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EVALUATION OF
METAL PRIMERS AND WOOD SEALERS

by

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EVALUATION OF METAL PRIMERS AND WOOD SEALERS

At the request of the Maintenance Division, samples of two coating materials were tested in the Research Laboratory for their suitability as metal primers and wood sealers. These materials were tested in comparison with three other materials of known acceptable quality which were available for similar uses.

Both durability and the practical aspects of handling and application were considered in evaluating and comparing these materials. Water absorption and accelerated weathering tests were run on wood panels treated with the various sealers. Flexibility by bending, and corrosion resistance in a salt fog chamber were determined on the metal panels. The materials involved have been designated as Materials 1, 2, 3, 4, and 5 in the evaluation.

TESTS ON STEEL PANELS

A sufficient number of 18-ga. steel panels for all tests were prepared at one time in the Maintenance Sign Shop in a manner as close to actual practice as possible. In these tests, Materials 1, 2, and 3 were considered as metal primers.

As soon as the panels had cooled to room temperature after cleaning and drying, the various priming materials were sprayed on both faces and all edges sufficient to provide good coverage. These panels were then baked for 15 minutes at 250° F. A finish coat of white sign enamel was then sprayed on and this, too, was baked for 15 minutes at 250° F. This completed the preparation of the steel panels.

The ease of handling and spraying all three materials was considered excellent in all cases.

Bending Test

Flexibility of the coatings was determined by bending over a mandrel according to Department specifications. These specifications require that the coating withstand bending 180 degrees over a 1/2-inch mandrel without checking, chipping, or peeling. Figure 1 shows the three sets of panels after bending. Visual inspection revealed no faults in the surfaces of the panels treated with Materials 1 and 2. Two of the three Material 3 panels did show peeling (left and center panels, bottom of Figure 1). Microscopic inspection showed no further faults other than distention of the coatings due to elongation.

These test panels were then placed in the salt fog chamber to check the continuity of the coatings after bending. Figure 2 shows the results after 81 hours. Material 1 panels which apparently passed the mandrel test definitely corroded. Both the Material 3 panel passing and the two panels failing the mandrel test corroded heavily after 28 hours and became progressively worse to the end of the test as shown. The Material 2 panels showed some stains from corrosion although very few compared with the Material 1 and Material 3 panels.

Corrosion Test

Relative corrosion resistance of the three materials on the original coated panels was determined according to ASTM Method B 117-49T as nearly as possible, using a salt fog chamber conforming to this standard. Three panels of each material were scratched diagonally in both directions across their faces down to the metal with a linoleum knife. Also tested was one plain unscratched panel of each sample. Results of the corrosion tests, including those on the bent panels, are summarized in Table I and photographs of the flat panels after 72 hours in salt fog are shown in Figures 3 and 4.

Under the conditions of these tests, Material 3 exhibited the greatest corrosion resistance. On the scratched panels, Material 3 definitely arrested the creep of rust from the scratches outward under the paint film although there was some blistering of the paint on one of the panels. While Material 2 shows considerable staining in the photograph of Figure 4, actually the rust did not progress from the scratches and there was practically no blistering of the paint film. Material 1 was the least resistant to corrosion and blistered the most of the three materials in the test.

Accelerated Weathering

Three panels each primed with Materials 1, 2, and 3 and painted were subjected to accelerated weathering in the Atlas Weather-ometer, using a cycle of 108 minutes of light alternating with 12 minutes of light with water. The test was continued for 48 cycles of 22 hours each, which approximates 2 years of normal weathering. Observations made both before and after washing with a detergent are recorded in Table II, and the panels after washing the bottom half are shown in Figure 5.

TABLE II. WEATHEROMETER TEST RESULTS

Material	Rating (1)			
	Before Washing		After Washing	
	Discoloration	Loss of Luster	Discoloration	Loss of Luster
Material 1	2	3	8	3
Material 2	6	9	9	9
Material 3	3	3	8	2

(1) 10 - none; 8 - light; 5 - medium; 2 - heavy; 0 - complete failure

In this test, Material 2 showed up best; Material 3 was intermediate and Material 1 poorest.

TABLE I. SUMMARY OF CORROSION TEST RESULTS

	Rating ⁽¹⁾		
	Blistering	Discoloration	Rust Creep at Film Breaks
Scratched Panels			
Material 1	5	5	8
Material 2	9	4	9
Material 3	8	7	7
Plain Panels⁽²⁾			
Material 1	8	6	-
Material 2	10	8	-
Material 3	10	9	-
Bent Panels			
Material 1	-	5	5
Material 2	-	8	10
Material 3	-	3	7

(1) Average of three panels rated 0 - 10 as follows:

- 10 - None
- 8 - Light
- 5 - Medium
- 2 - Heavy
- 0 - Complete failure

(2) One specimen each

TESTS ON WOOD PANELS

Test panels were made of 3/4-inch pine plywood, using Materials 1, 2, 4, and 5 as wood sealers. The plywood panels were 2-3/4 by 6 inches and were oven-dried for 15 minutes at 250° F. before coating. They were then spray-coated with the various materials on all faces and edges and allowed to air-dry. All materials were easy to handle in the shop. Following are approximate times to air-dry:

Material 1	-	2 minutes
Material 2	-	1-1/2 hours
Material 4	-	1 hour
Material 5	-	3 minutes

Water absorption tests were run on one set of panels and another set of panels was subjected to 18 cycles of accelerated weathering in the same manner as the steel panels. This is equivalent to about 9 months of actual weathering and produced sufficient breakdown to warrant termination of the test at this point.

Water Absorption Test

Water absorption was determined in accordance with ASTM Method D 805-52 except that weighings were made at several other intervals of immersion in addition to the 24 hours specified in this test. Absorption is calculated on an oven-dry basis. Table III gives the average results of three panels tested of each of the four sealers and one set of plain untreated panels.

TABLE III. SUMMARY OF WATER ABSORPTION TESTS

Materials	Average Moisture Absorbed, Percent						
	1/2 hr.	1 hr.	3 hr.	5 hr.	7 hr.	24 hr. *	9 da.
Untreated Wood	12	16	23	27	29	38	66
Material 1	5	7	12	15	17	28	52
Material 2	5	7	12	16	18	29	54
Material 4	2	3	6	7	8	17	48
Material 5	7	8	15	19	21	32	61

* ASTM test period

Results of the absorption tests definitely show Material 4 to be the least susceptible to water absorption by a wide margin. There is little to choose among the remaining three although Materials 1 and 2 are slightly superior to Material 5.

Accelerated Weathering

Three wood panels of each of the four samples were subjected to accelerated weathering in the Atlas Twin Arc Weather-ometer, using the same cycle as the one for metal panels. Figure 6 shows the panels after 18 cycles with the unweathered reference. Observations at the end of the test are given in Table IV.

TABLE IV. RESULTS OF ACCELERATED WEATHERING TEST

	Material 1	Material 2	Material 4	Material 5
Checks:				
Av. length, in.	3	2	6	2-6
Av. separation, in.	3/16	1/4	1/8	1/8 - 1/4
Delamination, total in.	none	7 (1)	3-1/2	4-3/4
Surface texture	hard, coarse	hard, coarse	soft, fuzzy	soft, fuzzy
Bleached	yes	yes	yes	yes
Discolored	no	light green	no	no
End Grain	checked	checked	checked	checked
Side Grain	OK	OK	OK	OK

(1) All on one block

In spite of their relatively high moisture absorption, Materials 1 and 2 weathered better than the other two. Panels treated with Materials 1 and 2 showed less surface checking, less delamination of the plywood layers, and retained a better surface than those treated with either Material 4 or Material 5. Material 4 panels were the first to delaminate and show signs of bleaching and second to start checking. The Material 5 group were first to check and the second to bleach and delaminate. Panels treated with Material 1 commenced bleaching, swelling, and checking shortly thereafter, while Material 2 showed these faults only late in the test.

Recommendations

From the results of the tests reported herein, it is recommended that a sufficient quantity of Material 2 be bought to enable a thorough trial by the Maintenance Division in shop practice and field service, both as a metal primer and wood sealer. Final approval should await the outcome of this trial.

Identification of Materials Used in
the Evaluation Study

Material No.	Brand Name	Source
1	Arnex - A	Wyco Paint & Chemical Co. - Detroit
2	Arnex - AS - 100Z	Wyco Paint & Chemical Co. - Detroit
3	Zinc Chromate	Michigan Specification No. 28
4	Woodlife	Protection Products Co. - Kalamazoo
5	Sherwood Sealer	Sherwood Products. - Lansing