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TEAR, TENSILE, AND PUNCTURE TESTING OF POLYESTER SAFETY FILM: DR15 SR PS5 – 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	16.4	2875
Transverse Direction	16.2	2837

*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	98	17218	148	91	16013	10
Transverse Direction	137	23334	121	89	15226	8

Puncture Testing Conclusions

Average Puncture Strength [lbf]
91.1

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 PS5 by the client. Specimens were sectioned using dies (tear), film cutters (tensile), and scissors (puncture). Material thickness was measured with adhesive removed as 0.0057 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	0.0057	14.9	2608	
	2	0.0057	17.4	3055	
	3	0.0057	16.7	2924	
	4	0.0057	16.2	2849	
	5	0.0057	15.8	2777	
	6	0.0057	17.5	3076	
	7	0.0057	15.5	2726	
	8	0.0057	16.4	2873	
	9	0.0057	16.8	2943	
	10	0.0057	16.6	2918	
	Average			16.4	2875
	Standard Deviation			0.8	144
Transverse Direction	1	0.0057	16.9	2959	
	2	0.0057	15.7	2753	
	3	0.0057	16.7	2928	
	4	0.0057	18.6	3269	
	5	0.0057	16.4	2875	
	6	0.0057	15.1	2652	
	7	0.0057	16.1	2823	
	8	0.0057	15.3	2679	
	9	0.0057	14.9	2606	
	10	0.0057	16.1	2829	
	Average			16.2	2837
	Standard Deviation			1.1	192

*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	5	0.998	0.0057	97	16985	166
	6	0.999	0.0057	95	16667	158
	7	0.998	0.0057	97	16971	153
	8	0.997	0.0057	110	19379	127
	9	1.007	0.0057	92	16087	134
	Average			98	17218	148
	Standard Deviation			7	1262	16
Transverse Direction	1	1.068	0.0057	138	22741	102
	2	1.017	0.0057	132	22794	108
	3	1.019	0.0057	132	22752	106
	4	1.022	0.0057	140	23974	129
	5	1.007	0.0057	140	24407	160
	Average			137	23334	121
	Standard Deviation			4	797	24

Sample	Specimen	Width [in]	Thickness [in]	Yield Strength Force [lbf]	Tensile Strength at Yield [psi]	Elongation at Yield [%]
Machine Direction	5	0.998	0.0057	92	16090	11
	6	0.999	0.0057	91	15919	9
	7	0.998	0.0057	91	15939	10
	8	0.997	0.0057	91	16100	10
	9	1.007	0.0057	92	16019	9
	Average			91	16013	10
	Standard Deviation			1	83	1
Transverse Direction	1	1.068	0.0057	93	15297	8
	2	1.017	0.0057	88	15181	8
	3	1.019	0.0057	88	15169	8
	4	1.022	0.0057	89	15304	8
	5	1.007	0.0057	87	15180	8
	Average			89	15226	8
	Standard Deviation			2	68	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	90.9
2	91.5
3	94.1
4	89.5
5	89.6
Average	91.1
Standard Deviation	1.9