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TEAR, TENSILE, AND PUNCTURE TESTING OF POLYESTER SAFETY FILM: DR15 SR PS9 – US UNITS

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REVISION NOTES

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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	29.4	2935
Transverse Direction	29.3	2934

*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	175	17045	127	159	15483	10
Transverse Direction	237	22763	170	153	14691	7

Puncture Testing Conclusions

Average Puncture Strength [lbf]
148.1

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 DR15 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 0.0100 in.

TEST METHOD

The specimens were allowed to condition at standard laboratory conditions of $72 \pm 4^{\circ}\text{F}$ and $50 \pm 5\%$ 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	0.0100	29.1	2901	
	2	0.0100	31.6	3159	
	3	0.0100	28.8	2881	
	4	0.0100	30.4	3045	
	5	0.0100	30.8	3077	
	6	0.0100	27.7	2768	
	7	0.0100	30.2	3024	
	8	0.0100	28.4	2836	
	9	0.0100	26.5	2651	
	10	0.0100	30.1	3008	
	Average			29.4	2935
	Standard Deviation			1.6	156
Transverse Direction	1	0.0100	28.7	2867	
	2	0.0100	30.5	3048	
	3	0.0100	29.6	2958	
	4	0.0100	29.2	2917	
	5	0.0100	29.2	2925	
	6	0.0100	29.3	2928	
	7	0.0100	30.4	3040	
	8	0.0100	28.7	2871	
	9	0.0100	28.5	2853	
	10	0.0100	29.3	2932	
	Average			29.3	2934
	Standard Deviation			0.7	67

*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	2	0.996	0.0100	169	16947	87
	6	1.021	0.0100	170	16566	138
	7	1.053	0.0100	186	17646	159
	8	1.000	0.0100	170	16898	115
	9	1.033	0.0100	178	17170	138
	Average			175	17045	127
	Standard Deviation			8	399	27
Transverse Direction	1	1.076	0.0100	256	23750	176
	2	1.038	0.0100	238	22820	175
	4	0.999	0.0100	230	22993	183
	5	1.001	0.0100	218	21678	143
	6	1.073	0.0100	243	22574	175
	Average			237	22763	170
	Standard Deviation			14	749	16

Sample	Specimen	Width [in]	Thickness [in]	Yield Strength Force [lbf]	Tensile Strength at Yield [psi]	Elongation at Yield [%]
Machine Direction	2	0.996	0.0100	155	15508	10
	6	1.021	0.0100	156	15180	11
	7	1.053	0.0100	164	15493	11
	8	1.000	0.0100	157	15635	10
	9	1.033	0.0100	162	15601	9
	Average			159	15483	10
	Standard Deviation			4	180	1
Transverse Direction	1	1.076	0.0100	166	15412	8
	2	1.038	0.0100	151	14486	7
	4	0.999	0.0100	147	14668	6
	5	1.001	0.0100	145	14492	6
	6	1.073	0.0100	155	14398	6
	Average			153	14691	7
	Standard Deviation			8	415	1

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	148.7
2	147.5
3	149.3
4	147.2
5	147.9
Average	148.1
Standard Deviation	0.9