Thermal Conductivity of Cane Fiberboard (U)

by

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Westinghouse Savannah River Company

Savannah River Site

Aiken, South Carolina 29808

MASTER

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ASET

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THERMAL CONDUCTIVITY OF CANE FIBERBOARD (U)

by

D. R. Leader

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Date

SRTC

SAVANNAH RIVER TECHNOLOGY CENTER, AIKEN, SC 29808
Westinghouse Savannah River Company
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(U)**

APPROVALS

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MATERIALS TECHNOLOGY SECTION**

DATE: 6/6/95

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SUMMARY

The thermal conductivity of cane fiberboard was measured in two planes; parallel to the surface and perpendicular to the surface of the manufactured sheet. The information was necessary to better understand the thermal response of a loaded shipping container. The tests demonstrated that the thermal conductivity of cane fiberboard in the plane parallel to the surface of the sheet was nearly twice as great as the conductivity of the same material in a plane perpendicular to the sheet. There was no significant difference in the conductivity in different directions within the plane parallel to the surface, and the presence of glue between layers of fiberboard did not significantly change the conductivity of the assembly. The tests revealed that the thermal conductivity measured in a direction perpendicular to the plane of the surface of a stack of cane fiberboard sheets not bonded together, decreases with an increase in the mean temperature. This was determined to be the result of air gaps between the sheets of fiberboard, and not related to the properties of the material itself.

BACKGROUND

The thermal conductivity of cane fiberboard samples was measured in the Thermal Measurements Laboratory at the Center for Applied Technology in St. Petersburg, Florida.* The thermal Measurements Lab is a small part of a major commercial testing laboratory that serves the building industry to establish the R-values of building materials.

The lab has the capability of measuring the R- value of assembled doors, windows and walls as well as small samples of building materials. The thermal conductivity of cane fiberboard samples for these tests was measured in a Dynatech (Cambridge, Mass) "Rapid-K" thermal conductivity instrument. This instrument is designed to measure the thermal transmission properties of a 12" x 12" sample up to 2" thick in accordance with ASTM specification C 518-91. The technique uses a heat flux transducer to measure the flow of heat through the center 4" x 4" section of the sample. The apparatus establishes a steady state unidirectional heat flux through the sample, which is clamped between two parallel plates that are each at constant but different temperatures. The calibration of the instrument is verified periodically per ASTM C 518-91 by measurement of a specimen of known thermal conductivity that is traceable to the National Institute of Standards and Technology (NIST).

* Center For Applied Engineering, Inc. 10301 Ninth Street North, St. Petersburg FL 33716, Phone (813) 576-4171.

Cane fiberboard is used in shipping containers for the weapons complex both as thermal insulator and energy absorber to cushion the payload under impact conditions. Disks that are slightly smaller than the inside diameter (ID) of a stainless steel drum are cut from 1/2" thick 4' x 8' sheets of cane fiberboard and stacked in the drum to completely fill it. A cylindrical hole is cut in the center of the stack for placement of the containment vessel that is to be shipped. In the older shipping containers, the stack of 1/2" disks is held together by four 1/4" diameter rods with a bolt on each end, but the latest design requires the disks to be glued together.

Cane fiberboard has been used by the building construction industry for many years as sheathing on the outside walls of residential and commercial buildings. It is manufactured from the crushed stalks of the sugar cane plant as well as some cellulose from recycled newsprint paper. Because the long cane fibers lie primarily in a plane parallel to the surface of the board, and because fibers are likely to transfer more heat along their axis than across them, it is reasonable to assume that cane fiberboard would have a higher thermal conductivity parallel to the surface than perpendicular to the surface. Although thermal conductivity perpendicular to the plane surface of the 1/2" thick sheet is well documented, no published information is available for the thermal conductivity parallel to the plane surface of the sheet.

Knowledge of thermal conductivity in both planes is necessary to understand the performance and thermal response of a loaded shipping package, because most of the heat is transferred through the fiberboard in a plane parallel to the surface of the sheets.

SAMPLE DESCRIPTION

The thermal conductivity of individual sheets of fiberboard as well as five different assemblies was measured in these tests. A description of each sample follows (The designation in brackets is the sample designation used in the test report from the Center for Applied Engineering):

Sample Assembly #1 [L-flat] - Four 12" x 12" x 1/2" sheets of cane fiberboard held together by water-base carpenters wood glue that was applied to the outer 1-inch edge of each surface. The purpose of the glue was to hold the four pieces together without having any influence on the thermal conductivity of the center 4" x 4" area where the heat flux was measured. This sample simulates fiberboard in the "old" packages, in which the sheets of fiberboard are not bonded together.

Sample Assembly #2 [L] - A "picture frame" was made by cutting a 11" x 11" opening in the center of a stack of four 12" x 12" sheets of 1/2" thick cane fiberboard that have been glued together. Twenty two strips of cane fiberboard 2" wide, 11" long and 1/2" thick were stacked into the opening of the picture frame. Each of the strips was cut with the 11 inch dimension parallel to the 8-foot length of the original sheet of cane fiberboard. The strips were held in the picture frame by friction as the result of a close fit - no glue was used to hold them in place. This sample was used to determine the thermal

conductivity of fiberboard in a plane parallel to the surface. Both 12" x 12" surfaces of this sample were smoothed by rubbing the sample across a plane surface coated with abrasive paper. This was done to assure good contact with the surface of the plates in the test instrument.

Sample Assembly #3 {W} - This sample is identical to sample #2 in every respect except that the strips were cut with the 11-inch dimensions parallel to the 4-foot dimension of the original sheet of cane fiberboard. This sample was used to determine if there was any difference in thermal conductivity that was related to the orientation of the fiberboard. Both 12" x 12" surfaces of this sample were smoothed by rubbing the sample across a plane surface coated with abrasive paper. This was done to assure good contact with the surface of the plates in the test instrument.

Sample Assembly #4 {L-glue} - This sample is identical to sample #2 in every respect except that the 2" x 11" surfaces of each strip were coated with water based carpenters wood glue before assembly. This sample was used to determine if the glue had any influence on thermal conductivity of fiberboard measured in a plane parallel to the surface. Both 12" x 12" surfaces of this sample were smoothed by rubbing the sample across a plane surface coated with abrasive paper. This was done to assure good contact with the surface of the plates in the test instrument.

Sample Assembly #5 {Series III} - This sample was similar to sample number 1, except that the surface area of adjacent sheets was coated with glue to form an essentially solid sample. This sample was used to determine the effect of glued assembly on conductivity measured perpendicular to the surface of the fiberboard.

In addition to the five assemblies described above, four individual 12" x 12" samples of 1/2" thick cane fiberboard were used in the testing process. The individual sheets were never fastened together in any way, but the thermal conductivity was measured on one sheet, then a stack of two sheets, then a stack of three sheets and finally a stack of four sheets. {These samples were used in the "SERIES II" tests and were designated 1-flat, 2-flat, 3-flat and 4-flat.} Sample assemblies #1, #2, #3 and #4 and the four individual samples were made from the same 4' x 8' sheet of cane fiberboard sheathing, but sample assembly #5 was made from a different sheet.

TEST DESCRIPTION

The same test instrument (Rapid K #2) was used with the same samples to measure thermal conductivity at two different mean temperatures. The high temperature tests were run at an average sample temperature of 180°F and an average temperature difference between the hot and cold surface of 40°F. Low temperature tests were done on the same samples at an average sample temperature of 75°F and an average temperature difference between the hot and cold surface of 40°F. Sample Assembly #4 was not run at the high temperature. The calibration of the machine was verified before and after each series of tests by measuring the conductivity of a standard sample of known conductivity verified by the NIST.

In each test, the sample is clamped between the two temperature controlled plates in the thermal conductivity measurement apparatus. The energy required to maintain the two surface temperatures at the specified values is controlled by a computer. After equilibrium conditions are established and maintained for a predetermined time, the computer automatically calculates the thermal conductivity of the sample. The minimum time required for a sample to reach equilibrium in the test equipment ranges between one and three hours, but the test can be continued for as long as desired.

Photograph #1 shows the test instrument with sample #3 being held in front of the open door. After the sample is placed into the instrument, a lever on the right side (not seen in the photograph) raises the lower surface and applies a spring loaded force on the sample so it is in contact with both the lower and upper surface of the instrument. The front door, which is insulated, is then closed and latched. Only the edge of the door and the latch are visible in the photograph. The dial indicator on the top of the instrument indicates the thickness of the sample being tested.

Photograph #2 is the display for the computer that controls six different instruments in the laboratory. Sample #1 (L-flat) had been in instrument RX 2 (center top in the display) for 115 minutes when this photograph was made.

There were three series of tests done on the samples: Series I tests were run on samples #1, #2, #3 at two different temperatures and at the low temperature only on sample #4. The data from these tests are summarized in Table I.

Series II tests were done with four individual 12" x 12" samples of fiberboard. Thermal conductivity was measured on each individual sample and on stacks of 2, 3 and 4 samples at both the 75°F and the 180°F mean temperature. Results of series II tests are summarized in Table II.

Series III thermal conductivity tests were all done on sample number 5. Six or seven different tests at each temperature were done on the same sample of four sheets that were glued together to form a solid assembly. Results of series III tests are summarized in Table III.

RESULTS AND DISCUSSION

The test results from the series I tests are summarized in Table I. The results confirm the hypothesis that the thermal conductivity in the plane parallel to the surface of the sheet is greater than the conductivity perpendicular to the surface. This is a reasonable result because the long hollow cane fibers which are inclined to conduct heat preferentially along their length are randomly oriented with their axis in a plane more or less parallel to the surface.

Samples #2 and #3 differed only in the orientation of the sample relative to the length of the original sheet of material. Although the thermal conductivity is slightly higher for

the sample cut in the direction parallel to the 4-foot dimension of the original sheet of fiberboard for the low temperature test, the opposite is true at the high temperature. The difference appears to be within the range of experimental error. Again, this is a reasonable result because there is no apparent alignment of the long cane fibers in any one direction.

Samples #2 and #4 differed only in the fact that the 22 individual pieces in the sample were glued together in sample #4. Although the conductivity for sample #4 is slightly higher, the difference does not appear to be significant. The glue line is very thin relative to the sample, and even if the glue had a slightly different coefficient of heat transfer than the fiberboard, it would not be likely to make a major change in the measured coefficient of heat transfer for the assembly.

One apparently anomalous result of these tests was that the thermal conductivity of sample 1 decreased at the higher mean temperature. Because this is inconsistent with the expected behavior of cane fiberboard, the second series of tests was run. Sample #1 was made from four 12" x 12" sheets that were glued together only at the edges and the coefficient of heat transfer is measured at the 4" square in the center of the sample.

A second series of tests was done to determine the reason for the apparently anomalous test results from sample #1. The tests results from the series II tests are summarized in table II. In these tests, the thermal conductivity of four individual boards was first measured individually and then in stacks two, three and four sheets thick. These tests confirmed the behavior of sample #1 in the series I tests. The thermal conductivity of a stack of sheets decreased with an increase in the mean temperature. At this point it was postulated that the mechanism for this unusual behavior was the result of the air gap between adjacent sheets in a stack of cane fiberboard that is not glued together.

Series III tests were run to verify the hypothesis that the air gap between sheets on sample #1 and the samples in the series II tests caused the thermal conductivity to decrease with an increase in temperature. The tests results from the series III tests are included at the bottom of table I. In this test, four sheets of fiberboard were glued together to form a solid sample 12" x 12" x 2". Thermal conductivity was measured at both the high and low mean temperature in the direction perpendicular to the face of the sheets. The tests were repeated at least six times and all test results were within the range expected for an experiment of this type. The thermal conductivity of the sample increased, as expected, at the higher temperature. These results verify the hypothesis that the decrease in measured thermal conductivity at higher temperatures for a stack of fiberboard that is not bonded together is the result of the air gap between the individual sheets of fiberboard, and is not related to some peculiar property of the material itself.

A copy of the test report from the Center for Applied Engineering is attached to this memo along with a copy of all of the original test data.

CONCLUSIONS

The thermal conductivity of cane fiberboard in a direction parallel to the surface is about twice the value of conductivity through the sheet. There is no significant difference in conductivity measured in different directions parallel to the surface based on the results of tests in two directions. The use of wood glue to bond multiple sheets together does not influence the conductivity in a direction parallel to the surface of the sheets, but the presence of an air gap between layers that are not bonded together results in decreased thermal conductivity at higher temperatures for a stack of unbonded sheets of fiberboard. All of the results appear reasonable and in agreement with the expected behavior of this material.

TABLE I

SAMPLE ID	MEAN TEMP. °F	Apparent Thermal Conductivity (Btu in/h ft ² °F)	Direction of Heat Flow Relative to the Surface of the sheet	Sheets Glued Together ?
1 {L-Flat}	74.7	0.420 (1)	Perpendicular	No
1 {L-Flat}	179.9	0.290 (1)	Perpendicular	No
2 {L}	75.0	0.762 (2)	Parallel	No
2 {L}	179.9	0.755 (1)	Parallel	No
3 {W}	75.1	0.803 (2)	Parallel	No
3 {W}	180.3	0.727 (1)	Parallel	No
4 {L-Glue}	75.0	0.797 (2)	Parallel	Yes
4 {L-Glue}	180.0	Not measured		
5 {SERIES III}	74.9	0.398 (1)	Perpendicular	Yes
5 {SERIES III}	180.0	0.440 (1)	Perpendicular	Yes

Notes:

(1) Average of two or more test results.

(2) Single test result.

TABLE II

Sample ID	Mean Temperature (°F)	Thickness (inch)	Apparent Thermal Conductivity (Btu in/h ft ² °F)
<u>Series II Tests</u>			
1-flat	74.6	0.523	0.387
2-flat	74.8	0.515	0.391
1,2-flat	74.9	1.024	0.411
3-flat	75.1	0.511	0.391
1,2,3-flat	74.8	1.547	0.426
4-flat	74.9	0.527	0.381
1,2,3,4-flat	75.4	2.058	0.415
1-flat	180.2	0.527	0.470
2-flat	180.1	0.529	0.460
1,2-flat	179.9	1.041	0.420
3-flat	180.1	0.529	0.450
1,2,3-flat	179.9	1.554	0.285
4-flat	180.3	0.528	0.449
1,2,3,4-flat	180.1	2.064	0.165

Photograph #1: Conductivity Measurement Instrument

Photograph #2: Computer Display

Center For Applied
Engineering, Inc.
Materials Testing Services

February 28, 1995

To: Mr. Douglas R. Leader
Westinghouse Savannah River Company
P. O. Box 616
Bldg. 773-A, Room D-1142
Aiken, SC 29802-0616

Subject: ASTM C518 Tests on Cane Fiberboard

SERIES I TESTS

Series I tests were conducted on samples identified by the client as L-flat, L-glue, L and W. Tests at mean temperatures of 180°F and 75°F were conducted on all samples except L-glue which was tested at 75°F only. Test results are summarized on the attached table. The L-flat data are questionable as the apparent thermal conductivity at 180°F was lower than at 75°F. This is inconsistent with typical thermal data.

SERIES II TESTS

Series II tests were conducted on samples identified as 1-flat, 2-flat, 3-flat and 4-flat. After testing individual samples, samples were stacked and identified as 1,2-flat; 1,2,3-flat; and 1,2,3,4-flat. Tests were conducted on all samples at both 180°F and 75°F mean temperature, a total of 14 tests. Densities of the 4 samples were:

1-flat	15.3 lb/ft ³
2-flat	15.9 lb/ft ³
3-flat	15.7 lb/ft ³
4-flat	15.3 lb/ft ³

Test results are summarized on the attached Table. The data obtained at 75°F mean temperature appear to be consistent with the overall average thermal conductivity obtained at 75°F from Series III. The 180°F data are questionable as the thermal conductivity should not decrease as additional samples are stacked, i.e., 1,2,3-flat and 1,2,3,4-flat.

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Mr. Douglas R. Leader - Continued
Westinghouse Savannah River Company
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SERIES III TESTS

Series III tests were conducted on a stack of four (4) nominal 0.5-inch thick fiberboard samples. The 4 samples were adhered with Carpenter's glue and allowed to dry overnight with heavy weights on top. The stack was placed in an oven and dried for approximately 24 hours at 215°F. The initial weight was 1345.9 grams; after drying the weight was 1178.5 grams. The stack was placed in a desiccator over the weekend and reweighed just prior to testing, 1182.0 grams. After testing at 180°F all day, the stack was reweighed, 1182.2 grams. The density of the sample was 15.7 lb/ft³.

For both mean temperature tests, the stack was left in the heat flow meter all day with ASTM C518 acceptable data taken throughout the day. As can be seen in the attached Table, the data are extremely constant for the 6 or 7 readings. These data are also as would be expected, the thermal conductivity at 180°F is approximately 11 percent higher than at 75°F.

R. G. MILLER
Manager
Materials Testing Services

RGM:dds

encl.

SUMMARY OF FIBERBOARD TEST RESULTS

Sample ID	Mean Temperature (°F)	Thickness (inch)	Apparent Thermal Conductivity (Btu in/h ft ² °F)
<u>Series I Tests</u>			
L-Flat	74.3	2.083	0.432
	75.1	2.075	0.407
Average	74.7	2.079	0.420
	179.8	2.102	0.280
	180.0	2.081	0.299
Average	179.9	2.092	0.290
L-Glue	75.0	2.012	0.797
L	75.0	2.008	0.762
	179.9	2.020	0.772
	179.9	2.008	0.737
Average	179.9	2.014	0.755
W	75.1	2.017	0.803
	180.5	2.029	0.795
	180.2	2.021	0.704
	180.2	2.021	0.682
Average	180.3	2.024	0.727

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SUMMARY OF FIBERBOARD TEST RESULTS

Sample ID	Mean Temperature (°F)	Thickness (inch)	Apparent Thermal Conductivity (Btu in/h ft ² °F)
Series II Tests			
1-flat	74.6	0.523	0.387
2-flat	74.8	0.515	0.391
1,2-flat	74.9	1.024	0.411
3-flat	75.1	0.511	0.391
1,2,3-flat	74.8	1.547	0.426
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3-flat	180.1	0.529	0.450
1,2,3-flat	179.9	1.554	0.285
4-flat	180.3	0.528	0.449
1,2,3,4-flat	180.1	2.064	0.165

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THERMAL MEASUREMENTS LABORATORIES

SUMMARY OF FIBERBOARD TEST RESULTS

Sample ID	Mean Temperature (°F)	Thickness (inch)	Apparent Thermal Conductivity (Btu in/h ft ² °F)
Series III Tests			
4, Nominal 0.5-inch Samples of Fiberboard Glued with Carpenter's Glue			
1	180.0	2.055	0.430
2	179.9	2.055	0.442
3	180.0	2.055	0.444
4	180.0	2.055	0.443
5	180.0	2.055	0.441
6	179.9	2.055	0.441
Average	180.0	2.055	0.440
1	74.9	2.038	0.395
2	74.9	2.038	0.400
3	74.9	2.038	0.399
4	74.9	2.038	0.398
5	74.9	2.038	0.397
6	74.9	2.038	0.397
7	74.9	2.038	0.398
Average	74.9	2.038	0.398

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Req No: 950041
Date: 01-11-1995

Steady-State Thermal Transmission Properties
by Means of the Heat Flow Meter per ASTM C 518

Project No: 257165

Run ID: 257165

Sample Description: SAMPLE-L-FLAT-AMB.

Specimen Orientation: Horizontal Heat Meter Location: Cold Surface

Instrument Used: Rapid-k #2

Duration of Measurement: 181 minutes

Average Heat Flux	=	8.57	Btu/(h sq-ft)
Average Hot Plate Temperature T_h	=	94.9	deg F
Average Cold Plate Temperature T_c	=	53.6	deg F
Average Temperature Difference	=	41.3	deg F
Average Sample Temperature	=	74.3	deg F
Average Thermal Resistance R	=	4.82	h sq-ft F/Btu
Average Thermal Conductance C	=	0.207	Btu/(h sq-ft F)

Calculations Based on Thickness Measured in Apparatus

Thickness	=	2.083	inch
Average Temperature Gradient	=	19.83	deg F/inch
Apparent Thermal Conductivity k	=	0.432	Btu-in/(h sq-ft F)

Operator:

Comments

Req No: 950041
Date: 01-11-1995

Steady-State Thermal Transmission Properties
by Means of the Heat Flow Meter per ASTM C 518

Project No: 257165

Run ID: 257165

Sample Description: SAMPLE-L-FLAT-AMB

Specimen Orientation: Horizontal Heat Meter Location: Cold Surface

Instrument Used: Rapid-k #2

Duration of Measurement: 81 minutes

Average Heat Flux	=	7.80	Btu/(h sq-ft)
Average Hot Plate Temperature T_h	=	95.0	deg F
Average Cold Plate Temperature T_c	=	55.2	deg F
Average Temperature Difference	=	39.8	deg F
Average Sample Temperature	=	75.1	deg F
Average Thermal Resistance R	=	5.09	h sq-ft F/Btu
Average Thermal Conductance C	=	0.196	Btu/(h sq-ft F)

Calculations Based on Thickness Measured in Apparatus

Thickness	=	2.075	inch
Average Temperature Gradient	=	19.16	deg F/inch
Apparent Thermal Conductivity k	=	0.407	Btu-in/(h sq-ft F)

Operator:

Comments

Req No: 950041
Date: 01-10-1995

Steady-State Thermal Transmission Properties
by Means of the Heat Flow Meter per ASTM C 518

Project No: 257165

Run ID: 257165

Sample Description: SAMPLE-L-FLAT

Specimen Orientation: Horizontal Heat Meter Location: Cold Surface

Instrument Used: Rapid-k #2

Duration of Measurement: 125 minutes

Average Heat Flux	=	5.36	Btu/(h sq-ft)
Average Hot Plate Temperature T_h	=	200.0	deg F
Average Cold Plate Temperature T_c	=	159.7	deg F
Average Temperature Difference	=	40.3	deg F
Average Sample Temperature	=	179.8	deg F
Average Thermal Resistance R	=	7.51	h sq-ft F/Btu
Average Thermal Conductance C	=	0.133	Btu/(h sq-ft F)

Calculations Based on Thickness Measured in Apparatus

Thickness	=	2.102	inch
Average Temperature Gradient	=	19.17	deg F/inch
Apparent Thermal Conductivity k	=	0.280	Btu-in/(h sq-ft F)

Operator: BS

Comments

CHK. 1990 AT CONCLUSION OF TEST

Req No: 950041
Date: 01-12-1995

Steady-State Thermal Transmission Properties
by Means of the Heat Flow Meter per ASTM C 518

Project No: 257165

Run ID: 257165

Sample Description: SAMPLE-L-FLAT

Specimen Orientation: Horizontal Heat Meter Location: Cold Surface

Instrument Used: Rapid-k #2

Duration of Measurement: 135 minutes

Average Heat Flux = 5.87 Btu/(h sq-ft)

Average Hot Plate Temperature T_h = 200.4 deg F

Average Cold Plate Temperature T_c = 159.5 deg F

Average Temperature Difference = 40.9 deg F

Average Sample Temperature = 180.0 deg F

Average Thermal Resistance R = 6.96 h sq-ft F/Btu

Average Thermal Conductance C = 0.144 Btu/(h sq-ft F)

Calculations Based on Thickness Measured in Apparatus

Thickness = 2.081 inch

Average Temperature Gradient = 19.64 deg F/inch

Apparent Thermal Conductivity k = 0.299 Btu-in/(h sq-ft F)

Operator:

Comments

Req No: 950041
Date: 01-11-1995

Steady-State Thermal Transmission Properties
by Means of the Heat Flow Meter per ASTM C 518

Project No: 257165

Run ID: 257165

Sample Description: SAMPLE-L-GLUE-AMB

Specimen Orientation: Horizontal Heat Meter Location: Cold Surface

Instrument Used: Rapid-k #2

Duration of Measurement:

66 minutes

Average Heat Flux	=	15.66	Btu/(h sq-ft)
Average Hot Plate Temperature T_h	=	94.8	deg F
Average Cold Plate Temperature T_c	=	55.3	deg F
Average Temperature Difference	=	39.5	deg F
Average Sample Temperature	=	75.0	deg F
Average Thermal Resistance R	=	2.52	h sq-ft F/Btu
Average Thermal Conductance C	=	0.396	Btu/(h sq-ft F)

Calculations Based on Thickness Measured in Apparatus

Thickness	=	2.012	inch
Average Temperature Gradient	=	19.64	deg F/inch
Apparent Thermal Conductivity k	=	0.797	Btu-in/(h sq-ft F)

Operator:

Comments

Req No: 950041
Date: 01-11-1995

Steady-State Thermal Transmission Properties
by Means of the Heat Flow Meter per ASTM C 518

Project No: 257165

Run ID: 257165

Sample Description: SAMPLE L

Specimen Orientation: Horizontal Heat Meter Location: Cold Surface

Instrument Used: Rapid-k #2

Duration of Measurement: 76 minutes

Average Heat Flux	=	15.11	Btu/(h sq-ft)
Average Hot Plate Temperature T_h	=	94.9	deg F
Average Cold Plate Temperature T_c	=	55.1	deg F
Average Temperature Difference	=	39.8	deg F
Average Sample Temperature	=	75.0	deg F
Average Thermal Resistance R	=	2.64	h sq-ft F/Btu
Average Thermal Conductance C	=	0.379	Btu/(h sq-ft F)

Calculations Based on Thickness Measured in Apparatus

Thickness	=	2.008	inch
Average Temperature Gradient	=	19.83	deg F/inch
Apparent Thermal Conductivity k	=	0.762	Btu-in/(h sq-ft F)

Operator: _____

Comments

FIRST RUN

Req No: 950041
Date: 01-10-1995Steady-State Thermal Transmission Properties
by Means of the Heat Flow Meter per ASTM C 518

Project No: 257165

Run ID: 257165

Sample Description: SAMPLE-L *Se = 14.16*

Specimen Orientation: Horizontal Heat Meter Location: Cold Surface

Instrument Used: Rapid-k #2

Duration of Measurement: 90 minutes

Average Heat Flux	=	15.48	Btu/(h sq-ft)
Average Hot Plate Temperature T_h	=	200.1	deg F
Average Cold Plate Temperature T_c	=	159.6	deg F
Average Temperature Difference	=	40.5	deg F
Average Sample Temperature	=	179.9	deg F
Average Thermal Resistance R	=	2.62	h sq-ft F/Btu
Average Thermal Conductance C	=	0.382	Btu/(h sq-ft F)

Calculations Based on Thickness Measured in Apparatus

Thickness	=	2.020	inch
Average Temperature Gradient	=	20.06	deg F/inch
Apparent Thermal Conductivity k	=	0.772	Btu-in/(h sq-ft F)

Operator: B

Comments

~~THK 1.990" AT conclusion of TEST~~

THK. 2.018 AT conclusion of TEST

Req No: 950041
Date: 01-13-1995

Steady-State Thermal Transmission Properties
by Means of the Heat Flow Meter per ASTM C 518

Project No: 257165

Run ID: 257165

Sample Description: SAMPLE-L

Specimen Orientation: Horizontal Heat Meter Location: Cold Surface

Instrument Used: Rapid-k #2

Duration of Measurement: 131 minutes

Average Heat Flux	=	14.75	Btu/(h sq-ft)
Average Hot Plate Temperature T_h	=	200.0	deg F
Average Cold Plate Temperature T_c	=	159.8	deg F
Average Temperature Difference	=	40.2	deg F
Average Sample Temperature	=	179.9	deg F
Average Thermal Resistance R	=	2.72	h sq-ft F/Btu
Average Thermal Conductance C	=	0.367	Btu/(h sq-ft F)

Calculations Based on Thickness Measured in Apparatus

Thickness	=	2.008	inch
Average Temperature Gradient	=	20.00	deg F/inch
Apparent Thermal Conductivity k	=	0.737	Btu-in/(h sq-ft F)

Operator: B

Comments

Req No: 950041
Date: 01-11-1995

Steady-State Thermal Transmission Properties
by Means of the Heat Flow Meter per ASTM C 518

Project No: 257165

Run ID: 257165

Sample Description: SAMPLE W

Specimen Orientation: Horizontal

Heat Meter Location: Cold Surface

Instrument Used: Rapid-k #2

Duration of Measurement:

71 minutes

Average Heat Flux	=	15.75	Btu/(h sq-ft)
Average Hot Plate Temperature T_h	=	94.9	deg F
Average Cold Plate Temperature T_c	=	55.3	deg F
Average Temperature Difference	=	39.6	deg F
Average Sample Temperature	=	75.1	deg F
Average Thermal Resistance R	=	2.51	h sq-ft F/Btu
Average Thermal Conductance C	=	0.398	Btu/(h sq-ft F)

Calculations Based on Thickness Measured in Apparatus

Thickness	=	2.017	inch
Average Temperature Gradient	=	19.62	deg F/inch
Apparent Thermal Conductivity k	=	0.803	Btu-in/(h sq-ft F)

Operator:

Comments

First Run

Req No: 950041
Date: 01-10-1995

Steady-State Thermal Transmission Properties
by Means of the Heat Flow Meter per ASTM C 518

Project No: 257165

Run ID: 257165

Sample Description: SAMPLE-W

Se = 14.16

Specimen Orientation: Horizontal

Heat Meter Location: Cold Surface

Instrument Used: Rapid-k #2

Duration of Measurement:

116 minutes

Average Heat Flux	=	15.49	Btu/(h sq-ft)
Average Hot Plate Temperature T_h	=	200.3	deg F
Average Cold Plate Temperature T_c	=	160.7	deg F
Average Temperature Difference	=	39.5	deg F
Average Sample Temperature	=	180.5	deg F
Average Thermal Resistance R	=	2.55	h sq-ft F/Btu
Average Thermal Conductance C	=	0.392	Btu/(h sq-ft F)

Calculations Based on Thickness Measured in Apparatus

Thickness	=	2.029	inch
Average Temperature Gradient	=	19.49	deg F/inch
Apparent Thermal Conductivity k	=	0.795	Btu-in/(h sq-ft F)

Operator: B

Comments NO CHANGE IN THER.

Req No: 950041
Date: 01-13-1995

Steady-State Thermal Transmission Properties
by Means of the Heat Flow Meter per ASTM C 518

Project No: 257165

Run ID: 257165

Sample Description: SAMPLE-W

Specimen Orientation: Horizontal Heat Meter Location: Cold Surface

Instrument Used: Rapid-k #2

Duration of Measurement: 111 minutes

Average Heat Flux	= 13.79 Btu/(h sq-ft)
Average Hot Plate Temperature T_h	= 200.0 deg F
Average Cold Plate Temperature T_c	= 160.4 deg F
Average Temperature Difference	= 39.6 deg F
Average Sample Temperature	= 180.2 deg F
Average Thermal Resistance R	= 2.87 h sq-ft F/Btu
Average Thermal Conductance C	= 0.348 Btu/(h sq-ft F)

Calculations Based on Thickness Measured in Apparatus

Thickness	= 2.021 inch
Average Temperature Gradient	= 19.60 deg F/inch
Apparent Thermal Conductivity k	= 0.704 Btu-in/(h sq-ft F)

Operator:

Comments

Req No: 950041
Date: 01-13-1995

Steady-State Thermal Transmission Properties
by Means of the Heat Flow Meter per ASTM C 518

Project No: 257165

Run ID: 257165

Sample Description: SAMPLE-W

Specimen Orientation: Horizontal Heat Meter Location: Cold Surface

Instrument Used: Rapid-k #2

Duration of Measurement: 54 minutes

Average Heat Flux	=	13.42	Btu/(h sq-ft)
Average Hot Plate Temperature T_h	=	200.1	deg F
Average Cold Plate Temperature T_c	=	160.3	deg F
Average Temperature Difference	=	39.7	deg F
Average Sample Temperature	=	180.2	deg F
Average Thermal Resistance R	=	2.96	h sq-ft F/Btu
Average Thermal Conductance C	=	0.338	Btu/(h sq-ft F)

Calculations Based on Thickness Measured in Apparatus

Thickness	=	2.021	inch
Average Temperature Gradient	=	19.66	deg F/inch
Apparent Thermal Conductivity k	=	0.682	Btu-in/(h sq-ft F)

Operator:

Comments

Req No: 950041
Date: 01-17-1995

Steady-State Thermal Transmission Properties
by Means of the Heat Flow Meter per ASTM C 518

Project No: 257165

Run ID: 257165

Sample Description: SAMPLE-1-FLAT-AMB

Specimen Orientation: Horizontal Heat Meter Location: Cold Surface

Instrument Used: Rapid-k #2

Duration of Measurement: 175 minutes

Average Heat Flux	=	29.54	Btu/(h sq-ft)
Average Hot Plate Temperature T_h	=	94.6	deg F
Average Cold Plate Temperature T_c	=	54.7	deg F
Average Temperature Difference	=	39.9	deg F
Average Sample Temperature	=	74.6	deg F
Average Thermal Resistance R	=	1.35	h sq-ft F/Btu
Average Thermal Conductance C	=	0.739	Btu/(h sq-ft F)

Calculations Based on Thickness Measured in Apparatus

Thickness	=	0.523	inch
Average Temperature Gradient	=	76.36	deg F/inch
Apparent Thermal Conductivity k	=	0.387	Btu-in/(h sq-ft F)

Operator: B

Comments

Req No: 950041
Date: 01-17-1995

Steady-State Thermal Transmission Properties
by Means of the Heat Flow Meter per ASTM C 518

Project No: 257165

Run ID: 257165

Sample Description: SAMPLE-2-FLAT-AMB

Specimen Orientation: Horizontal Heat Meter Location: Cold Surface

Instrument Used: Rapid-k #2

Duration of Measurement:

52 minutes

Average Heat Flux	=	30.17	Btu/(h sq-ft)
Average Hot Plate Temperature T_h	=	94.6	deg F
Average Cold Plate Temperature T_c	=	54.9	deg F
Average Temperature Difference	=	39.7	deg F
Average Sample Temperature	=	74.8	deg F
Average Thermal Resistance R	=	1.32	h sq-ft F/Btu
Average Thermal Conductance C	=	0.759	Btu/(h sq-ft F)

Calculations Based on Thickness Measured in Apparatus

Thickness	=	0.515	inch
Average Temperature Gradient	=	77.13	deg F/inch
Apparent Thermal Conductivity k	=	0.391	Btu-in/(h sq-ft F)

Operator:

Comments

Req No: 950041
Date: 01-18-1995

Steady-State Thermal Transmission Properties
by Means of the Heat Flow Meter per ASTM C 518

Project No: 257165

Run ID: 257165

Sample Description: SAMPLE-1-2-FLAT-AMB

Specimen Orientation: Horizontal Heat Meter Location: Cold Surface

Instrument Used: Rapid-k #2

Duration of Measurement: 57 minutes

Average Heat Flux	=	15.98	Btu/(h sq-ft)
Average Hot Plate Temperature T_h	=	94.8	deg F
Average Cold Plate Temperature T_c	=	55.0	deg F
Average Temperature Difference	=	39.8	deg F
Average Sample Temperature	=	74.9	deg F
Average Thermal Resistance R	=	2.49	h sq-ft F/Btu
Average Thermal Conductance C	=	0.401	Btu/(h sq-ft F)

Calculations Based on Thickness Measured in Apparatus

Thickness	=	1.024	inch
Average Temperature Gradient	=	38.89	deg F/inch
Apparent Thermal Conductivity k	=	0.411	Btu-in/(h sq-ft F)

Operator:

Comments

Req No: 950041
Date: 01-18-1995

Steady-State Thermal Transmission Properties
by Means of the Heat Flow Meter per ASTM C 518

Project No: 257165

Run ID: 257165

Sample Description: SAMPLE-3-FLAT-AMB

Specimen Orientation: Horizontal Heat Meter Location: Cold Surface

Instrument Used: Rapid-k #2

Duration of Measurement: 56 minutes

Average Heat Flux	=	30.26	Btu/(h sq-ft)
Average Hot Plate Temperature T_h	=	94.9	deg F
Average Cold Plate Temperature T_c	=	55.4	deg F
Average Temperature Difference	=	39.6	deg F
Average Sample Temperature	=	75.1	deg F
Average Thermal Resistance R	=	1.31	h sq-ft F/Btu
Average Thermal Conductance C	=	0.765	Btu/(h sq-ft F)

Calculations Based on Thickness Measured in Apparatus

Thickness	=	0.511	inch
Average Temperature Gradient	=	77.41	deg F/inch
Apparent Thermal Conductivity k	=	0.391	Btu-in/(h sq-ft F)

Operator: B

Comments

Req No: 950041
Date: 01-18-1995

Steady-State Thermal Transmission Properties
by Means of the Heat Flow Meter per ASTM C 518

Project No: 257165

Run ID: 257165

Sample Description: SAMPLE-1-2-3-FLAT AMB

Specimen Orientation: Horizontal Heat Meter Location: Cold Surface

Instrument Used: Rapid-k #2

Duration of Measurement:

54 minutes

Average Heat Flux	=	11.04	Btu/(h sq-ft)
Average Hot Plate Temperature T_h	=	94.9	deg F
Average Cold Plate Temperature T_c	=	54.8	deg F
Average Temperature Difference	=	40.1	deg F
Average Sample Temperature	=	74.8	deg F
Average Thermal Resistance R	=	3.63	h sq-ft F/Btu
Average Thermal Conductance C	=	0.276	Btu/(h sq-ft F)

Calculations Based on Thickness Measured in Apparatus

Thickness	=	1.547	inch
Average Temperature Gradient	=	25.90	deg F/inch
Apparent Thermal Conductivity k	=	0.426	Btu-in/(h sq-ft F)

Operator: B

Comments

Req No: 950041
Date: 01-18-1995

Steady-State Thermal Transmission Properties
by Means of the Heat Flow Meter per ASTM, C 518

Project No: 257165

Run ID: 257165

Sample Description: SAMPLE-4-FLAT-AMB

Specimen Orientation: Horizontal Heat Meter Location: Cold Surface

Instrument Used: Rapid-k #2

Duration of Measurement: 60 minutes

Average Heat Flux	=	28.76	Btu/(h sq-ft)
Average Hot Plate Temperature T_h	=	94.8	deg F
Average Cold Plate Temperature T_c	=	55.0	deg F
Average Temperature Difference	=	39.8	deg F
Average Sample Temperature	=	74.9	deg F
Average Thermal Resistance R	=	1.38	h sq-ft F/Btu
Average Thermal Conductance C	=	0.723	Btu/(h sq-ft F)

Calculations Based on Thickness Measured in Apparatus

Thickness	=	0.527	inch
Average Temperature Gradient	=	75.47	deg F/inch
Apparent Thermal Conductivity k	=	0.381	Btu-in/(h sq-ft F)

Operator:

Comments

Req No: 950041
Date: 01-18-1995

Steady-State Thermal Transmission Properties
by Means of the Heat Flow Meter per ASTM C 518

Project No: 257165

Run ID: 257165

Sample Description: SAMPLE-1-2-3-4-FLAT-AMB

Specimen Orientation: Horizontal Heat Meter Location: Cold Surface

Instrument Used: Rapid-k #2

Duration of Measurement:

86 minutes

Average Heat Flux	=	7.93	Btu/(h sq-ft)
Average Hot Plate Temperature T_h	=	95.1	deg F
Average Cold Plate Temperature T_c	=	55.7	deg F
Average Temperature Difference	=	39.4	deg F
Average Sample Temperature	=	75.4	deg F
Average Thermal Resistance R	=	4.96	h sq-ft F/Btu
Average Thermal Conductance C	=	0.201	Btu/(h sq-ft F)

Calculations Based on Thickness Measured in Apparatus

Thickness	=	2.058	inch
Average Temperature Gradient	=	19.12	deg F/inch
Apparent Thermal Conductivity k	=	0.415	Btu-in/(h sq-ft F)

Operator:

Comments

Req No: 950041
Date: 01-13-1995

Steady-State Thermal Transmission Properties
by Means of the Heat Flow Meter per ASTM C 518

Project No: 257165

Run ID: 257165

Sample Description: SAMPLE-1 FLAT

Specimen Orientation: Horizontal Heat Meter Location: Cold Surface

Instrument Used: Rapid-k #2

Duration of Measurement: 58 minutes

Average Heat Flux	=	35.28	Btu/(h sq-ft)
Average Hot Plate Temperature T_h	=	200.0	deg F
Average Cold Plate Temperature T_c	=	160.4	deg F
Average Temperature Difference	=	39.6	deg F
Average Sample Temperature	=	180.2	deg F
Average Thermal Resistance R	=	1.12	h sq-ft F/Btu
Average Thermal Conductance C	=	0.891	Btu/(h sq-ft F)

Calculations Based on Thickness Measured in Apparatus

Thickness	=	0.527	inch
Average Temperature Gradient	=	75.13	deg F/inch
Apparent Thermal Conductivity k	=	0.470	Btu-in/(h sq-ft F)

Operator:

Comments

Req No: 950041
Date: 01-17-1995

Steady-State Thermal Transmission Properties
by Means of the Heat Flow Meter per ASTM C 518

Project No: 257165

Run ID: 257165

Sample Description: SAMPLE-2-FLAT

Specimen Orientation: Horizontal Heat Meter Location: Cold Surface

Instrument Used: Rapid-k #2

Duration of Measurement: 56 minutes

Average Heat Flux	=	34.67	Btu/(h sq-ft)
Average Hot Plate Temperature T_h	=	200.0	deg F
Average Cold Plate Temperature T_c	=	160.1	deg F
Average Temperature Difference	=	39.9	deg F
Average Sample Temperature	=	180.1	deg F
Average Thermal Resistance R	=	1.15	h sq-ft F/Btu
Average Thermal Conductance C	=	0.869	Btu/(h sq-ft F)

Calculations Based on Thickness Measured in Apparatus

Thickness	=	0.529	inch
Average Temperature Gradient	=	75.42	deg F/inch
Apparent Thermal Conductivity k	=	0.460	Btu-in/(h sq-ft F)

Operator: _____

Comments

Req No: 950041
Date: 01-13-1995

Steady-State Thermal Transmission Properties
by Means of the Heat Flow Meter per ASTM C 518

Project No: 257165

Run ID: 257165

Sample Description: SAMPLE-1+2-FLAT

Specimen Orientation: Horizontal Heat Meter Location: Cold Surface

Instrument Used: Rapid-k #2

Duration of Measurement: 90 minutes

Average Heat Flux	=	16.38	Btu/(h sq-ft)
Average Hot Plate Temperature T_h	=	200.2	deg F
Average Cold Plate Temperature T_c	=	159.6	deg F
Average Temperature Difference	=	40.6	deg F
Average Sample Temperature	=	179.9	deg F
Average Thermal Resistance R	=	2.48	h sq-ft F/Btu
Average Thermal Conductance C	=	0.403	Btu/(h sq-ft F)

Calculations Based on Thickness Measured in Apparatus

Thickness	=	1.041	inch
Average Temperature Gradient	=	39.02	deg F/inch
Apparent Thermal Conductivity k	=	0.420	Btu-in/(h sq-ft F)

Operator: B

Comments

Req No: 950041
Date: 01-16-1995

Steady-State Thermal Transmission Properties
by Means of the Heat Flow Meter per ASTM C 518

Project No: 257165

Run ID: 257165

Sample Description: SAMPLE-3-FLAT

Specimen Orientation: Horizontal Heat Meter Location: Cold Surface

Instrument Used: Rapid-k #2

Duration of Measurement: 111 minutes

Average Heat Flux	=	34.06	Btu/(h sq-ft)
Average Hot Plate Temperature T_h	=	200.1	deg F
Average Cold Plate Temperature T_c	=	160.0	deg F
Average Temperature Difference	=	40.1	deg F
Average Sample Temperature	=	180.1	deg F
Average Thermal Resistance R	=	1.18	h sq-ft F/Btu
Average Thermal Conductance C	=	0.850	Btu/(h sq-ft F)

Calculations Based on Thickness Measured in Apparatus

Thickness	=	0.529	inch
Average Temperature Gradient	=	75.76	deg F/inch
Apparent Thermal Conductivity k	=	0.450	Btu-in/(h sq-ft F)

Operator:

Comments

Req No: 950041
Date: 01-16-1995

Steady-State Thermal Transmission Properties
by Means of the Heat Flow Meter per ASTM C 518

Project No: 257165

Run ID: 257165

Sample Description: SAMPLE-1+2+3-FLAT

Specimen Orientation: Horizontal Heat Meter Location: Cold Surface
Instrument Used: Rapid-k #2

Duration of Measurement:

186 minutes

Average Heat Flux

= 7.37 Btu/(h sq-ft)

Average Hot Plate Temperature Th

= 200.0 deg F

Average Cold Plate Temperature Tc

= 159.7 deg F

Average Temperature Difference

= 40.3 deg F

Average Sample Temperature

= 179.9 deg F

Average Thermal Resistance R

= 5.46 h sq-ft F/Btu

Average Thermal Conductance C

= 0.183 Btu/(h sq-ft F)

Calculations Based on Thickness Measured in Apparatus

Thickness

= 1.554 inch

Average Temperature Gradient

= 25.91 deg F/inch

Apparent Thermal Conductivity k

= 0.285 Btu-in/(h sq-ft F)

Operator:

Comments

Req No: 950041
Date: 01-17-1995

Steady-State Thermal Transmission Properties
by Means of the Heat Flow Meter per ASTM C 518

Project No: 257165

Run ID: 257165

Sample Description: SAMPLE-4-FLAT

Specimen Orientation: Horizontal Heat Meter Location: Cold Surface

Instrument Used: Rapid-k #2

Duration of Measurement: 56 minutes

Average Heat Flux	=	33.78	Btu/(h sq-ft)
Average Hot Plate Temperature T_h	=	200.2	deg F
Average Cold Plate Temperature T_c	=	160.4	deg F
Average Temperature Difference	=	39.8	deg F
Average Sample Temperature	=	130.3	deg F
Average Thermal Resistance R	=	1.18	h sq-ft F/Btu
Average Thermal Conductance C	=	0.849	Btu/(h sq-ft F)

Calculations Based on Thickness Measured in Apparatus

Thickness	=	0.528	inch
Average Temperature Gradient	=	75.32	deg F/inch
Apparent Thermal Conductivity k	=	0.449	Btu-in/(h sq-ft F)

Operator:

Comments

1

Req No: 950041
Date: 01-16-1995

Steady-State Thermal Transmission Properties
by Means of the Heat Flow Meter per ASTM C 518

Project No: 257165

Run ID: 257165

Sample Description: SAMPLE-1+2+3+4-FLAT

Specimen Orientation: Horizontal Heat Meter Location: Cold Surface

Instrument Used: Rapid-k #2

Duration of Measurement: 185 minutes

Average Heat Flux	=	3.21	Btu/(h sq-ft)
Average Hot Plate Temperature T_h	=	200.2	deg F
Average Cold Plate Temperature T_c	=	160.0	deg F
Average Temperature Difference	=	40.2	deg F
Average Sample Temperature	=	180.1	deg F
Average Thermal Resistance R	=	12.52	h sq-ft F/Btu
Average Thermal Conductance C	=	0.080	Btu/(h sq-ft F)

Calculations Based on Thickness Measured in Apparatus

Thickness	=	2.064	inch
Average Temperature Gradient	=	19.49	deg F/inch
Apparent Thermal Conductivity k	=	0.165	Btu-in/(h sq-ft F)

Operator:

Comments

Req No:
Date: 02-20-1995

Steady-State Thermal Transmission Properties
by Means of the Heat Flow Meter per ASTM C 518

Project No: 950245

Run ID: GERRY

Sample Description: FIBER-BOARD-GERRY

Specimen Orientation: Horizontal Heat Meter Location: Cold Surface

Instrument Used: Rapid-k #2

Duration of Measurement: 174 minutes

Average Heat Flux	=	8.37	Btu/(h sq-ft)
Average Hot Plate Temperature T_h	=	200.0	deg F
Average Cold Plate Temperature T_c	=	160.0	deg F
Average Temperature Difference	=	40.0	deg F
Average Sample Temperature	=	180.0	deg F
Average Thermal Resistance R	=	4.78	h sq-ft F/Btu
Average Thermal Conductance C	=	0.209	Btu/(h sq-ft F)

Calculations Based on Thickness Measured in Apparatus

Thickness	=	2.055	inch
Average Temperature Gradient	=	19.46	deg F/inch
Apparent Thermal Conductivity k	=	0.430	Btu-in/(h sq-ft F)

Operator: _____

Comments

Req No:
Date: 02-20-1995

Steady-State Thermal Transmission Properties
by Means of the Heat Flow Meter per ASTM C 518

Project No: 950245

Run ID: GERRY

Sample Description: FIBER-BOARD-GERRY

Specimen Orientation: Horizontal Heat Meter Location: Cold Surface

Instrument Used: Rapid-k #2

Duration of Measurement: 53 minutes

Average Heat Flux	=	8.59	Btu/(h sq-ft)
Average Hot Plate Temperature T_h	=	199.9	deg F
Average Cold Plate Temperature T_c	=	160.0	deg F
Average Temperature Difference	=	39.9	deg F
Average Sample Temperature	=	179.9	deg F
Average Thermal Resistance R	=	4.64	h sq-ft F/Btu
Average Thermal Conductance C	=	0.215	Btu/(h sq-ft F)

Calculations Based on Thickness Measured in Apparatus

Thickness	=	2.055	inch
Average Temperature Gradient	=	19.42	deg F/inch
Apparent Thermal Conductivity k	=	0.442	Btu-in/(h sq-ft F)

Operator:

Comments

Req No:
Date: 02-20-1995

Steady-State Thermal Transmission Properties
by Means of the Heat Flow Meter per ASTM C 518

Project No: 950245

Run ID: GERRY

Sample Description: FIBER-BOARD-GERRY

Specimen Orientation: Horizontal Heat Meter Location: Cold Surface

Instrument Used: Rapid-k #2

Duration of Measurement: 52 minutes

Average Heat Flux	=	8.63	Btu/(h sq-ft)
Average Hot Plate Temperature T_h	=	200.0	deg F
Average Cold Plate Temperature T_c	=	160.1	deg F
Average Temperature Difference	=	39.9	deg F
Average Sample Temperature	=	180.0	deg F
Average Thermal Resistance R	=	4.63	h sq-ft F/Btu
Average Thermal Conductance C	=	0.216	Btu/(h sq-ft F)

Calculations Based on Thickness Measured in Apparatus

Thickness	=	2.055	inch
Average Temperature Gradient	=	19.42	deg F/inch
Apparent Thermal Conductivity k	=	0.444	Btu-in/(h sq-ft F)

Operator:

Comments

Req No:
Date: 02-20-1995

Steady-State Thermal Transmission Properties
by Means of the Heat Flow Meter per ASTM C 518

Project No: 950245

Run ID: GERRY

Sample Description: FIBER-BOARD-GERRY

Specimen Orientation: Horizontal Heat Meter Location: Cold Surface

Instrument Used: Rapid-k #2

Duration of Measurement: 53 minutes

Average Heat Flux = 8.60 Btu/(h sq-ft)

Average Hot Plate Temperature T_h = 200.0 deg F

Average Cold Plate Temperature T_c = 160.0 deg F

Average Temperature Difference = 40.0 deg F

Average Sample Temperature = 180.0 deg F

Average Thermal Resistance R = 4.64 h sq-ft F/Btu

Average Thermal Conductance C = 0.215 Btu/(h sq-ft F)

Calculations Based on Thickness Measured in Apparatus

Thickness = 2.055 inch

Average Temperature Gradient = 19.44 deg F/inch

Apparent Thermal Conductivity k = 0.443 Btu-in/(h sq-ft F)

Operator:

Comments

Req No:
Date: 02-20-1995

Steady-State Thermal Transmission Properties
by Means of the Heat Flow Meter per ASTM C 518

Project No: 950245

Run ID: GERRY

Sample Description: FIBER-BOARD-GERRY

Specimen Orientation: Horizontal Heat Meter Location: Cold Surface

Instrument Used: Rapid-k #2

Duration of Measurement: 54 minutes

Average Heat Flux	=	8.57	Btu/(h sq-ft)
Average Hot Plate Temperature T_h	=	199.9	deg F
Average Cold Plate Temperature T_c	=	160.0	deg F
Average Temperature Difference	=	40.0	deg F
Average Sample Temperature	=	180.0	deg F
Average Thermal Resistance R	=	4.66	h sq-ft F/Btu
Average Thermal Conductance C	=	0.215	Btu/(h sq-ft F)

Calculations Based on Thickness Measured in Apparatus

Thickness	=	2.055	inch
Average Temperature Gradient	=	19.45	deg F/inch
Apparent Thermal Conductivity k	=	0.441	Btu-in/(h sq-ft F)

Operator:

Comments

Req No:
Date: 02-20-1995

Steady-State Thermal Transmission Properties
by Means of the Heat Flow Meter per ASTM C 518

Project No: 950245

Run ID: GERRY

Sample Description: FIBER-BOARD-GERRY

Specimen Orientation: Horizontal Heat Meter Location: Cold Surface

Instrument Used: Rapid-k #2

Duration of Measurement: 52 minutes

Average Heat Flux	=	8.58	Btu/(h sq-ft)
Average Hot Plate Temperature T_h	=	199.9	deg F
Average Cold Plate Temperature T_c	=	159.9	deg F
Average Temperature Difference	=	40.0	deg F
Average Sample Temperature	=	179.9	deg F
Average Thermal Resistance R	=	4.66	h sq-ft F/Btu
Average Thermal Conductance C	=	0.215	Btu/(h sq-ft F)

Calculations Based on Thickness Measured in Apparatus

Thickness	=	2.055	inch
Average Temperature Gradient	=	19.45	deg F/inch
Apparent Thermal Conductivity k	=	0.441	Btu-in/(h sq-ft F)

Operator: _____

Comments

Req No:
Date: 02-22-1995

Steady-State Thermal Transmission Properties
by Means of the Heat Flow Meter per ASTM C 518

Project No: 277165

Run ID: GERRY

Sample Description: FIBERBOARD-GERRY-AMB.-75

Specimen Orientation: Horizontal Heat Meter Location: Cold Surface

Instrument Used: Rapid-k #2

Duration of Measurement:

94 minutes

Average Heat Flux	=	7.67	Btu/(h sq-ft)
Average Hot Plate Temperature T_h	=	94.7	deg F
Average Cold Plate Temperature T_c	=	55.1	deg F
Average Temperature Difference	=	39.6	deg F
Average Sample Temperature	=	74.9	deg F
Average Thermal Resistance R	=	5.16	h sq-ft F/Btu
Average Thermal Conductance C	=	0.194	Btu/(h sq-ft F)

Calculations Based on Thickness Measured in Apparatus

Thickness	=	2.038	inch
Average Temperature Gradient	=	19.43	deg F/inch
Apparent Thermal Conductivity k	=	0.395	Btu-in/(h sq-ft F)

Operator:

Comments

Req No:
Date: 02-22-1995

Steady-State Thermal Transmission Properties
by Means of the Heat Flow Meter per ASTM C 518

Project No: 277165

Run ID: GERRY

Sample Description: FIBERBOARD-GERRY-AMB.-75

Specimen Orientation: Horizontal Heat Meter Location: Cold Surface

Instrument Used: Rapid-k #2

Duration of Measurement: 52 minutes

Average Heat Flux = 7.79 Btu/(h sq-ft)

Average Hot Plate Temperature T_h = 94.7 deg F

Average Cold Plate Temperature T_c = 55.0 deg F

Average Temperature Difference = 39.6 deg F

Average Sample Temperature = 74.9 deg F

Average Thermal Resistance R = 5.09 h sq-ft F/Btu

Average Thermal Conductance C = 0.196 Btu/(h sq-ft F)

Calculations Based on Thickness Measured in Apparatus

Thickness = 2.038 inch

Average Temperature Gradient = 19.45 deg F/inch

Apparent Thermal Conductivity k = 0.400 Btu-in/(h sq-ft F)

Operator: _____

Comments

Req No:
Date: 02-22-1995

Steady-State Thermal Transmission Properties
by Means of the Heat Flow Meter per ASTM C 518

Project No: 277165

Run ID: GERRY

Sample Description: FIBERBOARD-GERRY-AMB.-75

Specimen Orientation: Horizontal Heat Meter Location: Cold Surface

Instrument Used: Rapid-k #2

Duration of Measurement:

55 minutes

Average Heat Flux	=	7.77	Btu/(h sq-ft)
Average Hot Plate Temperature T_h	=	94.7	deg F
Average Cold Plate Temperature T_c	=	55.0	deg F
Average Temperature Difference	=	39.7	deg F
Average Sample Temperature	=	74.9	deg F
Average Thermal Resistance R	=	5.11	h sq-ft F/Btu
Average Thermal Conductance C	=	0.196	Btu/(h sq-ft F)

Calculations Based on Thickness Measured in Apparatus

Thickness	=	2.038	inch
Average Temperature Gradient	=	19.47	deg F/inch
Apparent Thermal Conductivity k	=	0.399	Btu-in/(h sq-ft F)

Operator:

Comments

Req No:
Date: 02-22-1995

Steady-State Thermal Transmission Properties
by Means of the Heat Flow Meter per ASTM C 518

Project No: 277165

Run ID: GERRY

Sample Description: FIBERBOARD-GERRY-AMB.-75

Specimen Orientation: Horizontal Heat Meter Location: Cold Surface

Instrument Used: Rapid-k #2

Duration of Measurement: 56 minutes

Average Heat Flux	=	7.74	Btu/(h sq-ft)
Average Hot Plate Temperature T_h	=	94.7	deg F
Average Cold Plate Temperature T_c	=	55.0	deg F
Average Temperature Difference	=	39.7	deg F
Average Sample Temperature	=	74.9	deg F
Average Thermal Resistance R	=	5.13	h sq-ft F/Btu
Average Thermal Conductance C	=	0.195	Btu/(h sq-ft F)

Calculations Based on Thickness Measured in Apparatus

Thickness	=	2.038	inch
Average Temperature Gradient	=	19.48	deg F/inch
Apparent Thermal Conductivity k	=	0.398	Btu-in/(h sq-ft F)

Operator: _____

Comments

Req No:
Date: 02-22-1995

Steady-State Thermal Transmission Properties
by Means of the Heat Flow Meter per ASTM C 518

Project No: 277165

Run ID: GERRY

Sample Description: FIBERBOARD-GERRY-AMB.-75

Specimen Orientation: Horizontal Heat Meter Location: Cold Surface

Instrument Used: Rapid-k #2

Duration of Measurement: 52 minutes

Average Heat Flux	=	7.74	Btu/(h sq-ft)
Average Hot Plate Temperature T_h	=	94.8	deg F
Average Cold Plate Temperature T_c	=	55.1	deg F
Average Temperature Difference	=	39.7	deg F
Average Sample Temperature	=	75.0	deg F
Average Thermal Resistance R	=	5.13	h sq-ft F/Btu
Average Thermal Conductance C	=	0.195	Btu/(h sq-ft F)

Calculations Based on Thickness Measured in Apparatus

Thickness	=	2.038	inch
Average Temperature Gradient	=	19.48	deg F/inch
Apparent Thermal Conductivity k	=	0.397	Btu-in/(h sq-ft F)

Operator:

Comments

Req No:
Date: 02-22-1995

Steady-State Thermal Transmission Properties
by Means of the Heat Flow Meter per ASTM C 518

Project No: 277165

Run ID: GERRY

Sample Description: FIBERBOARD-GERRY-AMB.-75

Specimen Orientation: Horizontal Heat Meter Location: Cold Surface

Instrument Used: Rapid-k #2

Duration of Measurement: 53 minutes

Average Heat Flux	=	7.75	Btu/(h sq-ft)
Average Hot Plate Temperature T_h	=	94.7	deg F
Average Cold Plate Temperature T_c	=	55.0	deg F
Average Temperature Difference	=	39.8	deg F
Average Sample Temperature	=	74.9	deg F
Average Thermal Resistance R	=	5.13	h sq-ft F/Btu
Average Thermal Conductance C	=	0.195	Btu/(h sq-ft F)

Calculations Based on Thickness Measured in Apparatus

Thickness	=	2.038	inch
Average Temperature Gradient	=	19.51	deg F/inch
Apparent Thermal Conductivity k	=	0.397	Btu-in/(h sq-ft F)

Operator: B

Comments

Req No:
Date: 02-22-1995

Steady-State Thermal Transmission Properties
by Means of the Heat Flow Meter per ASTM C 518

Project No: 277165

Run ID: GERRY

Sample Description: FIBERBOARD-GERRY-AMB.-75

Specimen Orientation: Horizontal Heat Meter Location: Cold Surface

Instrument Used: Rapid-k #2

Duration of Measurement:

52 minutes

Average Heat Flux	=	7.75	Btu/(h sq-ft)
Average Hot Plate Temperature T_h	=	94.7	deg F
Average Cold Plate Temperature T_c	=	55.0	deg F
Average Temperature Difference	=	39.7	deg F
Average Sample Temperature	=	74.9	deg F
Average Thermal Resistance R	=	5.12	h sq-ft F/Btu
Average Thermal Conductance C	=	0.195	Btu/(h sq-ft F)

Calculations Based on Thickness Measured in Apparatus

Thickness	=	2.038	inch
Average Temperature Gradient	=	19.49	deg F/inch
Apparent Thermal Conductivity k	=	0.398	Btu-in/(h sq-ft F)

Operator: B

Comments