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TEAR, TENSILE, AND PUNCTURE TESTING OF POLYESTER SAFETY FILM: DR25 SR PS9 – US UNITS

Eastman Performance Films, LLC	Date:	August 28, 2019
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4210 The Great Road	Report Number:	ESP031580P.4R0
Fieldale, VA 24089	Client Purchase Order Number:	45508066

REVISION NOTES

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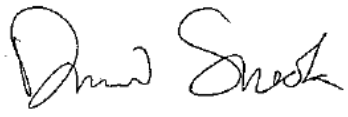
0	Original Release	08/28/19

Prepared by,



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INTRODUCTION

This report presents the results of tear, tensile, and puncture testing conducted on one sample of Polyester Safety Film material. The testing was authorized by Lisa Joyce of Eastman Performance Films, LLC on July 23, 2019. Testing and data analysis were completed August 16, 2019. The scope of work was limited to conducting tear, tensile, and puncture tests on the submitted sample and reporting the results.

CONCLUSIONS

Tear Testing Conclusions

Sample	Average Tear Resistance Force [lbf]	Average Resistance to Tearing [lbf/in]
Machine Direction	28.9	2862
Transverse Direction	29.3	2904

*See note in Test Results regarding ASTM D1004-13

Tensile Testing Conclusions

Sample	Average Break Strength Force [lbf]	Average Tensile Strength at Break [psi]	Average Ultimate Elongation [%]	Average Yield Strength Force [lbf]	Average Yield Strength [psi]	Average Elongation at Yield [%]
Machine Direction	177	17360	176	158	15515	11
Transverse Direction	236	22204	168	152	14361	7

Puncture Testing Conclusions

Average Puncture Strength [lbf]
146.8

SAMPLE IDENTIFICATION

One sample, consisting of one roll of polyester safety film, was received in the lab for testing on August 7, 2019. The sample is identified as DR25 SR PS9 by the client. Specimens were sectioned using dies (tear), film cutters (tensile), and scissors (puncture). Material thickness was measured with adhesive removed as 0.0101 in.

TEST METHOD

The specimens were allowed to condition at standard laboratory conditions of 72 ± 4°F and 50 ± 5% relative humidity for at least 40 hours prior to testing. The thickness of each material was determined for resistance and strength calculations. For this, representative samples were taken from each material thickness, the adhesive was removed with an organic solvent, the samples were cleaned with isopropyl alcohol and an average thickness was determined. All testing was conducted with the adhesive layer intact on the specimens. Testing was performed according to the standards detailed below, with notes of parameters and/or deviations.

Test Method	Test Method Title	Parameters and/or Deviations from Method
ASTM D1004-13	Standard Test Method for Tear Resistance (Graves Tear) of Plastic Film and Sheeting	Die Cut Specimens Test Speed: 2 in/min.
ASTM D882-12	Standard Test Method for Tensile Properties of Thin Plastic Sheeting	2” Grip Separation 1” x 10” Specimens, nominal Test Speed: 20 in/min Initial Strain Rate: 10.0 in/in·min
ASTM D4830/D4830M-98(2014)^{e1}	Standard Test Method for Characterizing Thermoplastic Fabrics Used in Roofing and Waterproofing – Section 7	3” x 3” Specimens Test Speed: 12 in/min

CALIBRATED TEST EQUIPMENT

Honeywell Temp/RH Chart Recorder, S/N 7852 243000007, ID MM190-024, cal. 02/Jul/19, due 02/Jul/20
MTS Universal Test Machine, Mdl Qtest / 50LP, System #1532, ID MM210-009.3 & 6, cal. 08/Mar/19, due 08/Mar/20
MTS Load Cell, 2250lbf Capacity, S/N 558821, ID PT-163-071, cal. 11/Jan/19, due 11/Jan/20
Interface Load Cell, 225 lbf Capacity, S/N 1030173, ID PT-163-067, cal. 15/Mar/19, due 15/Mar/20
Mitutoyo Digital 8" Calipers, S/N 0006565, ID MM160-068, cal. 12/Jul/19, due 12/Jul/20
Mitutoyo Digimatic 6" Calipers, S/N 0080204, ID MM160-106, cal. 12/Jul/19, due 12/Jul/20
Mitutoyo Micrometer, S/N 47007254, ID PT-163-048, cal. 10/Apr/19, due 10/Apr/20
18" Steel Ruler, ID PT-163-043, cal. 20/Dec/18, due 20/Dec/19

TEST RESULTS

Tear Results

Sample	Specimen	Thickness [in]	Tear Resistance Force [lbf]	Resistance to Tearing [lbf/in]
Machine Direction	1	0.0101	29.2	2890
	2	0.0101	29.1	2882
	3	0.0101	27.7	2747
	4	0.0101	27.6	2733
	5	0.0101	28.7	2844
	6	0.0101	31.0	3073
	7	0.0101	29.8	2954
	8	0.0101	27.2	2693
	9	0.0101	29.1	2877
	10	0.0101	29.5	2922
	Average		**28.9**	**2862**
	Standard Deviation		1.2	114
Transverse Direction	1	0.0101	30.1	2984
	2	0.0101	29.3	2897
	3	0.0101	29.6	2932
	4	0.0101	29.5	2924
	5	0.0101	28.3	2801
	6	0.0101	30.8	3048
	7	0.0101	29.1	2884
	8	0.0101	29.0	2869
	9	0.0101	28.9	2862
	10	0.0101	28.6	2834
	Average		**29.3**	**2904**
	Standard Deviation		0.7	72

*ASTM D1004-13 subsection 1.1.1 states, “Although resistance to tear can be expressed in newtons per microns, (pounds-force per mil) of specimen thickness, this is only advisable where correlation for the particular material being tested has been established. In most cases, comparison between films of dissimilar thickness is not valid.”

Nominal thickness of sample material was used for Resistance to Tearing calculations.

TEST RESULTS CONTINUED

Tensile Results

Sample	Specimen	Width [in]	Thickness [in]	Break Strength Force [lbf]	Tensile Strength at Break [psi]	Ultimate Elongation [%]
Machine Direction	1	0.996	0.0101	173	17210	140
	2	0.999	0.0101	183	18164	164
	3	1.010	0.0101	177	17392	188
	4	1.028	0.0101	183	17611	213
	5	1.028	0.0101	170	16425	175
	Average			**177**	**17360**	**176**
	Standard Deviation			6	634	27
Transverse Direction	1	1.116	0.0101	232	20626	165
	2	1.049	0.0101	239	22543	164
	3	1.017	0.0101	233	22663	170
	4	1.052	0.0101	241	22666	174
	6	1.025	0.0101	233	22522	168
	Average			**236**	**22204**	**168**
	Standard Deviation			4	885	4

Sample	Specimen	Width [in]	Thickness [in]	Yield Strength Force [lbf]	Tensile Strength at Yield [psi]	Elongation at Yield [%]
Machine Direction	1	0.996	0.0101	155	15454	11
	2	0.999	0.0101	158	15653	11
	3	1.010	0.0101	160	15735	10
	4	1.028	0.0101	163	15694	11
	5	1.028	0.0101	156	15040	10
	Average			**158**	**15515**	**11**
	Standard Deviation			3	287	1
Transverse Direction	1	1.116	0.0101	152	13458	7
	2	1.049	0.0101	153	14463	7
	3	1.017	0.0101	151	14717	7
	4	1.052	0.0101	155	14576	7
	6	1.025	0.0101	151	14592	6
	Average			**152**	**14361**	**7**
	Standard Deviation			2	513	0

All strength calculations were determined using the measured specimen width and nominal thickness without the adhesive, shown above.

TEST RESULTS CONTINUED

Puncture Results

Specimen	Puncture Strength [lbf]
1	147.8
2	147.7
3	146.6
4	146.9
5	145.2
Average	**146.8**
Standard Deviation	1.1