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November 28, 2005

Owens Corning  
Richard Gebhart  
World Headquarters  
1 Owens Way  
Toledo, OH 43659

Project: 05CA45305/SV1543

Subject: Testing of 1 inch Rigid Fiberglass Ductboard and 26 Gage  
Sheet steel

Dear Mr. Gebhart,

All testing work associated with project number 05CA45305, File Number SV1543 has been completed. Please see the attached data results. The total project cost was provided to you under separate cover.

At the request of the submitter, market samples of 1 inch fiberglass ductboard were obtained by UL from R. E. Miller in Raleigh, NC. The samples bore the UL Mark. In addition, samples of 26 gage galvanized sheet steel were obtained. UL did not determine whether the duct samples were representative of other manufactured products. The test results apply only to the samples actually tested by UL.

UL tested the samples in accordance with requirements of the Flame Penetration Test in the Tenth Edition of UL181, entitled, "Factory-Made Air Ducts and Air Connectors." The objectives of this project were to 1) perform testing to validate the previous Flame Penetration test results of existing UL Listed and labeled rigid fiberglass air duct, and 2) perform testing on 26 gage galvanized sheet steel that may be used for comparison.

In no event shall UL be responsible to anyone for whatever use or nonuse is made of the information contained in this Report and in no event shall UL, its employees or its agents, incur any obligation or liability for damages, including, but not limited to, consequential damages arising out of or in connection with the use, or inability to use, the information contained in this Report.

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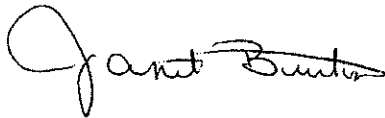
05CA45305/SV1543

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The sole purpose of this investigation was to develop information and data on rigid fiberglass air duct by means of the Flame Penetration Test of UL 181. The performed testing did validate previous Flame Penetration test results of existing UL Listed and labeled rigid fiberglass air duct. No other conclusions have been made from the data obtained. The information obtained by this investigation is to be submitted only to Authorities Having Jurisdiction in the State of Florida for their use.

Thank you for the opportunity to provide your company with these services. Please do not hesitate to contact us if you should have any questions or comments

Very truly yours,



JANET BURTON  
Engineering Project Handler  
Fire Protection - 3019AFPD  
(847) 664-3335

Reviewed by,



JAMES HATCHER  
Staff Engineer  
Fire Protection - 3019AFPD  
(847) 664-2688

Number of pages in this package 18

<b>TEST LOCATION:</b>			
<input type="checkbox"/> UL or Affiliate	<input type="checkbox"/> WTDP	<input type="checkbox"/> CTDP	<input type="checkbox"/> OTHER
Company Name			
Address			

<b>CLIENT INFORMATION</b>	
Company Name	Owens Corning
Address	World Headquarters 1 Owens Corning Way Toledo OH 43659

<b>AUDIT INFORMATION:</b>			
<input type="checkbox"/> Description of Tests	Per Standard No.	UL 181	Edition 10 <sup>th</sup>
<input type="checkbox"/> Tests Conducted by +	<u>RICK STONE</u> Printed Name		 Signature
<input type="checkbox"/> Reviewer at client facility (CTDP only)	Printed name		Signature
<input type="checkbox"/> UL Staff witnessing testing (WTDP only)	Printed name		Signature
Reviewed and accepted by Responsible Engineer	<u>Janet Burton</u> Printed Name		 Signature

<b>TESTS TO BE CONDUCTED:</b>			
Test No.	Done	Test Name	<input type="checkbox"/> Comments/Parameters <input type="checkbox"/> Tests Conducted by --+
		CONSTRUCTION DETAILS - FLEXIBLE DJCT	
		CONSTRUCTION DETAILS - RIGID DJCT	
		CONSTRUCTION DETAILS - JOINT TREATMENT	
		TEST FOR SURFACE BURNING CHARACTERISTICS	
		FLAME RESISTANCE TEST	
		BENDING TEST	
		FLAME PENETRATION TEST	
		BURNING TEST (Interior) (Exterior)	
		CORROSION RESISTANCE	
		MOLD GROWTH AND HUMIDITY TEST	
		TEMPERATURE TEST	

*Handwritten initials*

TESTS TO BE CONDUCTED:			
Test No.	Done	Test Name	[ ] Comments/Parameters [ ] Tests Conducted by ++
		PUNCTURE TEST	
		STATIC LOAD TEST (For Rigid Ducts)	
		STATIC LOAD TEST (For Flexible Ducts)	
		IMPACT TEST	
		EROSION TEST	
		PRESSURE TEST	
		COLLAPSE TEST	
		TENSION TEST	
		TORSION TEST	
		LEAKAGE TEST	

[ ] The test facility was deemed to have the environment and capabilities necessary to perform the tests included in this data package. (WDP Only)

Test Equipment- See "TEST EQUIPMENT INFORMATION"  
 Samples - See "TEST SAMPLE IDENTIFICATION"

Instructions -  
 + - When all tests are conducted by one person, printed name and signature can be inserted here instead of including printed name and signature on each page containing data. Must indicate number of pages in the data package.  
 ++ - When test conducted by more than one person, printed name and signature of person conducting the test can be inserted next to the test name instead of including printed name and signature on each page containing data. Must indicate number of pages in the data package.

Special Instructions -

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File SV1543

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Tested by: RICK STONE  
Printed Name

*[Signature]*  
Signature

Date 11/16/05

TEST EQUIPMENT INFORMATION

Inst. ID No.	Instrument Type	Test Number +, Test Title or Conditioning	Function /Range	Last Cal. Date	Next Cal. Date
TD0002		FLAME PEN	N/A	8/17/05	8/31/08
TD0022		" "	"	5/18/05	5/31/06
TS0010		" "	"	7/18/05	7/31/06
PG0224		" "	"	10/4/05	10/31/06
FM0010		" "	"	9/16/05	9/31/06
TE0050		" "	OF	11/4/04	11/30/05
WE0670		" "	N/A	2/19/03	2/28/06

+ - If Test Number is used, the Test Number must be identified on the data sheet pages or on the Data Sheet Package cover page.

The following additional information is required when using client's or rented equipment, or when a UL ID Number for an instrument number is not used. The Inst. ID No. below corresponds to the Inst. ID No. above.

Inst. ID No.	Make/Model/Serial Number/Asset No.





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RICK STONE

Printed Name

Signature

Date

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FLAME PENETRATION TEST

UL181, Ninth Edition

REQUIREMENT

Through opening, sample is to withstand the Flame Penetration Test without evidence of perforation to an extent which allows the direct passage of flame or gases, and without ignition occurring on the surface of the sample exterior to the combustion zone of the test furnace.

SAMPLE PREPARATION

1. Cut a 24-in by 24-in section of air duct by slitting the outer jacket down the length of the sample. Allow the insulation and scrim to separate at the overlaps. Cut through the length of the core, being careful to avoid tearing the film material.
2. Mark the jacket and the insulation with an arrow indicating the lengthwise direction of the sample.
3. Weigh fiberglass and determine the Weight Per Area of each sample as follows:

$$\frac{\text{weight (grams)}}{\text{area (in}^2\text{)}} \times 100 = \text{___ g/ft}^2$$

4. Mount sample in 2-ft by 2-ft frame such that the core wires run from one set of bolts to the other. The insulation, scrim, and vapor barrier should be mounted such that the directional arrow (indicating the sample length) is perpendicular to the core wires.

TEST SET-UP

A. Gas Flow

1. Pressure should be approximately 3.5 in. W.C.
2. Flow rate should be 53 ft<sup>3</sup>/hr ± 1 ft<sup>3</sup>.
3. Check flow rate by timing the revolutions of the meter. (10 revolutions = 1 ft<sup>3</sup>)

Example:

Given: 5 revolutions at 34 seconds

$$\frac{(5 \text{ rev})}{(34 \text{ sec})} \times \frac{(1 \text{ ft}^3)}{(10 \text{ rev})} \times \frac{(3600 \text{ sec})}{(1 \text{ hr})} = 52.94 \text{ ft}^3/\text{hr}$$

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To Adjust Gas Pressure: Use screwdriver to adjust gas pressure regulator. To increase flow, turn valve clockwise; to decrease flow, turn valve counter-clockwise. Check Water Column after each adjustment.

To Adjust Gas Flow: Turn the fine-tune valve using very slight adjustments. Check Water Column after each adjustment.

B. Calculate Correction Factor

This correction factor corrects the gas to 60°F and 30 in. Hg, which are Standard conditions for gas usage.

$$C = \frac{(A + G) \times 520}{30 \times (460 + T)}$$

where:

A = Barometric Pressure (as recorded from Barometer located inside test room)

G = Gas inlet Pressure (in. Hg)

(To convert from in. water, see \* below)

520 = Standard Temperature (°F)

30 = Standard Pressure (in. Hg)

460 = Absolute Temperature (°F)

T = Gas Temperature (°F; as recorded from gas in line)

$$\begin{aligned} & * \text{ Conversion of Inches H}_2\text{O to Inches Hg:} \\ & \text{in. H}_2\text{O} \times 0.07355 = \text{in Hg} \end{aligned}$$

C. Calculate BTU per Hour as follows before the end of each heating period:

$$\frac{\text{BTU}}{\text{Hr}} = \frac{N \times 3600 \times H \times C}{S}$$

where:

N = Number of cubic feet of gas measured (based upon number of revolutions)

3600 = Number of seconds in one hour

H = Gas Heating Value (BTU/ft<sup>3</sup>)

C = Correction Factor (calculated in item 4)

S = Time in seconds to obtain number of revolutions specified in "N"

Note - BTU/Hr must be between 54,000 to 55,000.

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PRE-HEAT

1. The furnace is to be fired for at least two (2) hours using natural gas.
2. A 1-inch thick, 18 lb./ft<sup>3</sup>, calcium silicate board shall be in place on the top of the furnace for the stabilization period.
3. The calcium silicate board shall contact nine (9) thermocouples in distributed grid. The thermocouple tips shall extend  $1 \pm 1/16$  inch below the bottom of the board's surface. During the pre-heat period, the temperature shall be maintained in the range of  $1425^{\circ}\text{F} \pm 70^{\circ}\text{F}$ .
4. The center, individual ring, average ring, and quadrant temperatures are to be measured by an automatic recording device every ten (1-) seconds and averaged each minute until the following conditions are met:
  - a) Furnace center temperature shall be a nominal  $1425^{\circ}\text{F} \pm 35^{\circ}\text{F}$  for fifteen (15) minutes before removal of the silicate board and placement of the sample on top of the furnace.
  - b) The average ring temperature shall be at least 90% of, but not greater than, the center temperature for fifteen (15) minutes before removal of the silicate board and placement of the sample on top of the furnace.
  - c) Individual quadrant temperatures shall be at least 90% of, but not greater than, the center temperature for fifteen (15) minutes before removal of the silicate board and placement of the sample on top of the furnace.
  - d) No individual ring temperature shall exceed  $100^{\circ}\text{F}$  ( $38^{\circ}\text{C}$ ) less than or greater than the average ring temperature.
5. Minor adjustments in the gas flow are allowed during this and subsequent stabilization period. The gas flow is not to be disturbed during the test periods.
6. For each succeeding test, the thermocouples grid board is to be replaced on the furnace until the stabilization conditions are met.

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Tested by:

**RICK STONE**

Printed Name

Signature

Date

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TEST METHOD

In Accordance with UL181, Ninth Edition

1. At the end of the stabilization period, the silicate board is to be removed and the air duct test sample is to be placed on top of the furnace within ten (10) seconds.
2. The test sample is to be subjected to a static load of 2 lb-mass per square inch (0.13 kg/cm<sup>2</sup>) over a bearing surface on the sample of 1-inch by 4-inches (25.4 mm by 102 mm), located at the geometric center and rotated to any position determined to be most critical for the penetration on the upper surface of that part of the sample exposed to the flame.
3. The static load is to be placed on the test sample three (3) to five (5) seconds after the test sample is in place.
4. The test is to be continued for a period of thirty (30) minutes. The test period is to be measured from the time the static load is applied to the test sample.

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Tested by: RICK STONE  
Print Name

R Stone  
Signature

Date 11/14/05

RESULTS

1-3/4 Hour Pre-Heat

Start Time: 10:30

Stop Time: 12:15

TEST No.: 1

1 in. thick  
UL Listed

Sample Designation OWENS CORNING / DUCT BOARD

Insulation Supplier/Designation OWENS CORN.

Weight Per Area of Insulation .705 g/ft<sup>2</sup>

Input Values	Time	Height
Gas Heating Value <u>1049.17</u> BTU/ft <sup>3</sup>	<u>0</u>	<u>18 3/4</u>
Gas Temperature <u>76.8</u> °F	<u>2:15</u>	<u>18 1/2</u>
Gas Inlet Press. <u>3.5</u> in. H <sub>2</sub> O	<u>2:30</u>	<u>18 1/4</u>
Barometric Press. <u>29.80</u> in. Hg	<u>3:00</u>	<u>18.0</u>
Measured Gas Flow <u>1</u> ft <sup>3</sup>	<u>3:30</u>	<u>17 3/4</u>
Time for 10 revolutions <u>74</u> sec	<u>4:00</u>	<u>17 1/2</u>
CALCULATED VALUES -		
Correction factor <u>0.97</u>		
BTU/Hr at start of test <u>49,538</u>		
Gas flow <u>48.65</u> ft <sup>3</sup> /hr		

Observations

Was the Weight Supported?  (Yes)  (No)  
If No, Time of Collapse \_\_\_\_\_ min. \_\_\_\_\_ sec.

Was there ignition of the exterior surface? [Yes]  (No)  
If Yes, time of ignition \_\_\_\_\_ min. \_\_\_\_\_ sec.

Was there Flame Penetration? [Yes]  (No)  
If Yes, time of penetration \_\_\_\_\_ min. \_\_\_\_\_ sec.

Additional comments regarding the activity of the samples during the test, or any unusual occurrences:

(Pass)  (Fail)

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Tested by: RICK STONE  
Printed Name

[Signature]  
Signature

Date 11/14/05

RESULTS

1-3/4 Hour Pre-Heat

Start Time: 10:30

Stop Time: 12:15

TEST No.: 2

1 in thick  
UL Listed

Sample Designation OWENS CORN./DUK BOARD

Insulation Supplier/Designation OWENS CORN.

Weight Per Area of Insulation .740 g/ft<sup>2</sup>

Input Values	Time	Height
Gas Heating Value <u>1049.17</u> BTU/ft <sup>3</sup>	<u>0</u>	<u>18 3/4</u>
Gas Temperature <u>76.8</u> °F	<u>1:30</u>	<u>18 1/2</u>
Gas Inlet Press. <u>3.5</u> in. H <sub>2</sub> O	<u>2:30</u>	<u>18 1/4</u>
Barometric Press. <u>29.80</u> in. Hg	<u>3:15</u>	<u>18.0</u>
Measured Gas Flow <u>1</u> ft <sup>3</sup>	<u>7:00</u>	<u>17 3/4</u>
Time for 10 revolutions <u>74</u> sec		
CALCULATED VALUES -		
Correction factor <u>0.97</u>		
BTU/Hr at start of test <u>49,538</u>		
Gas flow <u>48.65</u> ft <sup>3</sup> /hr		

Observations

Was the Weight Supported?  [Yes]  [No]  
If No, Time of Collapse \_\_\_\_\_ min. \_\_\_\_\_ sec.

Was there ignition of the exterior surface?  [Yes]  [No]  
If Yes, time of ignition \_\_\_\_\_ min. \_\_\_\_\_ sec.

Was there Flame Penetration?  [Yes]  [No]  
If Yes, time of penetration \_\_\_\_\_ min. \_\_\_\_\_ sec.

Additional comments regarding the activity of the samples during the test, or any unusual occurrences:

[Pass]  [Fail]

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 Tested by: RICK STONE Signature [Signature] Date 11/14/05  
 Printed Name Signature

RESULTS

1-3/4 Hour Pre-Heat

Start Time: 10:30 Stop Time: 12:15

TEST No.: 3

1 in. thick  
UL Listed

Sample Designation OWENS CORN. / DUCT BOARD

Insulation Supplier/Designation OWENS CORN.

Weight Per Area of Insulation .758 g/ft<sup>2</sup>

Input Values	Time	Height
Gas Heating Value <u>1049.17</u> BTU/ft <sup>3</sup>	<u>0</u>	<u>18 3/4</u>
Gas Temperature <u>76.8</u> °F	<u>1:10</u>	<u>18 1/2</u>
Gas Inlet Press. <u>3.5</u> in. H <sub>2</sub> O	<u>2:25</u>	<u>18 1/4</u>
Barometric Press. <u>29.80</u> in. Hg	<u>3:15</u>	<u>18.0</u>
Measured Gas Flow <u>1</u> ft <sup>3</sup>	<u>4:30</u>	<u>17 3/4</u>
Time for 10 revolutions <u>74</u> sec	<u>8:45</u>	<u>17 1/2</u>
CALCULATED VALUES -		
Correction factor <u>0.97</u>		
BTU/Hr at start of test <u>49,538</u>		
Gas flow <u>48.65</u> ft <sup>3</sup> /hr		

Observations

Was the Weight Supported?  [Yes]  [No]  
 If No, Time of Collapse \_\_\_\_\_ min. \_\_\_\_\_ sec.

Was there ignition of the exterior surface?  [Yes]  [No]  
 If Yes, time of ignition \_\_\_\_\_ min. \_\_\_\_\_ sec.

Was there Flame Penetration?  [Yes]  [No]  
 If Yes, time of penetration \_\_\_\_\_ min. \_\_\_\_\_ sec.

Additional comments regarding the activity of the samples during the test, or any unusual occurrences:

[Pass]  [Fail]

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Tested by:

RICK STONE

Printed Name

Signature

Date

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RESULTS

1-3/4 Hour Pre-Heat

Start Time: 8:30

Stop Time: 12:15

TEST No.: 1

26 gage galvanized sheet steel

Sample Designation SHEET METAL

Insulation Supplier/Designation

Weight Per Area of Insulation 1.605 Kg ~~g/ft<sup>2</sup>~~ ft<sup>2</sup>

Input Values	Time	Height
Gas Heating Value 1049.17 BTU/ft <sup>3</sup>	0	17 3/4
Gas Temperature 77.6 °F	1:00	17 1/2
Gas Inlet Press. 3.5 in. H <sub>2</sub> O		
Barometric Press. 29.83 in. Hg		
Measured Gas Flow 1 ft <sup>3</sup>		
Time for 10 revolutions 72 sec		
CALCULATED VALUES -		
Correction factor 0.97		
BTU/Hr at start of test 2,289		
Gas Flow 50.00 ft <sup>3</sup> /hr		

Observations

Was the Weight Supported?  Yes  No

If No, Time of Collapse \_\_\_\_\_ min. \_\_\_\_\_ sec.

Was there ignition of the exterior surfaces?  Yes  No

If Yes, time of ignition \_\_\_\_\_ min. \_\_\_\_\_ sec.

Was there Flame Penetration?  Yes  No

If Yes, time of penetration \_\_\_\_\_ min. \_\_\_\_\_ sec.

Additional comments regarding the activity of the samples during the test, or any unusual occurrences:

Pass  Fail

Project No. 05CA45305  
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Printed Name

File SV1543  
[Signature]  
Signature

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RESULTS

1-3/4 Hour Pre-Heat

Start Time: 8:30

Stop Time: 12:15

TEST No.: 2

26 gage galvanized sheet steel

Sample Designation SHEET METAL

Insulation Supplier/Designation \_\_\_\_\_

Weight Per Area of Insulation 1.604 Kg ft<sup>2</sup>

Input Values	Time	Height
Gas Heating Value <u>1049.17</u> BTU/ft <sup>3</sup>	<u>0</u>	<u>12 3/4</u>
Gas Temperature <u>71.6</u> °F	<u>50 SEC</u>	<u>17 1/2</u>
Gas Inlet Press. <u>3.5</u> in. H <sub>2</sub> O		
Barometric Press. <u>29.83</u> in. Hg		
Measured Gas Flow <u>1</u> ft <sup>3</sup>		
Time for 10 revolutions <u>72</u> sec		
CALCULATED VALUES -		
Correction factor <u>0.97</u>		
BTU/Hr at start of test <u>50.889</u>		
Gas flow <u>50.00</u> ft <sup>3</sup> /hr		

Observations

Was the Weight Supported?  Yes  No  
If No, Time of Collapse \_\_\_\_\_ min. \_\_\_\_\_ sec.

Was there ignition of the exterior surface?  Yes  No  
If Yes, time of ignition \_\_\_\_\_ min. \_\_\_\_\_ sec.

Was there Flame Penetration?  Yes  No  
If Yes, time of penetration \_\_\_\_\_ min. \_\_\_\_\_ sec.

Additional comments regarding the activity of the samples during the test, or any unusual occurrences:

Pass  Fail

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Tested by:

RICK STONE

*[Signature]*

Date

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Printed Name

Signature

RESULTS

1-3/4 Hour Pre-Heat

Start Time: 8:30

Stop Time: 12:15

TEST No.: 3

*26 gage galvanized sheet steel*

Sample Designation SHEET METAL

Insulation Supplier/Designation \_\_\_\_\_

Weight Per Area of Insulation 1.645 Kg *BTU<sup>2</sup>*

Input Values	Time	Height
Gas Heating Value <u>1049.17</u> BTU/ft <sup>3</sup>	<u>0</u>	<u>17 3/4</u>
Gas Temperature <u>77.6</u> °F	<u>55 SEC</u>	<u>17 1/2</u>
Gas Inlet Press. <u>3.5</u> in. H <sub>2</sub> O		
Barometric Press. <u>29.83</u> in. Hg		
Measured Gas Flow <u>1</u> ft <sup>3</sup>		
Time for 10 revolutions <u>72</u> sec		
CALCULATED VALUES -		
Correction factor <u>0.97</u> <i>0.97 notes</i>		
BTU/Hr at start of test <del>50,000</del>		
Gas flow <u>50.00</u> ft <sup>3</sup> /hr <i>50,000</i>		

Observations

Was the Weight Supported?  [Yes]  [No]

If No, Time of Collapse \_\_\_\_\_ min. \_\_\_\_\_ sec.

Was there ignition of the exterior surface?  [Yes]  [No]

If Yes, time of ignition \_\_\_\_\_ min. \_\_\_\_\_ sec.

Was there Flame Penetration?  [Yes]  [No]

If Yes, time of penetration \_\_\_\_\_ min. \_\_\_\_\_ sec.

Additional comments regarding the activity of the samples during the test, or any unusual occurrences:

[Pass]  [Fail]

RESULTS