

U.S. Department of Commerce

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National Bureau of Standards  
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# National Bureau of Standards Certificate

## Standard Reference Material 730

### Thermal Conductivity - Tungsten

J. G. Hust and P. J. Giarratano

Thermal Conductivity ( $\lambda$ )\* as a Function of Temperature ( IPTS-68 and NBS P2-20) (4 to 3000 K)

T (K)	$\lambda$ ( $\text{W} \cdot \text{m}^{-1} \cdot \text{K}^{-1}$ )	T (K)	$\lambda$ ( $\text{W} \cdot \text{m}^{-1} \cdot \text{K}^{-1}$ )
4	154	250	180
6	231	300	172
8	306	350	164
10	377	400	157
		450	151
12	444	500	146
14	503		
16	553	600	138
18	591	700	132
20	618	800	127
		900	123
30	585	1000	120
40	438		
50	330	1200	114
60	275	1400	110
70	245	1600	107
80	229	1800	105
90	218	2000	102
100	211		
		2200	101
120	202	2400	99
140	197	2600	98
160	194	2800	97
180	190	3000	97
200	187		

\*Residual resistivity ratio = 75.

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J. Paul Cali, Chief  
Office of Standard Reference Materials

(over)

This SRM is available in sintered and arc-cast form of the following sizes:

Sintered tungsten:

SRM 730-SIS	(0.32 cm dia, 5 cm long)
SRM 730-S2S	(0.32 cm dia, 10 cm long)
SRM 730-S3S	(0.32 cm dia, 20 cm long)
SRM 730-MIS	(0.64 cm dia, 5 cm long)
SRM 730-M2S	(0.64 cm dia, 10 cm long)
SRM 730-M3S	(0.64 cm dia, 20 cm long)

Arc-cast tungsten

SRM 730-SIA	(0.64 cm dia, 5 cm long)
SRM 730-S2A	(0.64 cm dia, 10 cm long)
SRM 730-S3A	(0.64 cm dia, 20 cm long)
SRM 730-MA	(0.83 cm dia, 5 cm long)
SRM 730-LA	(1.02 cm dia, 5 cm long)
SRM 730-LXA	(1.27 cm dia, 5 cm long)

Longer rods may be obtained by special order. The three larger diameter arc-cast specimens 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 thermal conductivity 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<sup>a</sup> cooperative program on heat-transport properties [2]. Because of the variation in reported results, the uncertainty is higher at high temperatures as shown below:

Uncertainties

4 - 300 K	2%
300 - 2000 K	2-5%
above 2000 K	5-8%

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

[1] J. G. Hust and P. J. Giarratano, 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.

<sup>a</sup>Advisory Group for Aerospace Research and Development (NATO)