Architectural Testing

PERFORMANCE TEST REPORT

Rendered to:

VELUX America Inc.

PRODUCT: Polypropylene Supports

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

130 Derry Court
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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:	D3964.03-106-31
Test Dates:	03/01/14
Through:	03/14/14
Report Date:	04/11/14
Test Record Retention Date:	03/14/18

Product: Polypropylene Supports

Project Summary: Architectural Testing, Inc. was contracted by VELUX America Inc. to perform testing on the polypropylene supports 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.*

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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.

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). The reported self-ignition temperature of 380 ºC (716 ºF) exceeds the IBC Section 2606.4 requirement of 650ºF minimum.

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	3.0632	0	3.0632	400	427	414	404	428	417
2	3.1356	2.1399	0.9957	360	386	373	369	385	400
3	3.1555	0	3.1555	380	406	394	392	405	416
4	3.1020	2.1536	0.9484	370	394	382	376	394	406

Specimen	Ignition (min:sec)	Combustion Type	Observations (min:sec)					
			Char	Melt	Bubble	Foam	Smoke	Soot
1	4:20	Flame	-	0:10	1:15	-	1:06	5:19
2	-	-	-	0:45	4:00	-	2:15	-
3	8:40	Flame	-	0:26	3:27	-	1:43	9:16
4	-	-	-	0:15	0:47	-	1:49	-

Self-Ignition Temperature: **380ºC**

Test Results: (Continued)

ASTM D 1929 - Self-Ignition and Flash Ignition

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	3.1276	0.0289	3.0987	360	368	366	364	367	371
2	3.0661	0.0351	3.0310	340	348	344	351	347	358
3	3.0813	2.7530	0.3283	330	335	335	336	338	370

Specimen	Ignition (min:sec)	Combustion Type	Observations (min:sec)					
			Char	Melt	Bubble	Foam	Smoke	Soot
1	7:12	Flame	-	0:40	3:36	-	2:48	9:23
2	9:32	Flame	-	0:33	5:13	-	4:00	12:25
3	-	-	-	1:12	5:41	-	-	-

Flash Ignition Temperature: **340ºC**

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	0.983	1.017	0.157	49.9	20.1
2	1.024	1.008	0.157	31.5	14.7
3	1.022	1.022	0.156	59.0	28.3

Average Smoke Density Rating: **20.9**

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

The test specimen was 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

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	183	75	24.6	Melts, flaming drips, that may be helping to fuel the burn.
2	Y	Y	135	75	33.3	
3	Y	Y	145	75	31.0	

Average Linear Burning Rate, V = 60L/t = 29.6 mm/min

Note: *29.6 mm/min linear burning rate corresponds to a Class CC2 product. The test specimens were an average of 5" (nominal 127 mm) long by 0.5" (nominal 13 mm) wide by 0.115" (nominal 2.92 mm) 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 specimens tested. This report may not be reproduced, except in full, without the written approval of Architectural Testing, Inc.

For ARCHITECTURAL TESTING, INC.:

Rodney E. Holland - Technician I
Components / Materials Testing

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 - Photograph (1)
Appendix B - Drawing (1)
Appendix C - Light Absorption Curves (4)

Revision Log

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

APPENDIX A

Photograph

Photo No. 1
Thick material (top specimen)
Thin material (bottom specimen)
Polypropylene Support-Test materials for:
ASTM D 1929-01
ASTM D 2843-04
ASTM D 635-06

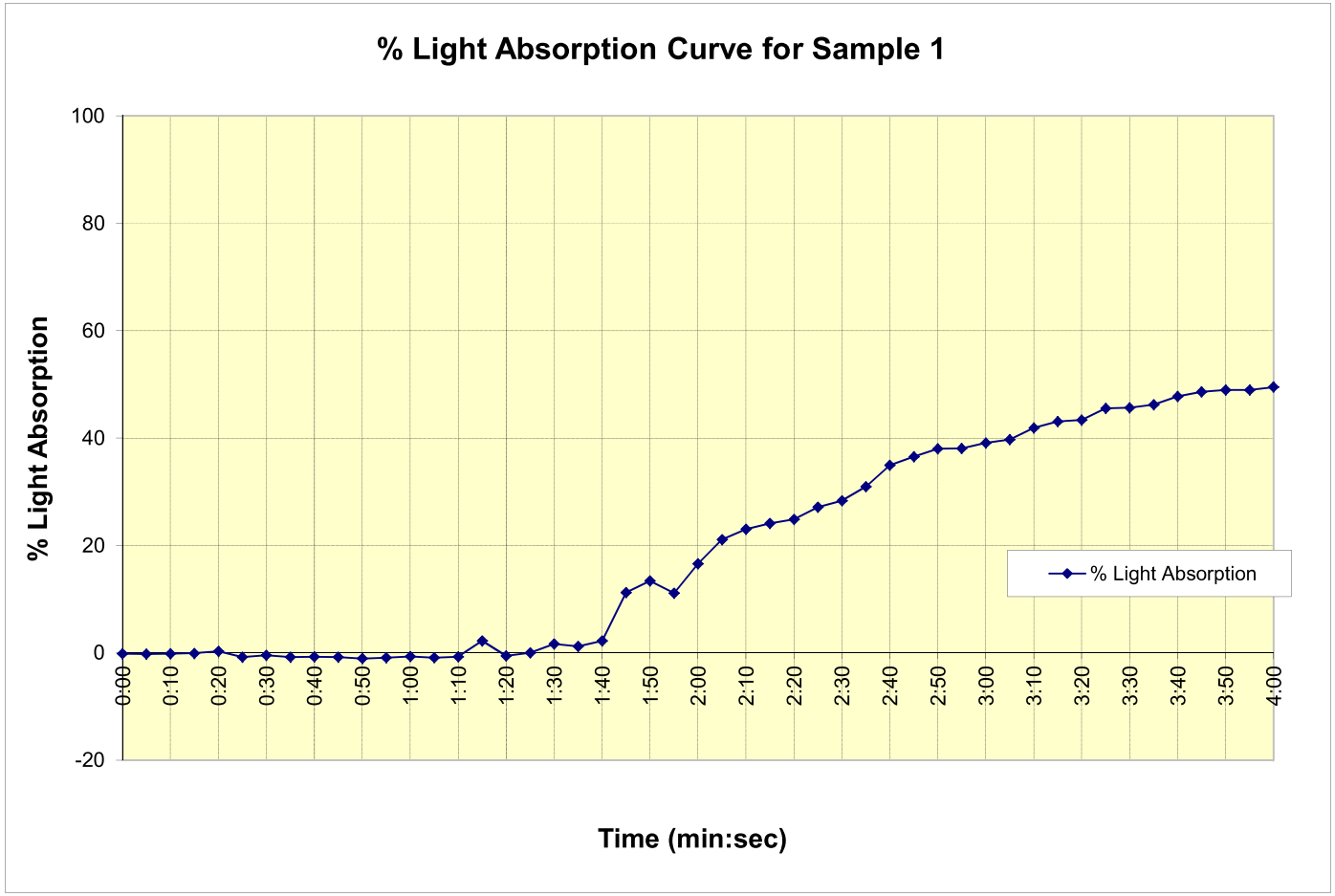
Smoke Density Testing per ASTM D 2843

Exit Sign Chamber

ATI No.: D3964.03-106-31
Test Date: 3/1/2014
Technician: DMC

Time (min:sec)	% Light	% Light Absorption
0:00	100.16	-0.16
0:05	100.23	-0.23
0:10	100.14	-0.14
0:15	100.07	-0.07
0:20	99.71	0.29
0:25	100.80	-0.80
0:30	100.46	-0.46
0:35	100.76	-0.76
0:40	100.74	-0.74
0:45	100.79	-0.79
0:50	101.06	-1.06
0:55	100.89	-0.89
1:00	100.68	-0.68
1:05	100.90	-0.89
1:10	100.71	-0.71
1:15	97.78	2.22
1:20	100.56	-0.56
1:25	99.96	0.04
1:30	98.35	1.65
1:35	98.80	1.20
1:40	97.78	2.22
1:45	88.75	11.25
1:50	86.57	13.43
1:55	88.86	11.14
2:00	83.41	16.59
2:05	78.88	21.12
2:10	76.96	23.04
2:15	75.89	24.11
2:20	75.16	24.84
2:25	72.83	27.17
2:30	71.66	28.34
2:35	69.02	30.98
2:40	65.05	34.95
2:45	63.48	36.52
2:50	61.97	38.03
2:55	61.91	38.09
3:00	60.90	39.10
3:05	60.29	39.71
3:10	58.11	41.89
3:15	56.88	43.12
3:20	56.63	43.37
3:25	54.43	45.57
3:30	54.34	45.66
3:35	53.77	46.23
3:40	52.23	47.77
3:45	51.36	48.64
3:50	51.03	48.97
3:55	51.04	48.96
4:00	50.49	49.51

Sample #	Manufacturer	Product Name	Material Type	Width (in)	Length (in)	Thickness (in)
1	Velux America Inc.	Support	Polypropylene	0.983	1.017	0.157



Calibration	Resistance (kΩ)
100% Light	2.409

Plot Area	240	Maximum Smoke Density	49.95 %
Area Under Curve	48.2	**Smoke Density Rating***	**20.1**

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

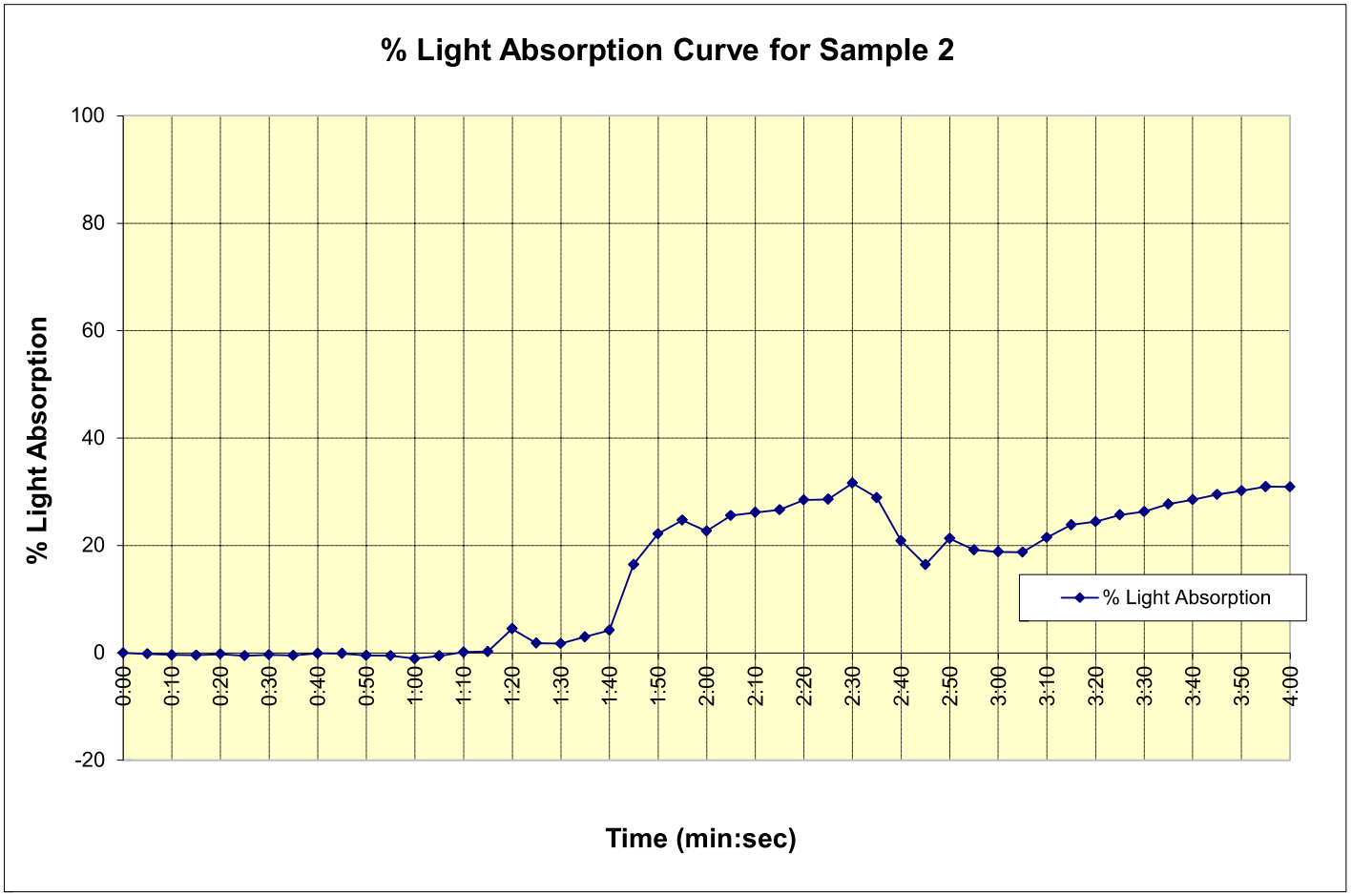
Smoke Density Testing per ASTM D 2843

Exit Sign Chamber

ATI No.: D3964.03-106-31
Test Date: 3/1/2014
Technician: DMC

Time (min:sec)	% Light	% Light Absorption
0:00	100.04	-0.04
0:05	100.22	-0.22
0:10	100.42	-0.42
0:15	100.46	-0.46
0:20	100.28	-0.28
0:25	100.56	-0.56
0:30	100.38	-0.38
0:35	100.50	-0.50
0:40	100.12	-0.12
0:45	100.14	-0.14
0:50	100.50	-0.50
0:55	100.55	-0.55
1:00	101.10	-1.10
1:05	100.61	-0.61
1:10	99.90	0.10
1:15	99.79	0.21
1:20	95.55	4.45
1:25	98.22	1.78
1:30	98.28	1.72
1:35	97.04	2.96
1:40	95.84	4.16
1:45	83.57	16.43
1:50	77.87	22.13
1:55	75.32	24.68
2:00	77.36	22.64
2:05	74.46	25.54
2:10	73.88	26.12
2:15	73.38	26.62
2:20	71.54	28.46
2:25	71.43	28.57
2:30	68.42	31.58
2:35	71.14	28.86
2:40	79.15	20.85
2:45	83.59	16.41
2:50	78.70	21.30
2:55	80.86	19.14
3:00	81.22	18.78
3:05	81.29	18.71
3:10	78.55	21.45
3:15	76.20	23.80
3:20	75.60	24.40
3:25	74.34	25.66
3:30	73.75	26.25
3:35	72.32	27.68
3:40	71.53	28.47
3:45	70.54	29.46
3:50	69.84	30.16
3:55	69.08	30.92
4:00	69.13	30.87

Sample #	Manufacturer	Product Name	Material Type	Width (in)	Length (in)	Thickness (in)
2	Velux America Inc.	Support	Polypropylene	1.024	1.008	0.157



Calibration	Resistance (kΩ)
100% Light	2.360

Plot Area	240	Maximum Smoke Density	31.58 %
Area Under Curve	35.2	**Smoke Density Rating***	**14.7**

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

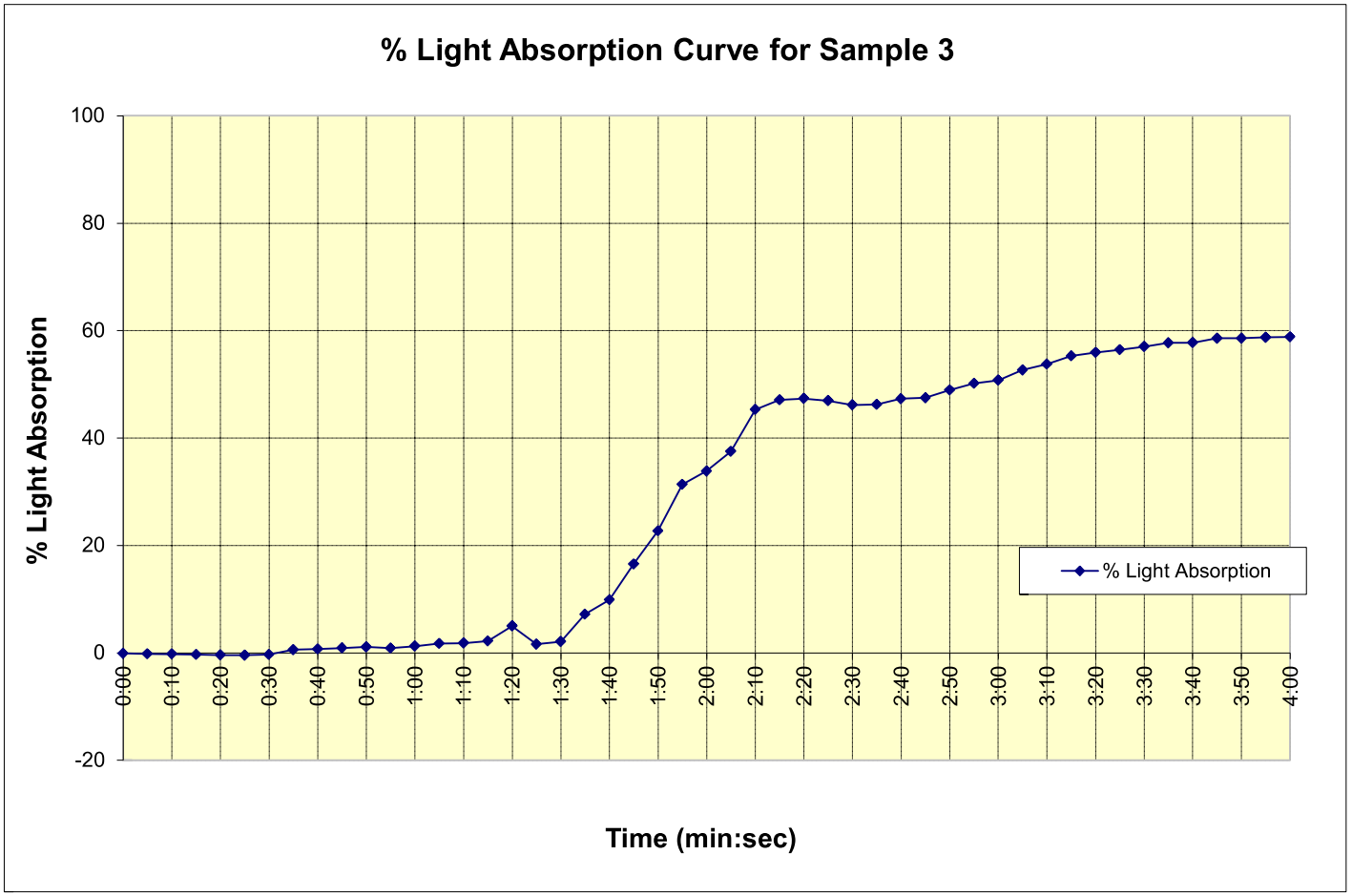
Smoke Density Testing per ASTM D 2843

Exit Sign Chamber

ATI No.: D3964.03-106-31
Test Date: 3/1/2014
Technician: DMC

Time (min:sec)	% Light	% Light Absorption
0:00	100.12	-0.12
0:05	100.21	-0.21
0:10	100.26	-0.26
0:15	100.33	-0.33
0:20	100.43	-0.43
0:25	100.47	-0.47
0:30	100.33	-0.33
0:35	99.43	0.57
0:40	99.34	0.66
0:45	99.12	0.88
0:50	98.92	1.08
0:55	99.15	0.85
1:00	98.79	1.21
1:05	98.29	1.71
1:10	98.21	1.79
1:15	97.84	2.16
1:20	95.02	4.98
1:25	98.42	1.58
1:30	97.93	2.07
1:35	92.84	7.16
1:40	90.15	9.85
1:45	83.51	16.49
1:50	77.30	22.70
1:55	68.68	31.32
2:00	66.17	33.83
2:05	62.53	37.47
2:10	54.71	45.29
2:15	52.94	47.06
2:20	52.69	47.31
2:25	53.06	46.94
2:30	53.88	46.12
2:35	53.77	46.23
2:40	52.70	47.30
2:45	52.54	47.46
2:50	51.11	48.89
2:55	49.87	50.13
3:00	49.27	50.73
3:05	47.36	52.64
3:10	46.29	53.71
3:15	44.75	55.25
3:20	44.11	55.89
3:25	43.59	56.41
3:30	43.00	57.00
3:35	42.30	57.70
3:40	42.26	57.74
3:45	41.44	58.56
3:50	41.46	58.54
3:55	41.27	58.73
4:00	41.19	58.81

Sample #	Manufacturer	Product Name	Material Type	Width (in)	Length (in)	Thickness (in)
3	Velux America Inc.	Support	Polypropylene	1.022	1.022	0.156



Calibration	Resistance (kΩ)
100% Light	2.394

Plot Area	240	Maximum Smoke Density	59.05 %
Area Under Curve	67.9	**Smoke Density Rating***	**28.3**

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

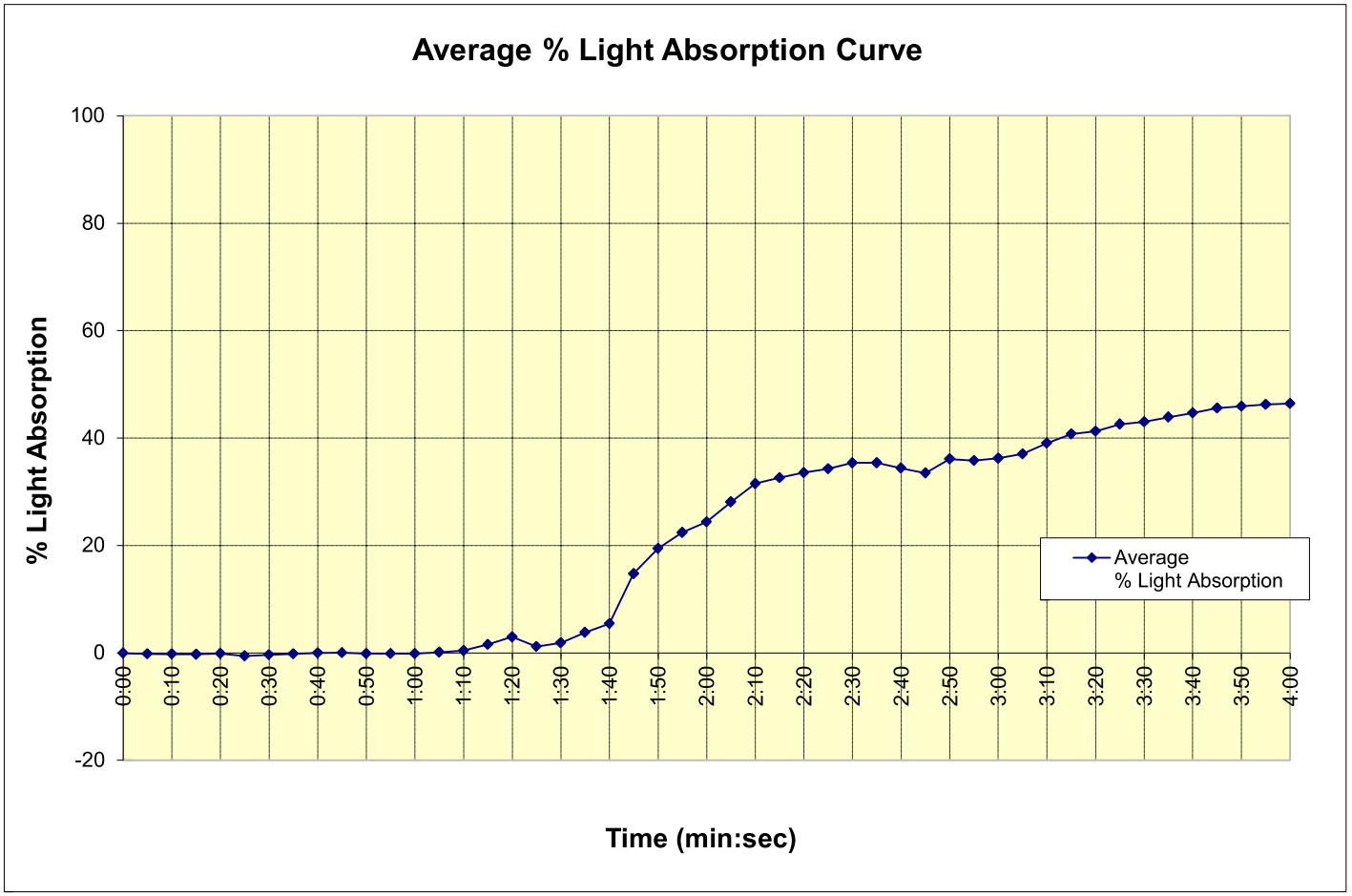
Smoke Density Testing per ASTM D 2843

Exit Sign Chamber

ATI No.: D3964.03-106-31
Test Date: 3/1/2014
Technician: DMC

Time (min:sec)	Average % Light Absorption
0:00	-0.11
0:05	-0.22
0:10	-0.27
0:15	-0.29
0:20	-0.14
0:25	-0.61
0:30	-0.39
0:35	-0.23
0:40	-0.07
0:45	-0.02
0:50	-0.16
0:55	-0.20
1:00	-0.19
1:05	0.07
1:10	0.39
1:15	1.53
1:20	2.96
1:25	1.13
1:30	1.81
1:35	3.78
1:40	5.41
1:45	14.72
1:50	19.42
1:55	22.38
2:00	24.35
2:05	28.04
2:10	31.48
2:15	32.60
2:20	33.53
2:25	34.22
2:30	35.35
2:35	35.36
2:40	34.37
2:45	33.46
2:50	36.07
2:55	35.79
3:00	36.20
3:05	37.02
3:10	39.01
3:15	40.72
3:20	41.22
3:25	42.55
3:30	42.97
3:35	43.87
3:40	44.66
3:45	45.55
3:50	45.89
3:55	46.20
4:00	46.40

Sample #	Manufacturer	Product Name	Material Type	Width (in)	Length (in)	Thickness (in)
AVERAGE	Velux America Inc.	Support	Polypropylene	1.010	1.016	0.157



Calibration	Resistance (kΩ)
100% Light	2.409

Plot Area	240	Maximum Smoke Density	46.62 %
Area Under Curve	50.1	**Smoke Density Rating***	**20.9**

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