

GRAFFITI SHIELD, INC.

TEST REPORT

SCOPE OF WORK

VARIOUS MATERIAL PROPERTY EVALUATIONS ON MULTI-LAYER FILM PRODUCT

REPORT NUMBER

J0631.01-106-31 R0

TEST DATES

01/02/19 - 04/12/19

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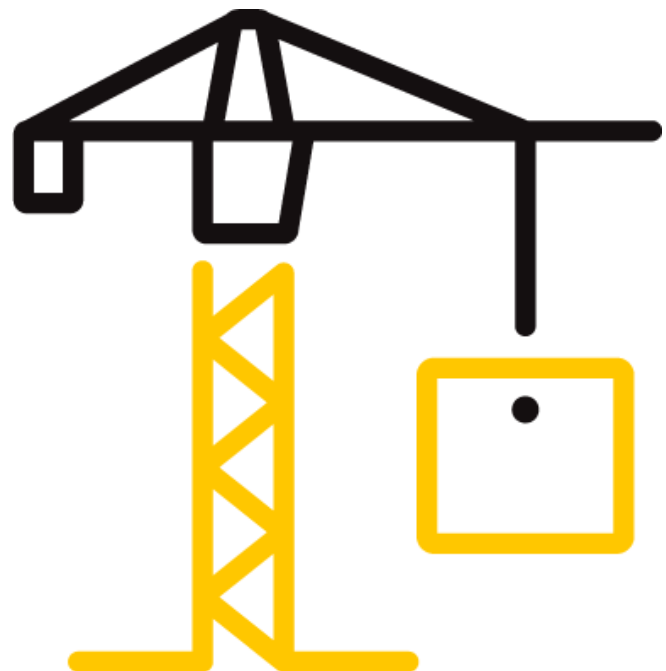
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TEST REPORT FOR GRAFFITI SHIELD, INC.

Report No.: J0631.01-106-31 R0

Date: 04/17/19

REPORT ISSUED TO

GRAFFITI SHIELD, INC.

2940 E. La Palma Avenue
Suite D
Anaheim, California 92806

SECTION 1

SCOPE

Products: Multi-Layer Film

Intertek Building & Construction (B&C) was contracted by Graffiti Shield, Inc. to evaluate their multi-layer film in accordance with ASTM E162, ASTM E662, Bombardier SMP 800C, ASTM D882, ASTM D3330, ASTM D1308, ANSI Z26.1, FMVSS 302, and ASTM D5116. Results obtained are tested values and were secured by using the designated test methods. Testing was conducted at the Intertek B&C test facility in York, Pennsylvania, the Intertek test facility in Middleton, Wisconsin, and the Intertek test facility in Kentwood, Michigan.

This report does not constitute certification of this product nor an opinion or endorsement by this laboratory.

For INTERTEK B&C:

COMPLETED BY:	Jonathan M. Bright	REVIEWED BY:	Joseph M. Brickner
TITLE:	Engineer Materials Laboratory	TITLE:	Project Engineer Materials Laboratory
SIGNATURE:		SIGNATURE:	
DATE:	04/17/19	DATE:	04/17/19

JMB:jmb/kf

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SECTION 2

TEST METHODS

The specimens were evaluated in accordance with the following:

ASTM E162-16, *Standard Test Method for Surface Flammability of Materials Using a Radiant Heat Energy Source*

ASTM E662-18, *Standard Test Method for Specific Optical Density of Smoke Generated by Solid Materials*

Bombardier SMP 800C, *Toxicity of Smoke*

ASTM D882-18, *Standard Test Method for Tensile Properties of Thin Plastic Sheeting*

ASTM D3330-04(2018), *Standard Test Method for Peel Adhesion of Pressure-Sensitive Tape*

ASTM D1308-02(2013), *Standard Test Method for Effect of Household Chemicals on Clear and Pigmented Organic Finishes*

ANSI/SAE Z26.1 (1996), *American National Standard for Safety Glazing Materials for Glazing Motor Vehicles and Motor Vehicle Equipment Operating on Land Highways - Safety Standard*

FMVSS 302, *Federal Motor Vehicle Safety Standard - Flammability of Interior Materials*

ASTM D5116-17, *Standard Guide for Small-Scale Environmental Chamber Determinations of Organic Emissions from Indoor Materials/Products*

SECTION 3

MATERIAL SOURCE

The materials were provided by Graffiti Shield, Inc on 12/17/18. The following were received: 71 specimens of various sizes. The material was tested as received. Representative test specimens will be retained by Intertek B&C for a minimum of four years from the test completion date.

SECTION 4

LIST OF OFFICIAL OBSERVERS

NAME	COMPANY
Jonathan M. Bright	Intertek B&C
Joseph M. Brickner	Intertek B&C

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SECTION 5

TEST PROCEDURES

All conditioning of test specimens and test conditions were at standard laboratory conditions unless otherwise reported. Refer to the test related photos in Section 9.

ASTM E162 - Flammability Using Radiant Heat Source

Testing was conducted by the Intertek Middleton, WI laboratory. See report 103795546MID-003REV1 for the test procedure details.

ASTM E662 - Smoke Density

Testing was conducted by the Intertek Middleton, WI laboratory. See report 103795546MID-001 for the test procedure details.

Bombardier SMP 800C - Toxicity of Smoke

Testing was conducted by the Intertek Middleton, WI laboratory. See report 103795546MID-002 for the test procedure details.

FMVSS 302 Flammability of Interior Materials

Testing was conducted by the Intertek Middleton, WI laboratory. See report 103795546MID-004 for the test procedure details.

ASTM D5116 - Small Scale Environmental Chamber Determinations

Testing was conducted by the Intertek Kentwood, MI laboratory. See report 103786946GRR-001 for the test procedure details.

ASTM D882 - Tensile Properties

The tensile strength was determined utilizing an Instron UTM (ICN: 005740) equipped with a 10 kN load cell (ICN: 005965). Five specimens were tested at a 10 in. gauge length operating at a crosshead speed of 1 in/min and five specimens were tested at a 6 in. gauge length and a crosshead speed of 6 in/min.

ASTM D3330 - 90° Peel Adhesion

Specimens were individually mounted to an Instron UTM (ICN: 005740) using a 2 kN load cell (ICN: 005742) and a sliding 90° peel test rig. A tab was lifted at one end of the specimen to allow for mounting into the grips of the test machine. The crosshead moved in tension at a rate of 12 in/min for a total of 7 in. in order to calculate an average peel strength.

ASTM D1308 - Effect of Chemicals - Covered Spot Test

One drop of hydrofluoric acid was applied to the film on three test specimens. Each specimen allowed the drop to remain for either 15 minutes, 1 hour, or 16 hours. At the end of each exposure period, any remaining hydrofluoric acid was cleaned off and the specimens were observed for any signs of discoloration, change in gloss, blistering, softening, swelling, and loss of adhesion.

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ANSI Z26.1 Test #1 - Light Stability (100 hrs. UV)

The regular luminous transmittance of three flat specimens was measured utilizing a Gretag MacBeth Color i5 spectrophotometer with Illuminant A. Each specimen was subjected to UV-A ultraviolet radiation at 340nm in a Q-LAB Model QUV/SE Accelerated Weathering Chamber for 100 continuous hours at an irradiance of 0.83 W/m²/nm and a distance of 50 mm. Conditioning temperature was 45°C. No moisture cycle was used.

ANSI Z26.1 Test #2 - Luminous Transmittance

The regular luminous transmittance of the material was measured utilizing a Gretag MacBeth Color i5 spectrophotometer with Illuminant A, prior to, and following weathering in accordance with Test 16.

ANSI Z26.1 Test #15 - Optical Deviation and Visibility Distortion

Ten flat specimens were tested for Optical Deviation and Visibility Distortion. The area 25 mm (1 in.) from all edges was masked to not be viewed during testing.

For Optical Deviation, the specimens were placed in a frame 7.62 m (25 Ft.) in front of a 305 mm (12 in.) by 305 mm (12 in.) light box with a 13mm (0.5 in.) hole surrounded by a 114 mm (4.5 in.) diameter slit. Both the hole and the slit were back lit. The exterior side of the specimen faced the box. The entire unmasked area of the specimen was surveyed from the interior side of the specimen.

For Visibility Distortion, the specimens were placed in a moveable frame 127 mm (5 in.) from a white screen with the exterior side facing the screen. A slide projector with a 500 watt lantern was placed 7.62 m (25 ft.) away from the screen in such a way that the light shined through the specimen and hit the screen. The specimen was moved away from the screen in steps of 127 mm (5 in.). At each stop the shadow of the specimen was observed.

ANSI Z26.1 Test #17 - Abrasion Resistance (Plastics)

The haze of the films was measured utilizing a Gretag MacBeth Color i5 spectrophotometer (ICN: 004725). For each material, three specimens were subjected to 100 cycles on a Taber Model 5130 Abraser (ICN: Y001522) with Calibrase CS-10F wheels and a 500 gram load employed on each wheel. The fine side of a Taber ST-11 resurfacing stone was utilized to reface the wheels for 25 cycles before abrading each specimen.

ANSI Z26.1 Test #19 - Chemical Resistance (Nonstressed)

The resistance of the film to certain chemicals was determined by exposing two new specimens each to five different chemicals. The five chemicals utilized were one-percent solution of nonabrasive soap in deionized water, kerosene, undiluted denatured alcohol, gasoline (ASTM Reference Fuel C), and windshield cleaner. Each specimen was held in the fluid for one minute, immediately wiped with absorbent cotton, and examined for evidence of tackiness, crazing, or apparent loss of transparency.

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ANSI Z26.1 Test #28 - Resistance to Temperature Change

The capability of the film to withstand changes in temperature without deterioration was determined by exposing two nominally twelve-inch square specimens in diverse temperature conditions. Each specimen was placed in a So-low chest freezer (ICN: INT000206) for six hours at -40°F, in still air for one hour at 73°F, in an ESPEC environmental chamber (ICN: 005615) for three hours at 162°F, and then cooled to 70°F in still air.

SECTION 6

TEST SPECIMEN DESCRIPTIONS

TEST PROCEDURE	NUMBER OF SPECIMENS	NOMINAL SPECIMEN DIMENSIONS	VISUAL CHARACTERISTICS
ASTM E162	5	6" X 18"	Clear Multi-Layer Film on Glass Substrate
ASTM E662	12	75mm square	
Bombardier SMP 800C	4	75mm ²	
ASTM D882	10	1" X 12"	
ASTM D3330	5	1" X 12"	
ASTM D1308	3	2" square	
ANSI Z26.1 Test #1	3	12" square	
ANSI Z26.1 Test #2	3	12" square	
ANSI Z26.1 Test #15	10	12" square	
ANSI Z26.1 Test #17	3	4: square	
ANSI Z26.1 Test #19	10	1" X 7"	
ANSI Z26.1 Test #28	2	12" square	
FMVSS 302	3	4" X 12"	
ASTM D5116	1	12" square	

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SECTION 7

TEST RESULTS

ASTM E162 - Flammability Using Radiant Heat Source*

OBSERVATIONS	
Specimen 1	After sample ignited light black smoke @2s, flaming drips @3:40, specimen half extinguished @11:09
Specimen 2	After sample ignited light black smoke @2s, flaming drips @3:03, specimen half extinguished @13:58
Specimen 3	After sample ignited light black smoke @2s, specimen half extinguished @5:21, reigniting @ 7:32, flaming drips @7:57
Specimen 4	After sample ignited light black smoke @2s, flaming drips @3:10, specimen half extinguished @4:45

TEST RESULTS				
	SPECIMEN 1	SPECIMEN 2	SPECIMEN 3	SPECIMEN 4
Time to Ignition (sec)	1	1	1	1
Baseline Temperature (°C)	240.054	240.054	240.054	240.054
Maximum Temperature (°C)	247.311	248.681	242.970	243.262
Temperature Rise (°C)	7.26	8.63	2.92	3.21
Time to 3 Inches (min)				
	2.72	2.92	2.58	3.08
Time to 6 Inches (min)				
	4.08	3.53	3.67	4.38
Time to 9 Inches (min)				
	6.63	4.57	9.28	9.42
Time to 12 Inches (min)				
	13.78	0.00	14.08	0.00
Time to 15 Inches (min)				
	0.00	0.00	0.00	0.00
Time to Flaming Runs (min)				
	0.00	0.00	0.00	0.00
Time to Flaming Drips (min)				
	3.67	3.05	7.95	3.17
Total Exposure Time (min)				
	15.00	15.00	15.00	15.00
Beta				
	23.5	23.5	23.5	23.5
Heat Evolution Factor, Q				
	1.76	2.09	0.71	0.78
Flame Spread Factor, Fs				
	2.51	2.97	2.47	2.11
Radiant Panel Index, Is				
	4.42	6.22	1.75	1.64
Radiant Panel Index				
	3.51	<i>Results as Calculated</i>		
Radiant Panel Index				
	5	<i>Rounded to the nearest multiple of 5</i>		

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PERCENTAGE WEIGHT LOSS			
Specimen	Initial Wt. (g)	Fallen Material Wt. (g)	Wt. Loss (%)
1	1,026.82	2.45	0%
2	1,027.05	2.36	0%
3	1,027.61	6.88	1%
4	1,028.88	2.40	0%

*Testing was performed at the Intertek Middleton, WI laboratory.

ASTM E662 - Smoke Density*

25kW/m ² RADIANT NON-FLAMING MODE SUMMARY							
RUN	SPECIMEN	Ds @ 1.5 min	Ds @ 4 min	MAX Ds (first 4 min)	MAX Ds Time (first 4 min)	MAX Ds	MAX Ds TIME
1	25kW no flame	0.0	6.0	6.0	3:55.0	165.0	19:56.0
2	25kW no flame	0.0	3.0	3.0	3:52.2	226.0	19:57.4
3	25kW no flame	0.0	3.0	3.0	3:44.3	183.0	19:47.5
Average		0.0	4.0	4.0	0:00.0	191.3	19:53.6
SPECIMEN #	OBSERVATIONS						
1	1:30 center bubbling, becoming opaque, 2:05 film peel from surface, 2:45 white smoke, 3:50 blackening film						
2	1:30 center bubbling, becoming opaque, 2:05 film peel from surface, 2:45 white smoke, 3:50 blackening film						
3	1:30 center bubbling, becoming opaque, 2:05 film peel from surface, 2:45 white smoke, 3:50 blackening film						

25kW/m ² RADIANT FLAMING MODE SUMMARY							
RUN	SPECIMEN	Ds @ 1.5 min	Ds @ 4 min	MAX Ds (first 4 min)	MAX Ds Time (first 4 min)	MAX Ds	MAX Ds TIME
1	25kW w/ flame	1.0	6.0	6.0	3:57.2	95.0	15:25.0
2	25kW w/ flame	2.0	8.0	8.0	3:55.7	100.0	19:07.1
3	25kW w/ flame	2.0	10.0	10.0	3:57.2	109.0	14:10.3
Average		1.7	8.0	8.0	0:00.0	101.3	16:14.2
SPECIMEN #	OBSERVATIONS						
1	15s bubbling, 24s crack, 40s flashes. 1:20 ignition with 4 inch orange and blue flames, 2:00 fully blackened surface, 4:30 flame out						
2	15s bubbling, 24s crack, 40s flashes. 1:00 ignition with 4 inch orange and blue flames, 2:00 fully blackened surface, 4:40 flame out						
3	15s bubbling, 24s crack, 40s flashes. 1:16 ignition with 4 inch orange and blue flames, 2:00 fully blackened surface, 4:35 flame out						

*Testing was performed at the Intertek Middleton, WI laboratory.

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Bombardier SMP 800C - Toxicity of Smoke*

SMOKE TOXICITY AFTER 4 MINUTES (25 kw/m² RADIANT FLUX) WITHOUT A PILOT FLAME		
COMPOUND	ANALYSIS DETECTION LIMITS (ppm)	SPECIMEN 1
CO (ppm)	20.1	158.8
CO ₂ (ppm)	573.0	Not Detected
HCl (ppm)	40.7	Not Detected
HCN (ppm)	28.9	Not Detected
HBr (ppm)	40.8	Not Detected
HF (ppm)	77.9	Not Detected
NO (ppm)	7.5	Not Detected
NO ₂ (ppm)	30.8	Not Detected
SO ₂ (ppm)	4.7	Not Detected
SMOKE TOXICITY AFTER 4 MINUTES (25 kw/m² RADIANT FLUX) WITH A PILOT FLAME		
COMPOUND	ANALYSIS DETECTION LIMITS (ppm)	SPECIMEN 1
CO (ppm)	20.1	332.2
CO ₂ (ppm)	573.0	8,217.6
HCl (ppm)	40.7	Not Detected
HCN (ppm)	28.9	Not Detected
HBr (ppm)	40.8	Not Detected
HF (ppm)	77.9	Not Detected
NO (ppm)	7.5	Not Detected
NO ₂ (ppm)	30.8	Not Detected
SO ₂ (ppm)	4.7	Not Detected

SAMPLE MODE	NON-FLAMING MODE	FLAMING MODE
Mass-initial	85.6	84.94
Mass-final (g)	83.4	81.39
Mass-change (g)	-2.2	-3.55
Time to ignition (s)	n/a	60
Time to flameout (s)	n/a	520
Burn duration (s)	n/a	460

*Testing was performed at the Intertek Middleton, WI laboratory.

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FMVSS 302 - Flammability of Interior Materials*

SPECIMEN	TOTAL TIME (sec)	EXTENT OF BURNING (mm)	BURNING RATE (mm/min)	PASS/FAIL
1	0	0	NA	Pass
2	0	0	NA	Pass
3	0	0	NA	Pass
Average		0	NA	

OBSERVATIONS

Material melted away from test flame with no visible flaming, there is no rate of burn, material did not burn to the timing zone. Sample only burned where test flame was applied.

*Testing was performed at the Intertek Middleton, WI laboratory.

ASTM D5116 - Small Scale Environmental Chamber Determinations*

SAMPLE AND CHAMBER CONDITIONS DURING TEST PERIOD				
PARAMETER		SYMBOL	VALUE	UNITS
Sample Dimensions	Length	-	0.305	m
	Width	-	0.305	m
Exposed Surface Area		A	0.093	m ²
Chamber Volume		V	0.116	m ³
Chamber Loading Factor		L	0.802	m ² m ⁻³
Inlet Air Flow Rate		Q	0.116	m ³ h ⁻¹
Air Change Rate		N _{ACH}	0.999	h ⁻¹
Area Specific Flow Rate		q _A	1.245	m h ⁻¹
Testing Duration		t	72	h
Chamber Pressure (Range)		P	17.1 (15.6-20.1)	Pa
Average Temperature (Range)		T	23.4 (23.2-23.5)	°C
Average Humidity (Range)		RH	50.0 (47.0-51.8)	% RH

ANALYSIS OF INDIVIDUAL VOCs VIA GC-MS				
RETENTION TIME (min.)	PEAK ID	CAS #	CHAMBER CONCENTRATION (µg/m ³)	EMISSION FACTOR (µg/m ² h)
-	**	-	-	-

**No individual VOCs were detected above the 2.0 (µg/m³) quantitation limit.

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ANALYSIS OF LOW MOLECULAR WEIGHT ALDEHYDES AND KETONES VIA HPLC			
PEAK ID	CAS	CHAMBER CONCENTRATION ($\mu\text{g}/\text{m}^3$)	EMISSION FACTOR ($\mu\text{g}/\text{m}^2\text{h}$)
Formaldehyde	50-00-0	< 0.8	< 1.0
Acetaldehyde	75-07-0	< 3.8	< 4.8
Propionaldehyde	123-38-6	< 0.4	< 0.5
n-Butyraldehyde	123-72-8	< 0.4	< 0.5
Benzaldehyde	100-52-7	< 0.3	< 0.4
Valeraldehyde	110-62-3	< 0.1	< 0.1
hexaldehyde	66-25-1	< 0.7	< 0.9

Concentrations listed with "<" indicate the observed concentration was below the detection limit.

*Testing was performed at the Intertek Kentwood, MI laboratory.

ASTM D882 - Tensile Properties

10 IN. GAUGE LENGTH				
SPECIMEN NO.	THICKNESS (in)	WIDTH (in)	PEAK LOAD (lbf)	TENSILE STRENGTH (psi)
1	0.004	0.512	36.702	17,921
2	0.004	0.517	37.066	17,924
3	0.004	0.511	36.204	17,712
4	0.004	0.516	33.660	16,308
5	0.004	0.514	34.278	16,672
Average	0.004	0.514	35.582	17,307

6 IN. GAUGE LENGTH				
SPECIMEN NO.	THICKNESS (in)	WIDTH (in)	PEAK LOAD (lbf)	TENSILE STRENGTH (psi)
1	0.004	0.516	47.183	22,860
2	0.004	0.514	45.091	21,931
3	0.004	0.513	47.127	22,967
4	0.004	0.514	46.662	22,696
5	0.004	0.514	49.129	23,895
Average	0.004	0.514	47.038	22,870

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ASTM D3330 - 90° Peel Adhesion

SPECIMEN NO.	WIDTH (in)	PEAK LOAD (lb _f)	AVERAGE LOAD (lb _f)	AVERAGE PEEL STRENGTH (lb _f /in)
1	0.894	2.46	1.77	1.97
2	0.869	2.31	1.93	2.22
3	0.870	2.57	2.11	2.43
4	0.871	2.68	2.42	2.78
5	0.873	1.27	0.965	1.11
6	0.868	1.44	1.19	1.37
7	0.869	0.938	0.770	0.886
8	0.869	2.97	1.98	2.27
9	0.869	1.26	1.15	1.32
10	0.868	1.41	1.03	1.19
Average	0.872	1.93	1.53	1.75

ASTM D1308 - Effect of Chemicals - Covered Spot Test

HYDROFLUORIC ACID	
EXPOSURE TIME	OBSERVATIONS
15 minutes	No effect
1 hour	No effect
16 hours	No effect

ANSI Z26.1 Test #1 - Light Stability (100 hrs. UV)

SPECIMEN NO.	OPACITY		% CHANGE	OBSERVATIONS
	0 hrs	100 hrs		
1	80.53	80.73	0.25	No defects or discoloration
2	79.22	80.05	1.05	No defects or discoloration
3	80.40	80.67	0.34	No defects or discoloration
Average	80.05	80.48	0.55	

ANSI Z26.1 Test #2 - Luminous Transmittance

SPECIMEN NO.	OPACITY
1	80.53
2	79.22
3	80.40
Average	80.05

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ANSI Z26.1 Test #15 - Optical Deviation and Visibility Distortion

OPTICAL DEVIATION								
SPECIMEN NO.	OVERALL THICKNESS (mm)	FLAT OR CURVED			OBSERVATIONS			
1	6.14	Flat			No image shift			
2	6.12	Flat			No image shift			
3	6.09	Flat			No image shift			
4	6.09	Flat			No image shift			
5	6.10	Flat			No image shift			
6	6.08	Flat			No image shift			
7	6.08	Flat			No image shift			
8	6.10	Flat			No image shift			
9	6.09	Flat			No image shift			
10	6.14	Flat			No image shift			
VISIBILITY DISTORTION								
SPECIMEN NO.	OVERALL THICKNESS (mm)	SAMPLE DISTANCE FROM SCREEN IN INCHES						
		5	10	15	20	25	30	35
1	6.14	NP	NP	P	P	P	P	P
2	6.12	NP	NP	P	P	P	P	P
3	6.09	NP	NP	P	P	P	P	P
4	6.09	NP	P	P	P	P	P	P
5	6.10	NP	P	P	P	P	P	P
6	6.08	NP	NP	P	P	P	P	P
7	6.08	NP	NP	P	P	P	P	P
8	6.10	NP	NP	P	P	P	P	P
9	6.09	NP	NP	P	P	P	P	P
10	6.14	NP	NP	P	P	P	P	P
NP = No Patches P=Patches								

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ANSI Z26.1 Test #17 - Abrasion Resistance

SPECIMEN NO.	HAZE (%)		CHANGE (%)
	0 cycles	100 cycles	
1-1	3.09	5.81	2.72
1-2	2.95	7.30	4.35
1-3	3.24	3.93	0.69
1-4	2.37	4.61	2.24
Average	2.91	5.41	2.50
2-1	1.91	4.36	2.45
2-2	2.31	4.79	2.48
2-3	2.53	5.70	3.17
2-4	2.60	5.61	3.01
Average	2.34	5.12	2.78
3-1	3.24	4.07	0.83
3-2	2.20	2.75	0.55
3-3	1.91	3.64	1.73
3-4	2.26	4.25	1.99
Average	2.40	3.68	1.28
Overall Average	2.55	4.74	2.19

ANSI Z26.1 Test #19 - Chemical Resistance

CHEMICAL	SPECIMEN NO.	OBSERVATIONS
Non-abrasive Soap	1	No effect
	2	No effect
Kerosene	1	No effect
	2	No effect
Denatured Alcohol	1	No effect
	2	No effect
Gasoline	1	No effect
	2	No effect
Windshield Cleaner	1	No effect
	2	No effect

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ANSI Z26.1 Test #28 - Resistance to Temperature Change

SPECIMEN	POST EXPOSURE OBSERVATIONS
1	No cracking, clouding, delaminating, or deterioration.
2	No cracking, clouding, delaminating, or deterioration.

SECTION 8

CONCLUSION

There test methods requested did not contain specific performance requirements for the multi-layer film product.

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Date: 04/17/19

SECTION 9 PHOTOGRAPHS

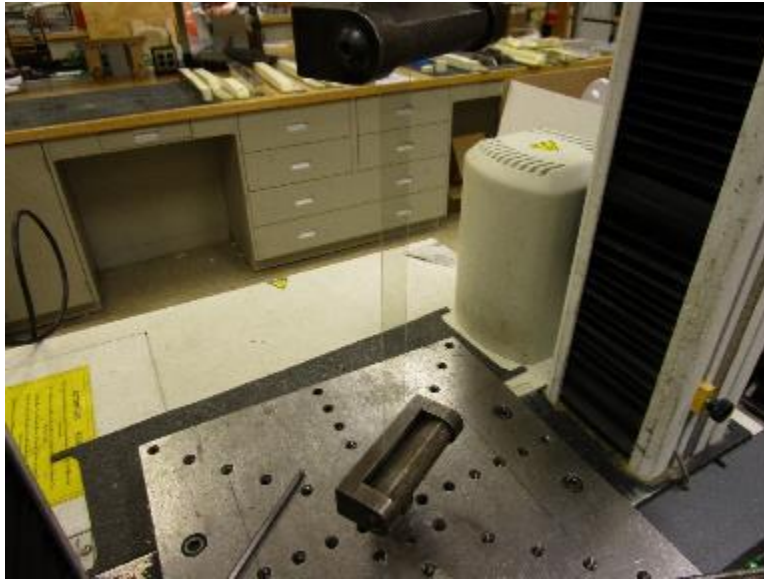


Photo No. 1
ASTM D882 Tensile Test Setup

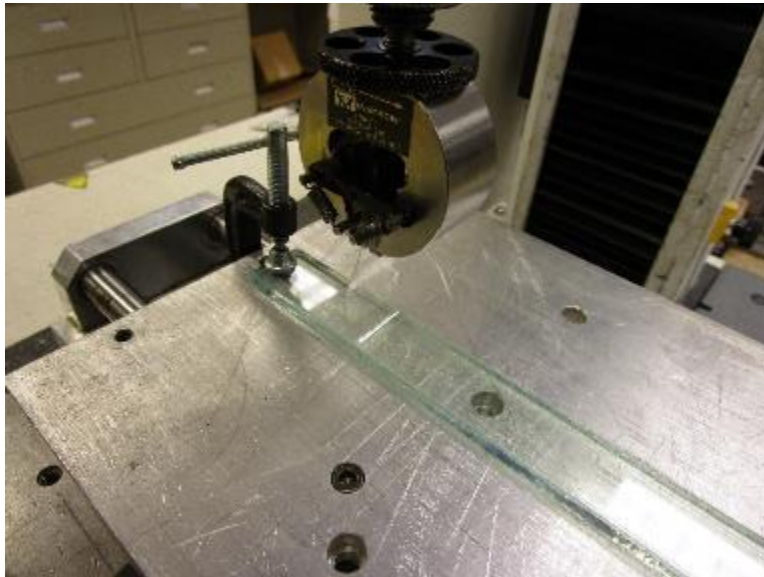


Photo No. 2
ASTM D3330 90° Peel Adhesion Test Setup

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Photo No. 3
ASTM D1308 Covered Spot Test

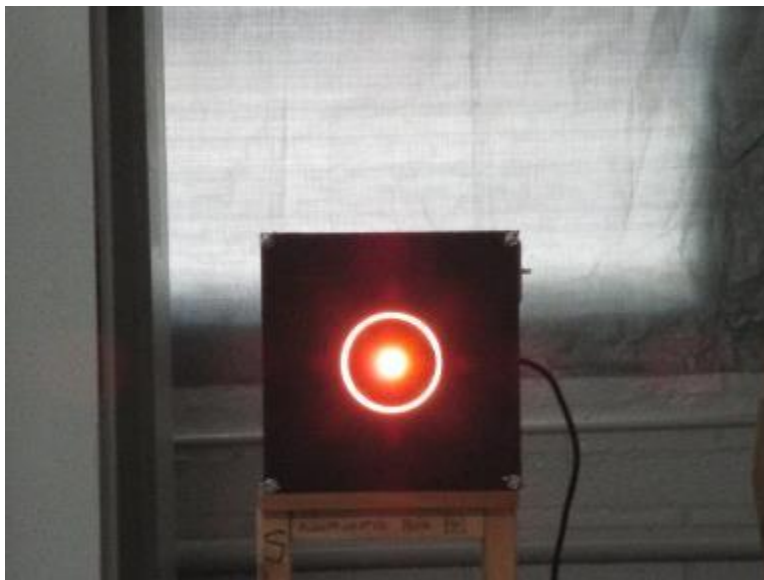


Photo No. 4
ANSI Z26.1 Test #15 Optical Deviation

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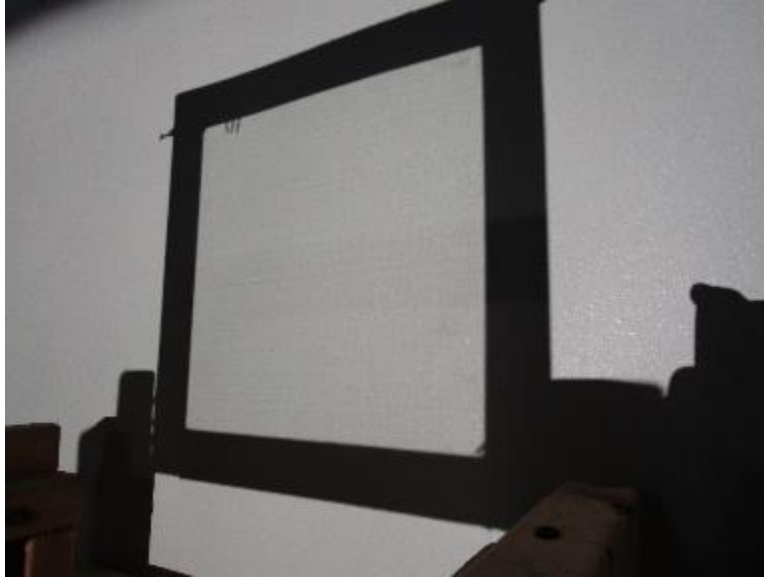


Photo No. 5
ANSI Z26.1 Test #15 Visibility Distortion

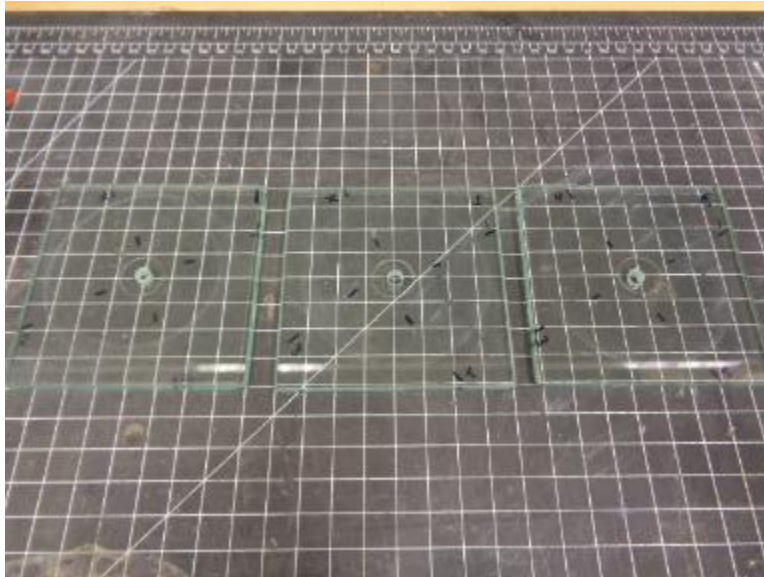


Photo No. 6
ANSI Z26.1 Test #17 Abrasion Resistance Specimens

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Photo No. 7

ANSI Z26.1 Test #19 Chemical Resistance Test Setup



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SECTION 10

REVISION LOG

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