Stainless Steel Temperature Probe

(Order Code TMP-BTA)

The Stainless Steel Temperature Probe is a rugged, general-purpose laboratory temperature sensor. It is designed to be used as you would use a thermometer for experiments in chemistry, physics, biology, Earth science, and environmental science. **Note:** Do not completely submerge the sensor. The handle is not waterproof. This probe is the same as the probe shipped with CBL 2. Typical uses include the following:

- heat of fusion experiments
- monitoring endothermic and exothermic reactions
- weather studies
- specific heat experiments
- insulation studies

NOTE: This product is to be used for educational purposes only. It is not appropriate for industrial, medical, research, or commercial applications.

Using the Stainless Steel Temperature Probe with a Computer

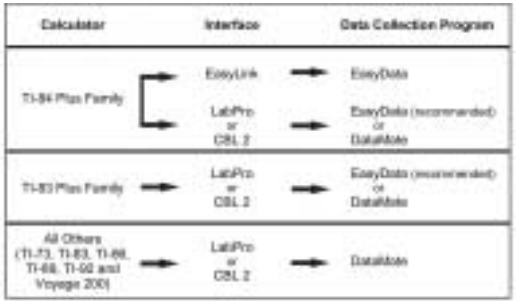
This sensor can be used with a computer and any of the following lab interfaces: Vernier LabPro® or Go!®Link.

1. Connect the Stainless Steel Temperature Probe, interface, and computer.
2. Start the Logger *Pro*® or Logger Lite® software.
3. The program will automatically identify the Stainless Steel Temperature Probe, and you are ready to collect data.

Using the Stainless Steel Temperature Probe with TI Calculators

This sensor can be used with a TI graphing calculator and any of the following lab interfaces: LabPro, CBL 2™, and Vernier EasyLink®. Here is the general procedure to follow when using the Stainless Steel Temperature Probe with a graphing calculator:

1. Connect the data-collection interface to the graphing calculator.
2. Connect the Stainless Steel Temperature Probe to any of the analog ports on the interface or to EasyLink.
3. Start the EasyData or DataMate App—the application you choose to use depends on your calculator and interface. See the chart for more information.



4. The Stainless Steel Temperature Probe will be identified automatically, and you are ready to collect data.

If the data-collection application is not on your calculator, use the following instructions to load it onto the calculator.

- **EasyData App**–This program may already be installed on your calculator. Check to see that it is EasyData version 2.0 or newer. If it is not installed or is an older version, it can be downloaded to your computer from the Vernier web site, www.vernier.com/easy/easydata.html. It can then be transferred from the computer to the calculator using TI-Connect and a TI unit-to-computer cable or TI-GRAPH LINK cable. See the Vernier web site, www.vernier.com/calc/software/index.html for more information on the App and Program Transfer Guidebook.
- **DataMate program**–This program can be transferred directly from LabPro or CBL 2 to the TI graphing calculator. Use the calculator-to-calculator link cable to connect the two devices. Put the calculator into Receive mode, and then press the Transfer button on the interface.

Using the Stainless Steel Temperature Probe with a Palm Powered™ device

1. Connect the Palm Powered handheld, LabPro, and the Stainless Steel Temperature Probe.
2. Start Data Pro.
3. Tap New, or choose New from the Data Pro menu. Tap New again. The Stainless Steel Temperature Probe will be identified automatically.
4. You are now ready to collect data.

Specifications

- Temperature range: –40 to 135°C (–40 to 275°F)
- Maximum temperature that the sensor can tolerate without damage: 150°C
- 12-bit resolution (LabPro):

0.17°C	(–40 to 0°C)
0.03°C	(0 to 40°C)
0.1°C	(40 to 100°C)
0.25°C	(100 to 135°C)

- 10-bit resolution (CBL 2):

0.68°C	(–40 to 0°C)
0.12°C	(0 to 40°C)
0.4°C	(40 to 100°C)
1.0°C	(100 to 135°C)

- Temperature sensor: 20 kΩ NTC Thermistor
- Accuracy: ±0.2°C at 0°C, ±0.5°C at 100°C
- Response time (time for 90% change in reading): 10 seconds (in water, with stirring)
  400 seconds (in still air)
  90 seconds (in moving air)

- Probe dimensions: Probe length (handle plus body): 15.5 cm
  Stainless steel body: length 10.5 cm, diameter 4.0 mm
  Probe handle: length 5.0 cm, diameter 1.25 cm

This sensor is equipped with circuitry that supports auto-ID. When used with LabPro, Go! Link, EasyLink, or CBL 2, the data-collection software identifies the sensor and uses pre-defined parameters to configure an experiment appropriate to the recognized sensor.

How the Stainless Steel Temperature Probe Works

This probe uses the 20 kΩ NTC Thermistor. The thermistor is a variable resistor whose resistance decreases nonlinearly with increasing temperature. The best-fit approximation to this nonlinear characteristic is the Steinhart-Hart equation. At 25°C, the resistance is approximately 4.3% per °C. The LabPro or CBL 2 interface measures the resistance value, R, at a particular temperature, and converts the resistance using the Steinhart-Hart equation:

$$T = [K_0 + K_1(\ln 1000R) + K_2(\ln 1000R)^3]^{-1} - 273.15$$

where T is temperature (°C), R is the measured resistance in kΩ, $K_o = 1.02119 \times 10^{-3}$, $K_1 = 2.22468 \times 10^{-4}$, and $K_2 = 1.33342 \times 10^{-7}$. Fortunately, our programs take care of this conversion for you, and provide readings in °C (or other units, if you load a different calibration).

Probe Chemical Tolerance

The Stainless Steel Temperature Probe body is constructed from grade 316 stainless steel.[1] This high-grade stainless steel provides a high level of corrosion resistance for use in the science classroom. Here are some general guidelines for usage:

1. The probe handle is constructed of molded plasticized Santoprene®. While this material is very chemical resistant, we recommend that you avoid submerging the probe beyond the stainless steel portion.
2. Always wash the probe thoroughly after use.
3. The probe can be left continuously in water at temperatures within the range of –40° to 150°C. Continuous usage in saltwater will cause only minor discoloration of the probe, with no negative effect on performance.
4. You can leave the probe continuously in most organic compounds, such as methanol, ethanol, 1-propanol, 2-propanol, 1-butanol, n-hexane, lauric acid, paradichlorobenzene, phenyl salicylate, and benzoic acid. The probe should not be left in n-pentane for more than 1 hour.
5. The probe can be left in strong basic solutions, such as NaOH, for up to 48 hours, with only minor discoloration. We do not recommend usage in basic solutions that are greater than 3 M in concentration.
6. The chart provides the maximum length of time we recommend for probe exposure to some common acids. Probes left in an acid longer than these times may bubble and/or discolor, but will still be functional. We do not recommend probes be left to soak in any acid longer than 48 hours.

Maximum acid exposure time	
1 M HCl	20 min
2 M HCl	10 min
3 M HCl	5 min
1 M H_2SO_4	48 hours
2 M H_2SO_4	20 min
3 M H_2SO_4	10 min
1 M HNO_3	48 hours
2 M HNO_3	48 hours
3 M HNO_3	48 hours
1 M CH_3COOH	48 hours
2 M CH_3COOH	48 hours
3 M CH_3COOH	48 hours
1 M H_3PO_4	48 hours
2 M H_3PO_4	48 hours
3 M H_3PO_4	48 hours

[1] Grade 316 stainless steel has a composition of 0.08% carbon, 2.0% manganese, 0.75% silicon, 0.04% phosphorus, 0.03% sulfur, 16-18% chromium, 10-14% nickel, 2-3% molybdenum, and 0.1% nitrogen.

Do I Need to Calibrate This Probe? Probably Not

In most cases, the Stainless Steel Temperature Probe will never need to be calibrated. It is calibrated extremely well before it ships. However, if the need arises to calibrate the sensor, and you are using Logger Pro 3.3 or newer, the sensor can be custom-calibrated. **Note** this can only be done on computers, and can not be done from DataMate or EasyData (calculators) or DataPro (Palm OS).

The process of calibrating a Stainless Steel Temperature probe connected to LabPro and Logger *Pro* is different than the process for most other sensors. One reason is that this probe uses a thermistor, which has a non-linear response, and you need to calibrate it at three different temperatures.

You will need a thermometer and three containers of water at three different temperatures.

Choose Experiment/Calibrate and then choose the Stainless Steel Temperature Probe. Choose Calibrate Now. For each of the three water baths, place the temperature probe in the bath with the thermometer. Allow both readings to stabilize, click Keep, and enter the temperature reading measured by the thermometer. Click Done after the third water bath reading.

If you want the calibration to be saved with the file for later use after you calibrate, you need to do two things:

- Go to the calibration dialog box and choose Calibration Storage from the pull down menu. Then set the Calibration Retrieval Preference to Experiment file.
- Save the Experiment file.

After this, when you open that experiment file, the calibration stored with the experiment file will be used, instead of the normal calibration stored on the computer for this probe.

Warranty

Vernier warrants this product to be free from defects in materials and workmanship for a period of five years from the date of shipment to the customer. This warranty does not cover damage to the product caused by abuse or improper use

Vernier
Measure. Analyze. Learn.™
Vernier Software & Technology
13979 S.W. Millikan Way • Beaverton, OR 97005-2886
Toll Free (888) 837-6437 • (503) 277-2299 • FAX (503) 277-2440
info@vernier.com • www.vernier.com

Rev 9/27/06