R-271

A COMPARATIVE STUDY of the DROP-IN and OVERLAY METHODS of REFLECTORIZING TRAFFIC PAINTS

NOVEMBER 1956

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A paper to be presented at the
Thirty-Sixth Annual Meeting of the Highway Research Board
Washington, D. C., January 7-11, 1957

Highway Research Project 47 G-36 (7a)

Research Laboratory
Testing and Research Division
Report No. 271
November 21, 1956

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SYNOPSIS

In the course of the development of Michigan's Traffic paint procurement procedures it became desirable to establish a fixed policy with regard to the use of glass beads for reflectorization. Two methods, drop-in and overlay, were studied in controlled field tests on concrete and bituminous surfaces conducted in much the same way as the annual performance tests for procurement purposes.

Two top quality paints, both white and yellow, were applied in four different wet film thicknesses using the same amount of binder and the same overall bead grading in the companion stripes for each film thickness. In the drop-in method, 6 lb. of beads per gallon of paint were dropped in the wet paint film immediately after application; in the overlay method, 4 lb. of beads per gallon of paint were premixed and 2 lb. dropped on the prebeaded paint in the stripe. The test was continued for more than a year with evaluations at approximately 3-month intervals.

The results indicated little difference in the performance of paints reflectorized by the two methods. In most cases, any observable difference was in favor of the drop-in method when the test stripes were evaluated on the basis of performance over the entire test period. It was found also in these tests that thicker films gave longer-lasting stripes, but that life was not increased in proportion to the amount of material used.

A COMPARATIVE STUDY OF THE DROP-IN AND OVERLAY METHODS OF REFLECTORIZING TRAFFIC PAINT

For the past 4 years, Michigan has been purchasing white and yellow traffic paint on the basis of performance tests. During this time the specifications governing procurement procedures provided for the testing and purchase of reflectorized paint furnished in one of the following four ways:

1. Paint only. Entire bead complement to be provided by the Michigan State Highway Department.

2. Paint containing no beads. Entire bead complement to be furnighed by the paint vendor.

3. Paint with beads premixed. Supplementary drop-in beads to be provided by the Michigan State Highway Department.

4. Paint with beads premixed. Supplementary drop-in beads to be furnished by the paint vendor.

Each vendor was not only free to choose any one of these ways of furnishing the paint but also permitted to specify the type of reflectorization to be used with his paint in the test stripes, whether or not he proposed to furnish the beads. This policy originated in the desire to leave the way open for the acceptance of proprietary products and to give each prospective vendor the opportunity of furnishing a complete paint-bead system should he so choose.

It soon became evident that procurement procedures could be considerably streamlined and statewide striping operations greatly simplified if it were possible to standardize on a single method of reflectorization. Prior to adopting the performance method of testing, traffic paints were reflectorized by the overlay method wherein 4 lb. of beads (Type 2A) per gal. of paint were premixed and 2 lb. of beads (Type 1A) dropped on the prebeaded paint in the stripe. A troublesome feature of this method, however, is the difficulty of maintaining spray guns in working order during application, especially in putting down black-white skip lines, where the white paint valve opens and closes every 50 ft. The fine beads indent the valve seats and score the stems, resulting in frequent interruptions to repair the gun to keep the paint from leaking over the black segment of the stripe.

Consequently, it was decided to conduct controlled field tests of paints reflectorized by both the drop-in and overlay methods to serve as a basis for the selection of a single method to be used in future work. In the meantime, the question of optimum film thickness for maximum economy and performance had been raised, so the scope of the tests was extended to include this variable also.

DESCRIPTION OF TESTS

Both white and yellow paints of known good performance from two different producers and of entirely different formulations were placed in two test sections, one each on portland cement concrete and bituminous concrete. These two test sections were located adjacent to those for regular performance tests on US 27 between Lansing and Charlotte and the paints were applied in September and October, 1954. The tests were conducted in the same general way as the annual performance tests, procedures for which have been given in detail in a previous paper (1). For convenience, however, pertinent features will be described briefly in connection with the present tests.

Application

Wet film thicknesses of 12, 15, 18 and 21 mils were used for the drop-in applications and corresponding thicknesses of 14.4, 18.0, 21.6 and 25.2 mils for the premix applications. These premix film thicknesses took into account the bulking due to 4 lb. of beads per gal. of paint so that the same amount of binder was present in the corresponding applications by drop-in and overlay. Both sets carried the same proportion of beads of the same grading. In the one case, all 6 lb. (per gal.) were dropped in; in the other, 4 lb. were premixed and the other 2 lb. dropped on. The gradings of the two types of beads used in the overlay method combined to produce the grading used for drop-in. All three gradings are given in Table 1, and some physical properties of the four paints in Table 2.

Rate of application was controlled to within plus or minus 5 percent of the specified film thickness by the use of a specially designed spraying machine which delivers a metered quantity of paint to each stripe by direct

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(1) Procuring Traffic Paints on the Basis of Performance Tests. C. C. Rhodes, Proceedings, Highway Research Board, Vol. 35.

displacement. Three stripes were used for each application and detailed observations were made during the work, including air temperature and relative humidity, atomization pressure, wet film thickness, drying time, and stripe width. Nominal rates of application and actual wet film thicknesses of the test stripes are given in Table 3, and a summary of application data in Table 4.

Evaluation

Day and night evaluations were made independently by four different observers shortly after the paints were put down and at intervals of approximately 3 months thereafter for almost a year and a half, making a total of seven evaluations. Details of the method of rating may be found in the paper previously referred to. However, this method of rating constitutes an important feature of the Michigan procedure and is briefly described below because of its bearing on the interpretation of the test results.

At each evaluation, individual stripes are given ratings of 0 to 10 on each of three qualities - night visibility, durability, and general appearance. These three qualities are not considered of equal importance and night visibility is weighted 50 percent, durability 40 percent, and general appearance 10 percent. After the final evaluation, a service factor is determined for each paint which represents its overall performance in all of the test sections over the entire test period. Service factor is defined as the sum of the products of the average weighted rating for each time interval between evaluations and the time of the interval in days, and this sum divided by 100. Mathematically it is expressed as

$$\text{Service Factor} = \frac{r_1t_1 + r_2t_2 + \ldots r_nt_n}{100}$$

where r_1, r_2, etc. are the average weighted ratings for the time intervals t_1, t_2, etc. in days between successive evaluations.

Thus it can be seen that this method of evaluation takes into account the performance of the stripes during all stages of the test and does not necessarily put the paints in the same order as that determined by terminal ratings alone. This point will be illustrated later in the discussion of the results obtained in the present tests.

RESULTS AND DISCUSSION

The complete results of the tests are given in Table 5 and in the graphs of Figure 1, which show weighted rating plotted against time for all applications. In Table 6, service factors for each rate of paint application have been combined into a single value for each of the two methods of reflectorization by averaging the results from two test sections for both white and yellow paints from the two different sources. Also shown in Table 6 are the ratios, in percent, of these service factors to one representing perfect performance. Perfect service factor is calculated on the basis of a weighted rating of 10 throughout the test - the highest possible score. Since the average period covered by the seven evaluations in these tests was 483 days, the service factor for perfect performance is 48.3.

Drop-In Versus Overlay

In general the drop-in application performed better than the overlay but the superiority is not great nor is it consistent. From the results in Table 6 it may be seen that the apparent superiority of the drop-in application in the thinner films falls off as the rate of application increases so that there is no significant difference in the results for the two reflectorization methods in the heavier films.

For all practical purposes the two types of application may be regarded as equal in performance when evaluated on the basis of service factor as defined above. In a majority of cases terminal ratings were higher for the overlay applications at 483 days, but failed to compensate for the better performance of the corresponding drop-in applications in the earlier stages of the test. This fact illustrates the point brought out in the previous section concerning terminal condition versus overall performance as a criterion for appraisal and shows that the method of evaluation in this case has considerable influence on the interpretation and use of test results. However, even if terminal rating alone were employed as a basis for judgment in the present tests, the general conclusion that the two methods were essentially equal in performance would still hold.

Rate of Application

Data on which to base an estimate of the relative economy of the various rates of application may be found by referring again to Table 6. In making the cost analysis for the various film thicknesses, the average service factor for both methods of reflectorization will be used, since the material costs for a given rate of application are the same regardless of the way the beads are applied. In other words, the amount of paint binder used in the four rates of application is 13.2, 16.5, 19.7, and 23.0 gal. per mi. respectively, and by design these quantities of binder are the same for both methods of reflectorization. However, the wet film thicknesses as applied are 20 percent greater for the overlay applications than for the drop-in due to the bulk of the premixed beads. In both methods, bead quantities bear a fixed ratio to the volume of paint, so the cost of this item is also the same for drop-in and overlay applications. In addition, the cost of application must be included and will be assumed constant for the various rates of application, as the operation itself costs little more at an application rate of 23 gal. per mi. than at 13.

For the purpose of comparison, the cost of each application rate will be adjusted on the basis of its performance compared to an application having a perfect rating for the entire test period. To do this, the cost per mile of continuous 4-in. stripe is divided by the decimal fraction corresponding to "percent of perfect" to give a figure representing cost per mile per unit of service. Assuming that the cost of the paint plus beads is \$3.00 per gal. and the operational cost is \$10.00 per mile, the average costs per mile per unit of service for the four rates of application are as follows:

$$\frac{(13.2 \times \$3.00) + \$10.00}{0.51} = \$\ 97.25$$

$$\frac{(16.5 \times \$3.00) + \$10.00}{0.56} = \$106.25$$

$$\frac{(19.7 \times \$3.00) + \$10.00}{0.58} = \$119.14$$

$$\frac{(23.0 \times \$3.00) + \$10.00}{0.62} = \$127.42$$

It is evident from the foregoing analysis that the heavier films gave better service, but not in proportion to the amount of material used. By a simple calculation it can be shown that the three heavier applications would have had to have ratings of approximately 61, 71 and 81 percent of perfect, respectively, in order to equal the unit cost of the lightest application.

Drying Time Versus Film Thickness

Average drying times and wet film thicknesses for all of the sections reflectorized by the two methods are given in Table 7. As would be expected, drying time increased with increasing film thickness. Except for the lightest application rate, the drying times of stripes reflectorized by the overlay method were shorter than those of the corresponding stripes with drop-in beads and the difference became greater as the film thickness increased. It is also apparent that drying times for these paints became excessive at application rates of more than 16.5 gal. per mi.

CONCLUSION

The results of this study definitely pointed to abandonment of the overlay method of reflectorization in favor of the drop-in application as a standard method in Michigan. While the two methods are practically equal in efficiency and material cost, there is a considerable difference between them in the cost of operation and equipment maintenance. In addition to the damage to paint guns by premixed beads mentioned previously, there is an extra expense incurred when the mixing of beads and paint is done by the paint crews on the job. Trouble has been encountered in getting proper mixing by means of the agitators in the paint tanks and sometimes excessive settling occurs on standing. Besides this, there is a tendency for the fine beads to drift while being transferred to the paint tank, especially on windy days, and these beads find their way into equipment bearings and moving parts, causing destructive abrasion.

These tests also show that it would not be economical to increase the rate of application from the 16.5 gal. per mi. used at present in Michigan. In fact, the reverse is indicated. Moreover, drying time is a critical quality of traffic paints and sometimes hampers the formulation of more durable products. Thinner films would make it possible to tolerate a normally slower dry, thus offering more leeway to the formulator in the development of better traffic paints.

TABLE 1

GLASS BEAD GRADINGS

Sieve No.	Sieve Opening, Inches	Total Percent Passing		
		Overlay Method		Drop-In Method
		Type 1A	Type 2A	1A-2A mixed 1:2
30	0.0232	100.0	---	100.0
40	0.0165	67.6	---	89.2
50	0.0177	14.1	100.0	71.4
60	0.0098	2.5	97.5	65.9
100	0.0059	---	45.7	30.5
200	0.0029	---	5.1	3.4

TABLE 2

PHYSICAL PROPERTIES OF TEST PAINTS

Test	Brand No. 1		Brand No. 2	
	White	Yellow	White	Yellow
Paint Composition, percent by wt.				
Pigment	57.7	57.0	67.8	68.1
Vehicle	42.3	43.0	32.2	31.9
Vehicle Composition, percent by wt.				
Non-volatile matter	43.2	41.6	33.2	33.8
Volatile matter	56.8	58.4	66.8	66.2
Wt. per Gal.; 77 F., lb.	12.24	12.39	14.17	14.62
Consistency, 77 F., KU	72	69	78	77
Drying Time, min., ASTM D711	95	97	45	50
Color, daylight illumination				
Chromaticity coordinate x	0.331	0.475	0.315	0.446
Chromaticity coordinate y	0.326	0.419	0.324	0.416
Luminous Directional Reflectivity, percent	86	69	78	51

TABLE 3

RATES OF APPLICATION

Brand No.	Refl. Method	Nominal Rate of Application[a]			Actual Wet Film Thickness, Mils[b]			
					White Paint		Yellow Paint	
		Gal. Per Mi.	Film Thick., Mils	Permissible Range, Mils	Test Section 1	Test Section 2	Test Section 1	Test Section 2
1	Drop-in	13.2	12.0	11.4 - 12.6	11.3	12.5	12.4	12.5
		16.5	15.0	14.3 - 15.7	15.0	14.9	15.0	14.8
		19.7	18.0	17.1 - 18.9	18.1	17.7	17.5	17.9
		23.0	21.0	20.0 - 22.1	20.7	20.6	20.6	21.4
	Overlay	15.8	14.4	13.7 - 15.1	13.9	13.9	14.0	14.6
		19.7	18.0	17.1 - 18.9	18.5	18.1	18.2	17.9
		23.7	21.6	20.5 - 22.7	21.1	21.4	22.1	21.3
		27.6	25.2	23.9 - 26.5	24.9	24.6	24.9	25.7
2	Drop-in	13.2	12.0	11.4 - 12.6	12.9	11.8	12.6	12.0
		16.5	15.0	14.3 - 15.7	15.0	14.6	15.1	15.0
		19.7	18.0	17.1 - 18.9	18.7	18.4	18.2	17.3
		23.0	21.0	20.0 - 22.1	21.4	21.2	21.4	21.5
	Overlay	15.8	14.4	13.7 - 15.1	15.6	14.2	15.2	14.8
		19.7	18.0	17.1 - 18.9	18.9	18.8	18.7	18.0
		23.7	21.6	20.5 - 22.7	21.8	21.4	20.5	22.0
		27.6	25.2	23.9 - 26.5	26.4	24.7	25.4	24.6

(a) Exclusive of drop-in beads.
(b) Calculated by weight from test stripes 100 cm. long on paper strips.

TABLE 4
SUMMARY OF APPLICATION DATA

Test Area	Pavement	Color	Paint Brand No.	Refl. Method	Nominal Wet Film Thickness, Mils	Stripe No.	Time	Air Temp., deg. F	R. H., Percent	Drying Time, Min.	Calc. Film, Mils	Atom. Pressure, psi.	Stripe Width, Inches	Date Applied	Weather
TEST AREA 1	CONCRETE	WHITE	1	Drop-in	12.0	1- 3	9:15	63	69	30	11.3	50	3-3/4	Aug. 31, 1954	Clear - light North wind
					15.0	4- 6	9:53			46	15.0	50	3-7/8		
					18.0	7- 9	10:20			53	18.1	50	3-7/8		
					21.0	10-12	10:36			51	20.7	50	4-0		
				Overlay	14.4	13-15	12:04	71	48	26	13.9	40	4-0		Clear - moderate wind
					18.0	16-18	12:50			27	18.5	40	3-7/8		
					21.6	19-21	1:36			30	21.1	40	3-7/8		
					25.2	22-24	2:04	71	48	42	24.9	40	4-0		
			2	Drop-in	21.0	25-27	11:10	46	72	70	21.4	30	4-0	Oct. 19, 1954	Clear - mild Northwest wind
					18.0	28-30	11:45	49	67	37	18.7	30	4-0		
					15.0	31-33	12:04			51	15.0	30	4-0		
					12.0	34-36	12:16	50	55	32	12.9	30	4-0		
				Overlay	25.2	37-39	1:42	51	50	80	26.4	30	3-7/8		
					21.6	40-42	2:04			59	21.8	30	3-7/8		
					18.0	43-45	2:23	52	46	37	18.9	30	4-0		
					14.4	46-48	2:47			40	15.6	30	3-7/8		
		YELLOW	1	Overlay	14.4	1- 3	12:48	73	61	50	14.0	50	3-7/8	Sept. 1, 1954	Clear - moderate West wind
					18.0	4- 6	1:22			59	18.2	46	4-0		
					21.6	7- 9	1:37			63	22.1	40	4-0		
					25.2	10-12	2:25			71	24.9	40	3-7/8		
				Drop-in	12.0	13-15	3:15	77	48	35	12.4	40	3-7/8		Hazy - moderate West wind
					15.0	16-18	3:32			53	15.0	40	3-7/8		
					18.0	19-21	3:50			67	17.5	40	3-7/8		
					21.0	22-24	4:36	76	48	94	20.6	40	4-0		
			2	Overlay	25.2	25-27	10:20	56	62	85	25.4	30	4-0	Oct. 21, 1954	Clear - light West wind
					21.6	28-30	10:50			60	20.5	30	4-0		
					18.0	21-33	11:06			54	18.7	30	3-7/8		
					14.4	34-36	11:38	59	52	27	15.2	30	3-7/8		
				Drop-in	21.0	37-39	1:05	61	44	100	21.4	30	3-7/8		
					18.0	40-42	1:35			70	18.2	30	4-0		
					15.0	43-45	1:48			52	15.1	30	3-7/8		
					12.0	46-48	2:09	64	38	41	12.6	30	3-7/8		
TEST AREA 2	BITUMINOUS	WHITE	1	Overlay	25.2	25-27	9:50	80	57	82	24.6	40	3-7/8	Sept. 2, 1954	Clear - light Southwest wind
					21.6	28-30	10:15			65	21.4	40	3-7/8		
					18.0	31-33	10:43			41	18.1	40	3-7/8		
					14.4	34-36	11:22			31	13.9	40	3-7/8		
				Drop-in	21.0	37-39	12:53			83	20.6	40	4-0		Moderate West wind
					18.0	40-42	1:10	85	56	67	17.7	40	4-0		
					15.0	43-45	1:32			45	14.9	40	4-0		
					12.0	46-48	1:54			28	12.5	40	3-7/8		
			2	Overlay	25.2	1- 3	1:36	65	52	119	24.7	30	4-0	Oct. 22, 1954	Clear, calm
					21.6	4- 6	1:55			84	21.4	30	4-0		
					18.0	7- 9	2:15			35	18.8	30	4-0		
					14.4	10-12	2:41			51	14.2	30	3-7/8		
				Drop-in	21.0	13-15	3:00	67	49	95	21.2	30	4-1/8		Clear, light West wind
					18.0	16-18	3:15			67	18.4	30	4-0		
					15.0	19-21	3:27			48	14.6	30	4-0		
					12.0	22-24	3:45	65	56	35	11.8	30	3-7/8		
		YELLOW	1	Drop-in	21.0	37-39	9:58	62	89	102	21.4	40	4-0	Sept. 8, 1954	Light overcast - moderate West wind
					18.0	40-42	10:23			80	17.9	40	4-0		
					15.0	13-15	10:39			66	14.8	40	3-7/8		
					12.0	46-48	10:58	63	64	49	12.5	40	3-7/8		
				Overlay	25.2	49-51	12:31	65	61	64	25.7	40	4-0		
					21.6	52-54	12:43			57	21.3	40	4-0		
					18.0	55-57	1:03			58	17.9	40	3-7/8		
					14.4	58-60	1:21	66	53	44	14.6	40	3-7/8		
			2	Drop-in	21.0	1- 3	9:42	49	86	223	21.5	30	4-0	Oct. 22, 1954	Clear, calm
					18.0	4- 6	10:01			89	17.3	30	4-0		
					15.0	7- 9	10:15			68	15.0	30	4-0		
					12.0	10-12	10:30	54	76	55	12.0	30	4-0		
				Overlay	25.2	13-15	10:54			108	24.6	30	3-7/8		
					21.6	16-18	11:20			85	22.0	30	4-0		
					18.0	19-21	11:33			67	18.0	30	4-0		
					14.4	22-24	11:40	63	55	65	14.8	30	4-0		

TABLE 5

SUMMARY OF APPLICATION DATA

1954 TRANSVERSE STRIPES

BRAND	AGE IN DAYS	FACTOR EVALUATED	WHITE								YELLOW							
			DROP - IN				PREMIX				DROP - IN				PREMIX			
			12 Mils	15 Mils	18 Mils	21 Mils	14.4 Mils	18.0 Mils	21.6 Mils	25.2 Mils	12 Mils	15 Mils	18 Mils	21 Mils	14.4 Mils	18.0 Mils	21.6 Mils	25.2 Mils
BRAND 1	8	General Appearance	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
		Durability	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
		Night Visibility	7.8	7.2	7.2	7.7	7.9	7.0	7.1	4.8	8.5	7.9	7.2	7.1	7.9	7.4	7.5	7.5
		Weighted Rating	8.9	8.9	8.8	8.9	9.0	8.5	8.6	7.4	9.3	9.0	8.6	8.6	9.0	8.7	8.8	8.8
	73	General Appearance	7.1	7.0	7.3	6.9	7.1	8.4	8.7	9.5	6.0	6.4	6.4	6.3	6.3	7.4	7.9	9.2
		Durability	8.9	9.0	9.3	9.3	7.5	9.0	9.2	9.3	6.3	7.8	7.1	8.3	6.1	7.9	7.9	9.3
		Night Visibility	7.8	8.3	8.1	8.8	7.1	7.0	7.2	5.6	5.8	7.0	6.6	7.4	5.4	6.3	6.3	6.5
		Weighted Rating	8.2	8.5	8.5	8.8	7.3	8.0	8.2	7.5	6.1	7.3	6.8	7.7	5.8	7.1	7.1	7.9
	157	General Appearance	6.1	6.5	6.6	6.4	5.4	6.3	6.8	7.6	3.8	4.4	4.6	4.6	3.8	4.4	5.0	5.7
		Durability	6.0	7.0	7.2	7.4	5.1	5.8	6.8	7.4	4.1	5.6	5.7	6.4	3.5	5.2	5.9	6.7
		Night Visibility	4.7	5.5	5.5	5.9	3.8	4.6	5.5	4.8	3.4	4.3	4.2	4.9	2.8	3.6	3.6	4.0
		Weighted Rating	5.4	6.2	6.3	6.6	4.5	5.3	6.2	6.1	3.8	4.9	4.8	5.5	3.2	4.4	4.7	5.3
	224	General Appearance	4.5	4.6	4.6	4.6	4.1	5.0	5.5	6.0	3.8	3.9	4.0	4.0	3.6	4.4	4.6	5.2
		Durability	5.2	6.0	6.3	6.3	4.3	5.2	5.9	6.3	3.8	4.8	4.9	5.4	3.4	4.9	5.3	6.0
		Night Visibility	3.5	4.3	4.4	4.6	3.7	4.3	4.8	5.5	3.0	3.8	4.3	4.8	2.5	3.2	3.4	3.6
		Weighted Rating	4.3	5.0	5.2	5.3	4.0	4.8	5.3	5.9	3.5	4.2	4.5	5.0	2.9	4.0	4.3	4.8
	318	General Appearance	4.0	4.3	4.5	4.5	3.6	4.1	4.6	4.9	2.8	3.0	3.3	3.4	2.6	3.5	4.0	4.0
		Durability	4.3	5.0	5.8	5.9	3.2	4.2	4.7	5.1	3.1	4.1	4.3	4.9	2.8	3.7	4.3	4.9
		Night Visibility	2.2	2.3	2.6	3.2	2.5	3.2	3.6	3.9	1.5	2.4	2.5	2.9	1.6	2.0	2.3	2.2
		Weighted Rating	3.3	3.6	4.1	4.4	2.9	3.7	4.2	4.5	2.3	3.2	3.3	3.8	2.2	2.9	3.2	3.5
	373	General Appearance	3.5	4.1	4.8	4.5	2.6	3.4	4.0	4.5	2.4	2.8	3.2	3.3	1.9	2.8	3.4	4.0
		Durability	4.1	5.3	5.5	5.8	3.2	4.4	4.6	5.1	2.4	3.2	4.3	4.5	2.2	3.2	3.9	4.9
		Night Visibility	1.7	2.0	2.3	2.3	1.9	2.5	3.3	3.8	1.7	2.4	2.8	3.4	1.6	2.2	2.2	2.7
		Weighted Rating	2.9	3.6	3.9	3.9	2.5	3.4	3.9	4.4	2.1	2.8	3.5	3.9	1.9	2.7	3.1	3.7
	483	General Appearance	2.5	3.0	3.2	3.2	2.2	2.7	3.2	3.5	1.5	2.2	2.5	2.2	2.0	2.2	3.2	3.2
		Durability	2.3	3.9	4.1	4.0	1.6	2.8	3.1	3.6	1.3	2.1	3.0	3.0	1.7	2.4	3.0	3.6
		Night Visibility	1.8	2.1	2.5	2.2	1.7	2.5	3.1	3.7	1.4	2.0	2.4	3.1	1.9	2.1	2.4	2.5
		Weighted Rating	2.1	2.9	3.2	3.1	1.8	2.7	3.2	3.7	1.4	2.1	2.7	3.4	1.8	2.3	2.7	3.0
BRAND 2	7	General Appearance	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
		Durability	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
		Night Visibility	7.9	7.5	6.3	7.1	7.4	7.5	7.1	7.5	7.7	6.3	6.0	6.9	7.3	7.2	6.9	7.0
		Weighted Rating	9.0	8.8	8.2	8.6	8.7	8.8	8.6	8.8	8.9	8.2	8.0	8.5	8.6	8.6	8.5	8.5
	90	General Appearance	7.2	7.6	7.5	8.3	7.4	7.6	7.9	8.6	7.9	7.9	8.1	8.4	7.8	8.3	8.4	8.9
		Durability	8.9	9.2	9.4	9.5	8.8	9.1	9.1	9.2	9.4	9.6	9.6	10.0	9.5	9.5	9.9	9.9
		Night Visibility	6.6	7.5	7.5	7.4	6.1	6.0	5.5	5.7	6.7	6.8	7.0	7.1	5.6	5.6	5.8	5.6
		Weighted Rating	7.6	8.2	8.3	8.3	7.4	7.4	7.2	7.4	7.9	8.0	8.2	8.4	7.4	7.5	7.7	7.7
	175	General Appearance	5.5	6.0	6.1	6.1	6.3	6.6	7.0	7.4	6.2	6.5	6.8	6.5	6.5	6.8	7.0	7.7
		Durability	7.7	8.4	8.6	9.0	7.4	8.2	8.6	9.0	8.2	8.6	8.9	9.3	8.0	8.4	8.6	9.1
		Night Visibility	6.1	6.6	7.2	7.6	6.6	7.0	6.8	7.4	5.6	6.3	7.0	7.1	5.9	6.1	6.0	5.8
		Weighted Rating	6.7	7.4	7.7	8.0	6.9	7.5	7.6	8.0	6.7	7.3	7.7	7.9	6.8	7.1	7.2	7.4
	269	General Appearance	5.6	6.1	6.4	6.4	5.6	6.1	6.7	7.5	5.6	5.6	6.6	6.0	6.0	6.2	6.5	7.4
		Durability	7.7	8.5	8.3	9.1	6.9	7.4	7.6	8.8	8.1	8.6	8.8	8.9	7.6	8.1	8.5	9.0
		Night Visibility	4.4	5.3	5.4	5.9	4.8	5.5	5.7	6.2	3.4	4.3	4.7	5.8	3.8	4.3	4.2	4.3
		Weighted Rating	5.9	6.7	6.7	7.3	5.7	6.4	6.6	7.4	5.6	6.2	6.4	7.1	5.6	6.0	6.2	6.5
	349	General Appearance	6.1	7.1	7.5	7.5	5.6	6.1	7.2	8.4	5.2	6.3	6.1	6.4	5.8	6.4	6.6	7.6
		Durability	7.3	8.5	8.7	8.7	6.0	7.0	7.5	8.4	6.8	7.8	8.1	8.7	6.1	7.0	7.7	8.3
		Night Visibility	3.3	3.8	3.9	4.5	3.7	4.4	5.2	5.6	3.4	3.9	4.7	5.4	3.3	3.7	4.0	4.3
		Weighted Rating	5.2	6.0	6.1	6.5	4.8	5.6	6.3	7.1	5.0	5.7	6.2	6.9	4.7	5.3	5.8	6.3
	434	General Appearance	3.7	4.2	4.5	4.5	3.2	4.0	4.2	5.7	3.7	4.0	4.2	4.2	3.7	4.2	5.0	6.2
		Durability	5.4	7.1	7.6	7.7	3.8	4.9	5.6	7.9	5.1	5.6	6.9	7.1	4.0	5.5	6.3	7.6
		Night Visibility	3.2	3.4	3.4	3.1	3.3	3.9	4.0	4.4	3.1	3.5	3.9	3.8	3.9	4.1	4.3	4.5
		Weighted Rating	4.2	5.1	5.2	5.1	3.5	4.3	4.7	6.0	4.0	4.4	5.2	5.2	4.0	4.7	5.2	5.9
	498	General Appearance	4.3	5.3	5.8	6.1	4.1	4.6	4.9	6.1	3.7	4.4	5.3	6.1	3.8	4.5	5.0	6.0
		Durability	4.2	5.2	5.8	6.3	3.6	4.4	5.1	6.1	3.8	4.5	5.6	6.0	4.1	4.7	5.4	6.4
		Night Visibility	1.7	2.1	1.9	1.8	2.4	3.1	3.5	4.1	2.0	1.7	2.3	2.6	2.4	3.0	3.1	3.9
		Weighted Rating	3.0	3.7	3.9	4.0	3.1	3.8	4.3	5.1	2.9	3.1	3.9	4.3	3.2	3.8	4.3	5.2

TABLE 6

SERVICE FACTORS

Gal. of Paint Per Mile[a]	Drop-In		Overlay		Average, Both Methods	
	Service Factor	Percent of Perfect[b]	Service Factor	Percent of Perfect[b]	Service Factor	Percent of Perfect[b]
13.2	25.6	53	23.4	48	24.5	51
16.5	27.6	57	26.4	55	27.0	56
19.7	28.6	59	27.8	58	28.2	58
23.0	30.2	62	29.8	62	30.0	62

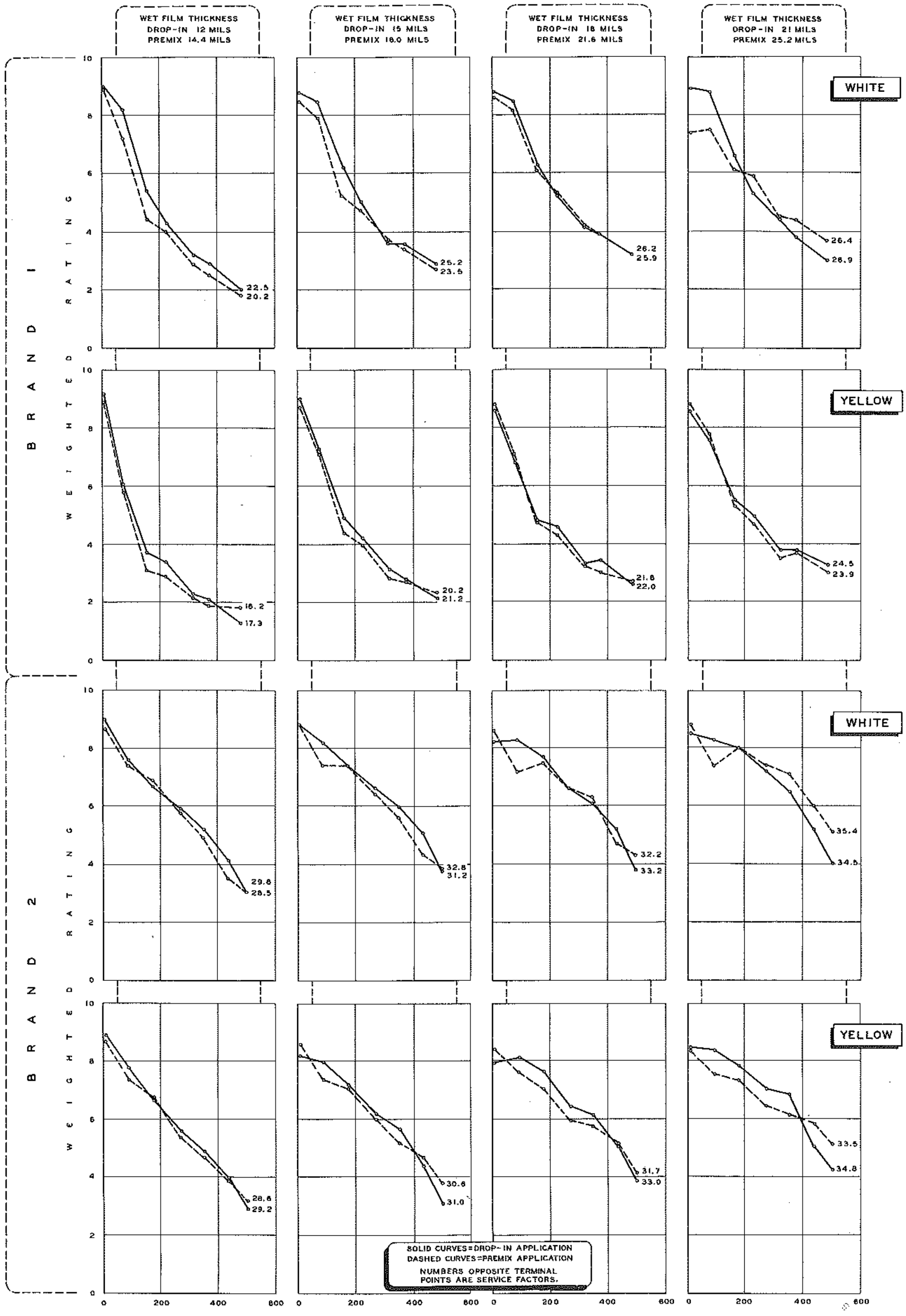
(a) Exclusive of beads of any kind
(b) Service Factor for perfect performance = 48.3

TABLE 7

WET FILM THICKNESS AND DRYING TIME

Gal. of Paint per Mile[a]	Drop-In Method: Wet Film Thickness, Mils[b] Nominal	Drop-In Method: Wet Film Thickness, Mils[b] Average for Method	Drop-In Method: Average Drying Time, Min.	Overlay Method: Wet Film Thickness, Mils[b] Nominal	Overlay Method: Wet Film Thickness, Mils[b] Average for Method	Overlay Method: Average Drying Time, Min.	Average Drying Time Both Methods, Min.
13.2	12.0	12.3	38	14.4	14.5	42	40
16.5	15.0	14.9	54	18.0	18.3	47	51
19.7	18.0	18.0	66	21.6	21.5	63	65
23.0	21.0	21.1	102	25.2	25.1	81	92

(a) Exclusive of beads of any kind
(b) Exclusive of drop-in beads



WEIGHTED RATINGS AND SERVICE FACTORS OF EXPERIMENTAL TRAFFIC STRIPES

FIGURE 1