FLUKE®
Calibration

# 5623B
## Precision RTD Freezer Probe

Users Guide

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# Introduction

## General

The Platinum Resistance Thermometer (PRT) model 5623B is designed to be a secondary standard interpolating instrument converting temperature to resistance. The 5623B assembly design allows for exposure to very cold temperature (–100 °C) and is an ideal reference for verification, monitoring or calibrating control sensors in located in freezers or incubators. The 5623B may also be used as a temperature standard for calibration of industrial sensors. The PRT is used with a readout device to detect temperature changes or actual temperature. The 5623B covers the range from –100 °C to 156 °C. Standard length is 6 inches. Custom lengths are available on request.

## Recalibration

The recalibration of the 5623B PRT should be scheduled according to the user's company Quality Assurance requirements. Normally, a PRT is recalibrated annually. Unless the PRT is used only over a limited range, calibration over the full range of the PRT (–100 °C to 156 °C) is recommended. For information on recalibrating your 5623B, contact Fluke for assistance (see "How to Contact Fluke").

Depending on the user's Quality Assurance requirements, the PRT drift should be checked periodically at the Triple Point of Water (TPW). For information on drift with respect to mechanical shock and oxidation, refer to the "Troubleshooting" section of this manual.

# Before You Start

## Symbols Used

Table 1 lists the International Electrical Symbols. Some or all of these symbols may be used on the instrument or in this manual.

**Table 1. International Electrical Symbols**

| Symbol | Description | Symbol | Description |
|---|---|---|---|
|  | Electric Shock | O | Off |
|  | Hot Surface (Burn Hazard) | I | On |
|  | Read the Users Manual (Important Information) |  | Fuse |
| ~ | AC (Alternating Current) |  | Battery |
| ≂ | AC-DC |  N10140 | C-TICK Australian EMC Mark |
| ⎓ | DC |  | Canadian Standards Association |
|  | Double Insulated | CE | CE Complies with European Union Directives |
|  | PE Ground |  | The European Waste Electrical and Electronic Equipment (WEEE) Directive (2002/96/EC) Mark |
| **CAT II** | CAT II equipment is designed to protect against transients from energy-consuming equipment supplied from the fixed installation, such as TVs, PCs, portable tools, and other household appliances. | | |

## Safety Information

Use this instrument only as specified in this manual. Otherwise, the protection provided by the instrument may be impaired.

The following definitions apply to the terms “Warning” and “Caution”.

- “Warning” identifies conditions and actions that may pose hazards to the user.
- “Caution” identifies conditions and actions that may damage the instrument being used.

**⚠Warning**

**To avoid personal injury, follow these guidelines:**

- **DO NOT use this instrument to measure the temperature of any hazardous live component (>30 V ac rms, 42 V ac peak, or 60 V dc).**
- **Use of this instrument at high temperatures for extended periods of time can cause the handle to become hot.**
- **Follow all safety guidelines listed in the Users Guide.**
- **Calibration Equipment should only be used by trained personnel.**
- **Use the Product only as specified, or the protection supplied by the Product can be compromised.**
- **DO NOT use the Product around explosive gas, vapor, or in damp or wet environments.**

**⚠Caution**

**To avoid possible damage to the instrument, follow these guidelines:**

- **DO NOT drop or hit the probe in any way. This will cause damage to the probe internally and affect its calibration.**
- **Read “PRT Care and Handling Guidelines” before removing the PRT from the shipping box. Incorrect handling can damage the PRT and void the warranty.**
- **Keep the shipping container in case it is necessary to ship the PRT. Incorrect packaging of the PRT for shipment can cause irreparable damage.**

## How to Contact Fluke

To contact Fluke, call one of the following telephone numbers:

- Technical Support USA: 1-800-44-FLUKE (1-800-443-5853)
- Calibration/Repair USA: 1-888-99-FLUKE (1-888-993-5853)
- Canada: 1-800-36-FLUKE (1-800-363-5853)
- Europe: +31 402-675-200
- Japan: +81-3-3434-0181
- Singapore: +65-738-5655
- Anywhere in the world: +1-425-446-5500

Or, visit Fluke’s website at www.fluke.com.

To register your product, visit http://register.fluke.com.

To see, print, or download the latest manual supplement, visit

http://us.fluke.com/usen/support/manuals.

# Specifications

See Table 2 for a list of the specifications.

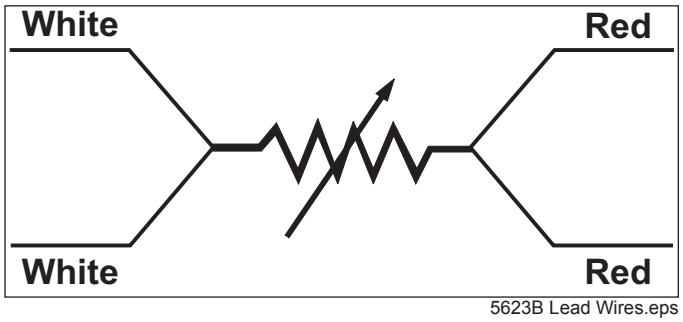
**Table 2. Specifications**

| Parameter | Range |
|---|---|
| Temperature Range | –100 °C to 156 °C |
| Nominal Resistance at 0.01 °C | 100 Ω ±0.1 Ω |
| Temperature Coefficient | 0.003925 Ω/Ω/ °C |
| Drift [1] | ±0.1 °C at 0.010 °C |
| Hysteresis | ±0.01 °C maximum |
| Sheath Dimensions (Length x Diameter) | 152 mm x 6.35 mm (6 in x 0.25 in) |
| Sheath Material | Inconel™ 600 |
| Transition Junction Temperature Range [2] | –100 °C to 156 °C |
| Minimum Immersion Length [3] (<5 mK error) | 114 mm (4.5 in) |
| Lead-wire Cable Type | Teflon™ -insulated, 22 AWG, Silver-plated Stranded Copper |
| Lead-wire Length | 609.6 cm (240 in) |
| Calibration | Includes Manufacturer's NVLAP-Accredited Calibration |
| [1] After 100 hours at maximum temperature.<br>[2] Temperatures outside this range will cause irreparable damage.<br>[3] Per ASTM E 644 | |

# Installation

## Lead Wire Identification

The 5623B PRT is equipped with a four-wire cable (see Figure 1). Four lead wires are used to cancel lead wire resistance. For best results, the readout device should be equipped to handle four-terminal resistors. The lead wires are two different colors. Lead wire pairs attached to each end of the sensor are identified by red and white insulation.




5623B Lead Wires.eps

**Figure 1. PRT Schematic**

# PRT Care and Handling Guidelines

**⚠Caution**

**Read this section before removing the PRT from the shipping box or case.**

Care must be taken in handling the PRT to maintain calibration accuracy. Care should still be used when handling the PRT even though the Inconel sheath is durable and provides good protection for the sensor. Correct handling of the PRT will prolong the life expectancy. When not in use, the PRT should be stored in an optional protective case that can be purchased by contacting Fluke (see "How to Contact Fluke"). The handle is designed to be immersed.

## PRT Handling Guidelines

- Keep the thermometer as clean as possible.
- Immerse the thermometer in the appropriate liquid for the temperature range. If a dry block is used, the well diameter should allow the PRT to comfortably slip in and out without excess movement. For best results, immerse the thermometer as deep as possible to avoid "stem effect" (the temperature error caused by the conduction of heat away from the sensor).
- Allow sufficient time for the thermometer to stabilize before making measurements. This allows for the best accuracy.
- Use the correct drive current with the thermometer to prevent error in temperature or resistance. Fluke recommends 1 mA.
- Use the protective shipping box provided or other protection when the thermometer is not in use.
- **DO NOT** subject the thermometer to any physical shock or vibration.
- **DO NOT** use pliers or other devices to squeeze the sheath. This action can permanently damage the PRT.
- **DO NOT** subject the thermometer to temperatures above the highest specified operating temperature.
- **DO NOT** expose the thermometer's handle or cables to extreme temperatures. The temperature limits of the handle and cables are: –100 °C to 156 °C.
- **DO NOT** screw a clamp down so tight that it dents the sheath. This can permanently damage the PRT.

# Operation

For best results, be familiar with the operation of the heat source and the readout instrument. Be sure to follow the manufacturer's instructions for the readout instrument and the heat source.

## Immersion Requirements

Stem effect can cause measurement errors for any thermometer not immersed in the fluid at least 114 mm (4.5 in). This error is due to heat lost or gained by the sensing element through the thermometer stem. In addition, heat losses occur due to radiation losses from the sensing element to the housing. The immersion depth for standards is dependent on several factors including accuracy requirements and type of liquid. Therefore, we recommend a 114 mm (4.5 in) minimum immersion depth. The handle is designed to be immersed. The temperature limits of the handle are –100 °C to 156 °C. Temperatures outside these limits can damage the handle and the probe. Convection of heat from the heat source must be kept within the handle limits. The exact immersion depth required can be determined by performing a gradient test taking measurements approximately every 1.27 cm (0.5 in) until there is a significant difference in readings. Allow the thermometer to stabilize at each new depth. Plot the results to see the stem effect.

## Thermal EMF

Two factors contribute to thermal EMF, chemical consistency and physical consistency. Variations in chemical structure due to impurities can contribute to thermal EMF. Also discrepancies in crystal structure can contribute to thermal EMF. These factors are minimized by annealing the full length of wire before construction of the PRT.

Likewise, connection to extension lead wires and readout instruments can be a source of thermal EMF. The thermal EMF is caused by a difference in temperature between two connections. If the two connections are the same temperature, there will be little or no thermal EMF effects.

However, if there is a substantial temperature difference between connections, the thermal EMF effects will be significant. Therefore, cover or insulate any exposed bridge or galvanometer terminals to lessen the source of error. The effects of thermal EMF can be canceled by using an ac bridge or a dc bridge with reversible current.

# Troubleshooting

In the event that the probe appears to function abnormally, this section may be of use in solving the problem. Several possible problem conditions are described along with likely causes and solutions. If a problem arises, please read this section carefully and attempt to understand and solve the problem. If the probe seems faulty or the problem cannot otherwise be solved, contact Fluke for assistance (see "How to Contact Fluke"). Be sure to have the model number and serial number of your probe available.

**Table 3. PRT Troubleshooting**

| Problem | Solution |
|---|---|
| Data changes greater than 0.1 °C are observed. | Mechanical shock can cause temperature errors as great as 0.5 °C. If this is observed, first measure and record the $R_{tpw}$. |
| Data changes less than 0.1 °C. | Slight mechanical shock can cause temperature errors less than 0.1 °C. |
| Data unstable. | • If the data is unstable at the Triple Point of Water (TPW), check connections for evidence of a bad connection. If the connector appears to be in good condition and the connections are good, the PRT may be damaged. Contact Fluke for assistance (see "How to Contact Fluke").<br>• If the data is unstable at high temperatures, it may be due to electrical noise in the system. Reduce the temperature and observe the data. If it is stable, electrical noise is interfering with the measurements at high temperatures. Check the grounding of the readout device and the heat source. A faulty ground on either device could interfere with high temperature measurements. A ground wire attached to the metal sheath of the PRT may help to reduce electrical noise interference. |
| Temperature readout is different than expected. For example, the heat source is set at 150 °C, the PRT measures 125 °C. | • Measure the PRT resistance at TPW.<br>• The PRT sensor may be shorted if the measured resistance at 0 °C is significantly less than the probe's nominal resistance. For example, a probe whose nominal resistance is 100 Ω but measures 70 Ω at 0 °C.<br>• If the resistance of the PRT is only a few ohms, there may be a short in the four lead-wires.<br>• If the PRT is open, the resistance will be "Out of Limits" or in the kilohm or megohm range.<br>For more information or assistance, Contact Fluke (see "How to Contact Fluke"). |