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Corporate Offices / Laboratories

297 Buell Road
Rochester, NY 14624
(585) 328-7668
Fax: (585) 328-7777

SELF IGNITION TEMPERATURE
RATE OF BURN AND SMOKE DENSITY TESTS

Rendered To

TRANSPARENT PROTECTION SYSTEMS, INC.
6643 42ND TERRACE NORTH
WEST PALM BEACH, FL 33407

REPORT NUMBER

ETC-01-753-10724.0

PRODUCT SERIES/MODEL

POLYCARBONATE PLASTIC 0.09 INCH THICK - NON-FOAM PLASTIC

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 POLYCARBONATE PLASTIC 0.09 INCH THICK

Summary of Results

<u>No.</u>	<u>Test Name</u>	<u>Test Method</u>	<u>Test Result</u>	<u>Dade County Criteria</u>
1.	Self Ignition Temperature	ASTM D 1929	800 °F	Passed (> 650 °F)
2.	Rate of Burning	ASTM D 635	C-1	Passed (C-1: <1.0 in/min)
3.	Smoke Density	ASTM D 2843	43.6 %	Passed (< 75 %)

Scope of Work

ETC Laboratories was contracted by Transparent Protection Systems, Inc. to perform Self Ignition Temperature, Rate of Burn and Smoke Density tests on a Polycarbonate plastic 0.09 inch thick material. The tests were performed according to the following test methods:

- ASTM D1929-96 *Standard Test Method for Ignition Properties of Plastics*
- ASTM D635-96 *Rate of Burning and/or Extent and Time of Burning of Self-Supporting Plastics in a Horizontal Position*
- ASTM D2843-93 *Standard Test Method for Density of Smoke from the Burning or Decomposition of Plastics*

The purpose of the testing was to determine the materials ability to meet the requirements of an approved plastic as described in section 3505.2 of the South Florida Building Code.

Test Specimen

One set of specimens has been received by ETC Laboratories and used for testing. The sample was cut into three groups of specimens for the three tests to be performed. The number and the size of the specimens in each group were:

- 20 specimens in the Self Ignition Temperature group measuring 3/4 by 3/4 by 0.09 inch;
- 20 specimens in the Rate of Burn group measuring 6 by 1/2 by 0.09 inches;
- 20 specimens in the Smoke Density Test group measuring 1 by 1 by 0.09 inch;

The specimens were conditioned at 73 degrees F and 50% RH for a minimum of 48 hours prior to testing.

Test Equipment

The Self Ignition Temperature test was conducted with a Blue-M model CF56622C furnace, Watlow Series 942 controller and Altek model 322-1 thermometer. The furnace had been modified to conform to the requirements of the specification; the Watlow controller maintained the desired temperature and the Altek thermometer measured the specimen temperature. Rate of Burn test was conducted using a standard laboratory

Bunsen burner, a ring stand and clamps to hold the wire gauze and specimen as required by the specification. The Smoke Density Test was conducted with an apparatus built by ETC Laboratories to the requirements of ASTM D2843.

Test Procedures

1. ASTM D 1929 Self Ignition Test:

The test was conducted according to the requirements of the ASTM D1929-96. A 3-gram specimen is exposed to a selected temperature within the hot air ignition furnace. Flaming, glowing, or a sudden rise in sample temperature are indications of specimen ignition. If combustion occurs, the temperature is lowered if combustion does not occur, the temperature is raised until the minimum self-ignition temperature is determined.

2. ASTM D 635 Rate of Burning Tests:

The test was conducted according to the requirements of the ASTM D635-96. To begin, the specimens are marked by scribing two lines, 25 mm and 100 mm from one end. Next, the specimen is supported horizontally from the end nearest the 100 mm mark while the other end is exposed to a standard specified gas flame for 30 seconds or until the flame front reaches the 25 mm mark, whichever comes first. The time for the flame front to reach the 25 mm mark, the time to reach the 100 mm mark or for the flame to go out and the extent of burning are measured and recorded. The average time of burning, extent of burning, and rate of burning are calculated and reported as required.

3. ASTM D 2843 Smoke Density Test:

This test was conducted according to the requirements of the ASTM D2843-93. To begin, a specimen is exposed to a standard propane burner flame within a 12" by 12" by 31" high chamber. The smoke generated by the burning specimen is substantially trapped within the chamber. A light beam is passed through the upper portion of the chamber and the intensity of the light through the smoke is measured with a photoelectric cell. The light intensity is plotted versus time and the Smoke Density Rating is calculated as the percentage area under the curve.

Test Results

Listed in Tables 1, 2 and 3 are the results from the Self-Ignition Temperature, Rate of Burn, Smoke Density and Comparative Tensile tests. In Figure 1 the Smoke Density graph is shown. The **Ignition Point** of the sample was determined to be 800 degrees F. The minimum allowed by the South Florida Building Code Section 3505.2 is 650 degrees F therefore; **the sample meets the requirements.**

The **Average Time of Burning (ATB)** of the sample was determined to be 10 seconds (rounded value in accordance with ASTM D 635) and the **Average Extent of Burning (AEB)** was 1.21 in. Therefore; according to the South Florida Building Code Section 3505.2 **the sample meets the requirement and earns a rating of C-1.** During the Rate of Burn Test, none of ten specimens burned to the 100 mm mark, the ATB and AEB were calculated according to section 9.2 of the test method and reported.

The sample earned a **Smoke Density Rating** of 43.6. The maximum allowed by the South Florida Building Code Section 3505.2 is 75 therefore; **the sample meets the requirements.**

Table 1 Self Ignition Temperature Test Result

Specimen Number	Temperature (°F)	Result
1	800	No ignition
2	820	ignition
3	840	Ignition
4	860	Ignition
5	880	Ignition
6	900	Ignition
Spontaneous Ignition Temperature = 800°F		Meets Requirement
SFBC section 3505.2(a) requires a Minimum Self Ignition Temperature above 650°F		

Table 2 Rate/Extent of Burning Test Result

Specimen Number	Time to 25mm (t ₁) seconds	Time to Cease (t) seconds	Burning Rate cm/min
1	13	19	9.79
2	14	25	7.92
3	11	21	10.00
4	10	16	12.38
5	9	29	6.21
6	8	12	14.00
7	10	15	11.20
8	10	15	11.20
9	9	18	10.00
10	10	18	10.67
Average Time, seconds	10.4	18.8	-
Average Time of Burning (ATB), seconds			10
Average Extent of Burning (AEB), in.			1.21
Resultant Rating: C-1			Meets requirement
SFBC 3505.2(a) Requirement: C-1 < 1 in/min, C-2 < 2.5 in/min			

Table 4 Smoke Density Test Result

Time (min:sec)	Light Absorbed (%)				% of Area Represented
	Spec #1	Spec #2	Spec #3	Avg.	
0	0.0	0.0	0.0	0.0 %	0.00
15	19.7	9.2	27.4	18.8 %	1.41
30	62.5	42.4	66.9	57.3 %	5.70
45	75.3	61.6	76.4	71.1 %	9.63
1:00	77.0	62.5	70.8	70.1 %	10.59
1:15	70.1	67.6	65.7	67.8 %	10.34
1:30	60.8	64.0	59.5	61.4 %	9.69
1:45	55.3	60.1	54.8	56.7 %	8.86
2:00	47.9	52.4	50.0	50.1 %	8.01
2:15	42.1	47.6	46.1	45.3 %	7.15
2:30	33.7	42.1	42.3	39.4 %	6.35
2:45	26.9	37.4	39.4	34.6 %	5.55
3:00	22.7	34.0	36.6	31.1 %	4.93
3:15	20.5	31.4	34.3	28.7 %	4.49
3:30	19.6	28.9	32.4	27.0 %	4.18
3:45	19.0	26.9	30.9	25.6 %	3.94
4:00	18.7	25.2	29.6	24.5 %	3.76
Smoke Density Rating = 43.6				Result Meets Requirement	
SFBC 3505.2(a) Requirement: Rating of less than 75					

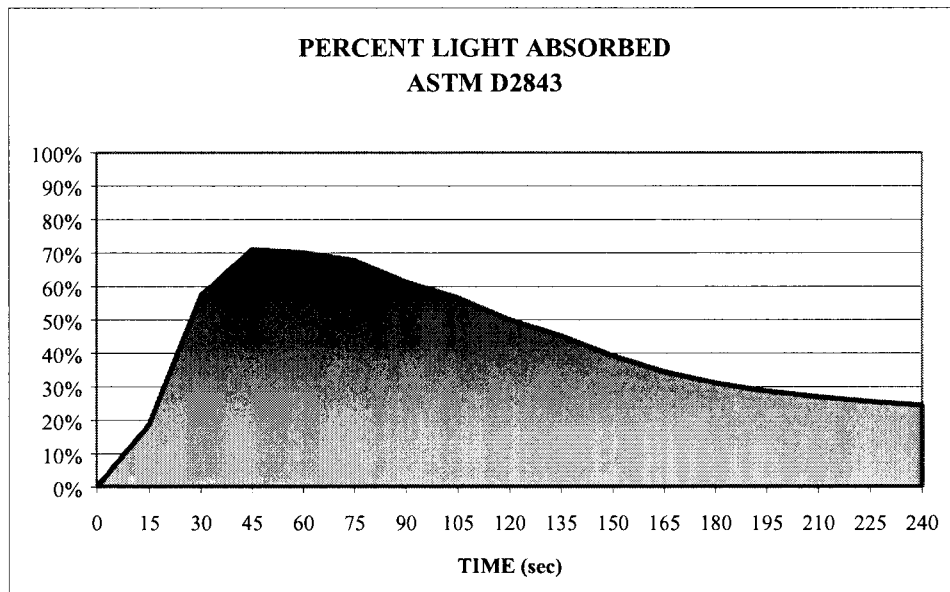


Figure 1 Percent Light Absorbed Versus Time for the Smoke Density Test

Conditions, Terms, and General Notes Regarding The Test

These test results were obtained by employing all requirements of the designated test methods with no deviations. The test results and specimen supplied for testing in compliance with the referenced specifications.

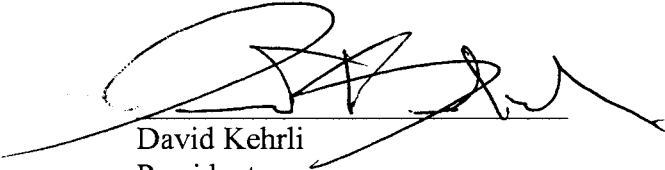
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David Kehrl
President