RADCO TEST REPORT
Project No. 196109.R

Insulated Composite Materials Tested in Accordance with ASTM C518-04

Prepared for

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by

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TL-209

1.0 INTRODUCTION

At the request of Cal Poly Corporation, RADCO conducted tests on samples of Composite material in accordance with ASTM C518-04 *Thermal Transmission Properties by Means of Heat Flow Meter Apparatus.*

2.0 MATERIAL

Three (3) 10 in. x 10 in. x 3 in. (254.0 mm x 254.0 mm x 76.2 mm) specimens of Composite material were received at RADCO's Long Beach, CA test facility on October 29, 2019.

2.1 CONDITIONING

Samples were conditioned for a period of not less than 40 hours at a temperature of 73.4 ± 4°F (23 ± 2 °C) and a relative humidity of 50 ±5%.

3.0 TEST PROCEDURES & RESULTS

3.1 TEST EQUIPMENT

The tests were conducted using the following equipment:

1. Steel rule graduated to 1mm
2. Sartorius Model GP3202 electronic digital scale
3. Mitutoyo Caliper 8 inch
4. Netzsch HFM446 Lambda Series heat flow meter thermal conductivity instrument

3.2 TEST PROCEDURE

Testing was conducted in accordance with ASTM C518-04. Three (3) 10 in. x 10 in. x 3 in. specimens of the product described in Section 2.0 that were provided pre-formed, and tested at their specific mean temperatures of 75°F. Thickness measurements are as reported by the test apparatus. The recorded data and results are shown in the table below.

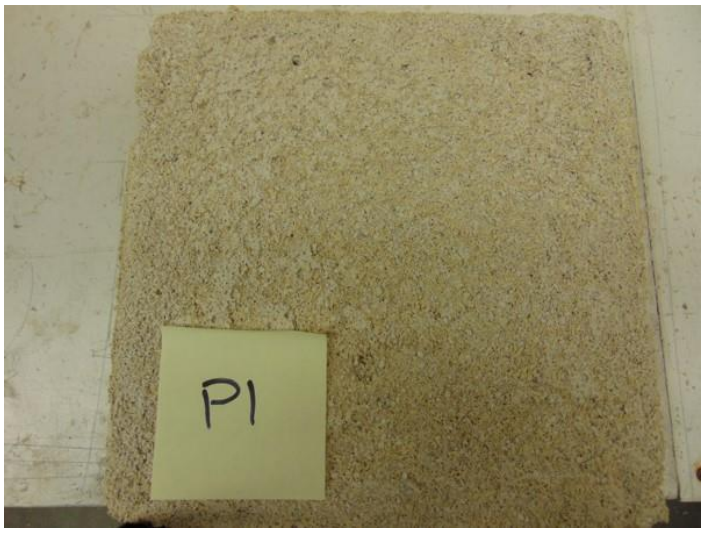
3.3 TEST RESULTS

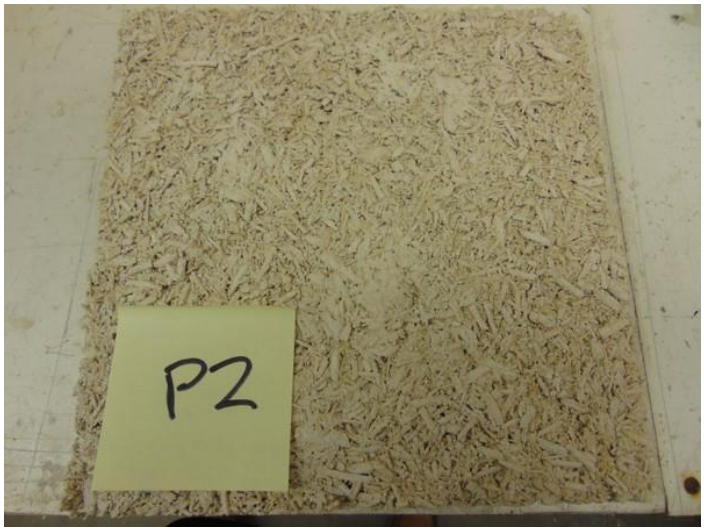
The recorded data and the results are shown in the following table.

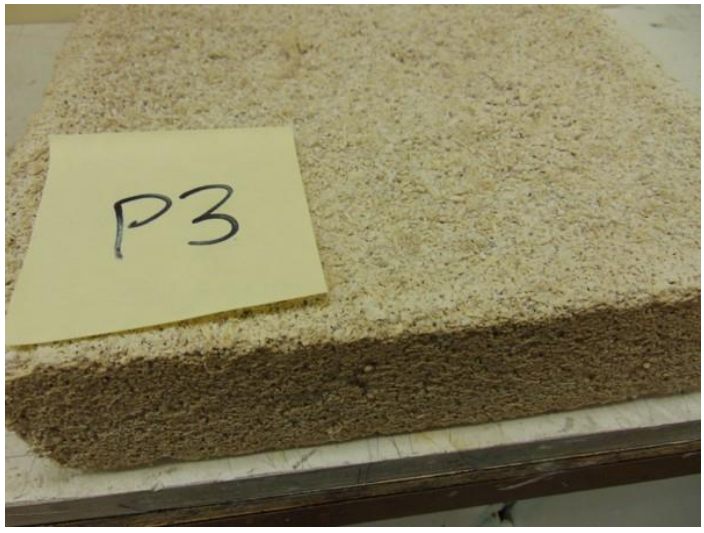
Specimens tested at 75°F	1	2	3
Date of test	10/30/19	10/30/19	10/31/19
Mean temperature during test °F:	75.00	75.00	75.00
Temperature gradient during test °F:	14.07	12.84	13.65
Specimen thickness as tested (in):	2.84	3.12	2.93
Duration of measurement portion of test (hrs:min:sec):	05:14:17	03:26:33	03:13:40
Final specimen mass (wt.) after test (g):	1142.05	1510.45	1069.00
Specimen percent mass (wt.) change:	0.05	-0.06	0.05
Thermal conductivity "k": BTU·in/(Hr.ft^2.°F)	0.40	0.53	0.42
Thermal resistance "R" per thickness tested: (Hr.ft^2.°F)/BTU	7.07	5.88	6.92
Density of Specimen (pcf)	15.34	20.18	14.03
Average Thermal resistance "R" per thickness tested: (Hr.ft^2.°F)/BTU	6.62		

Note 1: Last heat flow meter calibration date = 10/30/19
Note 2: Type of calibration material used = fiberglass

4.0 PHOTOGRAPHS







Appendix

Equipment Calibration Certifications: Sartorius Model GP3202 electronic digital scale, Mitutoyo Caliper Model #500-172-20 8” x 0.0005” Digital

AMERICAN GAGE

Calibration / Service Certificate

A2LA ACCREDITED
CERT #4296.01

Customer Name : **RADCO**

3220 E. 59th Street, Long Beach, CA

Test # : **113676 - 1**
Report # : 89549 - 3 - 418188
P O # : DC12132018

This certificate applies only to the item specified below and shall not be reproduced, except in full, without prior written approval from American Gage.

Equipment Serviced :

On-Site ☐ Status : **Calibrated** Interval (mo): **12**

Control # : **5** Manufacturer : **Mitutoyo** Model : **500-172-20**

Serial # : 13092081 Description : **Caliper** Range/Type : **8x.0005" Digital**

Specifications - Condition :

Equipment Accuracy : **±.001"**

Procedure : **NA17-20MD-07 2/97 NAVAIR**

Temperature °C : **20** Humidity % : **45**

As Found Condition : **In Tolerance**

Returned Condition : **In Tolerance**

Cal/Service Date : **12/19/18**

Cal/Service Due : **12/19/19**

Serviced by AGI technician, ID number AG 7, J Alay.

Remarks :

This calibration certificate is covered by A2LA Certificate of Accreditation (4296.01) for ISO/IEC 17025
The uncertainty (K-2) does not exceed ±(300+4.5L) µ" at a 95% confidence level.

Nominal	Initial Reading	Final Reading
.500"	.5000"	same
1.000	1.0000	
2.000	2.0000	
4.000	4.0000	
8.000	8.0000	

Standards Employed :

Standard	Manufacturer	Model	Description	Specifications	Cal Due	Trace No
101	Doall	N/A	Gage Block Set	Grade 2	2/4/2019	LD15-0204/101-18
102	Ringmaster	N/A	Cylindrical Ring Set	Charted	2/4/2019	LD15-0204/102-18
132	Dapra	Hoke	Long Blocks	Grade 2	2/4/2019	LD15-0204/132-18

American Gage certifies: This service was performed in accordance with industry accepted methods. The American Gage quality system has received a Certificate of Accreditation for compliancy with the ISO/IEC 17025 (which includes applicable ISO 9001:2008 requirements). The calibration system is designed to comply as required with ANSI/NCSL Z540-1, ISO 10012, the former MIL-STD-45662A standards, and/or contractual requirements. The instrument serviced, unless otherwise specified, was verified for conformance and meets accepted industry and/or manufacturer specifications and was calibrated/serviced employing, as required, standards/instruments traceable to the National Institute of Standards and Technology (NIST) and/or accepted industry standards. Any test uncertainty ratio (TUR) less than 4:1 that is not an industry and/or a manufacturer accepted ratio appears in the remarks section. The statements of compliance with specifications are based on a 95% confidence level with a coverage factor of k=2 for the expanded uncertainty of measurement results on which the decision is based. The content of this report was reviewed and approved, as indicated below, by an authorized American Gage Quality Assurance representative.

Approved by : R Arnold AGQA 2
On 12/19/2018

Reviewed and Issued by: Q.A. 1 12/19/2018

Report and Certificate of Calibration

CAL-CERT
CALIBRATION CERTIFICATION
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www.Cal-Cert.com

Toll Free
888-700-4100

Address
120 S. Chaparral Ct Suite 110
Anaheim Hills, CA 92808

Local
714-696-5300

A2LA ACCREDITED
CERT #4986.02

Report #:	10832-93057-615	**Customer PO#:**	
Customer Name:	Radco		
Customer Address:	3220 East 59th Street		
City:	Long Beach	**State:** CA	**Zip:** 90805
Contact:	Darwin Cano		
Service Address:	120 S. Chaparral Court, Suite 110	Anaheim Hills, CA 92808	

Calibration Standards

3-00443 | Weight Set | Troemner | SN: 76933 | Cal: 10/27/2017 | Due: 10/31/2019 | Vendor: Oregon Dept of Ag | Report #: OR-17-275-F
3-00986 | Thermo-Hygrometer | Comark | SN: 06259400318 | Cal: 08/27/2019 | Due: 08/31/2020 | Vendor: Cal-Cert | Range: 95 %RH 122 °F | Report #: 10455-78096-894

Instrument Data

Calibration Date:	September 18, 2019	**Reference:**	ASTM E-898
Calibration Due Date:	September 18, 2020	**Cal-Cert Procedure:**	CP-002
Calibration Frequency:	12 Months	**Indicating System:**	Digital
Manufacturer:	Sartorius	**Temperature:**	72 °F
Model Number:	GP3202	**Humidity:**	38% RH
Type:	Digital Balance	**Asset #:**	38
Serial #:	17750582	**Service Location:**	Cal-Cert Lab
Scale Capacity:	3,200 grams	**As Found:**	PASS
		As Left:	PASS

Scale Linear Test

Instrument Range: 3200.00 grams **Resolution:** 0.01 grams

Calibration Standard grams	As Found UUT grams	As Found Error grams	As Left UUT grams	As Left Error grams	As Left % of Error	Tolerance (As Left) Allowable Error	
						Error	Condition
0.00	0.00	0.00	0.00	0.00	0.000	0.00	PASS
320.00	320.01	0.01	320.01	0.01	0.003	0.32	PASS
640.00	640.02	0.02	640.02	0.02	0.003	0.64	PASS
960.00	960.02	0.02	960.02	0.02	0.002	0.96	PASS
1280.00	1280.01	0.01	1280.01	0.01	0.001	1.28	PASS
1600.00	1600.01	0.01	1600.01	0.01	0.001	1.60	PASS
1920.00	1920.03	0.03	1920.03	0.03	0.002	1.92	PASS
2240.00	2240.03	0.03	2240.03	0.03	0.001	2.24	PASS
2560.00	2560.05	0.05	2560.05	0.05	0.002	2.56	PASS
2880.00	2880.05	0.05	2880.05	0.05	0.002	2.88	PASS
3200.00	3200.04	0.04	3200.04	0.04	0.001	3.20	PASS
1600.00	1600.02	0.02	1600.02	0.02	0.001	1.60	PASS
0.00	0.00	0.00	0.00	0.00	0.000	0.00	PASS

Expanded Uncertainty± 0.0414 grams

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Manufacturer: Sartorius **Type:** Digital Balance **Serial #:** 17750582

FUNCTIONAL CHECKS					
OFF CENTER LOAD:		**HYSTERESIS: Load Increments**		**REPEATABILITY:**	
Loading position	1600.00	Test Weight Applied. % of load	Readings	Test Weight Applied	1600.00
Right	1600.00	0%	0.00	1st	1600.02
Left	1600.03	(R1) 50%	1600.01	2nd	1600.03
Front	1600.03	100%	3200.04	3rd	1600.02
Back	1600.02	(R2)50%	1600.02	4th	1600.02
As Left	PASS	0%	0.00	5th	1600.03
		As Left	PASS	As Left	PASS
Tolerance Deviation of lowest and highest reading within 0.1%		Tolerance The Difference of R1 and R2 must be within 0.1%		Tolerance Deviation of lowest and highest reading within 0.1%	

Remarks:

We sincerely thank you for your business. Please call us at 714-696-5300 for all your sales and calibration needs.
Cleaning and preventative maintenance were performed as part of this service.

Cal-Cert is accredited by A2LA under Calibration Laboratory Code #4986.02.
A2LA is recognized under the ILAC mutual recognition agreement (MRA).

This certificate is hereby issued that the above instrument was tested for accuracy with calibrated standards traceable to the National Institute of Standards and Technology (NIST). The information provided on this form complies with the data gathering and reporting requirements of ISO/IEC 17025 and ANSI/NCSL Z540.1, and meets the requirements of all applicable references and Cal-Cert procedures listed above.
Any stated measurement uncertainty includes the uncertainty of the Calibration standards used, combined with the uncertainty of the measurement process using the RSS method with a k=2 for an approximate 95% level of confidence. The calibration process meets or exceeds a ratio of 4:1 unless otherwise stated.
All tolerances were derived from the applicable standards and pass/fail determination is based on those tolerances. The customer determined any recommended due dates indicated on the certificate.

This report shall not be reproduced except in full, without written approval from Cal-Cert.

Service Engineer: Soph Ok **Date:** September 18, 2019

Technical Manager: Marshall Doyle **Signature:** MDoyle

REPORT#: 10832-93057-615

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