TEST REPORT

REPORT NUMBER: 101847068MID-001
ORIGINAL ISSUE DATE: Nov. 2, 2014
REVISED DATE: na

EVALUATION CENTER
Intertek
8431 Murphy Drive
Middleton, WI 53562

Rendered To:
Advanced Insolutions Inc.
PO Box 1004A
Nelson BC V1L6A5
Att: Jesse Ewing
Email: jesse@advancedinsolutions.com

PRODUCTS EVALUATED: Proloft™ Aerogel Blanket
EVALUATION PROPERTY: ASTM C518: *Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Apparatus*

Report for compliance with the applicable requirements of the following criteria: ASTM C518, 2013, Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Apparatus.

1 Table of Contents

2 Introduction

Intertek has conducted testing for Advanced Insolutions Inc. on Proloft™ Aerogel Blanket to evaluate the thermal transmission properties. Testing was conducted in accordance with ASTM, following the standard methods of C518 (2013) Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus. This evaluation began Sept 29, 2014 and was completed Sept 30, 2014.

3 Test Samples

3.1. SAMPLE SELECTION

Samples were received directly from the client. Samples were received at the Intertek Middleton Evaluation Center, Sept 27, 2014 in good condition.

3.2. SAMPLE AND ASSEMBLY DESCRIPTION

The samples were place at 72 ^{o}F +/- 50% relative humidity for minimum of 24 hours prior to starting the test. The samples were cut to about 12 inches by 12 inches prior to testing by the client. The exact dimensions and density is reported in section 4.2.

4 Testing and Evaluation Methods

4.1. Thermal Conductivity

The heat flow meter apparatus establishes steady state unidirectional heat flux through a test specimen between two parallel plates at constant but different temperatures. By appropriate calibration of the heat flux transducer(s) 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, thermal resistance, or resistivity.

The accurate use of the test method is limited by the capability of the apparatus to reproduce unidirectional constant heat flux density in the specimens, and by the precision in the measurement of temperature, thickness, EMF produced by the heat flux transducer, etc.

The apparatus shall not be used at temperatures, thickness or resistances, other than those within the range of the calibration; unless it can be shown that there is no difference in accuracy.

The apparatus must be capable of maintaining at least a 10°C temperature difference across the specimen for the duration of the test, unless a smaller LT is a requirement of a particular test. The specimens tested may also limit the use of the test method and these limitations are outlined in Practice C1045.

This evaluation was accomplished using a HFM436/3/1 ER Heat Flow Meter Thermal Conductivity Instrument, manufactured by Netzsch. The HFM436/3/1 ER determines thermal conductivity in accordance with ASTM C 518.

Heat flow through a solid, results from having a temperature gradient in the material. Thermal conductivity is a material property, which determines how much heat flows through a given thickness of the material when there is a temperature difference. The Fourier linear heat flow equation defines thermal conductivity under steady state conditions as:

$$\mathbf{l} = \text{ø}\frac{DX}{DT}$$

where:

$\mathbf{l}$ = thermal conductivity, $\frac{W}{m \bullet K}$

ø = heat flux, $\frac{W}{m^2}$

DT = temperature difference across distance LX, K

DX = distance between hot and cold plates, m

Prior to each series of tests, the HFM436/3/1 ER was calibrated using a sample whose thermal conductivity is known and traceable to national standards.

To perform the test, the specimens are placed in the HFM436/3/1 ER instrument, the top (hot) plate is brought downwards creating contact of both plates with the test specimen. The hot and cold plates were then allowed to equilibrate to the required temperatures and their exact temperatures were read from the instrument.

The mean temperature for testing is 75^{o}F with a temperature difference between plates at 40^{o}F.

Density Measurements were taken using standard ASTM D1622.

Testing and Evaluation Results

4.2. RESULTS AND OBSERVATIONS

The instrument measured thickness is defined as the measured maximum thickness between the hot and cold plates. The measured thickness is defined as that using ASTM D1622. The ASTM D1622 thickness will not measure any warping or high points in the center of the specimens.

The R/inch is reported using both the ASTM D1622 measured and instrument measured thickness.

The instrument measured thickness is the actual thickness the sample was run and the data was collected and R-value calculated.

The ASTM D1622 measured thickness is not the thickness the sample was run, data collected and the R-value calculated. This is not a measurement but a recalculated R-value using the data collected from the actual instrument thickness created data.

Test Information	Thermal Conductivity	Thermal Conductivity	Thermal Resistance	Thermal Resistance	Thermal Resistance per inch	Thermal Resistance per meter	Thermal Conductance	Heat Flux
	K Value	K Value	R Value	R Value	R/in	R/m	U	q
Units:	Btu-in/hr-ft^2-°F	W/m-K	Hr-ft^2-°F/Btu	m^2-K/W	Hr-ft^2-°F/Btu/in	m^2-K/W/m	W/m^2-K	W/m^2
Specimen 1	0.112902	0.01628	3.16334	0.5571	8.86	61.40	1.80	8.55
Specimen 2	0.110522	0.01594	3.21384	0.5660	9.04	62.66	1.77	8.34
Specimen 3	0.108847	0.01570	3.49840	0.6161	9.19	63.70	1.62	7.78
Specimen 4	0.110266	0.01590	3.23312	0.5694	9.07	62.88	1.76	8.35
Specimen 5	0.110085	0.01588	3.39081	0.5972	9.09	63.00	1.67	8.01
Average	0.110524	0.01594	3.29990	0.5811	9.05	62.73	1.72	8.21

Test Information	Duration of the measurement	Instrument Measured Thickness	Instrument Measured Thickness	Delta Temperature	Delta Temperature	Mean Temperature	Mean Temperature	Temperature Gradient	
Units:	min	(in)	(m)	°F	°C	°F	°C	°F/in	°K/m
Specimen 1	0:46:34	0.357	0.009073	40.57	4.76	72.58	22.54	113.59	50.90
Specimen 2	0:47:24	0.356	0.009032	40.50	4.72	72.66	22.59	114.01	50.98
Specimen 3	0:53:08	0.381	0.009672	40.63	4.79	72.61	22.56	106.70	49.61
Specimen 4	0:46:14	0.357	0.009055	40.56	4.76	72.66	22.59	113.76	50.93
Specimen 5	0:52:19	0.373	0.009479	40.61	4.78	72.66	22.59	108.77	50.02
Average	0:49:08	0.365	0.009262	40.57	4.76	72.63	22.57	111.37	50.49

	ASTM D1622 Measured Thickness		R/in (measured)	Thermal Conductivity
Specimen #	mm	inches	Hr-ft^2-°F/Btu/in	Btu-in/hr-ft^2-°F
Specimen 1	7.78	0.30640	10.3243	0.096859
Specimen 2	8.16	0.32106	10.0100	0.099900
Specimen 3	8.72	0.34331	10.1903	0.098133
Specimen 4	7.88	0.31024	10.4215	0.095956
Specimen 5	8.39	0.33012	10.2715	0.097357
Average	8.18	0.32222	10.2435	0.097641

Density determined by ASTM D1622

Specimen	Length (mm)	Width (mm)	Depth (mm)	Weight	Density	
	Avg.	Avg.	Avg.	(kg)	(kg/m^3)	(lbs/ft^3)
1	306.45	304.26	7.78	0.1400	192.93	12.04
2	306.18	304.67	8.16	0.1426	187.45	11.70
3	305.53	305.63	8.72	0.1532	188.15	11.75
4	306.59	304.71	7.88	0.1415	192.21	12.00
5	301.03	307.35	8.39	0.1470	189.49	11.83
				Mean:	**190.05**	**11.86**
				StdDev:	2.43	0.15
				COV:	0.01	0.01

4.2.1. Deviations from the Standard

There were no deviations to the standard.

4.2.2. Statement of Measurement Uncertainty

The uncertainty of the Netzsch Thermal Conductivity Instrument HFM436/3/1 ER is estimated to be 1-3%. The uncertainty may increase with differing thickness and density from the standard.

4.2.3. Calibration of ASTM C518

NIST standard SRM1450c Fibrous Glass board #1450C748 was run before testing began. There was less than 1% deviation from the calibration values at the test conditions.

5 Conclusion

Intertek has conducted testing for Advanced Insolutions Inc. on Proloft™ Aerogel Blanket to evaluate the thermal transmission properties. Testing was conducted in accordance with ASTM, following the standard methods of C518 (2013) Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.

These results are listed as is and there are no pass fail criteria for this testing.

R/inch using instrument measure thickness is 9.1 R/inch (Hr-ft2-ºF/Btu/in).
R/inch using ASTM D1622 measured thickness is 10.2 R/inch (Hr-ft2-ºF/Btu/in).

The conclusions of this test report may not be used as part of the requirements for Intertek product certification. Authority to Mark must be issued for a product to become certified.

INTERTEK

Reported by:

Bryan Bowman
Chemist

Reviewed by:

Mark Crawford
Chemist and Team Lead

REVISION SUMMARY

DATE	SUMMARY
Nov 2, 2014	Original Issue Date