

Wide-Range Temperature Probe

(Order Code WRT-BTA)



This rugged temperature probe features a wide temperature range, from -20 to 330°C . The high upper limit of the sensor allows for melting point determinations of most organic compounds. It uses RTD (Resistance Temperature Detection) technology to establish a $\pm 0.1^{\circ}\text{C}$ accuracy, as well as excellent stability and repeatability. Each unit is individually calibrated, and the calibration is stored on a smart chip in the sensor. It is designed to be used as you would use a thermometer for experiments in organic and inorganic chemistry, physics, biology, Earth science, and environmental science.

Note: Do not completely submerge the sensor. Typical uses include the following:

- fractional distillation
- melting temperature of organic compounds
- synthesis and analysis of aspirin
- heat of fusion experiments
- Hess's law experiments
- specific heat experiments

Important: When using this sensor, keep in mind that important electronic circuitry is built into the handle of the probe. For optimal accuracy of the RTD, keep the handle of the probe from warming above 40°C (104°F). If necessary, shield the handle from high-temperature sources using aluminum foil or other shielding material.

Collecting Data with the Wide-Range Temperature Probe

This sensor can be used with the following interfaces to collect data.

- Vernier LabQuest[®] 2 or the original LabQuest[®] as a standalone device or with a computer
- Vernier LabQuest[®] Mini with a computer
- Vernier LabPro[®] with a computer
- Vernier Go![®]Link with a computer
- Vernier SensorDAQ[®] with a computer
- TI-Nspire[™] Lab Cradle

Here is the general procedure to follow when using the Wide-Range Temperature Probe:

1. Connect the Wide-Range Temperature Probe to the interface.
2. Start the data-collection software.
3. The software will identify the Wide-Range Temperature Probe and load a default data-collection setup. You are now ready to collect data.

Data-Collection Software

This sensor can be used with an interface and the following data-collection software.

- **Logger Pro** is used with LabQuest 2, LabQuest, LabQuest Mini, LabPro, or Go!Link
- **Logger Lite** is used with LabQuest 2, LabQuest, LabQuest Mini, LabPro, or Go!Link
- **LabQuest App** is used when LabQuest 2 or the original LabQuest is used as a standalone device.
- **DataQuest[™] Software for TI-Nspire[™]** This calculator application for the TI-Nspire can be used with the TI-Nspire Lab Cradle.
- National Instruments **LabVIEW[™]** software is a graphical programming language sold by National Instruments. It is used with SensorDAQ and can be used with a number of other Vernier interfaces. See www.vernier.com/labview for more information.

Note: This sensor **cannot** be used with TI calculators in combination with EasyLink, LabPro, CBL[™], or CBL 2[™].

NOTE: Vernier products are designed for educational use. Our products are not designed nor recommended for any industrial, medical, or commercial process such as life support, patient diagnosis, control of a manufacturing process, or industrial testing of any kind.

Specifications

Temperature range:	-20 to 330°C (-4 to 626°F)
Maximum temperature that the sensor can tolerate without damage:	380°C
13-bit resolution (SensorDAQ):	0.05°C
12-bit resolution (LabPro, LabQuest 2, LabQuest, LabQuest Mini, TI-Nspire [™] Lab Cradle):	0.10°C
Temperature detector used:	Platinum RTD ($100\ \Omega$)
Accuracy:	$\pm 0.1^{\circ}\text{C}$ at 0°C
Voltage Range:	0.2 – $4.8\ \text{V}$
Response time (time for 90% change in reading):	14.5 seconds (in water, still) 8.0 seconds (in water, with stirring) 420 seconds (in still air)
Probe dimensions:	Probe length (handle plus body): $24.5\ \text{cm}$ Stainless steel body: length $17.0\ \text{cm}$, diameter $0.64\ \text{cm}$ ($6.4\ \text{mm}$) Probe handle: length $6.8\ \text{cm}$, width $2.25\ \text{cm}$, thickness $1.3\ \text{cm}$

This sensor is equipped with circuitry that supports auto-ID. When used with LabQuest 2, LabQuest, LabQuest Mini, LabPro, Go! Link, TI-Nspire™ Lab Cradle, or SensorDAQ, the data-collection software identifies the sensor and uses pre-defined parameters to configure an experiment appropriate to the recognized sensor.

How the Wide-Range Temperature Probe Works

The detector is an RTD (Resistance Temperature Detection) sensor whose output increases nonlinearly with increasing temperature. The best-fit approximation to this nonlinear characteristic is a quadratic equation:

$$T = K_0 + K_1 * V + K_2 * V^2$$

where T is temperature (°C), $K_0 = \sim -33.8$, $K_1 = \sim 73.2$, and $K_2 = \sim 0.90$. During the Vernier custom calibration, these values are adjusted slightly, to achieve a $\pm 0.1^\circ\text{C}$ accuracy value. The data acquisition programs convert V to °C (or other units, if you choose a different calibration).

Probe Chemical Tolerance

The stainless-steel 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 laboratory. 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 -20° to 330°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.

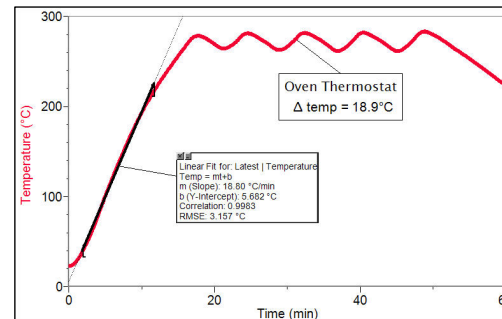
Maximum acid exposure time	
1 M HCl	20 min
2 M HCl	10 min
3 M HCl	5 min
1 M H ₂ SO ₄	48 hours
2 M H ₂ SO ₄	20 min
3 M H ₂ SO ₄	10 min
1 M HNO ₃	48 hours
2 M HNO ₃	48 hours
3 M HNO ₃	48 hours
1 M CH ₃ COOH	48 hours
2 M CH ₃ COOH	48 hours
3 M CH ₃ COOH	48 hours
1 M H ₃ PO ₄	48 hours
2 M H ₃ PO ₄	48 hours
3 M H ₃ PO ₄	48 hours

¹ Grade 316 Wide-Range 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.

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.

Calibration

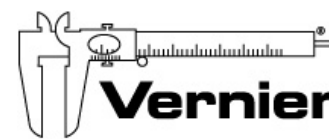
The Wide-Range Temperature Probe will never need to be calibrated. Each probe is carefully calibrated before it ships, and this unique calibration is stored on a smart chip in the sensor. **Note:** There is no method to perform a calibration of this sensor in most of our software programs; however, there is no need to do so. Logger Pro does allow for an approximate calibration, but the results would likely be less accurate than the custom factory calibration.



Temperature cycles of an oven using the Wide-Range Temperature 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.



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