MICHIGAN
STATE HIGHWAY DEPARTMENT
Charles M. Ziegler
State Highway Commissioner

ASTM 1954 COOPERATIVE TRAFFIC PAINT TESTS

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In carrying out the decision of Group 2, Subcommittee IV of D-1 to conduct further field and accelerated laboratory wear tests of traffic paints, Michigan again participated in the 1954 tests on the same basis as in previous programs. While most of the other cooperators were to use knurled wheels in a Taber Abraser for the laboratory accelerated abrasion test, Michigan was to continue with a wear table developed in the Research Laboratory of the Highway Department. Parallel field tests were also conducted on a portland cement concrete pavement as prescribed by the committee. No apparatus was available for performing the laboratory abrasion test described by Dr. Vannoy.

The six test paints were received from the National Lead Company on May 28, 1954. Due to the fact that the experimental striping machine was in the process of being completely redesigned and rebuilt, the field stripes could not be put down until September 9, 1954. However, at the time of the last evaluation on March 9, 1955, they had reached an age of 6 months (181 days) and all stripes had reached at least 50 percent wear in the traffic lane, although the total wear in the four wheels tracks of both lanes was less than 50 percent in most cases.

Field Test

Three stripes of each paint were applied transversely across both lanes of the concrete roadway of a four-lane divided highway on US-27 about 8 miles southwest of Lansing. A general view of the test section 33 days after putting down the stripes is shown in Figure 1. This roadway carries an average daily traffic of 4000 vehicles. Detailed observations were made during the application, including air temperature and relative humidity, wet film thickness, drying time, stripe width, time of day and general weather conditions. These observations are recorded in Table 1. The striping machine was designed to deliver an equal quantity of paint to each stripe so that all paints were applied at the same rate of 15 mils wet film thickness irrespective of travel speed of the machine or consistency of the paint. The figures in the table for wet film thickness obtained by a weight check on paper strips show that this value was very closely approximated in all cases. The precision of film thickness control is also demonstrated by the fact that the visible wear was very nearly the same in the three replica stripes of each paint, as can be seen in the photographs of the stripes at the later stages of the tests.

Evaluations were made at monthly intervals and photographs taken at each evaluation. Evaluations were made visually by estimating the area of sub-- strate exposed in each wheel track for a distance of 9 inches each side of the point of greatest wear. It was unfortunate that a mojority of the test paints again failed mostly by scaling or chipping rather than abrasion, making comparison with laboratory abrasion tests difficult.

Laboratory Wear Test

The laboratory abrasion test was conducted by means of the Department's paint wear machine. This machine has been redesigned to employ two knurled steel rings 12-1/2 inches in diameter and 4 inches in width. One of these acts as a drive wheel, rotating a 30-inch Masonite disk approximately 33 rpm. The other wheel, directly opposite the first and aligned in the wear track of the first, rotates freely.

A total of 18 paint stripes can be applied radially on the Masonite disk. In this case, the six paints were applied in triplicate. All paints were applied by pouring and striking off in masked areas to a wet film thickness of 23 mils. The paints were air-cured for a period of three weeks before starting the test.

Actual dry film thicknesses were recorded at intervals of about 2000 revolutions for the first five readings and at intervals of about 20,000 revolutions thereafter. Film thickness was measured by means of the Department's beta ray backscatter thickness gage, results being expressed in mils.

The knurled steel wheels were chromium plated after knurling, but in spite of this it can be stated that a very gradual wheel wear occurs, the amount of which can be estimated from successive tests. Although it is impossible to produce, in the case of any given paint stripe, a uniform pattern of wear across the stripe lengthwise (from side to side of the path created by the tread of the wheel), it is perfectly possible to produce a symmetrical wear pattern. This is accomplished by proper alignment of the wheels, which should be slanted toward each other at their tops approximately one degree from normal. It then remains only to take measurements with the beta gage always at the same spot or area.

Experience in this laboratory has shown that particles of the supporting material may be expected to become dislodged and cover the surfaces of the paint stripes as a thin coating. Since this coating would tend to render the beta gage measurements inaccurate, it has been found expedient to remove it by a brief washing and rinsing, followed by a fast drying with a warm air blast.

Results and Discussion

Results of both the field and laboratory tests are given in Table 3. Also included in this table are the results of the Michigan 1953 tests and the overall results of the ASTM 1953 cooperative tests. Photographs of the test stripes at each of the seven evaluations are also appended.

There are two features of these results that should be singled out for specific comment:

1. The 1954 Michigan laboratory test is in fairly good agreement with the ASTM average for all cooperators in 1953 in spite of wide differences in test equipment and techniques.

2. There is very little correlation between the Michigan field tests and the laboratory tests conducted by either Michigan or the ASTM group.

Concerning the second item just above, it is pertinent to point out again that most of the paints in the Michigan field tests for both 1953 and 1954 failed by scaling or chipping off from the concrete surface, whereas the same paints failed entirely by abrasion in the laboratory. The location of the test section was changed for the 1954 tests to an entirely different highway from that used for the 1953 tests in an effort to avoid this disturbing factor. Although the chipping was not quite as severe last year as it was in 1953, it was still the predominant cause of failure.

While it might be argued that better correlation could be achieved if conditions were so chosen that failure by abrasion only would be assured in both laboratory and field, such a test would fall far short of fully evaluating a traffic paint in service. There are a good many miles of concrete pavement in Michigan where traffic paint has a tendency to scale, and paints that resist this tendency are obviously better than those that do not. This is illustrated in the Michigan field tests for 1953 and 1954 where paints MW-1503 and MW-1715 held the No. 1 and No. 3 ratings respectively for both years in spite of the fact that they show up consistently as poorest of the lot in nearly all other tests. These two paints are the only ones that did not chip or scale appreciably in either field test.

This difference in type of failure means that the same quality is not being measured in the laboratory and field tests, and probably is a major factor contributing to the variable results and generally unsatisfactory correlation obtained in the cooperative program so far. If this is true, then it follows that a laboratory test method which fails to take adhesion to the concrete substrate as well as abrasion into account cannot reasonably be expected to parallel field performance consistently.

TABLE 1

SUMMARY OF APPLICATION DATA

ASTM 1954 Cooperative Tests
September 9, 1954

Paint No.	Stripe Nos.	Time, A.M.	Air Temp.* F.	Rel. Hum. Percent	Drying Time, Min.	Film Thick** Mils	Stripe Width In.
MW-1479	1- 3	10:23	63	64	45	14.7	4-0
MW-1503	4- 6	10:36	---	---	79	15.1	4-0
MW-1517	7- 9	10:51	---	---	34	15.1	4-0
MW-1689	10-12	11:05	---	---	55	14.9	3-7/8
MW-1713	13-15	11:36	69	51	36	15.1	4-0
MW-1715	16-18	11:51	68	50	54	14.8	3-7/8

* Weather clear with a light south wind.

** Calculated by weight from test stripes 100 cm. long on paper strips.

TABLE 2

WEATHER DATA, FIELD TESTS

ASTM 1954 Cooperative Tests

Week Beginning:	Air Temperature Max.	Min.	Mean	Relative Humidity, Percent Max.	Min.	Mean	No. Days Precip.*	No. Days Sunshine **
Sept. 1954								
9	76	46	61.1	94	43	76.0	5	5
16	78	43	61.7	96	34	72.9	4	6
23	83	37	62.0	93	37	65.1	3	7
30	79	37	61.1	95	46	82.6	6	6
Oct. 1954								
7	75	32	59.6	94	28	72.9	6	6
14	72	31	46.2	92	41	74.4	4	5
21	73	35	53.4	96	37	67.0	2	7
28	55	26	36.9	98	48	75.2	6	7
Nov. 1954								
4	63	28	40.7	94	26	68.4	2	6
11	69	25	45.3	91	41	65.0	1	7
18	61	23	40.5	94	58	80.8	6	3
25	43	29	35.4	96	60	83.7	5	3
Dec. 1954								
2	39	12	25.4	92	50	69.9	3	5
9	37	17	29.8	94	62	81.8	5	3
16	35	5	21.9	88	55	75.7	4	4
23	47	23	33.7	97	58	79.0	5	3
30	46	23	34.0	93	55	80.2	4	5
Jan. 1955								
6	43	19	34.0	94	56	71.4	4	6
13	34	13	23.6	87	53	73.1	4	6
20	35	4	20.7	92	42	72.4	6	6
27	30	2	14.6	87	50	69.4	5	6
Feb. 1955								
3	47	0	24.9	96	34	71.7	5	6
10	37	2	20.9	98	55	77.4	7	6
17	49	14	30.6	88	53	71.2	4	7
24	43	15	34.2	98	44	77.4	6	5
Mar. 1955								
3	56	6	28.5	95	43	70.9	6	6
Total - 6 months							118	142

* Occurrence of a trace or more.
** Duration of 1 minute or more.

TABLE 3

TEST RESULTS

ASTM 1954 Cooperative Tests

Paint	Laboratory Wear Tests: No. Revolutions to 50 Percent Reduction, Thousands					Field Wear Tests *: No. Days to 50 Percent Reduction				
	1953 Test	Order of Rating	1954 Test	Order of Rating	(ASTM) 1953	1953 Test	Order of Rating	1954 Test	Order of Rating	(ASTM) 1953
MW-1479	50.3	1	80	2	2	119	6	154	4	1
MW-1503	40.5	2	20	6	5	183+	1	181	1	4
MW-1517	35.8	3	98	1	1	134	5	163	2	2
MW-1689	15.0	4	53	5	3	183	2	29	6	3
MW-1713	11.3	6	59	4	4	137	4	112	5	5
MW-1715	12.8	5	70	3	6	144	3	154	3	6

* Paints evaluated in traffic lane only.

Figure 1. General View of Test Section 33 Days After Application of Paints.