Department of Commerce
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Secretary
National Bureau of Standards
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National Bureau of Standards

Certificate

Standard Reference Material 1451

Thermal Resistance – Fibrous Glass Blanket

J. G. Hust

This Standard Reference Material (SRM) is intended for use in checking the performance of a guarded hot plate or in calibrating a heat flow meter used in measuring the thermal resistance of insulating materials.

Certified values of Thermal Resistance of a 2.54 cm thick specimen, R_o, as a function of density and temperature. (These values have been corrected for the thermal expansion of the measurement plates.)

Temperature (K)	Density ($kg \cdot m^{-3}$)			
	10	12	14	16
	Thermal Resistance, R_o ($m^2 \cdot K \cdot W^{-1}$)			
100	2.475	2.443	2.403	2.358
110	2.219	2.202	2.176	2.144
120	2.000	1.995	1.979	1.957
130	1.812	1.816	1.809	1.795
140	1.649	1.661	1.661	1.654
150	1.508	1.526	1.532	1.530
160	1.386	1.409	1.420	1.422
170	1.279	1.306	1.321	1.328
180	1.185	1.216	1.234	1.244
190	1.102	1.136	1.157	1.170
200	1.027	1.064	1.088	1.104
210	0.960	0.999	1.026	1.043
220	.898	.939	0.968	0.988
230	.842	.884	.914	.936
240	.789	.832	.864	.887
250	.739	.783	.816	.841
260	.693	.737	.771	.796
270	.650	.694	.728	.754
280	.609	.653	.688	.715
290	.571	.615	.649	.677
300	.536	.579	.613	.641
310	.503	.546	.580	.607
320	.472	.514	.548	.575
330	.444	.485	.518	.545

The tabulated values of thermal resistance were computed using an empirical equation obtained from a least squares analysis of 118 thermal resistance measurements made on 23 specimens taken from this particular lot of material. These certified values apply only to this lot of fibrous glass blanket. Values of thermal resistance of this SRM are expected to be within 3 percent of the computed values at temperatures from 250 to 330 K and increasing to 5 percent at 100 K. This estimate is based on the experimental data and includes both material variability and measurement uncertainty.

Gaithersburg, MD 20899
May 21, 1985

Stanley D. Rasberry, Chief
Office of Standard Reference Materials

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Thermal conductivity measurements were made on the NBS 100-cm line source guarded hot plate by B.G. Rennex in the Building Physics Division and on a 20-cm round guarded hot plate by J.G. Hust in the Chemical Engineering Science Division. Both of these guarded hot plates conform to ASTM C-177**. Measurements were made at mean temperatures ranging from 100 to 350 K with a temperature difference of about 25 K across the test specimen. The measurements of the two laboratories agreed to within the imprecision of the data.

The technical 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.K. Kirby and L.J. Kieffer.

SRM 1451 consists of fibrous glass made into a low-density blanket bonded with phenolic resin. The material was produced for NBS by Manville Corporation. The bulk density of the lot of material ranges from about 10 to 16 $kg \cdot m^{-3}$ (0.6 to 1.0 $lb \cdot ft^{-3}$).

Directions for Use:

Specimens must be air dried in an oven at 373 K for 24 hours before any measurements are made. See precaution on the following page. Because the as-tested thickness will most likely be different from 0.0254 m, the R values of this SRM can be calculated from

$$R = \frac{R_o}{0.0254} \times L$$

where R is the thermal resistance at the tested thickness L (in meters) and R_o is the certified value interpolated from the table or calculated from the equations given on the following page.

Data were fitted to an equation of the form:

$$\lambda(T,\rho) = a_1 + a_2\rho + a_3T + a_4T^3/\rho + a_5\exp - [(T-180)/75]^2$$

$\lambda(T,\rho)$ = thermal conductivity, $W \cdot m^{-1} \cdot K^{-1}$

ρ = bulk density, $kg \cdot m^{-3}$

T = mean specimen temperature, K

by the method of least squares. The values of the coefficients obtained are:

$$a_1 = -1.059 \cdot 10^{-4}$$

$$a_2 = 1.378 \cdot 10^{-4}$$

$$a_3 = 7.714 \cdot 10^{-5}$$

$$a_4 = 8.472 \cdot 10^{-9}$$

$$a_5 = 1.339 \cdot 10^{-3}$$

The standard deviation computed from residuals of the fit is 1.07 percent. All but one of the measured values were within 3 standard deviations of the computed values.

The certified values of thermal resistance were calculated from smoothed values of thermal conductivity by using

$$R_o = \frac{0.0254}{\lambda(T,\rho)}.$$

**Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Guarded Hot Plate, Annual Book of ASTM Standards, Section 4, Volume 04.06, American Society for Testing and Materials, Philadelphia, Pa., 1984.

Precautions:

1) This SRM should not be heated above 375 K (215 °F) at any time.

2) The density and as-tested thickness should be determined according to the procedure specified in ASTM C-177.

3) The plates of the apparatus must be in good thermal contact with the specimen but the pressure from the clamping force should not compress the specimen to less than 2.4 cm.

Conversions

Parameters	SI Units	Factors to Convert (Multiply SI Units)	Conventional Units
Density, ρ	$kg \cdot m^{-3}$	0.06243	$lb \cdot ft^{-3}$
Thermal conductivity, λ	$W \cdot m^{-1} \cdot K^{-1}$	0.9335	$Btu \cdot in \cdot h^{-1} \cdot ft^{-2} \cdot (°F)^{-1}$
Thermal resistance, R	$m^2 \cdot K \cdot W^{-1}$	5.6783	$h \cdot ft^2 \cdot °F \cdot Btu^{-1}$
Temperature, T	K	1.8(T-273.15)+32	°F