

National Bureau of Standards Certificate

Standard Reference Materials 1465, 1466,
 1467, 1468, and 1469

Sintered and Arc-Cast Tungsten

Thermal Conductivity (λ) and Electrical Resistivity (ρ)
 as a Function of Temperature (IPTS-68 and
 NBS P2-20) from 4 to 3000 K

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Note: This certificate combines the data given for SRM's 730 and 799; the data have not been changed. The SRM numbers have been changed to correspond to the different rod diameters.

T(K)	$\lambda(\text{W}\cdot\text{m}^{-1}\cdot\text{K}^{-1})$	$\rho(\text{n}\Omega\cdot\text{m})$	T(K)	$\lambda(\text{W}\cdot\text{m}^{-1}\cdot\text{K}^{-1})$	$\rho(\text{n}\Omega\cdot\text{m})$
4	154	0.650	250	180	43.93
6	231	0.650	300	172	55.5
8	306	0.651	350	164	67.5
10	377	0.652	400	157	79.8
12	444	0.655	450	151	92.4
14	503	0.659	500	146	105.3
16	553	0.666	600	138	132.1
18	591	0.676	700	132	159.8
20	618	0.691	800	127	188.4
30	585	0.865	900	123	217.3
40	438	1.315	1000	120	247.8
50	330	2.149	1200	114	309.6
60	275	3.393	1400	110	373.6
70	245	4.986	1600	107	438.3
80	229	6.83	1800	105	504
90	218	8.83	2000	102	571
100	211	10.93	2200	101	638
120	202	15.22	2400	99	706
140	197	19.56	2600	98	773
160	194	23.92	2800	97	840
180	190	28.29	3000	97	907
200	187	32.70			

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
 January 17, 1979
 Replaces Certificates for
 SRM's 730 and 799 dated
 August 11, 1975.

J. Paul Cali, Chief
 Office of Standard Reference Materials

(over)

These SRM's are available in sintered and arc-cast form of the following sizes:

Sintered tungsten:

SRM 1465	(0.32 cm dia, 5 cm long)
SRM 1466	(0.64 cm dia, 5 cm long)

Arc-cast tungsten:

SRM 1467	(0.83 cm dia, 5 cm long)
SRM 1468	(1.02 cm dia, 5 cm long)
SRM 1469	(1.27 cm dia, 5 cm long)

Longer rods of SRM's 1465 and 1466 may be obtained by special order. The three arc-cast SRM's are in relatively limited supply.

Measurements

Low-temperature (below ambient) characterization data [1] consist of thermal conductivity, electrical resistivity, and thermopower measurements on two specimens of sintered tungsten. Liquid helium and ice-point electrical resistivity measurements were performed on several dozen specimens of sintered and arc-cast tungsten specimens in various heat treatment conditions. Other characterization data such as hardness, density, grain size, and composition were also obtained. These characterization data show that the effect of material variability on these properties can be in excess of 5% below 90 K. This uncertainty caused by material variability can be reduced to below 2% by measuring the residual resistivity ratio of the specimen; if the value of the ratio is other than 75, use Table 5 [1] for interpolation. The effects of material variability at higher temperatures are within measurement uncertainty. High-temperature data were obtained on the arc-cast tungsten through the AGARD^a cooperative program on heat-transport properties [2]. None of the certified values have been corrected for thermal expansion.

The uncertainties of the certified data for thermal conductivity are 2% below 300 K, 2 to 5% from 300 to 2000 K and 5 to 8% above 2000 K. The uncertainties of the certified data for electrical resistivities are 2% over the entire temperature range.

These specimens have been annealed at 2300 K for one hour in vacuum. Details of the characterization measurements are presented in the first reference.

The densities of the sintered and arc-cast tungsten are 19.23 ± 0.05 and 19.20 ± 0.05 g·cm⁻³, respectively.

- [1] J. G. Hust and P. J. Giarrantano, Thermal Conductivity and Electrical Resistivity Standard Reference Materials: Tungsten, SRM's 730 and 799, from 4 to 3000 K, Nat. Bur. Stand. Special Publication 260-52 (1975).
- [2] Fitzer, E., Thermophysical Properties of Solid Materials Advisory Report 12 (1967); Advisory Report 38 (1972); Report 606 (1973), AGARD, NATO, France.

^aAdvisory Group for Aerospace Research and Development (NATO)