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TEAR, TENSILE, AND PUNCTURE TESTING OF POLYESTER SAFETY FILM: R20 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	17.2	3014
Transverse Direction	16.5	2899

*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	96	16418	172	91	15628	11
Transverse Direction	123	21590	144	85	14944	8

Puncture Testing Conclusions

Average Puncture Strength [lbf]
103.1

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 R20 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 – Specimen Transverse 1 slipped in the grips, and was discarded.

Sample	Specimen	Thickness [in]	Tear Resistance Force [lbf]	Resistance to Tearing [lbf/in]	
Machine Direction	1	0.0057	16.8	2941	
	2	0.0057	18.1	3173	
	3	0.0057	17.0	2989	
	4	0.0057	16.4	2868	
	5	0.0057	17.6	3086	
	6	0.0057	16.2	2843	
	7	0.0057	17.9	3141	
	8	0.0057	18.0	3165	
	9	0.0057	16.6	2909	
	10	0.0057	17.3	3028	
	Average			17.2	3014
	Standard Deviation			0.7	123
Transverse Direction	2	0.0057	15.1	2647	
	3	0.0057	16.4	2869	
	4	0.0057	16.1	2826	
	5	0.0057	17.4	3051	
	6	0.0057	15.7	2758	
	7	0.0057	16.3	2865	
	8	0.0057	18.3	3208	
	9	0.0057	17.2	3017	
	10	0.0057	17.5	3074	
	11	0.0057	15.3	2679	
	Average			16.5	2899
	Standard Deviation			1.0	183

*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	1.031	0.0057	93	15712	176
	2	1.029	0.0057	91	15445	165
	3	1.052	0.0057	91	15204	183
	4	0.999	0.0057	116	20460	182
	5	1.012	0.0057	88	15270	153
	Average			96	16418	172
	Standard Deviation			12	2268	13
Transverse Direction	1	0.998	0.0057	130	22864	158
	2	1.012	0.0057	120	20876	138
	3	0.997	0.0057	130	22797	147
	4	0.997	0.0057	120	21116	148
	6	1.011	0.0057	117	20295	129
	Average			123	21590	144
	Standard Deviation			6	1172	11

Sample	Specimen	Width [in]	Thickness [in]	Yield Strength Force [lbf]	Tensile Strength at Yield [psi]	Elongation at Yield [%]
Machine Direction	1	1.031	0.0057	92	15617	11
	2	1.029	0.0057	93	15798	11
	3	1.052	0.0057	92	15398	10
	4	0.999	0.0057	89	15685	11
	5	1.012	0.0057	90	15643	10
	Average			91	15628	11
	Standard Deviation			2	146	1
Transverse Direction	1	0.998	0.0057	86	15067	8
	2	1.012	0.0057	85	14797	8
	3	0.997	0.0057	85	15030	8
	4	0.997	0.0057	84	14855	7
	6	1.011	0.0057	86	14969	8
	Average			85	14944	8
	Standard Deviation			1	115	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	101.5
2	101.4
3	103.3
4	103.1
5	106.2
Average	103.1
Standard Deviation	1.9