R-270

MICHIGAN
STATE HIGHWAY DEPARTMENT
Charles M. Ziegler
State Highway Commissioner

1955

PERFORMANCE TESTS

OF WHITE AND YELLOW TRAFFIC PAINT

A. J. Permoda
W. Martin

Highway Research Project 47 G-36(8)

Research Laboratory
Testing and Research Division
Report No. 270
November 2, 1956

1955

PERFORMANCE TESTS OF WHITE AND YELLOW TRAFFIC PAINT

Transverse stripes for performance tests to be used as a basis for the purchase of 1957 white and yellow traffic paint requirements were put down last summer in the period August 24 to September 1, 1955. During this period weather conditions were very favorable for paint stripe application.

Altogether, 23 paints were applied in the test sections, white and yellow from each of 10 producers and three additional yellows made to our specifications for experimental use. According to the effective Department specifications, revised June 15, 1955, the producers had the privilege of recommending the rate of application of their paint as well as the particulars of bead application. The sources of the test traffic paints and the applicable recommendations are as follows:

TABLE 1

Source	Recommended Rates	
	Paint	Beads
	Gal per Mile	Pounds per Gal
1. Acme White Lead	16.5	6 on, MSHD No. 3
2. Cook Paint Co.	16.5	6 on, MSHD No. 3
3. Garland Co.	16.5	6 on, MSHD No. 3
4. Glidden Co.	16.5	6 on, MSHD No. 3
5. Silver Lead Co.	16.5	6 on, MSHD No. 3
6. Minn. Mining & Mfg. Co.	16.5	2 on, MSHD No. 1A
7. Baltimore P & C Works	16.5	2 on, Baltimore
8. Prismo Corporation	15.0	6 on, Prismo
9. LKR Chem. Products	16.5	4 in, 2 A: 2 on, 1A
10. Truscon Laboratories	16.5	4 in, 2 A: 2 on, 1A
11. MSHD No. 9A - Yellow	16.5	4 in, 2 A: 2 on, 1A
12. MSHD No. 10A - Yellow	16.5	4 in, 2 A: 2 on, 1A
13. MSHD No. 11A - Yellow	16.5	4 in, 2 A: 2 on, 1A

MSHD Experimental Formula 9A was based on an alkyd-Parlon vehicle, 10A on an epoxy-ester vehicle, and 11A on a silicone-alkyd vehicle.

Application

All paints were applied in four test sections across two lanes of roadway as before. Three stripes of every paint were applied in each test section. The paints were identified only by code number, with the stripes in each section being numbered consecutively in the order of application. Location of the various paints was again rotated in the four sections. The location of the test sections is given in Figure 1 which also shows the position, within the sections, of the various test paints by code number.

Recommendations of the manufacturer with regard to rate of paint application and type of bead application, i. e. drop-in or overlay, were followed carefully. When the manufacturer did not specify the rate of application, his paint was applied at the rate of 16.5 gallons per mile, which corresponds to a wet film thickness of 15.0 mils. All paints were deposited at wet film thicknesses deviating less than 5 percent from the recommended value as determined by a weight check at the site of application. A summary of the recorded application details including weather data, film thickness, drying time, and stripe width is given in Table 5.

As mentioned previously, test paint suppliers had the option of specifying the type of bead application desired for their products. Where no preference was expressed, MSHD Type III beads were applied by drop-in at the rate of 6 pounds per gallon of paint. Premix paints received 2 pounds of glass beads per gallon as an overlay.

Application personnel had observed that a short lineal distance of spray machine travel is generally required to build up to the preset, volumetric paint delivery from the spraying equipment. Because of this, the test stripes were started in the passing lane where performance ratings are no longer taken, and finished in the traffic lane where performance rating are taken. On divided highways, as employed in three out of four test areas, such application procedure is possible and was used to give added assurance of obtaining the present film thickness on all stripe portions in the traffic lane.

Qualification Tests

In accord with the specification requirements laboratory qualification tests for color, reflectivity, consistency, bleeding and settling were made on all test paints. The details of these requirements are given in the specifications. Results of the tests are given in Table 3, which shows that the following paints failed to meet one or more of the requirements as indicated:

White Paint

No. 76 Drying time, settling, bleeding on asphalt.

No. 82 Bleeding on tar.

No. 90 Settling.

Yellow Paint

No. 77 Drying time.

No. 83 Color, bleeding on asphalt.
This paint also had low reflectivity, although no minimum for this quality has been set in the specifications.

No. 91 Settling.

No. 94 Bleeding on asphalt, settling.

Field Performance Ratings

Ratings on the test stripes were made in all four test areas a few days after stripe deposition and at three month intervals thereafter. The average values for the factors evaluated are recorded in Table 4 for all test paints. The final evaluations on Test Areas 1 and 2 on US 27 - M 78 were made at about the 11-month level instead of twelve, in order to exclude from the ratings the erosion effects associated with travel of construction equipment in that zone.

The test stripes in Area 4, Bituminous, were not rated at the 12 month level because the traffic lane in that area was planed off. No notification to that effect was received by the rating team. Accordingly the 12 month's weighted rating of the test stripes is an average value for three instead of four test areas.

Results of Field Performance Tests

Half-year and one-year service factor values for all test stripes are tabulated in Table 2 along with corresponding one year's "percent of best" and "percent of perfect" values. A column in Table 2 also lists the results of the previously mentioned qualification tests.

An interim report on the results of the qualification tests was issued to the committee prior to its spring meeting on June 15, 1956. By action of the committee at that meeting the producers submitting paints, 76, 77, 82, 83, 90 and 91, not meeting the qualification tests, were disallowed from submitting paints for the 1956 performance tests.

Table 2 also includes a column listing the one-year "percent of perfect" values obtained in the 1954 performance testing of paints supplied by the same producers in 1954 as in 1955. In our mathematical rating system the "percent of perfect" value is an absolute one and can, within the limits of duplication, be used to compare paints participating in a one year's test program as well as paints submitted by the same producer for the different yearly tests.

A comparison of the "percent of perfect" values in Table 2 for white paints shows a decline in serviceability in Paint 84 and an improvement in Paint 76 between 1955 and 1954. Six other participating paints show no significant change in serviceability on this basis.

The same comparison for the yellow paints shows a decline in serviceability for Paints 85 and 92 and an improvement in Paints 81, 77, 89 and 75 between 1955 and 1954. Three other participating paints show no significant change in serviceability on this basis.

No recommendation concerning the paints to be selected for bids is made here. If the 50-percent-of-perfect value was used as a minimum acceptable value then six white paints and five yellow paints would be eligible for bid requests.

TABLE 2

SERVICE FACTORS
1955 Transverse Stripes
Age 348 Days

1954 One Year Percent of Perfect Value	Paint Number	Service Factors 184 days	Service Factors 348[a]	348 Days Percent of Best	348 Days Percent of Perfect	Qualification Tests[b]
		White Paints				
76	84[c]	12.3	21.6	100	62	P
56	80	11.9	20.4	94	59	P
48	76	13.5	19.5	90	56	NP
	78	13.2	19.1	88	55	P
54	74[c]	12.4	19.1	88	55	P
50	72[d]	11.8	18.7	87	54	P
50	88[d]	12.0	18.7	87	54	P
49	86[e]	11.9	16.9	78	49	P
45	82	11.6	16.8	78	48	NP
	90	10.7	15.1	70	43	NP
		Yellow Paints				
52	81	13.8	20.3	100	58	P
	79	13.7	20.2	99.5	58	P
76	85[c]	11.7	19.7	97	57	P
44	77	12.7	19.4	96	56	NP
54	87[e]	12.6	19.0	94	55	P
47	89[d]	12.1	18.6	92	53	P
52	73[d]	11.0	17.1	84	49	P
	93 Exp.[c]	10.7	15.7	77	45	P
38	83	10.7	14.7	72	42	NP
31	75[c]	11.0	14.3	70	41	P
	94 Exp.[c]	10.1	13.4	66	39	NP
49	92 Exp.[c]	10.1	12.9	64	37	P
	91	9.2	12.3	61	35	NP

[a] Service Factor for perfect performance = 34.8
[b] P - Passing; NP - Not Passing
[c] Applied as premix
[d] Furnished as premix
[e] Applied at rate of 15 gallons per mile of stripe

TABLE 3

SUMMARY OF QUALIFICATION TESTS
1955 Transverse Stripes

Paint No.	Color	Reflectivity Percent	Drying Time Field - Avg. Minutes	Consistency K. U. - 77°F Paint	Premix	Bleeding Index Asphalt	Tar	Settling 6 Mo.
	White							
72		82.6	37		76	7.6	4.3	7
74		82.9	32	77	89	8.3	4.0	8
76		79.1	62	74		3.3	7.3	2
78		86.8	29	76		5.6	5.6	8
80		88.4	31	74		6.6	4.3	7
82		87.4	39	70		5.3	3.0	8
84		82.3	25	84	95	7.3	5.0	7
86		86.7	36	76		6.6	4.0	8
88		84.5	57		88	8.0	5.0	9
90		88.0	25	65		6.3	7.0	2
	Yellow							
73	P_r*	54.0	48		76	7.3	7.0	7
75	P_r	57.0	49	72	83	7.6	7.0	7
77	P_g	54.6	87	76		7.0	8.0	9
79	P_o	51.7	32	72		5.0	7.6	9
81	P_r	52.6	51	74		6.0	6.6	7
83	F_r	40.8	49	75		3.6	8.6	8
85	P_g	56.5	16	82	95	7.0	7.6	7
87	P_g	57.3	59	75		8.0	6.3	8
89	P_g	56.8	55		92	8.0	6.6	9
91	P_r	54.9	41	64		5.6	7.0	1
92	P_g	58.1	8	77		7.6	6.6	9
93	P_o	57.7	18	76		5.3	6.6	8
94	P_g	58.1	16	77		2.6	5.3	4

*P indicates passing; F indicates failing;
Subscript o signifies exact color match with standard;
g green side of standard;
r red side of standard.

TABLE 4

SUMMARY OF PERFORMANCE DATA
1955 Transverse Stripes

Exposure Days	Paint No.	White Paint										Yellow Paint												
		72	74	76	78	80	82	84	86	88	90	73	75	77	79	81	83	85	87	89	91	92	93	94
9	General Appearance	9.0	8.7	9.2	7.6	7.8	8.7	9.0	8.4	8.4	9.2	9.0	9.1	9.6	7.8	8.3	8.6	9.4	8.0	7.9	8.6	9.6	9.3	9.4
	Durability	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	9.7	10.0	10.0	10.0	9.9	10.0	9.7	10.0	10.0	10.0	9.5	10.0	10.0	10.0
	Night Visibility	5.0	5.6	5.8	8.6	9.4	4.5	6.0	6.3	5.5	4.7	4.6	5.3	4.9	9.1	9.1	3.6	6.0	6.6	5.0	4.5	5.4	5.4	5.3
	Weighted Rating	7.4	7.7	7.8	9.1	9.5	7.1	7.9	8.0	7.6	7.2	7.2	7.6	7.4	9.3	9.4	6.5	7.9	8.1	7.3	6.9	7.7	7.6	7.6
90	General Appearance	7.4	7.0	7.6	5.6	6.4	6.0	7.0	6.0	8.1	5.8	7.2	6.8	8.5	6.0	6.6	5.5	7.2	6.4	7.0	5.8	6.5	6.8	6.7
	Durability	9.0	9.5	9.4	9.3	9.4	9.4	9.4	9.5	9.4	8.5	9.1	9.0	9.3	9.4	9.2	9.1	8.8	9.6	9.4	6.7	7.4	8.1	7.5
	Night Visibility	4.6	5.0	5.8	6.1	6.1	5.3	4.0	4.7	4.4	4.6	3.6	4.6	5.9	6.4	6.6	4.8	4.0	5.2	5.0	3.8	4.4	4.0	4.2
	Weighted Rating	6.6	7.0	7.4	7.3	7.4	7.0	6.5	6.8	6.8	6.3	6.2	6.6	7.5	7.6	7.6	6.6	6.2	7.1	7.0	5.2	5.8	5.9	5.8
184	General Appearance	5.8	6.0	6.4	5.0	6.6	4.9	6.8	5.3	6.4	5.0	5.5	3.8	6.0	4.9	5.4	4.0	5.7	5.6	5.6	4.0	3.7	4.8	3.6
	Durability	6.3	6.7	6.9	6.6	7.2	5.8	7.5	5.8	6.3	5.2	5.9	4.1	6.2	6.3	6.6	4.8	7.0	7.0	6.7	4.0	3.6	4.9	3.6
	Night Visibility	4.1	4.1	4.0	3.7	3.3	2.9	4.4	2.8	3.6	2.1	3.1	2.1	4.4	4.5	4.2	2.6	4.0	3.8	3.7	2.0	2.0	2.9	2.3
	Weighted Rating	5.2	5.3	5.4	5.0	5.2	4.3	5.9	4.2	5.0	3.6	4.5	3.1	5.3	5.3	5.3	3.6	5.4	5.3	5.1	3.0	2.8	3.9	3.0
277	General Appearance	4.2	3.8	5.2	3.5	4.9	3.3	5.8	3.5	4.3	3.2	4.1	1.9	4.3	3.0	4.3	2.0	5.4	4.1	4.2	2.2	1.8	3.2	1.7
	Durability	4.0	3.7	4.4	4.0	5.2	3.5	5.9	3.2	4.0	3.1	3.9	1.9	4.1	4.1	4.2	2.6	5.2	4.0	4.2	2.0	1.2	3.0	1.7
	Night Visibility	4.2	3.9	3.2	2.5	2.5	2.3	5.4	2.2	3.5	1.9	3.5	1.5	3.7	3.7	3.0	2.0	4.0	2.6	3.4	1.2	1.4	3.0	1.7
	Weighted Rating	4.1	3.8	3.9	3.2	3.8	2.9	5.6	2.7	3.8	2.5	3.7	1.7	3.9	3.8	3.6	2.2	4.6	3.3	3.8	1.6	1.4	3.0	1.7
348*	General Appearance	3.9	4.3	4.3	3.1	5.8	3.1	7.1	3.5	4.7	3.1	3.6	2.3	3.5	2.4	4.0	1.8	5.7	4.6	3.8	2.0	1.2	2.5	1.6
	Durability	3.6	4.0	4.2	3.8	6.3	3.7	7.4	3.6	4.2	2.8	3.8	1.8	3.7	3.3	4.5	2.2	6.2	5.6	4.2	1.7	1.0	2.4	1.5
	Night Visibility	2.8	2.6	1.4	1.9	1.5	1.3	4.1	1.1	2.4	1.0	1.8	1.1	2.3	2.4	2.0	1.1	3.2	1.8	1.9	0.7	0.7	1.7	1.1
	Weighted Rating	3.2	3.3	2.8	2.8	3.9	2.4	5.7	2.3	3.4	1.9	2.8	1.5	3.0	2.8	3.2	1.6	4.7	3.6	3.0	1.2	0.9	2.1	1.3

*Average of three Test Sections, because stripes were planed off in Test Area 4, Bituminous.

TABLE 5

SUMMARY OF APPLICATION DATA

1955 TRANSVERSE STRIPES

		Paint Number	Stripe Number	Time	Air Temp. °F.	Air R.H. %	Drying Time Minutes	Stripe Width Inches	Calcul. Thick. Mils	Atom. Pressure psig.	Weather Remarks	
TEST AREA ① US 27, 24 FOOT CONCRETE, EAST ROADWAY, 8 MILES SOUTHWEST OF LANSING	8-25-55	88	1- 3	8:55	71	68	45	4	14.8	50		WHITE
		72	4- 6				36	4	15.8	50		
		74	7- 9				42	4	15.2	50	Bright	
		84	10-12				32	4	15.3	50		
		76	13-15	10:09	79	53	69	4	15.0	40	plus	
		90	16-18				28	4-1/4	14.5	40		
		78	19-21				33	4	14.4	40	Light	
		80	22-24				34	4	14.6	40		
		82	25-27				45	4	15.1	35	Wind	
		86	28-30	11:22	83	45	39	4	13.8	35		
	8-24-55	87	1- 3	9:16	64	65	26	3-3/4	13.2	35		YELLOW
		91	4- 6				18	4	14.2	25		
		77	7- 9				129	4	14.8	40	Bright	
		79	10-12				35	4	14.6	40		
		81	13-15				53	3-3/4	15.0	50	plus	
		83	16-18	12:00	73	52	55	3-3/4	15.5	40		
		85	19-21	1:30	78	46	18	3-3/4	15.5	40	Light	
		89	22-24				76	3-3/4	15.4	50		
		92	25-27				9	3-3/4	15.1	50	Wind	
		93	28-30				16	4	14.5	50		
		94	31-33	3:01	75	47	11	3-3/4	14.6	50		
		73	34-36				43	4	14.2	50		
		75	37-39	3:44	75	47	40	4	14.4	50		
TEST AREA ② US 27, 20 FOOT BITUMINOUS, WEST ROADWAY, 8 MILES SOUTHWEST OF LANSING	8-25-55	86	1- 3	1:46	84	45	44	4	13.8	35		WHITE
		76	4- 6				53	4	14.3	40	Bright	
		82	7-10				43	4	15.6	35		
		80	11-12				30	4	14.2	40	plus	
		78	13-15				26	4	14.3	40		
		90	16-18	3:10	85	41	21	4-1/4	14.4	30	Light	
		88	19-21				61	4-1/4	14.3	50		
		72	22-24				48	4	14.5	50	Wind	
		74	25-27				32	4	15.5	50		
		72	28-30	4:11	83	45	19	3-3/4	15.0	50		
	8-26-55	89	1- 3	8:40	69	76	61	4	15.8	50		YELLOW
		73	4- 6				61	4	15.1	50		
		75	7- 9				72	4	14.8	50	Overcast	
		85	10-12				17	3-3/4	15.6	40		
		92	13-15	9:51	74	69	13	4	14.9	50	plus	
		93	16-18				22	4	15.1	50		
		94	19-21				20	4	14.6	50	Light	
		77	22-24				91	3-3/4	15.8	40		
		79	25-27				36	3-3/4	15.1	40	Wind	
		81	28-30				66	3-3/4	15.9	50		
		83	31-33				70	3-3/4	14.3	40		
		91	34-36	11:50	78	60	63	4-1/8	14.3	25		
		87	37-39	12:07			59	3-3/4	14.1	35		

TABLE 5 (CON'T)

SUMMARY OF APPLICATION DATA

1955 TRANSVERSE STRIPES

		Paint Number	Stripe Number	Time	Air Temp. °F	Air R.H. %	Drying Time Minutes	Stripe Width Inches	Calcul. Thick. Mils	Atom. Pressure psig	Weather Remarks	
TEST AREA (3) US 127, 22 FOOT CONCRETE, EAST ROADWAY, 0.3 MILES SOUTH OF MILLER ROAD	8-29-55	86	1- 3	10:15	82	65	33	3-3/4	13.9	35		WHITE
		78	4- 6				33	3-3/4	15.4	40	Overcast	
		76	7- 9				78	3-3/4	15.4	40		
		90	10-12				27	4-1/4	15.3	30	plus	
		80	13-15				43	3-7/8	14.3	40		
		82	16-18				40	3-7/8	15.3	35	Light	
		88	19-21	12:44	89	54	74	3-7/8	14.3	50		
		84	22-24				26	4	15.4	50	Wind	
		74	25-27				27	4	14.7	50		
		72	28-30	1:43	90	50	32	4	15.8	50		
	8-31-55	77	1- 3	9:58	64	60	45	3-3/4	14.4	40		YELLOW
		83	4- 6				26	4	14.4	40		
		81	7- 9				54	4	15.5	50	Bright	
		79	10-12				26	3-3/4	14.3	50		
		91	13-15				47	4-1/4	14.3	25	plus	
		87	16-18				60	3-3/4	13.0	35		
		89	19-21	11:40	68	54	54	3-3/4	15.2	50	Light	
		73	22-24				46	3-3/4	14.7	50		
		75	25-27				41	3-3/4	15.2	50	Wind	
		85	28-30				17	3-3/4	15.1	40		
		92	31-33				4	3-3/4		40		
		93	34-36				18	4		50		
		94	37-39	1:05	66	53	16	3-7/8		50		
TEST AREA (4) US 16, 20 FOOT BITUMINOUS, NORTH LANES, 0.2 MILES WEST OF OKEMOS-HASLETT ROAD	9-1-55	86	1- 3	1:58	73	46	29	3-3/4	13.8	35		WHITE
		76	4- 6				49	4	14.5	40	Bright	
		82	7- 9				28	3-3/4	15.9	35		
		80	10-12				17	3-7/8	14.3	40	plus	
		78	13-15				25	3-3/4	15.0	40		
		90	16-18	3:00	76	44	25	4-1/4	15.1	30	Light	
		88	19-21				47	4	14.7	50		
		72	22-24				33	4	15.4	50	Wind	
		84	25-27				23	4	14.4	50		
		74	28-30	3:37			25	4	14.3	30		
	9-1-55	92	1- 3	9:28	67	53	6	3-3/4	14.5	50		YELLOW
		93	4- 6				15	4		50		
		94	7- 9				15	4		50	Bright	
		85	10-12	10:12			12	3-3/4	15.0	40		
		75	13-15				42	4	15.5	50	plus	
		73	16-18				43	4	14.3	50		
		89	19-21				69	3-3/4	14.4	50	Light	
		77	22-24	10:50			84	3-3/4	14.4	40		
		83	25-27				46	4	14.6	40	Wind	
		81	28-30				32	4	15.0	50		
		79	31-33				30	4	15.2	50		
		91	34-36				37	4-1/4	14.6	25		
		87	37-39	11:44	73	46	61	3-3/4	13.2	35		

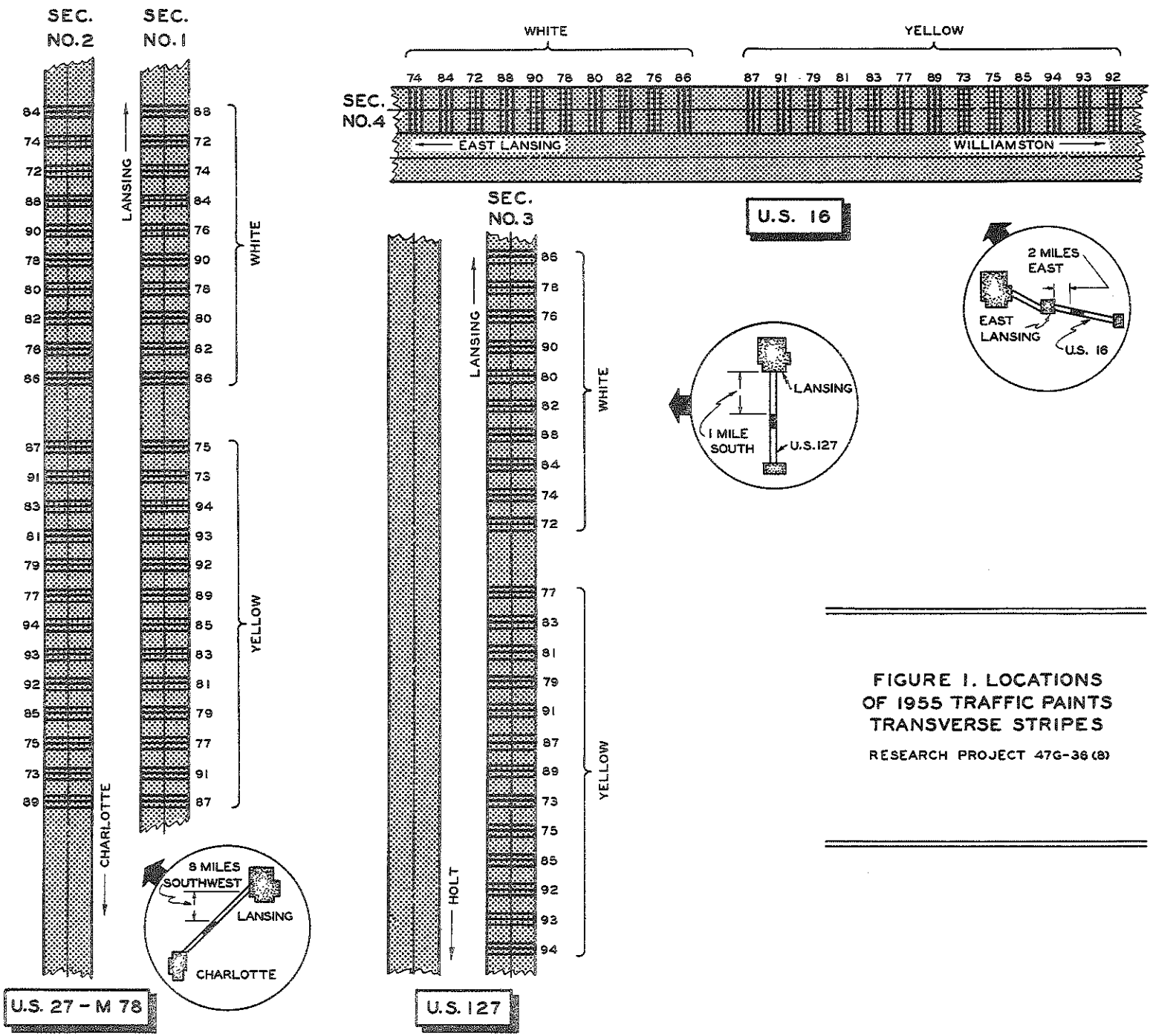

FIGURE 1. LOCATIONS OF 1955 TRAFFIC PAINTS TRANSVERSE STRIPES

RESEARCH PROJECT 47G-36(8)