Architectural Testing

PERFORMANCE TEST REPORT

Rendered to:

VELUX America Inc.

PRODUCT: Round Diffuser

Report No: D3964.04-106-31
Report Date: 04/11/14
Test Record Retention Date: 03/26/18

130 Derry Court
York, PA 17406-8405
phone: 717-764-7700
fax: 717-764-4129
www.archtest.com

Architectural Testing

PERFORMANCE TEST REPORT

Rendered to:

VELUX America Inc.
P.O. Box 5001
1418 Evans Pond Road
Greenwood, South Carolina 29648-5001

Report No:	D3964.04-106-31
Test Dates:	03/01/14
Through:	03/26/14
Report Date:	04/11/14
Test Record Retention Date:	03/14/18

Product: Round Diffuser

Project Summary: Architectural Testing, Inc. was contracted by VELUX America, Inc. to perform testing on the round diffuser used for their SUN TUNNEL tubular daylighting devices (TDD). The samples tested successfully met the performance requirements listed in the referenced specifications. Test specimens description and results are reported herein.

Test Methods: The test specimens were evaluated in accordance with the following methods.

ASTM D 1929-01, *Standard Test Method for Determining Ignition Temperature of Plastics.*

ASTM D 2843-04, *Standard Test Method for Density of Smoke from the Burning or Decomposition of Plastics.*

ASTM D 635-06, *Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position.*

IBC 2606.7.2, *Light Diffusing Systems, Installation*.

Test Procedures and Test Results: Testing procedures and the results obtained from testing are reported as follows. All conditioning of test specimens and test conditions were at standard laboratory conditions.

IBC 2606.7.2, Light Diffusing Systems
Temperature Exposure Test

The round diffuser was mounted into a box consisting of fire rated drywall and 2 x 4's and placed over a hot plate to achieve a temperature at which the square diffuser would fall from the mountings before igniting.

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Test Results: (Continued)

The specimen remained in place for fifteen minutes at an ambient room temperature of 79 ºC. The round diffuser fell from the mountings at 105 ºC. This temperature is more than 111 ºC below the ignition test results for the same material presented below. (See attached photographs of pre- and post-testing.)

ASTM D 1929 - Self-Ignition and Flash Ignition

Self-ignition temperature is the minimum temperature at which the self-heating properties of the specimen lead to ignition or ignition occurs of itself, under test conditions, in the absence of any additional flame ignition source. Flash ignition temperature is the minimum temperature at which, under specified test conditions, sufficient flammable gases are emitted to ignite momentarily upon application of a small external pilot flame. These temperatures were determined by observing the test specimen at a known temperature utilizing a self-ignition furnace (ICN 62156).

Caveat: *These test results relate only to the behavior of test specimens under the particular conditions of the test. They are not intended to be used, and shall not be used, to assess the potential fire hazards of a material in use.*

Self-Ignition

Specimen	Initial Mass (g)	Final Mass (g)	Mass Loss (g)	Initial Temperature (ºC)			Final Temperature (ºC)		
				Air	Furnace	Sample	Air	Furnace	Sample
1	3.1072	0	3.1072	400	427	416	402	427	417
2	3.1975	0	3.1975	440	467	457	448	467	466
3	3.1870	0	3.1870	480	506	492	482	506	493
4	3.1785	0	3.1785	460	488	472	473	492	477
5	3.0076	0	3.0076	450	477	463	459	478	463

Specimen	Ignition (min:sec)	Combustion Type	Observations (min:sec)					
			Char	Melt	Bubble	Foam	Smoke	Soot
1	-	-	-	0:11	0:35	-	3:00	-
2	-	-	-	0:18	0:30	-	1:17	-
3	1:24	Flame	-	0:10	0:25	-	1:24	3:37
4	2:33	Flame	-	0:19	0:30	-	2:02	-
5	2:17	Flame	-	0:13	0:26	-	1:53	-

Self-Ignition Temperature: **450ºC**

Test Results: (Continued)

Flash Ignition

Specimen	Initial Mass (g)	Final Mass (g)	Mass Loss (g)	Initial Temperature (ºC)			Final Temperature (ºC)		
				Air	Furnace	Sample	Air	Furnace	Sample
1	3.1108	0	3.1108	400	412	410	433	422	429
2	2.9821	0.0482	2.9339	360	369	367	386	377	382
3	3.1541	2.4684	0.6857	340	348	345	340	348	345
4	3.1911	2.1969	0.9942	350	358	356	347	357	354

Specimen	Ignition (min:sec)	Combustion Type	Observations (min:sec)					
			Char	Melt	Bubble	Foam	Smoke	Soot
1	0:15	Flame	-	0:15	1:07	-	3:15	4:30
2	0:25	Flame	-	0:25	1:10	-	6:51	-
3	0:50	-	-	0:50	3:41	-	-	-
4	0:30	-	-	0:30	2:05	-	-	-

Flash Ignition Temperature: **360 ºC**

ASTM D 2843 - Smoke Density

A test specimen was exposed to a flame inside a Smoke Chamber (ICN 004388). Due to the dripping of the test specimen, a second flame was introduced into the chamber to keep the entire test specimen exposed to a flame for the duration of the test. The horizontal light absorption was measured across the light beam path of a photoelectric cell, and the condition of the smoke chamber was observed. The Light Absorption Curves are presented in Appendix A.

Caveat: *This standard is used to measure and describe the response of materials, products, or assemblies to heat and flame under controlled conditions, but does not by itself incorporate all factors required for fire-hazard or fire risk assessment of the materials, products, or assemblies under actual fire conditions.*

Smoke Density

Specimen	Width (in)	Length (in)	Thickness (in)	Maximum Smoke Density (%)	Smoke Density Rating
1	1.084	1.090	0.243	46.4	7.3
2	1.086	1.024	0.246	29.8	13.3
3	1.089	1.009	0.243	51.8	21.4

Average Smoke Density Rating: **13.5**

Note: *During all smoke density tests, the letters on the exit sign were visible and readable through the smoke. The test specimens melted, flamed, and extinguished during the test.*

Test Results: (Continued)

ASTM D 635 - Rate of Burn

Thicker and thinner materials were tested from the round diffuser. The test specimens were supported horizontally at one end and the free end exposed to a gas flame from a laboratory burner (ICN Y002875) for 30 seconds. After removal of the flame, the test specimen was observed for time and extent of burning.

Caveat: *This standard is used to measure and describe the response of materials, products, or assemblies to heat and flame under controlled conditions but does not by itself incorporate all factors required for fire hazards or fire risk assessment of materials, products, or assemblies under actual fire conditions.*

Rate of Burn
Thicker Material

Specimen	Initial Burn	Sustained Burn Beyond 30 sec or 25 mm	Length Burned, L (mm)	Time, t (sec)	Linear Burn Rate, V (mm/min)	Comments
1	Y	Y	75	152	29.6	Melting, bubbling, flaming drips that could be helping to fuel the burn, charring
2	Y	Y	75	134	33.6	
3	Y	Y	75	150	30.0	

Average Linear Burning Rate, V = 60L/t = 31.1 mm/min

Rate of Burn
Thinner Material

Specimen	Initial Burn	Sustained Burn Beyond 30 sec or 25 mm	Length Burned, L (mm)	Time, t (sec)	Linear Burn Rate, V (mm/min)	Comments
1	Y	Y	75	105	42.9	Melting, bubbling, flaming drips that could be helping to fuel the burn, charring
2	Y	Y	75	109	41.3	
3	Y	Y	75	99	45.5	

Average Linear Burning Rate, V = 60L/t = 43.2 mm/min

Test Results: (Continued)

ASTM D 635 - Rate of Burn
(Continued)

Thicker Material

Note: *31.1 mm/min linear burning rate corresponds to a Class CC2 product. The test specimens were an average of .5" (nominal x 12.7 mm) long by .5" (nominal x 12.7 mm) wide by .117" (nominal x 2.97 mm) thick.*

Thinner Material

Note: *43.2 mm/min linear burning rate corresponds to a Class CC2 product. The test specimens were an average of 5" (nominal x 127 mm) long by .5" (nominal x 12.7mm) wide by .062" (nominal x 1.57mm) thick.*

Architectural Testing will service this report for the entire test record retention period. Test records that are retained such as detailed drawings, datasheets, representative samples of test specimens, or other pertinent project documentation will be retained by Architectural Testing, Inc. for the entire test record retention period.

Results obtained are tested values and were secured using the designated test methods. This report does not constitute certification of this product nor an opinion or endorsement by this laboratory. It is the exclusive property of the client so named herein and relates only to the specimen(s) tested. This report may not be reproduced, except in full, without the written approval of Architectural Testing, Inc.

For ARCHITECTURAL TESTING, INC.:

Digitally Signed by: Rodney E. Holland

Rodney E. Holland - Technician I
Components / Materials Testing

Digitally Signed by: Gary Hartman

Gary Hartman, P.E. - Director
Components / Materials Testing

REH:reh/nlh

Attachments (pages) This report is complete only when all attachments listed are included.
Appendix A - Photographs (1)
Appendix B - Light Absorption Curves (4)

Revision Log

Rev. #	Date	Page(s)	Revision(s)
0	04/11/14	N/A	Original report issue.

APPENDIX A

Photographs

Photo No. 1
Pretest - Round Diffuser

Photo No. 2
Post-test - Round Diffuser

APPENDIX B

Light Absorption Curves

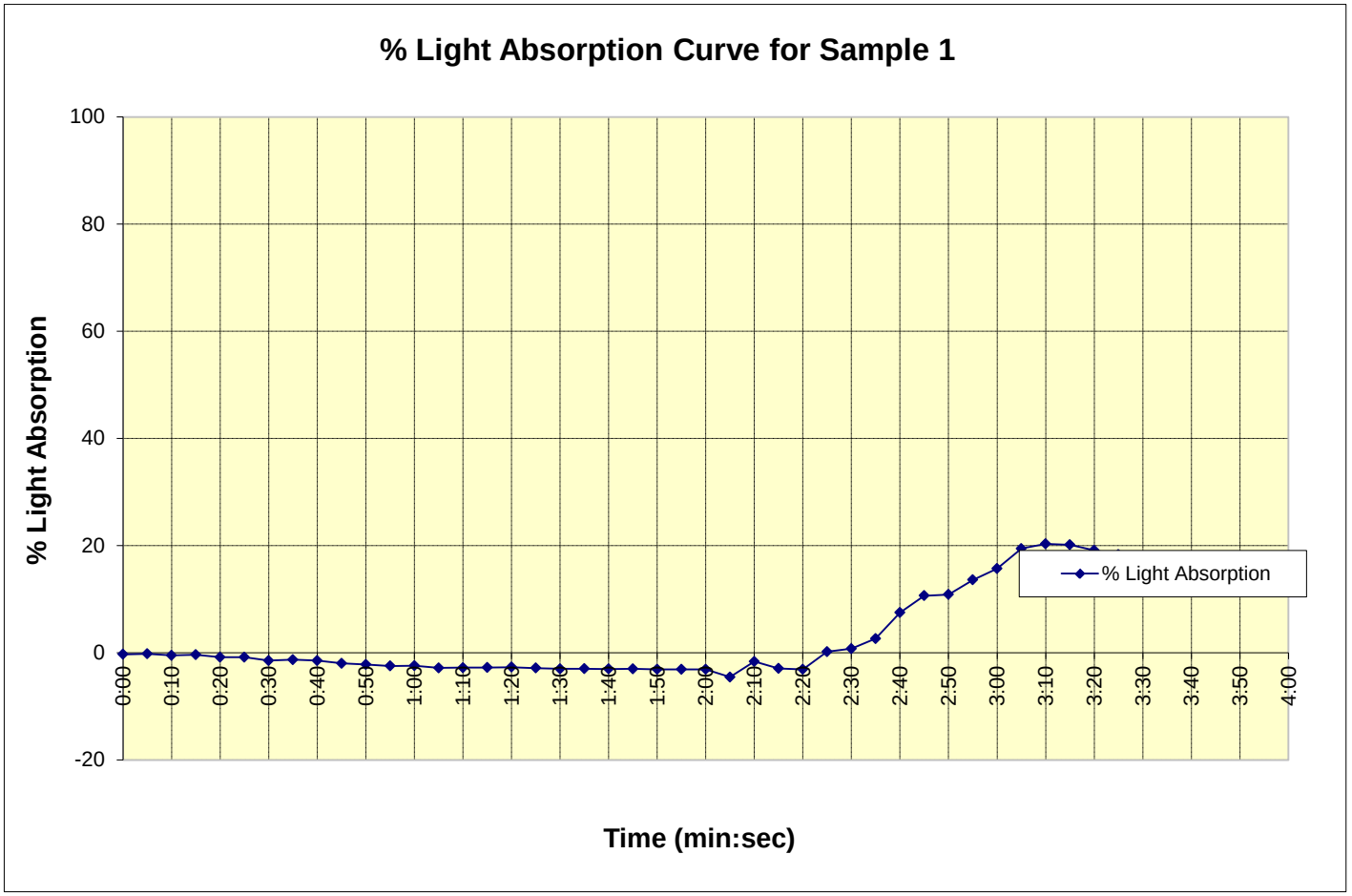
Smoke Density Testing per ASTM D 2843

Exit Sign Chamber

ATI No.: D3964.04-106-31
Test Date: 3/1/2014
Technician: DMC

Time (min:sec)	% Light	% Light Absorption
0:00	100.27	-0.27
0:05	100.15	-0.15
0:10	100.49	-0.49
0:15	100.35	-0.35
0:20	100.80	-0.80
0:25	100.83	-0.83
0:30	101.44	-1.44
0:35	101.27	-1.27
0:40	101.46	-1.46
0:45	101.96	-1.96
0:50	102.18	-2.18
0:55	102.43	-2.43
1:00	102.39	-2.39
1:05	102.82	-2.82
1:10	102.77	-2.77
1:15	102.74	-2.74
1:20	102.67	-2.67
1:25	102.83	-2.83
1:30	103.00	-3.00
1:35	102.97	-2.97
1:40	103.01	-3.01
1:45	102.99	-2.99
1:50	103.06	-3.06
1:55	103.09	-3.09
2:00	103.07	-3.07
2:05	104.52	-4.52
2:10	101.61	-1.61
2:15	102.90	-2.90
2:20	103.06	-3.06
2:25	99.78	0.22
2:30	99.23	0.77
2:35	97.34	2.66
2:40	92.48	7.52
2:45	89.33	10.67
2:50	89.10	10.90
2:55	86.38	13.62
3:00	84.26	15.74
3:05	80.55	19.45
3:10	79.68	20.32
3:15	79.82	20.18
3:20	80.86	19.14
3:25	81.66	18.34
3:30	82.43	17.57
3:35	83.66	16.34
3:40	84.10	15.90
3:45	84.52	15.48
3:50	85.31	14.69
3:55	86.13	13.87
4:00	86.44	13.56

Sample #	Manufacturer	Product Name	Material Type	Width (in)	Length (in)	Thickness (in)
1	Velux America Inc.	Round Diffuser	Plastic	1.080	1.015	0.243



Calibration	Resistance (kΩ)
100% Light	3.162

Plot Area	240	Maximum Smoke Density	46.42 %
Area Under Curve	17.5	**Smoke Density Rating***	**7.3**

* Note: Miami-Dade County requires the Smoke Density Rating to be less than 75.

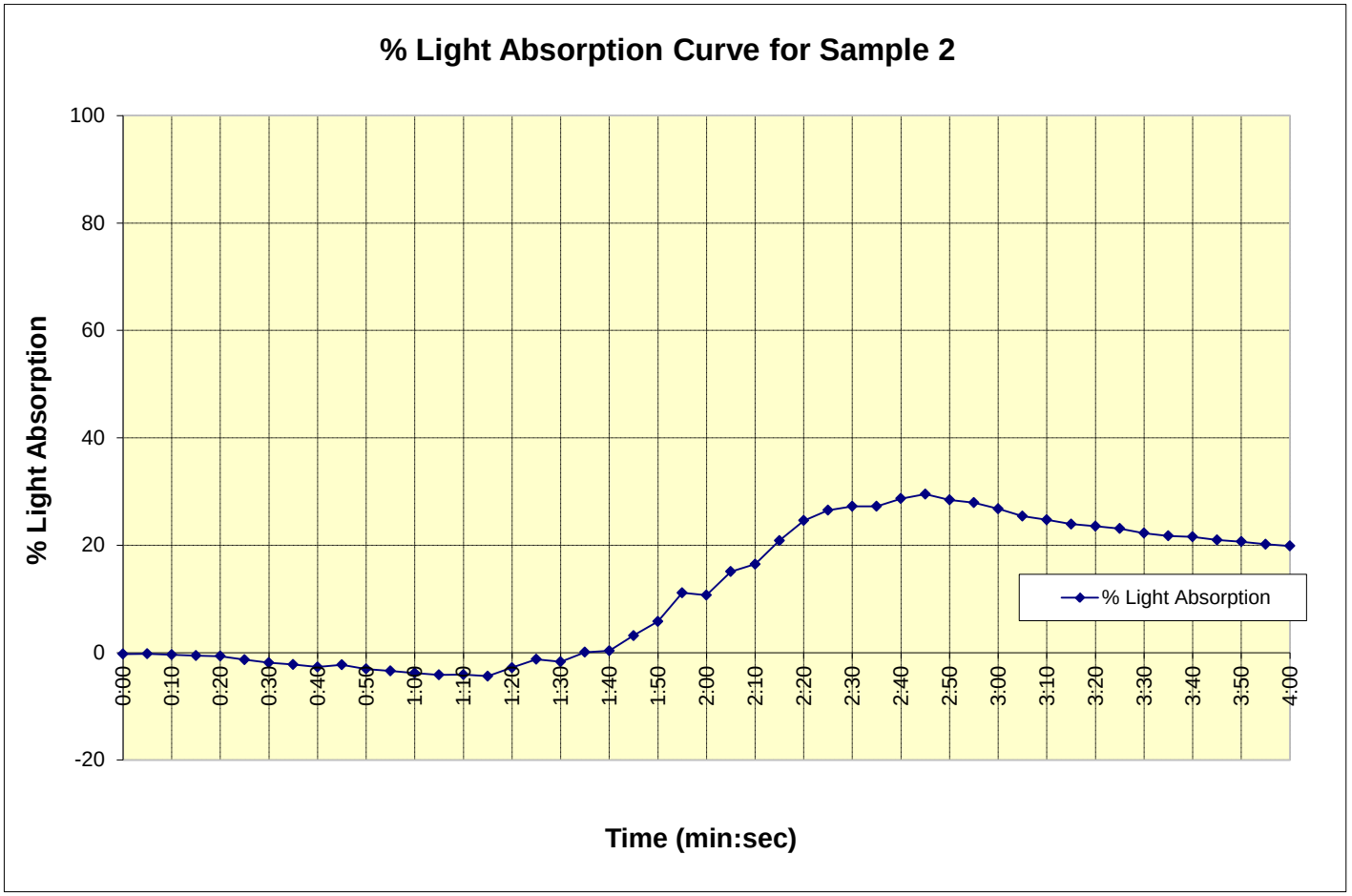
Smoke Density Testing per ASTM D 2843

Exit Sign Chamber

ATI No.: D3964.04-106-31
Test Date: 3/1/2014
Technician: DMC

Time (min:sec)	% Light	% Light Absorption
0:00	100.26	-0.26
0:05	100.20	-0.20
0:10	100.40	-0.40
0:15	100.56	-0.56
0:20	100.66	-0.66
0:25	101.33	-1.33
0:30	101.88	-1.88
0:35	102.24	-2.24
0:40	102.69	-2.69
0:45	102.27	-2.27
0:50	103.05	-3.05
0:55	103.43	-3.43
1:00	103.82	-3.82
1:05	104.16	-4.16
1:10	104.08	-4.08
1:15	104.39	-4.39
1:20	102.81	-2.81
1:25	101.24	-1.24
1:30	101.71	-1.71
1:35	99.92	0.08
1:40	99.65	0.35
1:45	96.83	3.17
1:50	94.19	5.81
1:55	88.86	11.14
2:00	89.32	10.68
2:05	84.91	15.09
2:10	83.53	16.47
2:15	79.15	20.85
2:20	75.41	24.59
2:25	73.47	26.53
2:30	72.75	27.25
2:35	72.75	27.25
2:40	71.31	28.69
2:45	70.48	29.52
2:50	71.54	28.46
2:55	72.08	27.92
3:00	73.21	26.79
3:05	74.59	25.41
3:10	75.25	24.75
3:15	76.06	23.94
3:20	76.46	23.54
3:25	76.91	23.09
3:30	77.76	22.24
3:35	78.25	21.75
3:40	78.43	21.57
3:45	79.02	20.98
3:50	79.34	20.66
3:55	79.83	20.17
4:00	80.14	19.86

Sample #	Manufacturer	Product Name	Material Type	Width (in)	Length (in)	Thickness (in)
2	Velux America Inc.	Round Diffuser	Plastic	1.086	1.024	0.246



Calibration	Resistance (kΩ)
100% Light	3.076

Plot Area	240	Maximum Smoke Density	29.87 %
Area Under Curve	31.9	**Smoke Density Rating***	**13.3**

* Note: Miami-Dade County requires the Smoke Density Rating to be less than 75.

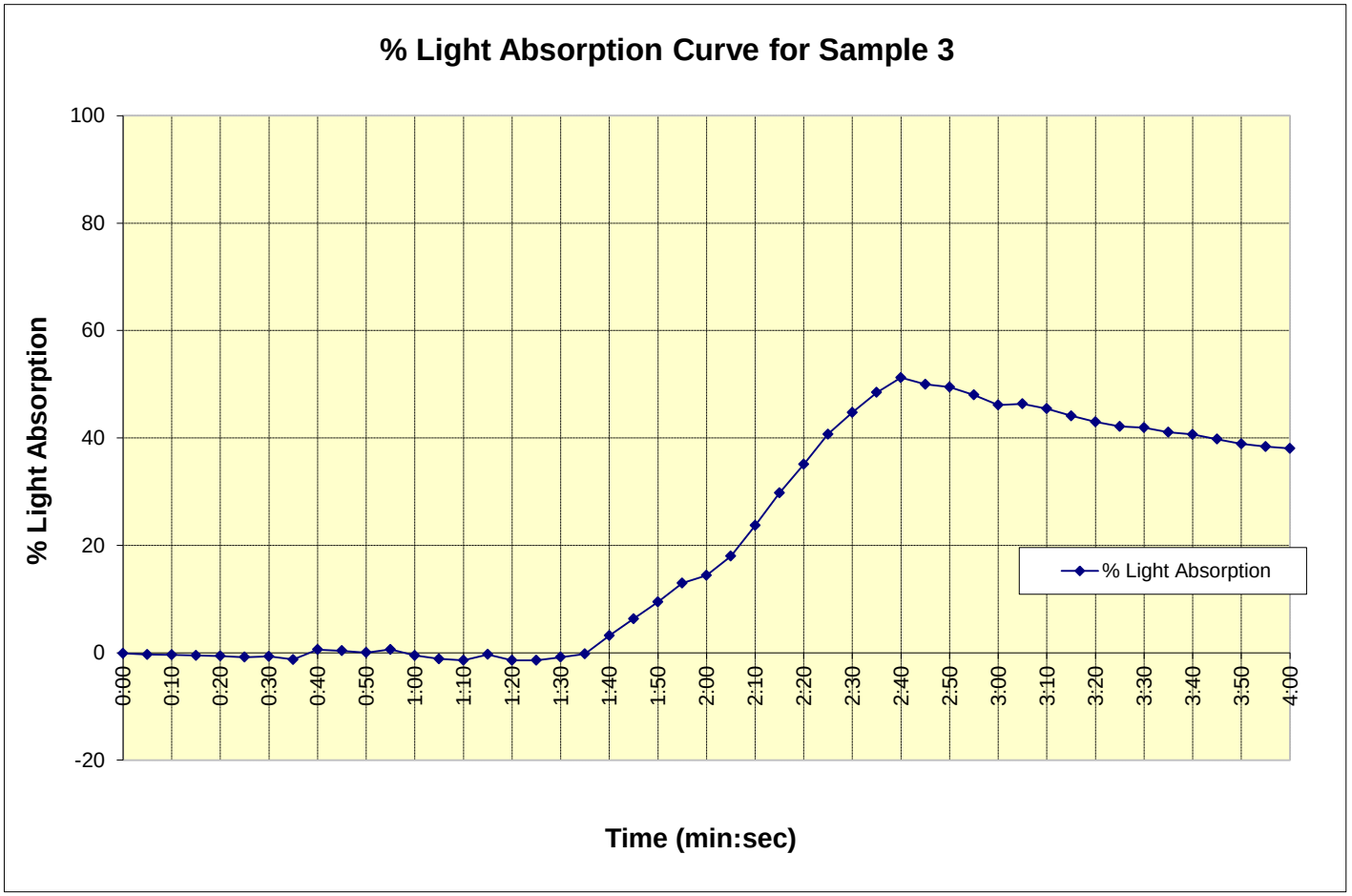
Smoke Density Testing per ASTM D 2843

Exit Sign Chamber

ATI No.: D3964.04-106-31
Test Date: 3/1/2014
Technician: DMC

Time (min:sec)	% Light	% Light Absorption
0:00	100.14	-0.14
0:05	100.35	-0.35
0:10	100.39	-0.39
0:15	100.52	-0.52
0:20	100.59	-0.59
0:25	100.83	-0.83
0:30	100.70	-0.70
0:35	101.27	-1.27
0:40	99.41	0.59
0:45	99.63	0.37
0:50	99.97	0.03
0:55	99.39	0.61
1:00	100.50	-0.50
1:05	101.14	-1.14
1:10	101.40	-1.40
1:15	100.32	-0.32
1:20	101.39	-1.39
1:25	101.41	-1.41
1:30	100.83	-0.83
1:35	100.20	-0.20
1:40	96.79	3.21
1:45	93.69	6.31
1:50	90.54	9.46
1:55	87.05	12.95
2:00	85.61	14.39
2:05	82.03	17.97
2:10	76.28	23.72
2:15	70.24	29.76
2:20	64.91	35.09
2:25	59.31	40.69
2:30	55.25	44.75
2:35	51.53	48.47
2:40	48.78	51.22
2:45	50.04	49.96
2:50	50.54	49.46
2:55	52.00	48.00
3:00	53.87	46.13
3:05	53.65	46.35
3:10	54.56	45.44
3:15	55.89	44.11
3:20	57.04	42.96
3:25	57.89	42.11
3:30	58.09	41.91
3:35	58.92	41.08
3:40	59.37	40.63
3:45	60.23	39.77
3:50	61.11	38.89
3:55	61.62	38.38
4:00	61.96	38.04

Sample #	Manufacturer	Product Name	Material Type	Width (in)	Length (in)	Thickness (in)
3	Velux America Inc.	Round Diffuser	Plastic	1.089	1.009	0.243



Calibration	Resistance (kΩ)
100% Light	2.643

Plot Area	240	Maximum Smoke Density	51.82 %
Area Under Curve	51.3	**Smoke Density Rating***	**21.4**

* Note: Miami-Dade County requires the Smoke Density Rating to be less than 75.

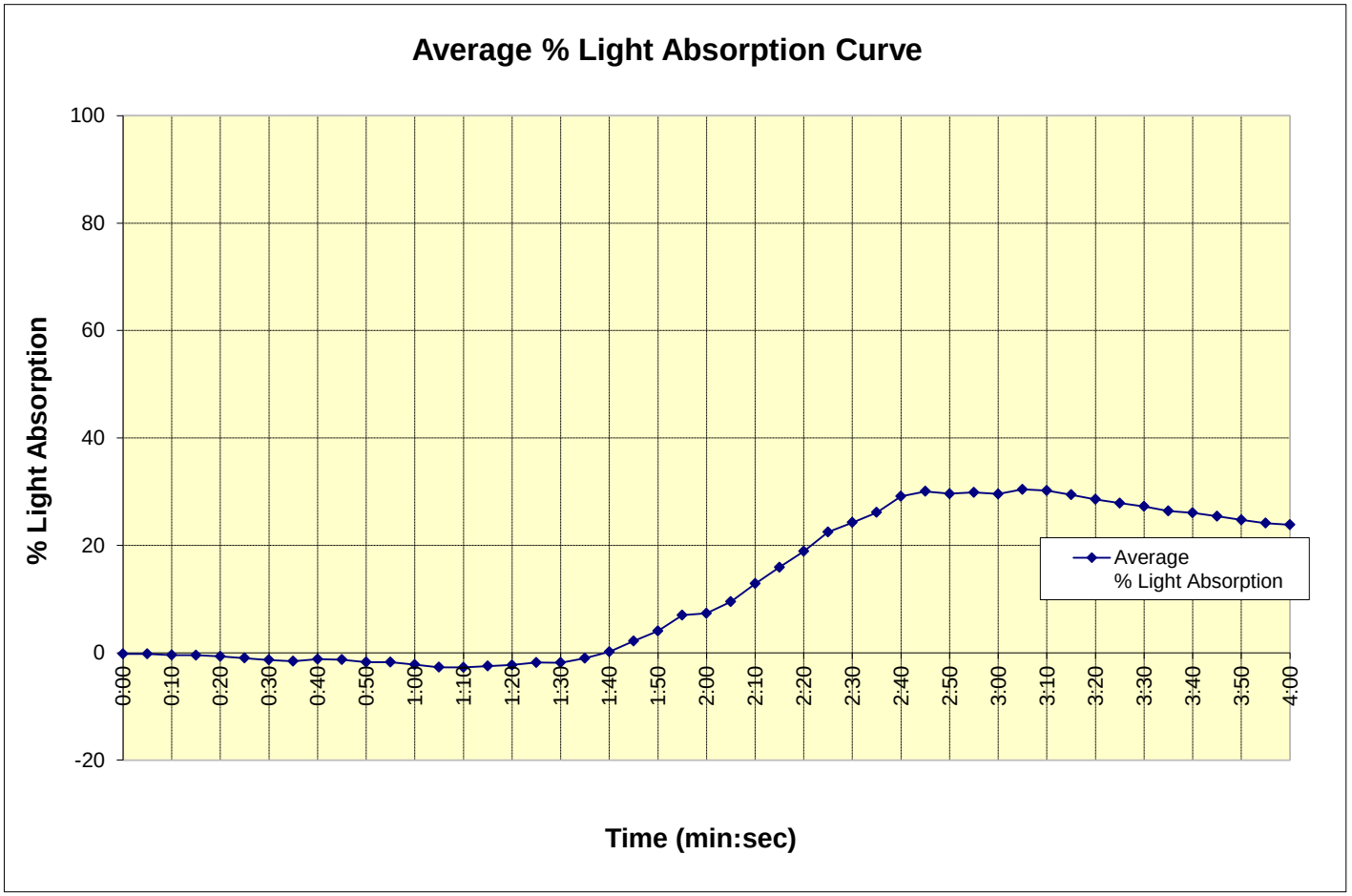
Smoke Density Testing per ASTM D 2843

Exit Sign Chamber

ATI No.: D3964.04-106-31
Test Date: 3/1/2014
Technician: DMC

Time (min:sec)	Average % Light Absorption
0:00	-0.22
0:05	-0.24
0:10	-0.42
0:15	-0.48
0:20	-0.68
0:25	-1.00
0:30	-1.34
0:35	-1.59
0:40	-1.19
0:45	-1.29
0:50	-1.73
0:55	-1.75
1:00	-2.23
1:05	-2.71
1:10	-2.75
1:15	-2.48
1:20	-2.29
1:25	-1.83
1:30	-1.85
1:35	-1.03
1:40	0.18
1:45	2.16
1:50	4.07
1:55	7.00
2:00	7.33
2:05	9.51
2:10	12.86
2:15	15.90
2:20	18.87
2:25	22.48
2:30	24.25
2:35	26.13
2:40	29.14
2:45	30.05
2:50	29.60
2:55	29.85
3:00	29.55
3:05	30.41
3:10	30.17
3:15	29.41
3:20	28.55
3:25	27.85
3:30	27.24
3:35	26.39
3:40	26.03
3:45	25.41
3:50	24.75
3:55	24.14
4:00	23.82

Sample #	Manufacturer	Product Name	Material Type	Width (in)	Length (in)	Thickness (in)
AVERAGE	Velux America Inc.	Round Diffuser	Plastic	1.085	1.016	0.244



Calibration	Resistance (kΩ)
100% Light	3.162

Plot Area	240	Maximum Smoke Density	30.75 %
Area Under Curve	32.5	**Smoke Density Rating***	**13.5**

* Note: Miami-Dade County requires the Smoke Density Rating to be less than 75.