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FIRE HAZARD EVALUATION USING THE MONSANTO TWO-FOOT FLAME TUNNEL

AND

SMOKE CHAMBER

Performed
on

April 4, 1995

for

Machemco, Inc.

Mr. Frank Brooks/Mr. Jack McLaughlin

Report No. 5096

Fort Worth, Texas

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FIRE HAZARD EVALUATION USING THE MONSANTO TWO-FOOT FLAME TUNNEL AND SMOKE CHAMBER

SAMPLE IDENTIFICATION:

Roofing Material - Rumber

SCOPE OF TESTING:

The purpose of this testing was to determine the protection a material affords its substrate and the comparative burning characteristics of coatings. The testing was accomplished using equipment and procedures to evaluate the flame spread over the surface of the material under controlled conditions. This establishes a basis for comparing surface-burning characteristics of different coatings without specific consideration of all the end-use parameters that might affect these characteristics under actual fire conditions.

In addition to the predicted flame spread rate, the afterflame time, afterglow time, smoldering and smoke developed rate may be measured. However, a relationship should not be presumed among these measurements.

SIGNIFICANCE:

A number of laboratory procedures are used in evaluating the effectiveness of fire-retardant and fire-resistant treatments and coatings. In general these methods measure the three stages of fire development: (1) ignition, (2) flame spread (rate of growth of the fire), and (3) conflagration extent. While all three are of extreme importance, flame spread has been recognized as the main factor associated with testing fire-retardant coatings. The Two-Foot Tunnel apparatus as produced by the Monsanto Company has been designed specifically to predict the performance by the ASTM E-84 (Steiner Tunnel) equipment. Flame spread ratings based upon ASTM E-84 have acquired common acceptance by regulatory agencies, but such large scale tests are seldom practical during the development or modification of a fire-retardant coating.

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This method provides the relative flame spread in comparison with standard materials. Results from the two-foot tunnel test have been shown to correlate to a predicted approximate ASTM E-84 result, according to the following equation:

$$y = 4.8 + 0.92x$$

where x is the result obtained from the Monsanto test apparatus and y is the predicted result from ASTM E-84.

Degree of the density of the smoke, particulate matter, and other effluent given off by the test specimen are continuously recorded during the flame spread test and rated as a percentage of the degree of smoke density of red oak. Comparative smoke density determinations are made by use of the Monsanto Smoke Chamber which was developed as an approximation of the smoke density equipment utilized in the ASTM E-84 equipment. No direct correlation data is available between smoke density results obtained by the Monsanto Chamber and those obtained by ASTM E-84.

TEST EQUIPMENT:

The Monsanto Two-Foot Flame Tunnel and Smoke Chamber consists of a 24 x 4 inch angle-iron frame inclined 28° from the horizontal. The sides and fire-end of the tunnel are covered with 1/4" asbestos-cement board which is attached to the inside of the frame. The open end, fire end and cutout sides allow a natural draft through the tunnel. Heat, gases and smoke rise by convection flow. The sample holder is notched along the bottom, or supporting lip angle at one inch intervals to assist in measurement of the flame advance. An observation window, a two-inch wide strip of 1/8" polished vycor plate, is located just below the sample holder and extending the full length of the tunnel. The glass is calibrated every inch from 4 to 22. The burner, using local commercial gas fuel, is placed 2 1/4" horizontally from the interior of the fire-end of the tunnel. A thermocouple, ignition transformer, time and regulating valve are part of the assembly.

The Smoke Chamber is equipped with a light source, photoelectric cell, milliamperes recorder, necessary stacks, vents and accessories.

Test results are shown on the following page.

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TEST RESULTS:

Test and Calibration Data:

Tunnel is calibrated prior to each day's operation by determining the difference in flame length of standard preconditioned mineral board and red oak boards.

<u>Data</u>	<u>Calibration Panels</u>		<u>Test Specimen</u>		
	<u>Red Oak</u>	<u>Mineral Board</u>	<u>No.1</u>	<u>No.2</u>	<u>No.3</u>
Flame Length (L) (Average of three highest consecutive flame front readings)	16.0	8.0	9	9	9.
Flame Spread (FS) (Flame length of test panel minus flame length of mineral board calibration panel)			1	1	1
Flame Spread Constant (k)					
$\frac{(100)}{L_o - L_a} = \frac{(100)}{(16.0-8.0)} = 12.5$					

EVALUATION OF TEST DATA:

<u>Determination</u>	<u>Test Specimen No. 1</u>	<u>Test Specimen No. 2</u>	<u>Test Specimen No. 3</u>	<u>Avg.</u>
Monsanto Flame Spread Rating (FS multiplied by k)	12.5	12.5	12.5	12.5
FLAME SPREAD - Predicted E-84 value by use of Monsanto formula	16.3	16.3	16.3	16.3

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Note: This test report contains only findings and results arrived at after employing the specified procedures listed herein. These findings and results apply only to the submitted sample or samples. This test report is not intended to constitute a recommendation for, or endorsement of, the product or material tested.

References:

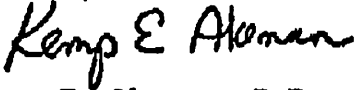
ASTM D3806, Small-scale Evaluation of Fire Retardant Paints (Two-Foot Tunnel Method)

ERDL Report No. 1226, Report No. 111939 Department of Commerce Vandersall, H.L., Journal of Paint Technology, Volume 39, No. 511494, Interior Federal Specification TT-P-00193Z (GSA-FSS) Harland, W.J. Journal of Paint Technology, Vol. 44, No. 57564.

Technician: Les Hall

Sincerely,

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Kemp E. Akeman, P.E.
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