



COMMERCIAL TESTING COMPANY

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Attn: Bahman

Re: RADIANT HEAT

Steady-State Heat Flux Measurements and
Thermal Transmission Properties
by Means of the Heat Flow Meter Apparatus

— ASTM C 518

Dura-Hold

Report Number 03-08417

Test Number 3479-6913
August 25, 2003

No-Muv Corporation
Dalton, Georgia

Commercial Testing Company is certified for this test by the Southern Building Code Congress International (SBCCI) as a testing laboratory for Fire and Materials testing, Evaluation Report Number TL-9506.

Commercial Testing Company

Jonathan Jackson

(Authorized Signature)

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INTRODUCTION

This report is a presentation of results of a test for the measurement of steady-state thermal transmission properties of a material submitted by No-Muv Corporation, Dalton, Georgia.

TEST METHOD

The material was tested in accordance with the ASTM International Test Method C 518, Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus. This test method covers the measurement of steady state thermal transmission through flat slab specimens using a heat flow meter apparatus. The heat flow meter apparatus is used widely because it is relatively simple in concept, rapid, and applicable to a wide range of test specimens. This a comparative, or secondary, method of measurement since specimens of known thermal transmission properties are used to calibrate the apparatus. Properties of the calibration specimens, obtained from a recognized national standards laboratory, are traceable to an absolute measurement method.

The heat flow meter apparatus establishes steady state one-dimensional heat flux through a test specimen between two parallel plates at constant but different temperatures. By appropriate calibration of the heat flux transducer with calibration standards and by measurement of the plate temperatures and plate separation. Fourier's law of heat conduction is used to calculate thermal conductivity, and thermal resistivity or thermal resistance and thermal conductance.

This test method provides a rapid means of determining the steady-state thermal transmission properties of thermal insulations and other materials with a high level of accuracy when the apparatus has been calibrated appropriately. Proper calibration of the heat flow meter apparatus requires that it be calibrated using specimens having thermal transmission properties determined previously by Test Methods C 177 or C 1114.

The thermal transmission properties of specimens of a given material or product may vary due to variability of the composition of the material; be affected by moisture or other conditions; change with time; change with mean temperature and temperature difference; and depend upon the prior thermal history. It must be recognized, therefore, that the selection of typical values of thermal transmission properties representative of a material in a particular application should be based on a consideration of these factors and will not apply necessarily without modification to all service conditions.

TEST APPARATUS

A Dynatech Engineering R-Matic capable of operating in the range of 0.1 - 3.0 Btu·in·h⁻¹·ft⁻²·°F⁻¹ was used for this test. The test apparatus consists of a hot plate, a cold plate, a heat flow meter, and the necessary electronic measurement devices. The test specimen is held between the two temperature controlled plates, of which the lower can be raised or lowered to the desired specimen thickness.

The hot plate temperature is controlled using two independently regulated elements: a 12" x 12" inner heater connected to a set-point controller; and, a surrounding element regulated by a null-balance controller using feedback from a thermopile located between the inner and outer heaters. The cold plate temperature is maintained below ambient by means of a freon cooling system and a controlled heater element. Thus, a mean sample temperature of 75°F can be obtained with any reasonable temperature gradient through the sample.

Heat flow through the sample is measured with a heat flow meter constructed by CRIR Laboratories, St. Gobain Industries of France. The meter covers a 10" x 10" area in the center of the specimen and measures apparent thermal conductivity, k , of the material being evaluated and is calculated as:

$$k = SE \left(\frac{\Delta X}{t_1 - t_2} \right)$$

where

k = thermal conductivity

- S = calibration constant derived from SRM 1453
- E = heat flow meter output
- ΔX = specimen thickness
- t1 = hot plate temperature
- t2 = cold plate temperature
- R = thermal resistance

From thermal conductivity, k , thermal resistance, R , is calculated as:

$$R = \frac{\Delta X}{k}$$

MATERIAL TESTED AND TEST RESULTS

The client submitted a sample of material identified as Dura-Hold carpet cushion.

Prior to testing, the R-Matic was calibrated using the National Institute of Standards and Technology (NIST) Standard Reference Material 1453, Expanded Polystyrene Board. SRM 1453 has a known Thermal Resistance of $2.254 \pm 0.028 \text{ h}\cdot\text{ft}^2\cdot^\circ\text{F}\cdot\text{Btu}^{-1}$ at a thickness of 0.528 inch a mean temperature of 75°F.

Mean Temperature (°F)	ΔX (inch)	Thermal Conductivity, k (Btu·in·h ⁻¹ ·ft ⁻² ·°F ⁻¹)	Thermal Resistance, R (h·ft ² ·°F·Btu ⁻¹)	Thermal Resistance, R per Inch (h·ft ² ·°F·Btu ⁻¹)
74.97	0.248	0.2924	0.848	3.42