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ASTM 1950 COOPERATIVE CHECK TESTS ON  
PAVEMENT MARKING PAINTS

ASTM Committee D-1, Subcommittee IV, Group 2,  
Cooperative Check Test Project on Traffic Marking Paints

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## ASTM 1950 COOPERATIVE CHECK TESTS ON PAVEMENT MARKING PAINTS

The report presents the results of accelerated field and laboratory wear tests on samples of pavement marking paint furnished by the Glidden Paint Company in September, 1950. The work was done as part of a cooperative group project sponsored by ASTM Subcommittee IV of Committee D-1 in an attempt to develop accelerated laboratory wear tests that would give essentially the same results that would be obtained under field service tests.

The test program included field and laboratory wear tests, accelerated paint settling tests, and determination of dry-to-no-dirt retention time. A total of six samples was received from the Glidden Company, two quarts each, labeled "A" through "F", inclusive.

Due to the fact that only two-quart samples of each paint were received, that a full quart was required for application in the field, and that at least one quart would be necessary for the proposed accelerated settling tests, leaving no paint left over for drying time determinations or other tests, it was decided to omit the accelerated paint settling tests.

### FIELD DURABILITY TESTS

The six paints were applied on October 3, 1950, on M-43, Michigan Avenue, between Lansing and East Lansing at Station 30+00. Traffic conditions approached 9660 vehicles per 24-hour period in one direction only.

Stripes were sprayed transversely across the north half of the boulevard on three-lane concrete 33 ft. in width. The stripes were 4 in. in width and as close to 0.015 in. in thickness as possible. The paint was applied in the usual manner for field service tests using equipment as shown in Figure 1. Field notes made at the time of application are presented in Table I.

Pictures of the different paint stripes when applied and at 100 days are shown in Figure 2. The unlettered stripes, No. 19, 20, and 21 represent paints not included in the group study. A 24-hour inspection was made after application with the notations shown in Table II.

Due to the fact that each stripe was approximately 30 ft. in length, with the exception of stripe No. 29, which was 10 ft. long, and the fact that there were two stripes for each paint, this resulted in a total of twelve wheel tracks over three traffic lanes for each paint (eight wheel tracks for stripes 28 and 29 - paint D).

These wheel track areas were inspected at intervals, and the percent of paint remaining within areas limited to a distance of 9 in. on each side of the point of greatest wear in each wheel track was estimated visually, following ASTM Designation: D 821-47.

The above percentages were averaged for each paint. Each average was plotted against age of the stripes in days, and the age at which this average crossed the 50 percent ordinate was taken as the end point.

The following end points were obtained for the six paints:

<u>Paint</u>	<u>End point, days</u>
D 53290 . . . . .	50
F 53292 . . . . .	54
C 53289 . . . . .	69
E 53291 . . . . .	70
B 53288 . . . . .	86
A 53287 . . . . .	110

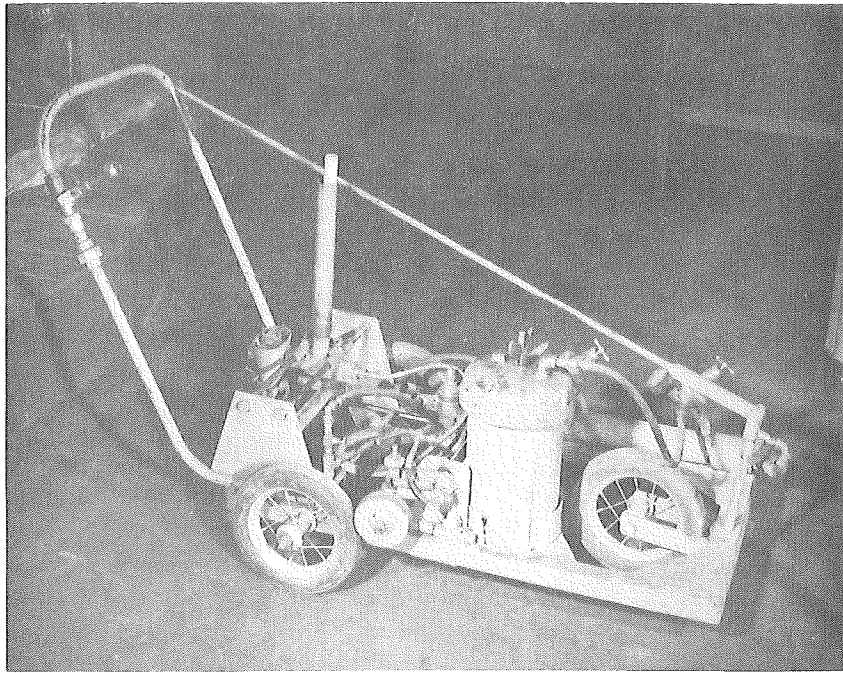
Pictures of each paint stripe at the end of different test periods are shown in Figures 3 and 4.

TABLE I  
SUMMARY OF FIELD TEST APPLICATION DATA

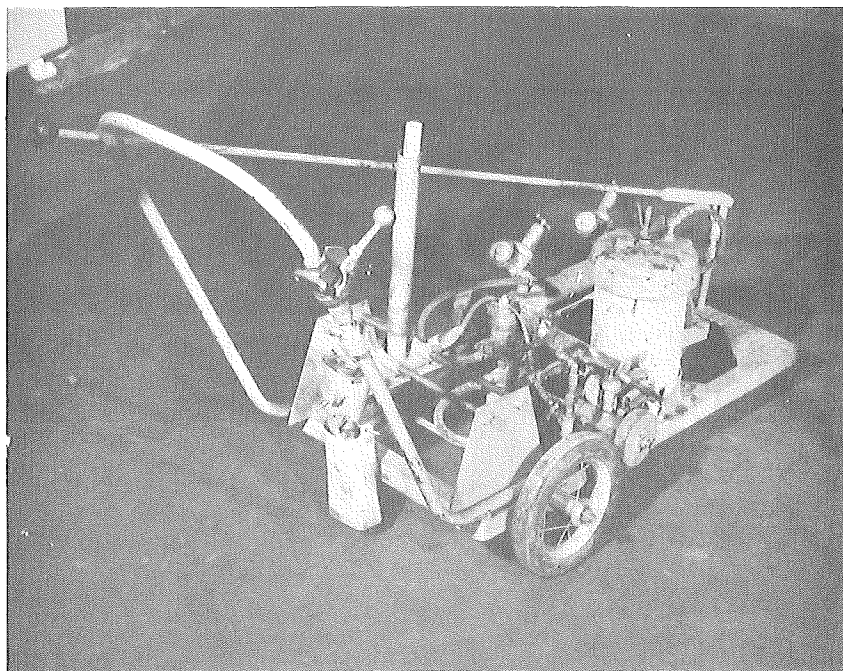
Paint Designation	Stripe Number	Air Temp.	Relative Humidity	Time, Seconds	Film Thickness in. x M	Time of day, p.m.	Weather	Pressure gun, psi.	Atomization psi.	Wind, m.p.h.	Remarks
A 53287	22	58	56	19	12	2:00	PC	50	70	2	Dry to touch 35 minutes
	23	58	56	21	14		PC	50	70	3	
B 53288	24	59	57	15	9		PC	40	60	3	Dry to touch 36 minutes
	25	59	57	15	15		PC	40	60	1	
C 53289	26	59	57	17	12		PC	40	60	2	Dry to touch 34 minutes
	27	59	57	18	16		PC	40	60	2	
D 53290	28	59	57	15	14		PC	20	30	4	Dry to touch 31 minutes Stripe 29 only 1/3 finished*
E 53291	30	58	51	18	17		PC	25	35	3	Dry to touch 34 minutes
	31	58	51	18	13		PC	25	40	7	
F 53292	32	59	47	17	10	3:00	PC	30	45	0	Dry to touch 105 minutes - soft
	33	59	47	16	15		PC	40	65	5	

\* Ran out of paint.

Note: PC equals partly cloudy. October 3, 1950.



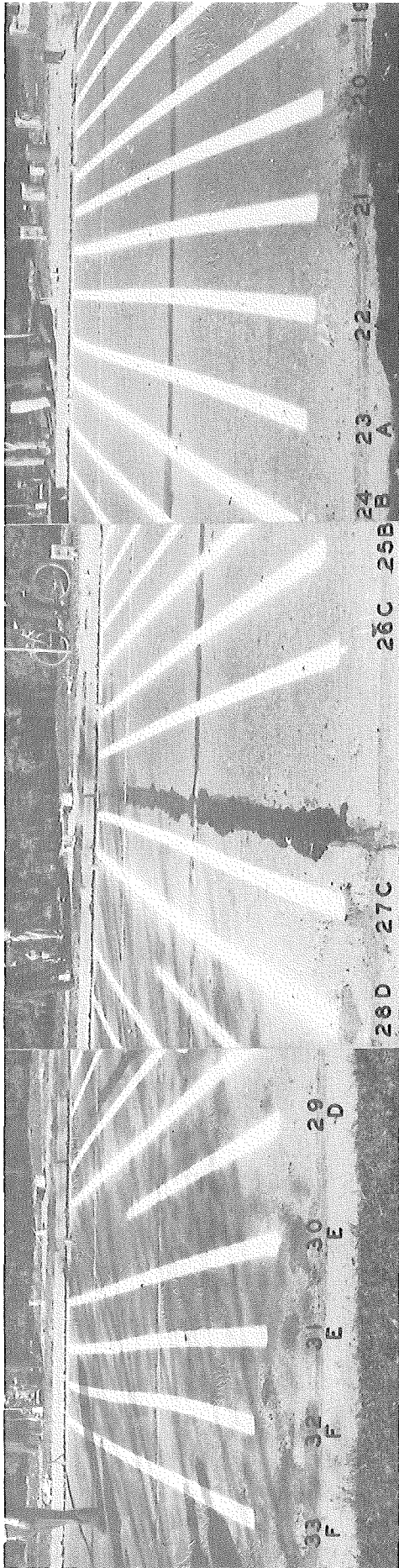
VIEW SHOWING STEERING MECHANISM



VIEW SHOWING BEAD DISPENSER

FIGURE 1

PAINT STRIPING MACHINE



DAY APPLIED

FIGURE 2



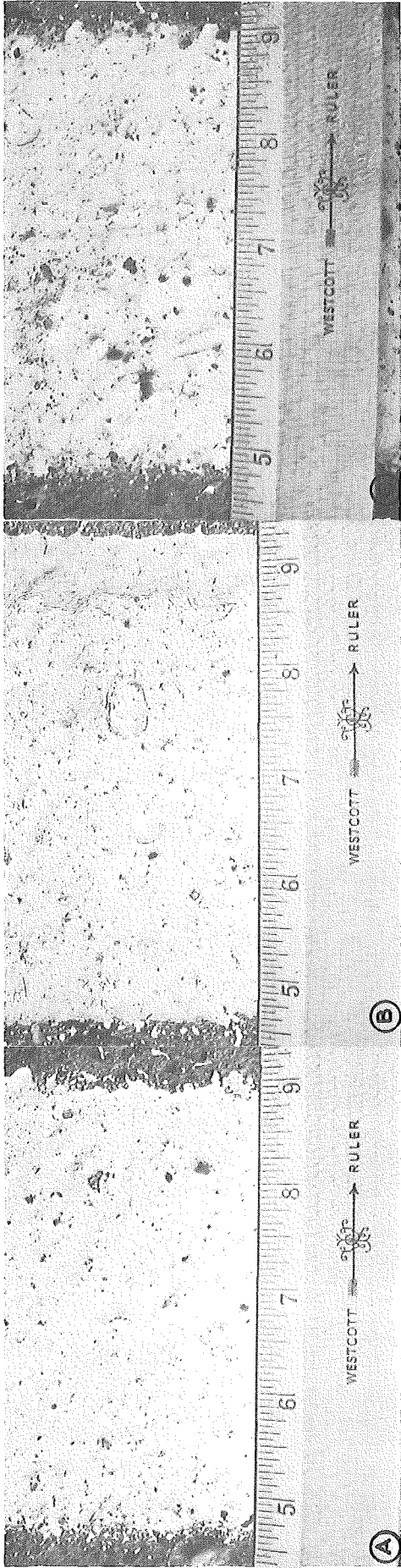
AGE: 100 DAYS

CHANGE IN APPEARANCE OF STRIPES AFTER 100 DAYS

## TABLE II

## SUMMARY OF 24-HOUR INSPECTION DATA

<u>Stripes</u>	<u>Paint</u>	<u>Remarks</u>
22, 23	A 53287	Drying: hard and glossy. Stripes discolored from dirt pickup.
24, 25	B 53288	Drying: hard and semi-glossy. White. No dirt pickup.
26, 27	C 53289	Drying: hard and dull. White. No dirt pickup.
28, 29	D 53290	Drying: orange peel, soft to thumb-nail. Slight discoloration.
30, 31	E 53291	Drying: soft. Stripes discolored from dirt pickup.
32, 33	F 53292	Drying: soft. Very slight discoloration.



AGE 23 DAYS

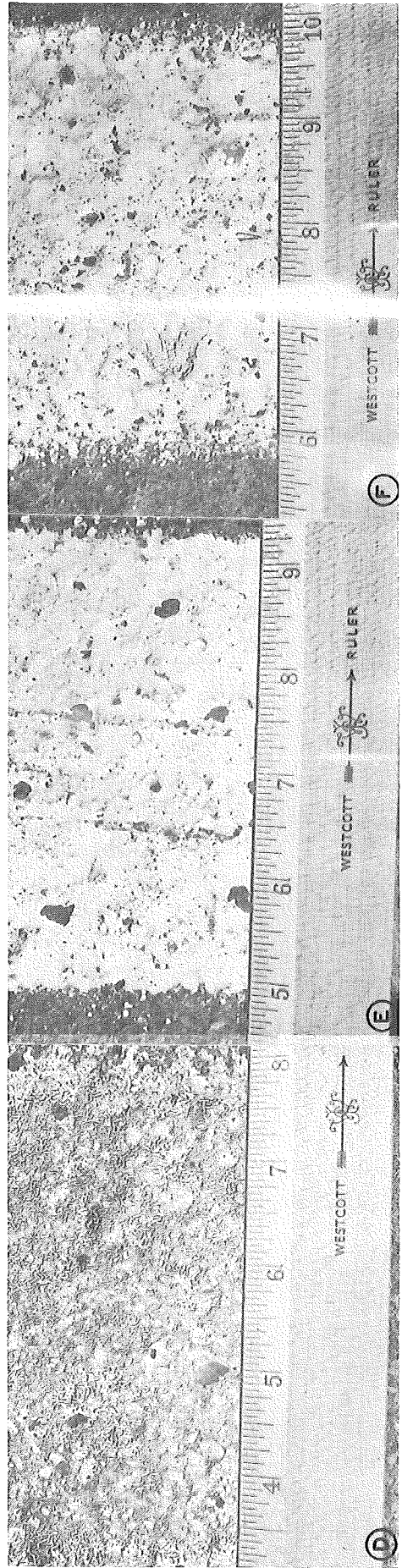


FIGURE 3  
CLOSE-UP VIEWS OF PAINT STRIPES.





▲ STRIPE 25, NORTH WHEEL TRACK .  
NORTH LANE, 50% REMAINING. PAINT B

▲ STRIPE 28, NORTH WHEEL TRACK .  
NORTH LANE, 50% REMAINING. PAINT D

▲ STRIPE 28, NORTH WHEEL TRACK .  
CENTER LANE, 50% REMAINING. PAINT D

AGE: 34 DAYS



◀ STRIPE 32, NORTH WHEEL TRACK .  
NORTH LANE, 50% REMAINING. PAINT F

AGE: 42 DAYS

▶ STRIPE 32, NORTH WHEEL TRACK .  
CENTER LANE, 50% REMAINING. PAINT F



FIGURE 4

WHEEL TRACK AREAS SHOWING 50% WEAR

## LABORATORY WEAR TEST

Wear tests were conducted on the six test paints following the method outlined in Federal Specification TT-P-115 with certain modifications. The photographs showing the laboratory wear machine and the appearance of the stripes at the beginning and at the conclusion of the tests will be found in Figures 5 and 6, respectively.

### Description of Wear Machine

The laboratory paint wear machine differs from the machine designed by the National Bureau of Standards and described in TT-P-115, in the following respects. The revolving turntable is 30 in. in diameter and supports a mortar ring, upon which the paint stripes are applied to a wet film thickness of 0.015 in. For convenience, the mortar ring is made in six equal sections, and when assembled constitutes a ring 30 in. O.D. and 17-3/4 in. I.D. The ring will accommodate eighteen stripes.

Two abrasive wheels are used instead of a single one. The wheel on the left in Figure 5 is the drive wheel, that on the right is the braking wheel. The braking wheel is slowed by means of the tension of a 1 kg. weight on a brake drum. Both wheels are counterbalanced to produce approximately the same pressure within the contact area between the tire and the concrete ring as that obtaining within the tire-pavement contact area in the case of an average motor vehicle.

An automatic water sprinkler simulates normal rainfall during the wet cycles of operation. Drying is done with an electric fan. A revolution indicator counts the number of revolutions of the turntable. Speed of the turntable is 34.5 r.p.m.

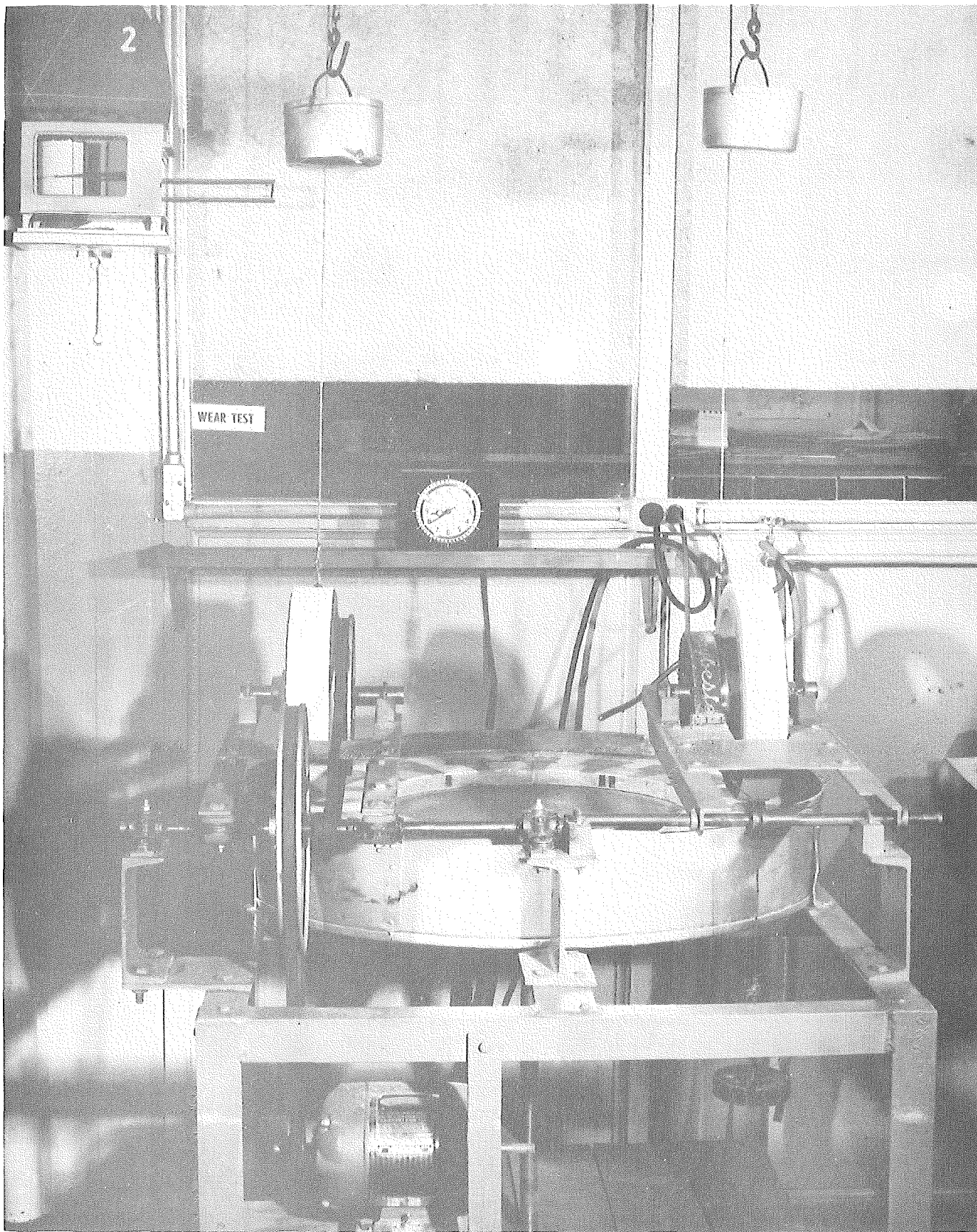
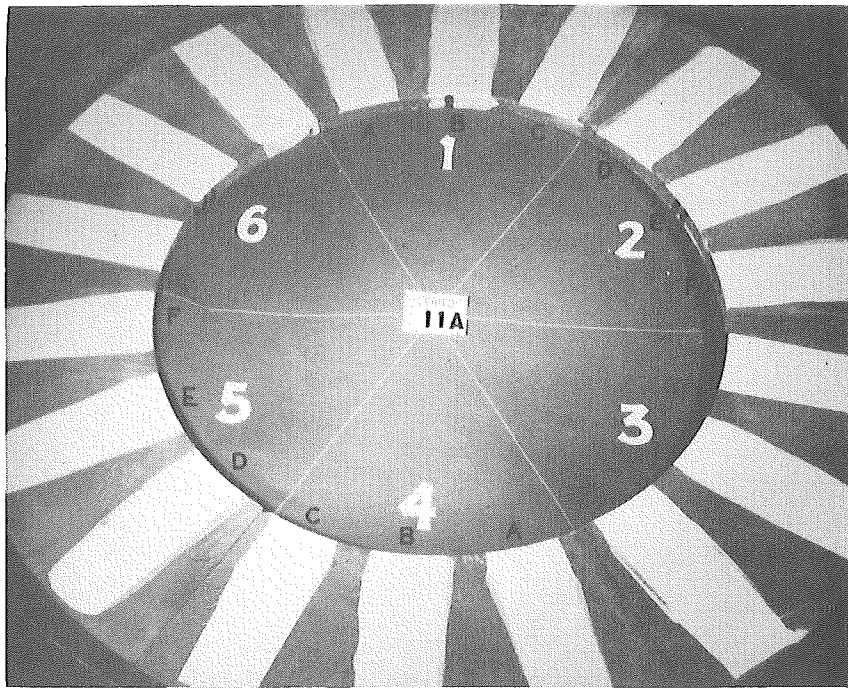
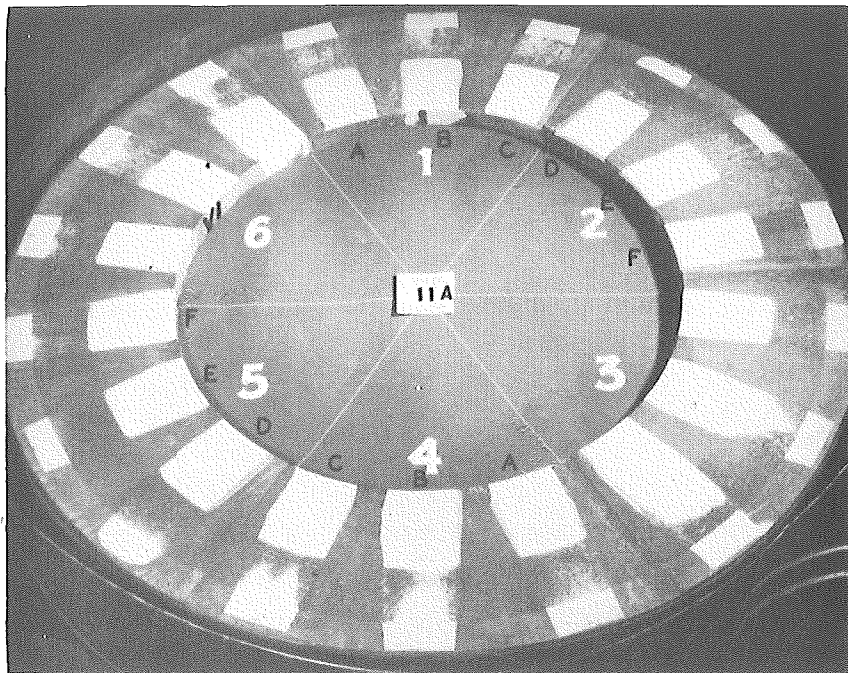


FIGURE 5

MSHD RESEARCH LABORATORY PAINT WEAR MACHINE



AT BEGINNING OF TESTS



AT COMPLETION OF TESTS

FIGURE 6  
LABORATORY WEAR TESTS

In an attempt to reduce air voids to a minimum, the mortar segments upon which the paint was applied were made from a mix designed in accordance with Weymouth's theory of particle interference. The concrete sand used had the following gradation after washing through a No. 200 sieve:

<u>Sieve No.</u>	<u>Percent Passing</u>
20 . . . . .	100.0
30 . . . . .	96.5
40 . . . . .	84.0
50 . . . . .	70.0
80 . . . . .	55.0
100 . . . . .	51.0
200 . . . . .	0.0

Proportions were as follows:

Sand . . . . .	12,470 g.
Cement, standard . . . . .	6,930 g.
Water . . . . .	2,772 g.

On the above basis, the cement content makes the material passing the No. 200 sieve equal to 35.7 percent, which follows Weymouth's curve fairly closely.

This resulted in a mix possessing maximum density and minimum voids.

After curing, the segments were polished with a carborundum hone.

### Test Results

The following results were obtained by the wear test:

<u>Paint</u>	<u>Cycles to 50% Wear</u>
E 53291 . . . . .	16,900
D 53290 . . . . .	22,100
F 53292 . . . . .	26,500
A 53287 . . . . .	35,500
C 53289 . . . . .	41,200
B 53288 . . . . .	44,500

The rate of paint wear is shown by curves in Figure 7.

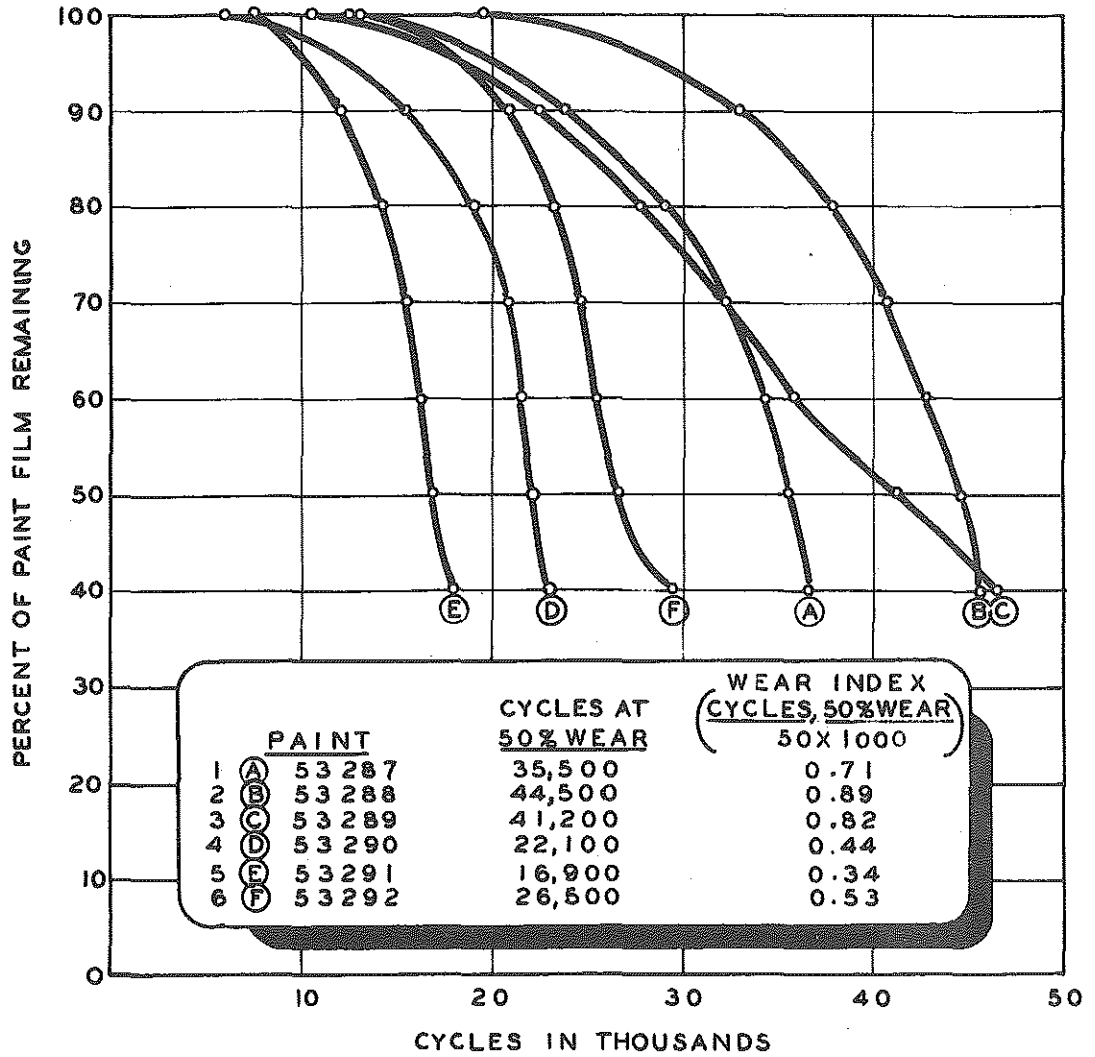


FIGURE 7

RATE OF PAINT LOSS  
ON LABORATORY PAINT WEAR MACHINE

Comparison of Field and Laboratory Wear Tests

For comparative purposes the results of both tests are presented as follows. They have been listed in the order of increasing durability.

FIELD TESTS		LABORATORY TESTS	
<u>Paint Designation</u>	<u>Days to Produce 50% Wear</u>	<u>Paint Designation</u>	<u>No. Cycles to 50% Wear</u>
D 53290	50	E 53291	16,900
F 53292	54	D 53290	22,100
C 53289	69	F 53292	26,500
E 53291	70	A 53287	35,500
B 53288	86	C 53289	41,200
A 53287	110	B 53288	44,500

No attempt is made to explain the poor correlation between these results and those from the field, other than to point out that such an explanation might be sought in the relative rates of "cure" of the different paints. It is conceivable that a given paint might possess twice the wearing qualities of another paint, provided both paints are allowed to cure naturally in the field for several weeks before being subjected to significant amounts of traffic. On the other hand, the wearing qualities might be the same or even reversed if heavy traffic is allowed over the paint continuously, starting within 30 minutes after application, because of the shorter cure in the latter case. Laboratory evidence to substantiate this view has been obtained on other paints since these wear tests were made.

### DRYING TIME TESTS

Times of drying to no pickup, to track free, and to no dirt retention were determined on the test paints, following the method suggested by the Committee in its "Draft of Proposed Tentative Method of Test for Dry to No Dirt Retention of Traffic Paint". See Appendix for test procedure.

The following results were obtained:

<u>Paint</u>	<u>Time of Dry to No Pickup, min.</u>	<u>Time of Dry to Track Free, min.</u>	<u>Time of Dry to No Dirt Retention hours</u>
A 53287	160	161	31.0
B 53288	218	307	27.7
C 53289	245	272	24.7
D 53290	1488	155	21.6
E 53291	318	335	9.4
F 53292	50	246	23.3

\*Note: It was noted by the operator that the paint films applied using paint D were very rough and uneven due to particles of pigment.

The above are averages of four separate determinations for each paint. All paints were applied by doctor blade to 0.015 in. wet film thickness. Application and entire test were conducted at 77° F. and 56 percent relative humidity.

#### Comparison between Durability and Time of Dry to No Dirt Retention

The following comparisons are noted between time of dry to no dirt retention and durability (Table III).



TABLE III

## COMPARISON BETWEEN PAINT WEAR AND DRYING TIME

Field Durability	Drying Time to No Dirt Retention	Laboratory Wear Test
Order of increasing durability	Order of time, increasing	Order of increasing durability
D	E	E
F	D	D
C	F	F
E	C	A
B	B	C
A	A	B

## APPENDIX

### Draft of Proposed Tentative Method of Test for Dry to No Dirt Retention of Traffic Paint

#### Scope

1. This method describes a laboratory test to determine the length of drying time after application of a traffic or pavement-marking paint for the film to show no dirt retention from the track of an automobile tire.

#### Apparatus

2. The apparatus shall consist of the following:
  - (a) A conventional type drawdown gage that casts a film having an approximate wet thickness of 0.015 in. (applicator clearance of approximately 0.02 in.).
  - (b) A weighted wheel (A.S.T.M. Designation D711-48 Apparatus Paragraph 2).
  - (c) One glass panel 6- by 12- in. for each paint to be tested.
  - (d) One U.S. Standard #50 mesh screen.
  - (e) Road soil reagent, moisture free.
  - (f) Dry inch paint brush.

#### Procedure

3.
  - (a) The panel shall be placed on a horizontal surface.
  - (b) A film of the paint(s) under test shall be applied by applicator gage the entire length of the glass panel, care being taken to move the gage at a uniform rate for each of the paints applied. The time of application shall be recorded and the coated panel allowed to remain in a horizontal position during the entire test under laboratory conditions specified (preferably 25°C. and 50 to

60 percent relative humidity).

- (c) After the film has dried "to no pick up", according to A.S.T.M. D711-48 it shall then be tested at intervals for dry to no dirt retention.
- (d) The dried soil reagent that passes the U.S. Std. 50 mesh screen shall be sprinkled crosswise of the entire width of the paint film in a band not less than 1/4 in. wide.
- (e) The weighted wheel shall be rolled along across the film on top of the band of soil. The test area shall immediately be brushed lightly with a clean, dry inch paint brush to remove free and excess soil.
- (f) The end point is reached when no particles of soil are visibly imbedded in the paint film after brushing. Record the time.

The dry to no dirt retention is the elapsed time between the application and the time at which the end point is reached.

NOTE: Slight smudging or staining is to be ignored.