- Dielectric/insulating material: Teflon®, 0.406 mm (0.016 in) diameter
- Shield: 0.711 mm (0.028 in) diameter braided 304 stainless steel (12 × 4 matrix of 44 AWG wire)
- Jacket material: Teflon® FEP, 1.0 mm (0.04 in)

**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.

- 4 32 AWG wires: Nb-48wt%Ti core with Cu-10wt%Ni jacket, CuNi to NbTi cross sectional area ratio = 1.5:1
- Each wire overcoated with Teflon® (PFA) insulation 0.003 in (75 µm) thick; wires cabled with approx. 25 mm twist pitch
- Clear Teflon® (PFA) extruded over the four-wire cable to an overall diameter of approx. 1.2 mm (0.048 in)
- Cable overbraided with 304 stainless steel wire
- Clear Teflon® (PFA) 0.008 in (200 µm) thick extruded over the entire cable; finished cable has an overall diameter 2.4 mm ±0.2 mm (0.094 in ±0.008 in)

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

<table>
<thead>
<tr>
<th>Magnetic field</th>
<th>Critical current (per wire)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 T</td>
<td>35 A</td>
</tr>
<tr>
<td>5 T</td>
<td>25 A</td>
</tr>
<tr>
<td>7 T</td>
<td>15 A</td>
</tr>
<tr>
<td>9 T</td>
<td>6 A</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Temperature (K)</th>
<th>295</th>
<th>77</th>
<th>4.2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wire resistance (Ω/m)</td>
<td>9.2</td>
<td>8.4</td>
<td>0*</td>
</tr>
<tr>
<td>Overbraid resistance (Ω/m)</td>
<td>0.90</td>
<td>0.64</td>
<td>0.62</td>
</tr>
<tr>
<td>Thermal conductivity—entire cable assembly (W/(m·K))</td>
<td>7.6</td>
<td>2.8</td>
<td>0.17</td>
</tr>
</tbody>
</table>

*Superconducting

Wire configurations

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

Temperature sensors

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

<table>
<thead>
<tr>
<th>Sensor type</th>
<th>Installed sensor package</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cernox™</td>
<td>SD</td>
</tr>
<tr>
<td>DT-670</td>
<td>SD</td>
</tr>
<tr>
<td>Platinum</td>
<td>Standard PT-100 Series packages</td>
</tr>
</tbody>
</table>

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. Otherwise contact our Sales department at 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
  - 2 = 1/8 in
  - 4 = 1/4 in
  - 1 Probes over 20 inches long are only available in 1/4-inch diameter
- **c** = probe mount
  - N = no probe mount adapter
  - S = Swagelok® fitting
  - F = CF™ flange mount
  - 2 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
  - 3 The CF™ flange is welded to the probe
- **d** = external cable/wire type
  - N = no external cable (usually used with Detoronics connector)
  - S = S1 coaxial cable (2-lead)
  - I = 30 AWG instrument cable (4-lead)
  - T = DT-32 (twisted pair of 32 AWG phosphor bronze wire)
  - QT = QT-32 (two twisted pairs of 32 AWG phosphor bronze wire)
  - QL = QL-32 (four 32 AWG wires in a ribbon configuration)
  - C = CryoCable™ (4-lead cryogenic coaxial cable)
  - 4 Lake Shore strongly recommends that all RTD temperature sensors use a 4-lead cable/wire type
- **e** = terminator
  - N = no connector (leads stripped and tinned)
  - B = BNC connector
  - D = 10-pin Detoronics connector
  - Y = 25-pin D-shell connector for temperature monitors
  - R = connector wired for temperature instruments (6-pin round)
  - 5 Selecting a Detoronics connector limits the following selections: d = N and f = 0; the Detoronics 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 — specify sensor model number with calibration range, if applicable
  - 6 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)