



## Test Report

### Selected Measurements on Tuff Stuff Under Concrete Insulation Supplied to R&D Services by Innovative Energy, Inc.

Prepared For:

Mr. Jim Kouns  
Innovative Energy, Inc.  
10653 W.181<sup>st</sup> Avenue  
Lowell, IN 46356

R & D Services, Inc.  
P.O. Box 2400  
Cookeville, Tennessee 38502-2400

Report: RD07298

Reviewed by:

A handwritten signature in cursive script, appearing to read 'Ronald S. Graves'.

Ronald S. Graves  
Vice President

June 28, 2007

The test results in this report apply only to the specimens tested. This report shall not be reproduced, except in full, without written approval of R & D Services, Inc. This report must not be used by the Client to claim product endorsement by R & D Services, Inc., NVLAP or any agency of the U.S. Government.

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Fax: 931-525-3896

## **Bleeding and Delamination Test Report**

Test Number: RD071853BD

Date of Test: May 25, 2007

Specimen Number: 1021070426-12

Date of Manufacture: 2007

Report prepared for: Innovative Energy, Inc. / Jim Kouns

Project: Adhesive Performance (Bleeding and Delamination) of Double Bubble with Foil on One Side-(Tuff Stuff).

### Procedure

This report presents the results of physical tests conducted on material manufactured by Innovative Energy and received by R&D Services, Inc. on April 26, 2007 for quality control testing. Testing was completed on May 25, 2007. The test was performed in accordance with the following test method.

ASTM C 1224-03, "Standard Specification for Reflective Insulation for Building Applications" - Section 9.5.1, Bleeding and Delamination.

### Specimen Preparation:

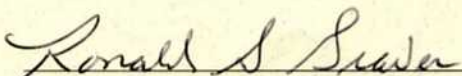
Three (3) 3 by 6 in samples were cut from separate locations on the insulation roll of product.

### Specimen Conditioning:

The specimens were vertically suspended in an oven at conditions of  $180^{\circ}\text{F} \pm 5^{\circ}\text{F}$  and 50 % relative humidity a minimum of 5 hours prior to evaluation.

### Observations:

The Innovative Energy Insulation was observed to have no bleeding or delamination under 5x magnification, thus, meeting the acceptance criteria of Section 9.5.1.4.



Reviewed By:

06-16-07

Date:

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The results in this report apply only to the specimen tested

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## **Pliability Test Report**

Test Number: RD071852PL

Date of Test: May 24-25, 2007

Specimen Number: 1021070426-12

Date of Manufacture: 2007

Report prepared for: Innovative Energy, Inc. / Jim Kouns

Project: Adhesive Performance (Pliability) of Double Bubble with Foil on One Side-(Tuff Stuff).

### Procedure

This report presents the results of physical tests conducted on material manufactured by Innovative Energy, Inc. and received by R&D Services, Inc. on April 26, 2007 for quality control testing. Testing was completed on May 25, 2007. The test was performed in accordance with the following test method.

ASTM C1224-03, "Standard Specification for Reflective Insulation for Building Applications" - Section 9.5.2, Pliability

### Specimen Preparation:

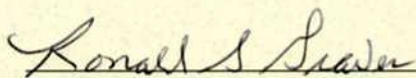
One (1) roll of Double Bubble with Foil on One Side (Tuff Stuff) was supplied to R&D Services, Inc. Two (2) sets of three (3) 3 by 6 in samples were cut from separate locations on the roll of product. One sample in each set contained a factory produced edge.

### Specimen Conditioning:

One set of specimens was conditioned at  $70^{\circ}\text{F} \pm 2^{\circ}\text{F}$  with  $50\% \pm 5\%$  relative humidity and the second set at  $32^{\circ}\text{F} \pm 2^{\circ}\text{F}$  with  $50\% \pm 5\%$  relative humidity a minimum of 24 hours prior to testing.

### Observations:

The specimens were folded in accordance with Section 9.5.2.4 and TAPPI Standard T512om-86. The Innovative Energy Insulation was observed to have no cracking or delamination when folded to an  $180^{\circ}$  bend, thus, meeting the acceptance criteria of Section 9.5.2.4.

  
Reviewed by:

06-16-07  
Date:

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The results in this report apply only to the specimen tested

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## Thermal Resistance Test Report

Date of Test: May 25, 2007

Date of Manufacture: 2007

HFM File Number: 07-7710

Specimen Number: 1021070426-12

Test Number: RD071851TR

Description of test specimen: Innovative Energy; Double Bubble with Foil on One Side-(Tuff Stuff).

Test Method: ASTM C 518-04, "Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus."

Report prepared for: Innovative Energy, Inc. / Jim Kouns

The results in this report were obtained with a heat-flow meter built and operated in accordance with ASTM C 518-04.

Heat flow meter:	<u>12 by 12</u>	inches x inches
Specimen thickness:	<u>0.314</u>	inches
Specimen density:	<u>2.55</u>	lb/ft <sup>3</sup>
Cold plate temperature:	<u>52.56</u>	deg F
Hot plate temperature:	<u>97.56</u>	deg F
Average specimen temperature:	<u>75.06</u>	deg F
Apparent thermal conductivity:	<u>0.2692</u>	Btu.in/ft <sup>2</sup> .hr.°F
Thermal resistivity ( R-per-inch):	<u>3.715</u>	ft <sup>2</sup> .hr.°F/Btu.in
Thermal resistance of specimen:	<u>1.17</u>	ft <sup>2</sup> .hr.°F/Btu

Notes: Calibration factor used for manual calculation? NA EMF NA

Edge guards or cabinet temperature satisfactory? Yes

Excessive moisture on cold plate? No

Length of time for test (hours)? 3.3

The precision of this test is estimated to be 2.5% (Section 10.3, ASTM C 518-04)

Ronald S. Swader  
Reviewed By:

06-16-07  
Date:

The results in this report apply only to the specimen tested. This test conforms to ASTM Test Method C 518-04 except for the report requirements. The report includes summary data but a full complement of data is available upon request.

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## **Compressive Strength Test Report**

Test Number: RD071848CS

Date of Test: May 20, 2007

Specimen: 1021070426-12

Date of Manufacture: 2007

Report prepared for: Innovative Energy, Inc./ Jim Kouns

Description of Material Tested: Double Bubble with foil on one side-Tuff Stuff.

### Test Method:

ASTM D 1621-00 -"Standard Test Method for Compressive Properties of Rigid Cellular Plastics", Procedure A

ASTM D 1621 results in data for the decrease in thickness of a test specimen expressed as a fraction of initial thickness. Test specimens are subjected to a downward compressive force to produce a relationship between applied force and specimen thickness. These data are used to determine the stress (force per unit area) required to reduce the specimen thickness by 10% of its initial value. Material is conditioned in the laboratory at 70 +/-4 F and 50 +/- 5% RH prior to testing. An Instron Model 4400R Universal Testing Machine is used for this test to compress up to 13% of the initial thickness.

### Test:

Number of specimens tested:	10	
Initial thickness of specimens:	0.25	inches
Area of specimens perpendicular to applied force	25	sq. in.
Cross-head speed:	0.10	in./min.

Specimen	Maximum Applied Force (lb <sub>f</sub> )	Compression at Max. Force (in.)	Applied Force @ 10% Compression	Stress @ 10% Compression lb <sub>f</sub> /in <sup>2</sup>
1	2.09	0.250	1.66	0.067
2	1.91	0.250	1.53	0.061
3	1.85	0.250	1.56	0.062
4	2.01	0.250	1.66	0.067
5	2.12	0.250	1.72	0.069
6	1.75	0.250	1.34	0.054
7	1.93	0.250	1.53	0.061
8	1.75	0.250	1.24	0.050
9	1.75	0.250	1.34	0.054
10	1.66	0.250	1.24	0.049
Average			1.48	0.059
Standard Deviation			0.18	0.007
Coefficient of Variation			12.2 %	11.9 %

The average value observed for the stress at 10% compression was 1.48 lb<sub>f</sub>/in<sup>2</sup>. Additional observation: The uncertainty in the result for stress at 10% compression is 11.9% at the 95% confidence level.

Reviewed By David W. Yankeese

Date 6/12/07

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The results in this report apply only to the specimens tested.



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## Slow Rate Penetration Resistance

Test Number: RD071849PTDate of Manufacture: 2007Specimen Number: 1021070426-12Date of Test: May 20, 2007

Description of test specimen: Double layer of polyethylene bubble-pack with aluminum foil on one face (Tuff Stuff). The thickness of the material is ¼ inch.

Report prepared for: Innovative Energy, Inc. / Jim Kouns

Test Method: ASTM F 1306 – “Standard Test Method for Slow Rate Penetration Resistance of Flexible Barrier Films and Laminates”.

ASTM F1306 uses a compression tester and a tapered fixture (probe) to determine the force required to force the 0.125-inch fixture tip through the facer. The force required for the penetration is observed to be the maximum point of increasing force as the fixture probe pushes against the surface.

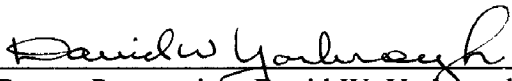
Material Tested: Two layers of polyethylene bubble-pack with aluminum foil on one face. The nominal thickness of the product is 0.25 inch. The product was identified by the name “Tuff Stuff”. The resistance to penetration was determined for the un-faced side. The penetration resistance was measured at the center of a polyethylene bubble since this appears to be the weakest point.

Test Results

Side Tested:	<u>Plastic Facer</u>
Max Force Applied (lb <sub>f</sub> )	30.55
Average of five tests	26.90
Average Displacement at Max Force (inches)	0.038
Stress at Max Force (lb <sub>f</sub> /in. <sup>2</sup> )	2300

The plastic facer was not penetrated.

The precision on the force measurement using this method for results in the range of this test sequence is 27% at the 95% confidence level.

  
Report Preparation: David W. Yarbrough, PhD, PE

6/12/07  
Date

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The results in this report apply only to the specimen tested.



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## Water Vapor Transmission Test Report

Test Number: RD071847WV

Date of Test: May 25-June 8, 2007

Specimen Number: 1021070426-12

Date of Manufacture: 2007

Report prepared for: Innovative Energy, Inc. / Jim Kouns

This report contains the results of a water vapor transmission test done in accordance with ASTM Standard Test Method E 96-05. Results were obtained using the desiccant method described in Section 11 of the Standard. The "perm" being reported was calculated using the method outlined in Section 13 of the Standard. The specimen was tested with a round pan holding the desiccant. The edges of the specimen were sealed to the top ledge of the pan with microcrystalline wax (60%) mixed with refined crystalline paraffin wax (40%).

Description of the Test Specimen: Polyethylene bubblepack with metallized facer on one side.

Manufactured By: Innovative Energy, Inc.

Test Conditions:	Temperature(°F)	73.2
	Relative Humidity (%)	49.8
	Test Duration (hr)	337

	No. 1	No.2	No.3
Test Results:	0.00462	0.00579	0.00488
Weight Gain (g)	0.1503	0.1503	0.1503
Specimen Area (ft <sup>2</sup> )	0.00141	0.00176	0.00149
Water Vapor Transmission (gr/h□ft <sup>2</sup> )	0.825	0.825	0.825
Saturation Pressure (in. Hg)	0.411	0.411	0.411
Pressure Difference (in. Hg)	0.0034	0.0043	0.0036
Permeance (perm, gr/ft <sup>2</sup> □h□(in. Hg))	n/a	n/a	n/a
Permeability (perm□in.)	yes	yes	yes
Figures showing data are attached			

Conclusion:

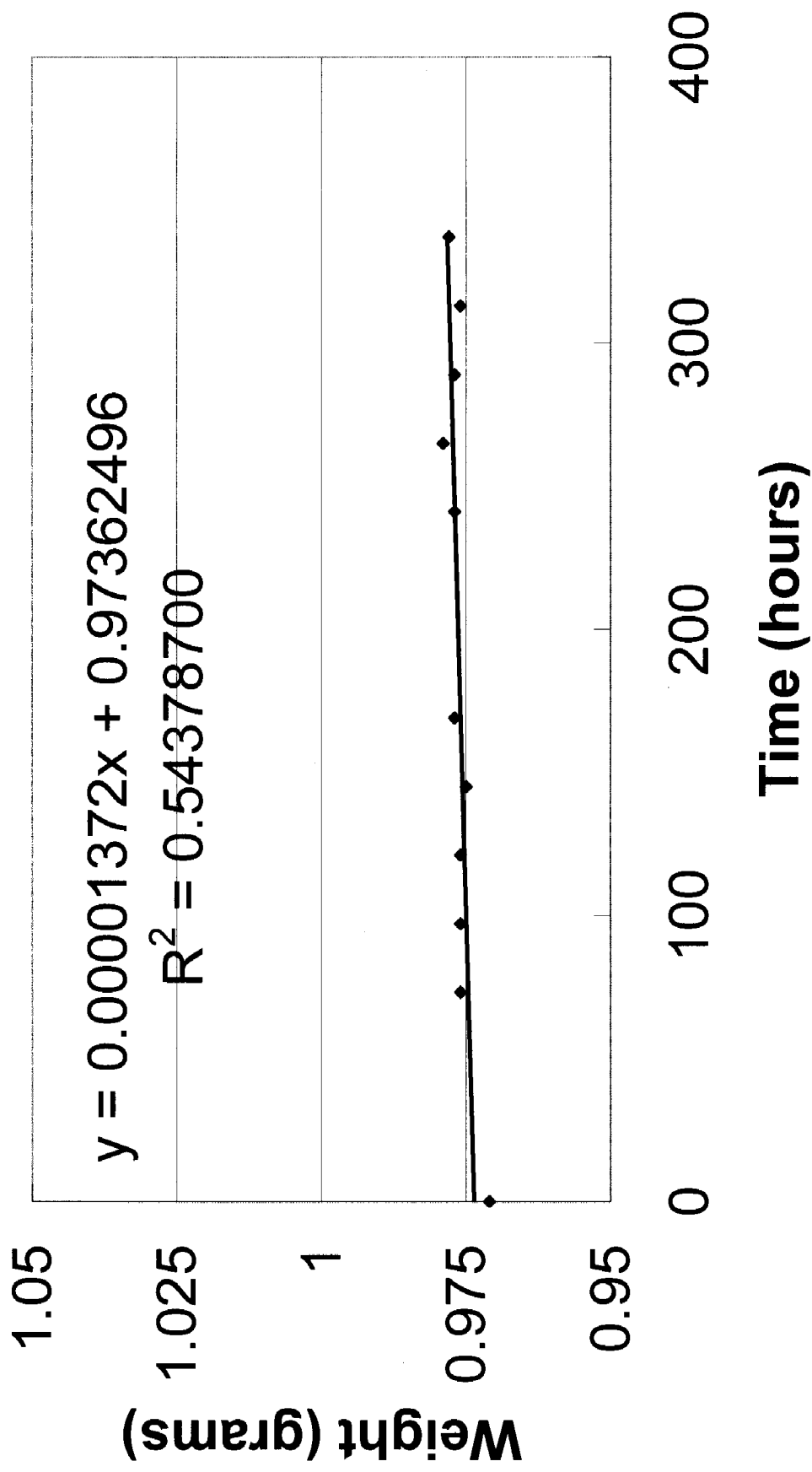
The material exhibited an average permeance of 0.004 perms under the conditions of the test.

David W. Farley  
 Reviewed By:

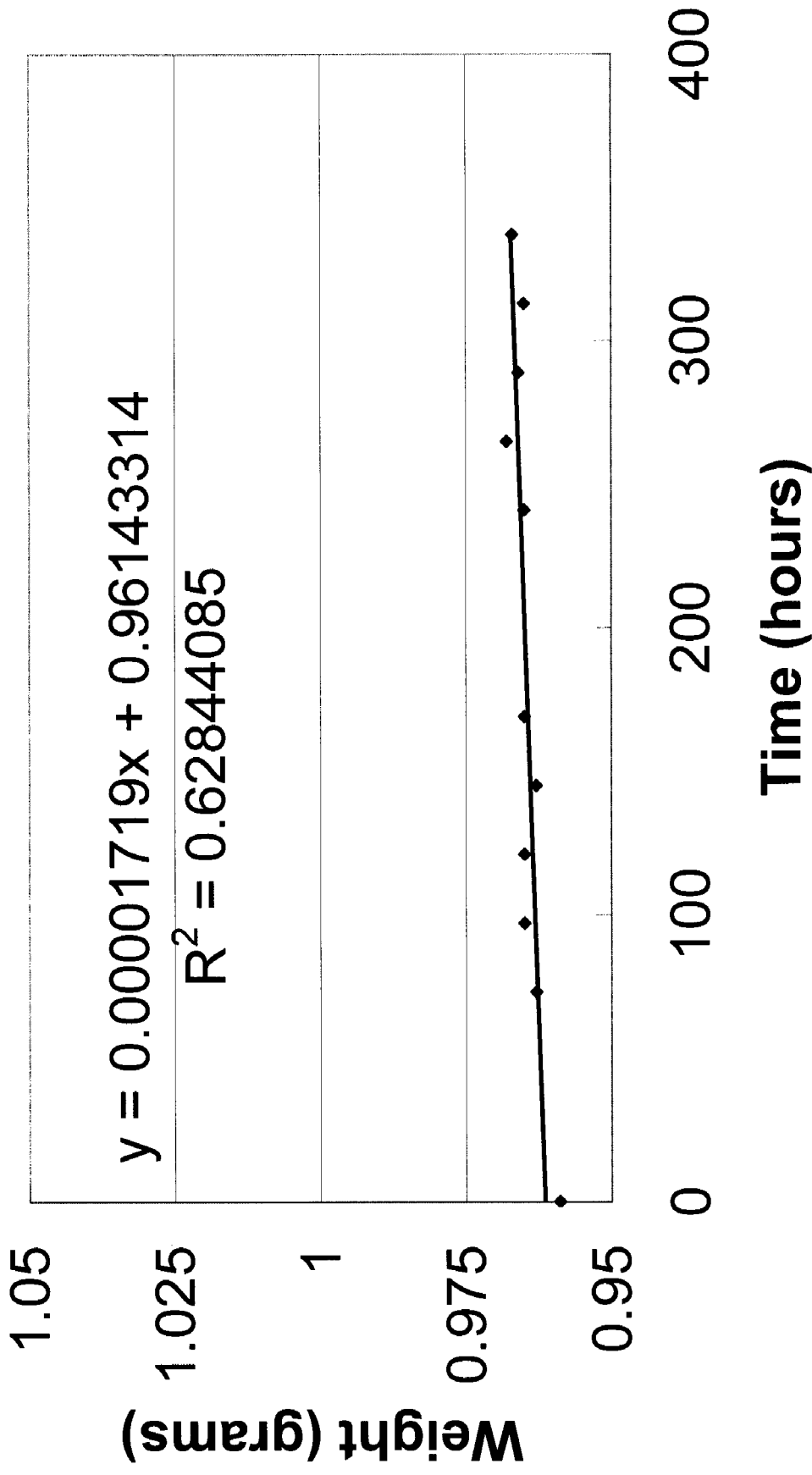
6/12/07  
 Date:

The results in this report apply only to the specimen tested.

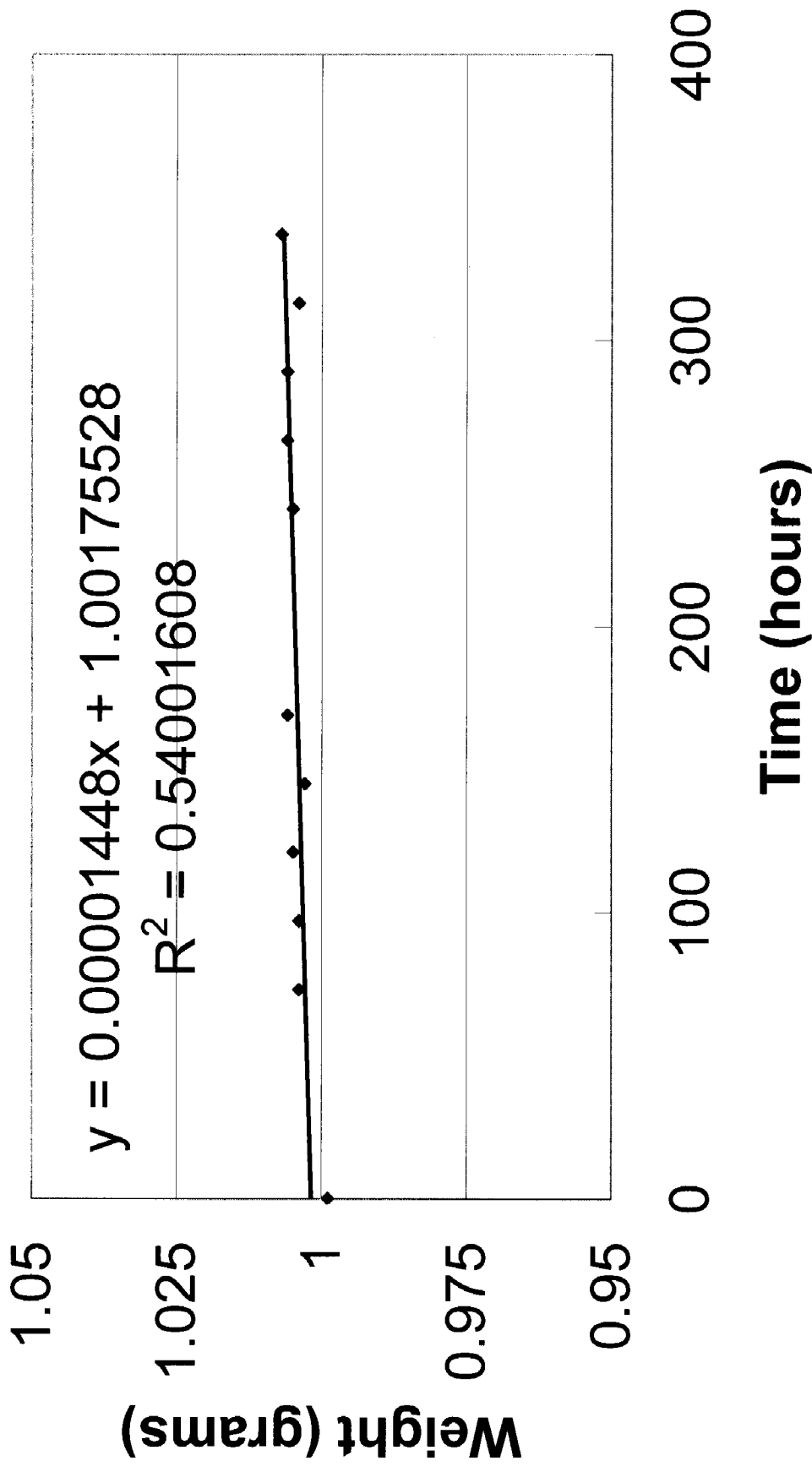
# Tuff Stuff Specimen One



# Tuff Stuff Specimen Two



# Tuff Stuff Specimen Three



## Test Report for Resistance to the Growth of Fungi

### Report Summary

Manufacturer: Innovative Energy, Inc.

Material Description: Double Bubble with Foil on One Side-Tuff Stuff (Foil Up).

ASTM Test Method: C 1338-00

Project Number: 1021

Specimen Number: 1021070426-12

Report Number: RD071888FR

Date of Report: June 21, 2007

Period of Test: May 24, 2007 – June 21, 2007

Test Result: Pass

Number of Specimens Observed: 3

Comparative Material: Southern Yellow Pine

Fungi Checked for Viability: Yes

Regular or Extended Test: Regular

### Background

The ASTM Standard Specification for many thermal insulations requires a test for the resistance of the insulation to the growth of fungi. Section 10 of C 1497, ASTM C 1338-00, Section 6.6 of ASTM C 1149, or Section 11 of ASTM C 739-05 are commonly used in the case of building materials. Evaluations for fungi growth are based on visual examinations at 40X magnification. The examinations at 40X magnification compare fungal growth on the material being evaluated with the fungal growth on an untreated comparative material that is exposed to the same environment as the test specimens. Both the material being tested and the comparative material are inoculated with a mixed spore suspension containing five specific fungal species to start the test. Since most fungi thrive in a relatively narrow range of temperature and humidity, inoculated specimens and comparative materials are maintained within temperature and relative

humidity ranges specified in the test method for the 28-day growth period. The purpose of the test is to provide an evaluation of the potential for fungal growth present in the insulation material relative to common types of wood used in building construction. The fungal species used in the tests for thermal insulation are listed below.

<i>Aspergillus niger</i>	ATCC 9642
<i>Aspergillus flavus</i>	ATCC 9643
<i>Aspergillus versicolor</i>	ATCC 11730
<i>Penicillium funiculosum</i>	ATCC 11797
<i>Chaetomium globosum</i>	ATCC 6205

A mixed spore suspension is produced from the above five species in accordance with the test method being followed. The viability of each of the five species is verified with each test as required by the test method being used. The ASTM test methods for resistance to fungal growth require a 40X visual comparison of test material and comparative materials 28 days after inoculation. The criteria for a pass/fail result at the end of the 28-day test period depends on the test method being followed.

#### Test using ASTM C 1338

Each of the replicate test specimens shall be determined to have either no fungal growth, fungal growth no greater than the comparative material, or fungal growth greater than the comparative material.

Results	<u>Specimen</u>	<u>Fungal Growth Comparison</u>
	1	<u>No growth.</u>
	2	<u>No growth.</u>
	3	<u>No growth.</u>

The pass/fail result: Pass

Basis for the pass/fail result: Three of three specimens passed.

This R&D Services, Inc. test report and the evaluation contained in the report are limited to the material tested. The extent to which the material tested is representative of the product being manufactured is the sole responsibility of the manufacturer. The test results are not purported to predict the performance of the material in a building or installation.

Karen McCully  
Evaluation

6-28-07  
Date

Ronald S. Seaman  
Review

06-28-06  
Date

References:

ASTM C 1338, "Standard test Method for Determining Fungi Resistance of Insulation Materials and Facings", 2002 Annual Book of ASTM Standards, Vol. 04.06, pp. 721-723.

ASTM C 1497, "Standard Specification for Cellulosic Fiber Stabilized Thermal Insulation", 2002 Annual Book of ASTM Standards, Vol. 04.06, pp. 849-852.

MIL-STD-810E, Method 508.4, "Fungus", 14 July 1989.

## Test Report for Resistance to the Growth of Fungi

### Report Summary

Manufacturer: Innovative Energy, Inc.

Material Description: Double Bubble with Foil on One Side-Tuff Stuff (Foil Down).

ASTM Test Method: C 1338-00

Project Number: 1021

Specimen Number: 1021070426-12

Report Number: RD071900FR

Date of Report: June 21, 2007

Period of Test: May 24, 2007 – June 21, 2007

Test Result: Pass

Number of Specimens Observed: 3

Comparative Material: Southern Yellow Pine

Fungi Checked for Viability: Yes

Regular or Extended Test: Regular

### Background

The ASTM Standard Specification for many thermal insulations requires a test for the resistance of the insulation to the growth of fungi. Section 10 of C 1497, ASTM C 1338-00, Section 6.6 of ASTM C 1149, or Section 11 of ASTM C 739-05 are commonly used in the case of building materials. Evaluations for fungi growth are based on visual examinations at 40X magnification. The examinations at 40X magnification compare fungal growth on the material being evaluated with the fungal growth on an untreated comparative material that is exposed to the same environment as the test specimens. Both the material being tested and the comparative material are inoculated with a mixed spore suspension containing five specific fungal species to start the test. Since most fungi thrive in a relatively narrow range of temperature and humidity, inoculated specimens and comparative materials are maintained within temperature and relative



humidity ranges specified in the test method for the 28-day growth period. The purpose of the test is to provide an evaluation of the potential for fungal growth present in the insulation material relative to common types of wood used in building construction. The fungal species used in the tests for thermal insulation are listed below.

<i>Aspergillus niger</i>	ATCC 9642
<i>Aspergillus flavus</i>	ATCC 9643
<i>Aspergillus versicolor</i>	ATCC 11730
<i>Penicillium funiculosum</i>	ATCC 11797
<i>Chaetomium globosum</i>	ATCC 6205

A mixed spore suspension is produced from the above five species in accordance with the test method being followed. The viability of each of the five species is verified with each test as required by the test method being used. The ASTM test methods for resistance to fungal growth require a 40X visual comparison of test material and comparative materials 28 days after inoculation. The criteria for a pass/fail result at the end of the 28-day test period depends on the test method being followed.

#### Test using ASTM C 1338

Each of the replicate test specimens shall be determined to have either no fungal growth, fungal growth no greater than the comparative material, or fungal growth greater than the comparative material.

<u>Results</u>	<u>Specimen</u>	<u>Fungal Growth Comparison</u>
	1	<u>No growth.</u>
	2	<u>No growth.</u>
	3	<u>No growth.</u>

The pass/fail result: Pass

Basis for the pass/fail result: Three of three specimens passed.

This R&D Services, Inc. test report and the evaluation contained in the report are limited to the material tested. The extent to which the material tested is representative of the product being manufactured is the sole responsibility of the manufacturer. The test results are not purported to predict the performance of the material in a building or installation.

Karen M. Culley  
Evaluation

6-28-07  
Date

Ronald S. Swain  
Review

06-28-07  
Date

#### References:

ASTM C 1338, "Standard test Method for Determining Fungi Resistance of Insulation Materials and Facings", 2002 Annual Book of ASTM Standards, Vol. 04.06, pp. 721-723.

ASTM C 1497, "Standard Specification for Cellulosic Fiber Stabilized Thermal Insulation", 2002 Annual Book of ASTM Standards, Vol. 04.06, pp. 849-852.

MIL-STD-810E, Method 508.4, "Fungus", 14 July 1989.



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Report Number 07-06117.1

R & D Services, Inc.  
Cookeville, Tennessee

Test Number 3907-8773-A  
June 7, 2007

## Tensile and Elongation

**Test Method:** The test was conducted in accordance with ASTM International Test Method D 638, *Tensile Properties of Plastics*. The test was conducted using an Instron CRE type tensile tester equipped with a 50-pound load cell and operated at an extension rate of 20 inches per minute. Type IV specimens were used for this test. The test results are presented as tensile strength in pounds per square inch, percent elongation at break, and percent ultimate elongation (the elongation at which rupture occurs in the application of continued tensile stress).

**Material Tested:** The test sample, a bubble wrap insulation product, was identified as **Tuff Stuff**.

### Test Results:

Specimen	Length Direction		
	Tensile Strength (psi)	Elongation at Break (%)	Ultimate Elongation (%)
1	197	16.7	72.2
2	169	22.2	133.3
3	165	11.1	116.7
4	160	22.2	94.4
5	154	16.7	66.7
Average	169	17.8	96.7

Width Direction		
Tensile Strength (psi)	Elongation at Break (%)	Ultimate Elongation (%)
161	22.2	377.8
182	27.8	338.9
154	22.2	127.8
160	27.8	222.2
135	22.2	222.2
158	24.4	257.8

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Report Number 07-06117.2

R & D Services, Inc.  
Cookeville, Tennessee

Test Number 3907-8773-B  
June 7, 2007

## Breaking Strength and Elongation

**Test Method:** The test was conducted in accordance with ASTM International Test Method D 751, *Standard Test Methods for Coated Fabrics*, Section 11 Breaking Strength, Procedure B — Cut Strip Test Method, using 1-inch wide strip specimens. The test was conducted using an Instron CRE type tensile tester equipped with a 50-pound load cell and operated at an extension rate of 12 inches per minute. The test results are presented as breaking strength in pounds force per inch of width, percent elongation at break, and percent ultimate elongation (the elongation at which rupture occurs in the application of continued tensile stress).

**Material Tested:** The test sample, a bubble wrap insulation product, was identified as **Tuff Stuff**.

### Test Results:

Specimen	Length Direction		
	Breaking Strength (lbf/inch)	Elongation at Break (%)	Ultimate Elongation (%)
1	22.5	16.7	93.3
2	23.2	33.3	150.0
3	23.6	30.0	113.3
4	23.1	36.7	126.7
5	23.5	30.0	163.3
<b>Average</b>	<b>23.2</b>	<b>29.3</b>	<b>129.3</b>

Width Direction		
Breaking Strength (lbf/inch)	Elongation at Break (%)	Ultimate Elongation (%)
24.0	33.3	256.7
19.8	26.7	140.0
21.1	16.7	203.3
21.8	36.7	213.3
21.7	30.0	133.3
<b>21.7</b>	<b>28.7</b>	<b>189.3</b>

Commercial Testing Company

(Authorized Signature)

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