U. S. Department of Commerce
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Secretary

National Bureau of Standards
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National Bureau of Standards Certificate

Standard Reference Material 733

Silver-28 Atomic Percent Gold Thermocouple Wire

L. L. Sparks and J. G. Hust

Thermoelectric Voltage of SRM 733 vs Common Thermocouple Materials

(Between Liquid Helium and Ice Fixed Points)

Thermocouple	EMF, μV* †
Pt vs SRM 733	541 ± 3
EP or KP[1] vs SRM 733	4098.3 ± 0.8
TP[1] vs SRM 733	521.8 ± 0.8
SRM 733 vs EN or TN[1]	5735.2 ± 0.8
SRM 733 vs KN[1]	2358.7 ± 0.8

*These data are calculated from reference data by Sparks, et al. [2] and more recent comparisons of SRM 733 (resistance annealed at 3.5A) to the SRM 733 wire used in [2] which was oven annealed at 400 °C for 1 hour. The Pt 67 wire used here was resistance annealed at 1000 °C for 1 hour.

†The uncertainties given are twice the estimated standard deviations. The larger uncertainty for Pt reflects the sensitivity of this pure material to trace impurities at liquid helium temperature. The effect of these impurities is strongly dependent on the temperatxure distribution along the wire. For dip tests, where the temperature gradient along the wire is extremely localized, a range of thermal voltages as large as 15 μV has been observed.

This SRM is available in the form of wire, 32 AWG (0.2019 mm diameter) and 3 meters long. The wires are supplied bare and unannealed.

The overall coordination and evaluation of data leading to certification of SRM 733 was performed by J. G. Hust and L. L. Sparks.

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.

Washington, D. C. 20234
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J. Paul Cali, Chief
Office of Standard Reference Materials

(over)

MEASUREMENTS

SRM 733 has been tested at selected intervals throughout the wire length. Residual resistivity ratio (ρ273K/ρ4K) measurements indicate a randomly distributed variation of less than 0.7 atom percent Au. Thermoelectric measurements on Ag - 25, 26, 27, 28, 29, and 30 atom percent Au alloys demonstrate that the thermoelectric difference caused by 0.7 atom percent change in Au concentration is undetectable.

PREPARATION PROCEDURE

The recommended procedure for preparing SRM 733 for use as a thermoelectric reference wire is as follows:

(1) Degrease and rinse in distilled water.
(2) Suspend wire in air and connect an electric current source.
(3) Continuously increase the current to obtain the proper annealing temperature (3.5 A for the 32 AWG wire).
(4) Maintain the 3.5 A for about 30 seconds.
(5) Gradually decrease the current to zero over a period of about 15 seconds.

REFERENCES AND FOOTNOTES

[1] ANSI, ASTM, and ISA (American National Standards Institute, American Society for Testing and Materials, and the Instrument Society of America, respectively) have adopted the following letter designations for thermocouple wires described in this certificate.

EN or TN	A copper-nickel alloy, constantan, often referred to as Adams' constantan; Advance[a], Cupron[d], nominally 55% Cu, 45% Ni.
EP or KP	A nickel-chromium alloy, often referred to as Chromel[b]; T-1[a], ThermoKanthal KP[c], Tophel[d]; nominally 90% Ni, 10% Cr.
KN	A nickel-aluminum alloy, often referred to as Alumel[b]; T-2[a], ThermoKanthal KN[c], Nial[d]; nominally 95% Ni, 2% Al, 2% Mn, 1% Si.
TP	Copper, usually Electrolytic Tough Pitch.

Registered Trademarks:
[a] Trademark - Driver-Harris Co.
[b] Trademark - Hoskins Manufacturing Co.
[c] Trademark - Kanthal Corp.
[d] Trademark - Wilbur B. Driver Co.

The use of trade names does not constitute an endorsement of any manufacturer's products. All materials manufactured in compliance with the established thermoelectric voltage standards are equally acceptable.

[2] Sparks, L. L., Powell, R. L., and Hall, W. J., Reference Tables for Low-Temperature Thermocouples, NBS (U.S.), Monogr. 124.

[3] Sparks, L. L. and Hust, J. G., Thermoelectric Voltage of Silver-28 Atomic Percent Gold Thermocouple Wire, SRM 733, Versus Common Thermocouple Materials (Between Liquid Helium and Ice Fixed Points), NBS Spec. Publ. 260-34 (In press).