

# National Bureau of Standards

## Certificate

### Standard Reference Material 1967

#### High-Purity Platinum Thermolement

#### Pt-67

This material is a high-purity (99.999 + wt. %), highly characterized platinum wire that has been prepared for use as the standard reference thermolement for calibration of base-metal and noble-metal thermocouple materials in the temperature range  $-197$  to  $1767$  °C. This Standard Reference Material (SRM 1967) is also suitable as the negative thermolement of the standard Type S thermocouple that defines the International Practical Temperature Scale of 1968 (IPTS-68) [1]. Standardized thermoelectric values for these applications are given in NBS Monograph 125 [2]. This material, Pt-67, replaces the former thermoelectric standard, Pt-27, which was used from 1922 to 1973. Selected portions of Pt-67 are used by the National Bureau of Standards and other national laboratories for calibration of thermocouple materials.

Extensive homogeneity testing was performed by NBS Washington and Boulder as well as by five cooperating laboratories: Engelhard Industries, Inc.; J. Bishop & Co.; Johnson, Matthey & Co., Ltd.; RCA Laboratories; and Sigmund Cohn Corp. A combination of the following methods was used: chemical analysis techniques included optical emission and spark source mass spectrometry, polarography, spectrophotometry, activation analysis, and vacuum fusion; and electrical measurements included thermoelectric, temperature coefficient of resistivity, and residual resistance ratio. The material is homogeneous within the limits of precision of most of these methods.

The overall coordination and evaluation of data leading to certification of SRM 1967 was performed by R. L. Powell, J. G. Hust and L. L. Sparks of the Cryogenics Division (Boulder) and by G. W. Burns of the Heat Division (Washington).

The technical and support aspects involved in the preparation, certification, and issuance of this Standard Reference Material were coordinated through the Office of Standard Reference Materials by R. E. Michaelis.

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J. Paul Cali, Chief  
Office of Standard Reference Materials

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### Supplementary Information

The effect of impurities at temperatures above 1200 °C are discussed in a Special Publication [3] that describes this material, its preparation, characterization, and properties. This publication also provides a history of the development of this thermoelectric standard (Pt-67). Pt-67 (SRM 1967) is a selected, highly homogeneous portion of SRM 680 that was prepared by Sigmund Cohn Corp. by induction melting of high-purity platinum sponge in a zirconium silicate crucible, and by casting into a platinum-lined, water-cooled copper mold. The ingot was trimmed, swaged, and drawn into 0.51 mm diameter wire using the utmost precautions to minimize contamination.

For a reference junction at 0 °C, the difference between the thermoelectric voltages of Pt-67 and Pt-27 can be approximated by

$$\Delta E_{67-27} = -7.5 \cdot 10^{-3} t_{68}$$

where  $\Delta E$  is expressed in microvolts and  $t_{68}$  in degrees Celsius. This relation was found to be valid from -197 to 1200 °C. The temperature coefficient of electrical resistance between 0 and 100 °C,

$$\alpha = \frac{R(100 \text{ }^\circ\text{C}) - R(0 \text{ }^\circ\text{C})}{100 R(0 \text{ }^\circ\text{C})},$$

was found to be  $3.926, (\pm 0.0012) \times 10^{-3}/^\circ\text{C}$ . The residual resistance ratio, determined from the specimen's electrical resistance at the ice point and at the boiling point of helium,

$$\text{RRR} = R(273 \text{ K})/R(4 \text{ K}),$$

was found to vary smoothly along the length of the wire from a value of 3407 to 3678. The average value is 3480.

Proper usage of this SRM requires careful annealing and handling techniques. The recommended procedures are:

- 1) Clean with ethanol and air dry.
- 2) Suspend the wire in a clean, dust-free enclosure and connect to a current source.
- 3) Continuously increase the current until the wire is at about 1200 °C.
- 4) Maintain this temperature for 10 minutes.
- 5) Slowly decrease the current until the temperature of the wire is just below incandescence, hold for 60 minutes and slowly cool to room temperature.
- 6) Care should be taken at all times to avoid unnecessary mechanical stresses of the wire. If the platinum is to be used at high temperatures, use special gloves or paper padding while handling.
- 7) High-purity sintered alumina tubing is recommended for insulating and protecting the platinum wire during use at high temperatures. After assembling the wire in an insulating tube, reanneal the assembly in a furnace for 60 minutes at 1100 °C, followed by slow cooling to room temperature.

### References

- [1] CIPM - Comite International des Poids et Mesures, International Temperature Scale of 1968, *Metrologia* 5, 35-44 (1969).
- [2] Powell, R. L.; Hall, W. J.; Hyink, C. H. Jr.; Sparks, L. L.; Burns, G. W.; Scroger, M. G.; and Plumb, H. H., Thermocouple Reference Tables Based on the IPTS-68, Natl. Bur. Stand. (US) Monograph 125, 401 pgs (U.S. Government Printing Office, Washington, D.C., 20402, (1974).
- [3] Powell, R. L.; Sparks, L. L.; and Hust, J. G.; Standard Reference Material 1967, Standard Thermocouple Material, Pt-67, Natl. Bur. Std. (US) Special Publication 260-XX (in press).