



OFFICE MEMORANDUM

DATE: January 3, 1985

TO: Paint Committee:

- M. E. Witteveen - Engineer of Traffic & Safety
- M. L. O'Toole - Acting Engineer of Testing & Research
- M. H. Musselman - Financial Services Division
- A. H. Williams - Assistant Engineer of Maintenance
- R. C. Bailey - Department of Management & Budget


FROM: F.J. Bashore

SUBJECT: 1976-1982 Performance Tests of "Fast Dry" White and Yellow Pavement Marking Paints.
Research Project 47 G-36
Research Report No. 1256

This is to transmit a summary of performance test results for the years 1976 through 1982. Test results have been presented annually to the Paint Committee for selection of eligible bidders, but written summaries have not been presented on a regular basis.

Performance test results, changes in specifications and test procedures, and changes in equipment are presented in chronological order.

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SUMMARY OF 1976-1982 PERFORMANCE TESTS OF "FAST DRY"
WHITE AND YELLOW PAVEMENT MARKING PAINTS.
RESEARCH PROJECT NO. 47G-36. RESEARCH REPORT NO. 1256

INTRODUCTION

Michigan has been using performance testing as a means of obtaining the best pavement marking paints at reasonable prices since the 1950's.

By specifying certain basic properties such as color, viscosity, and non-volatile, but not composition, the producer was free to use his technology to formulate a satisfactorily performing paint at the least cost possible.

This system has generally worked well with no significant problems until the early 1970's when studded tires came into wide usage. It has been the procedure to rate the transverse stripes over a period of one year in the manner prescribed by ASTM D 713 and choose the better performing materials for competitive bids for the next year's purchases. With increasing studded tire usage, the evaluation period was shortened because the stripes were destroyed very quickly in early winter. This shortened the evaluation period to about 180 days. At the peak of studded tire usage just before legislation was passed to outlaw their use except on emergency vehicles, performance testing was temporarily suspended. A formula specification was written for regular dry materials which were being phased out in favor of the fast-dry materials which required no coning. The first fast-dry pavement marking paints were purchased by certification of satisfactory performance until performance testing could again be performed after studded tires were outlawed.

This report summarizes performance tests conducted from 1976 through 1982. The specifications used during this period are in the appendix.

1976 PERFORMANCE TESTS

The 1976 Performance paints were applied as transverse stripes on June 8, 9, and 10, 1976, on portland cement concrete and bituminous concrete pavement. The test area was located on US-27 south of St. Johns, Michigan, a short distance north of Price Road.

The equipment used for applying the stripes was the hand operated striper constructed by the Traffic and Safety Division for applying stop bars, etc. The electric paint heater and airless paint pump were mounted on a truck with recirculating paint lines and an air supply line to the striper. A conventional airless paint gun and air operated bead gun were mounted on the striper along with a pressurized bead tank. The thickness of paint line was controlled by the speed at which the operator pushed the striper. This was monitored by measuring the stripe with a wet film gauge.

The standard procedure was to flush the paint system with toluene and then pump the paint sample through the system to expel the toluene. The heater was then turned on and the paint recirculated until a temperature of 160 F was attained. Application of the sample then began.

Application of the 50 gallon drum samples using a standard roadway striper was done on June 14, 1976. This was done to determine whether the material could be applied satisfactorily and also to determine dry times.

Specifications used for performing the service tests conformed to ASTM D 713 except for weighting of appearance, durability, and night visability for calculating the weighted rating.

The procedure used to calculate the weighted rating and service factor was the following:

$$\text{Weighted rating} = 0.10A + 0.40D + 0.50N$$

where:

A = Appearance rating (including color retention)

D = Durability rating

N = Night visibility rating

$$\text{Service Factor} = \frac{(r_1 t_1 + r_2 t_2 + r_3 t_3 \text{ etc.}) 10}{t_1 + t_2 + t_3 \text{ etc.}}$$

where:

$r_1, r_2, \text{ etc.}$ are the average weighted ratings.

$t_1, t_2, \text{ etc.}$ in days are the time intervals between evaluations.

The paints were rated for a period of 343 days but had been rated for only 118 days when paints were selected for invitation to bid for the next year's purchases. Tables 1 and 2 are summaries of the data obtained.

TABLE 1

1976 WHITE FAST DRY PERFORMANCE TEST RESULTS

Company Identification	Non-Volatile Matter, %	Consistency, KU	Luminous Directional Reflectivity, %	Dry Time, Minutes		SERVICE FACTOR, % OF MAX	
				Laboratory	Transverse	Longitudinal	118 Days
Specification Requirement	70 Min	95-125	80 Min		2 Max		
* William Armstrong Smith Co. B-65406	70.06	98		3	7.5	3-3/4	96.3 100.0
The Tropical Paint Co. 93-26-1B	78.64	95		>12	>10	>5	100.0 99.0
De Santis Coatings, Inc. L-318	71.31	96		3	5.5	4-1/4	93.2 93.3
* Prismo Universal Corp. #236	70.83	93		4	7.0	3-3/4	92.4 90.3
Bourbon Paint Corp. 8-15-75 Missouri Spec.	68.99	72		6	>11	5	98.1 99.5
* Baltimore Paint & Chemical Corp. TM-9282				2	8.0	2	98.8 99.6
* Synkoloid of Florida, Inc. FF-2-80	72.82	106		1	7.0	3-1/4	93.1 94.0
Baltimore Paint & Chemical Corp. TM-9284 (CL Rubber)	72.98	106		3	6.5	3-1/4	99.2 96.5
Baltimore Paint & Chemical Corp. 185-408	70.49	85		7	8.0		114.7 116.6
Control (Baltimore TM-9248)					6.0		101.2 99.1
Control & Flotation Beads					5.0		86.0 90.3

* Selected for request to bid

TABLE 2

1976 YELLOW FAST DRY PERFORMANCE TEST RESULTS

Company Identification	Non-Volatile Matter, %	Consistency, KU	Lightness, %	Laboratory	Dry Time, Minutes		SERVICE FACTOR, % OF MAX.	
					Transverse	Longitudinal	118 Days	343 Days
Specification Requirement	70 Min	95-125	50.7 Min				2 Max	
* William Armstrong Smith Co. B-65407	71.01	98		3	>7.5	3-3/4	97.6	98.8
* The Tropical Paint Co. 93-26-2B	77.33	88		>12	>8.5	4	100.0	100.0
* De Santis Coatings, Inc. L-319	71.16	85		1	>5	5	88.0	89.9
Prismo Universal Corp. #237	70.37	109		3	6	3-1/4	87.8	83.0
Bourbon Paint Corp. 8-15-75 Missouri Spec.	70.55	80		7	>8.5	4-1/2	95.0	97.5
* Baltimore Paint & Chemical Corp. TM-9281	72.67	105		3	5.5	2-3/4	95.2	97.4
* Synkoloid of Florida, Inc. FF-2-81	72.33	98		2	5.0	>5	98.6	100.0
Baltimore Paint & Chemical TM-9283 (CL Rubber)	71.25	87		8	5.0		109.5	115.7
Baltimore Paint & Chemical 185-413					4.0		90.9	94.0
Control (Baltimore TM-9253)					5.0		79.2	87.8
Control & Flotation Beads								

* Selected for request to bid

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1977 PERFORMANCE TESTS

The 1977 performance paints were applied as transverse stripes on May 16 and 17, 1977, in the same test area and with the same equipment as in 1976.

Application of the 50 gallon drum samples with a production type striper was done July 18, 1977.

Ratings and other data were compiled after 178 days for determination of acceptable bidders for the 1978 purchases.

Rating of the test stripes continued for a total of 370 days. During the period between November 10, 1977 and February 23, 1978, the Pittsburg Plate Glass paints began to fail badly in durability by chipping on both portland cement concrete and bituminous concrete. Both rated very high at the end of 178 days. The rating based on service factor after 370 days shows a significant but not a dramatic drop.

Tables 3 and 4 are summaries of the data obtained.

TABLE 3

1977 WHITE FAST DRY PERFORMANCE TEST RESULTS

Company Identification	Non-Volatile Matter, %	Consistency, KU	Luminous Directional Reflectivity, %	Dry Time, Minutes		SERVICE FACTOR, % OF MAX **	
				Laboratory	Transverse	Longitudinal	178 Days
Specification Requirement	70 Min	95-125	80 Min		2 Max		
Reliance Chemical Company B-67217	71.66	101	83.0	1	9-1/2	4-1/2	90.5 91.9
William Armstrong Smith B-67208	71.00	108	82.5	1	> 12	> 5	85.8 86.9
* Synkoloid of Florida FF2-276	72.58	104	83.0	1	5-1/2	4	96.9 93.3
* Baltimore Paint & Chemical Corp. TM-9316	73.36	97	85.8	1	5	2-1/2	97.5 94.1
De Santis Coatings, Inc. 12W-D26	72.39	123	84.6	1	8-1/2	5	88.2 80.4
* Prismo Universal B-4192	70.87	96	86.6	1	7	4-1/2	89.3 87.3
* Pittsburg Plate Glass 41-19(A33893-C)	71.34	90	86.2	3	8-1/2	3-3/4	100.0 85.3
Control (Baltimore TM-9282)					8-1/2		99.8 100.0
Minn. Chlorinated Rubber	69.04	74	86.6	6	> 12		101.1 107.3
Minn. 3-Minute Dry	72.58	87	89.0	1	> 10		102.9 108.3
Minn. 20-Second Dry	70.54	107	86.9	1	6		96.1 94.7
Indiana	75.55	142	86.6	1	> 12		97.2 99.7
Wisconsin	71.84	106	83.8	2	6		94.0 93.1

* Selected for request to bid

** % of Maximum, Performance paints only

TABLE 4

1977 YELLOW FAST DRY PERFORMANCE TEST RESULTS

Company Identification	Non-Volatile Matter, %	Consistency, KU	Lightness, %	Dry Time, Minutes		Color	SERVICE FACTOR, % OF MAX.	
				Lab.	Trans.		Long.	178 Days
Specification Requirement	70 Min	95-125	50.7 Min				2 Max	
Reliance Chemical Co. B-67218	70.51	100	53.3	1	8	> 5	Satisfactory	100.0 100.0
William Armstrong Smith B-67209	70.30	98	52.8	1	> 12	> 5	Satisfactory	88.6 87.3
* Synkoloid of Florida FF-2-275	72.21	102	53.0	1	5-1/2	2	Satisfactory	86.1 85.3
* Baltimore Paint & Chemical TM-9321	72.22	100	52.8	1	6	2	Satisfactory	88.9 87.6
De Santis Coatings, Inc. 12Y-D29	71.51	108	52.8	1	6	4-1/4	Satisfactory	77.0 72.5
* Prismo Universal B-4193	72.64	105	52.9	1	7	3	Satisfactory	79.8 79.4
* Pittsburg Plate Glass 41-20(A33894-C)	68.92	81	55.9	4	7	3-3/4	Border Line	97.7 82.5
Control (Baltimore TM-9281)								96.0 97.2

* Selected for request to bid

1978 PERFORMANCE TESTS

The 1978 performance paints were applied as transverse stripes on May 16 and 17, 1978, in the US-27 test area south of St. Johns. There were no changes in equipment from the previous year. There were several changes in application procedure. These were the following:

1. Each 5 gallon sample of paint was stirred with an air motor with double agitator blades before placing cover on the pressure pot.
2. A small aluminum panel was used to sample the first beaded stripe. This was examined under a B & L binocular microscope at 30X to determine bead embedment.
3. The bead gun was set at an approximate angle of 25° from vertical toward the paint gun so that the center of the paint pattern was 1-1/4 inch ahead of the bead pattern. This change was made to better duplicate the time interval of the production strippers.

Application of the 50 gallon drum samples with production equipment was done July 26, 1978.

Ratings of the transverse stripes after 195 days were used to select acceptable bidders for 1979 purchases but were continued for 303 days. Tables 5 and 6 show summaries of the compiled data.

Baltimore Paint and Chemical and DeSantis Coatings both submitted what they considered premium quality paints which are designated as experimental in Table 1. While the performance test results were good, we don't consider them significantly better than the other materials.

Samples of silane treated, moisture proof, and flotation beads were

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obtained from the Potter Company to compare their performance with the untreated beads used by the Department. Test results indicated that somewhat better performance is obtained with the silane treated beads but poorer with the moisture proof and flotation beads.

TABLE 5

1978 WHITE FAST DRY PERFORMANCE TEST RESULTS

Company Identification	Non-Volatile Matter, %	Consistency, KU	Luminous Directional Reflectivity, %	Dry Time, Minutes		Settling	SERVICE FACTOR, % OF MAX	
				Lab.	Trans.		Long.	195 Days
Specification Requirement	70 Min	95-125	80 Min	2 Max	6 Min			
* William Armstrong Smith B-69428	71.35	108	83.5	1	4	8	95.1	93.3
Baltimore Paint & Chemical TM-9342	73.66	114	85.5	4	4-1/2	4	95.0	93.6
De Santis Coatings, Inc. 12W-D48	73.45	100	82.3	6	3	2-3/4	96.2	92.6
* Prismo Universal B-4417	72.80	101	82.7	5	1	3-3/4	94.8	91.2
Standard of Detroit 7243	77.71	116	84.0	8	8	>5	100.0	100.0
Control (Synkoloid FF2-2-76)							96.7	95.1
Control W/Silane Treated Beads							101.7	101.4
Control W/Moisture Proof Beads							86.2	89.4
Control W/Flotation Beads							88.7	90.4
De Santis Coatings, Inc. Exp. 12W-D52	73.39	104		4	3		96.9	96.1
Baltimore Paint & Chemical Exp. 284-16	72.28	110		4	2		97.0	89.4
Baltimore Paint & Chemical 284-17	71.82	115		2	3		97.1	92.8

* Selected for request to Bid. In addition, Baltimore was requested to bid on their 1977 performance paint TM-9316.

TABLE 6

1978 YELLOW FAST DRY PERFORMANCE TEST RESULTS

Company Identification	Non-Volatile Matter, %	Consistency, KU	Lightness, %	Dry Time, Minutes			Settling	Color	SERVICE FACTOR, % OF MAX	
				Lab.	Trans.	Long.			195 Days	303 Days
Specification Requirements	70 Min	95-125	50.7 Min			2 Max				
* William Armstrong Smith B-69427	71.04	104	53.7	3	2	4	8	Satis.	98.3	97.4
* Baltimore Paint & Chemical TM-9343	71.63	108	51.2	1	4	3-3/4	6	Satis.	96.7	93.1
* De Santis Coatings, Inc. 12Y-D74	72.44	103	52.7	4	3	4-1/2	9	Satis.	97.7	94.0
Prismo Universal B-4418	73.18	108	50.4	7	3	4-1/4	8	Satis.	96.8	92.0
Standard of Detroit 7253	77.66	121	53.8	8	7-1/2	> 5	8-1/2	Satis.	100.0	100.0
Control (Synkoloid FF2-2-75)				> 7		3-3/4			96.2	94.7

* Selected for request to bid

1979 PERFORMANCE TESTS

Specifications for performance evaluation were significantly changed.

The most important changes were the following:

1. Statement of Characteristics forms are to be submitted with samples.
2. ASTM procedures are referenced and "Length of Useful Life" as defined by ASTM D 713 are to be used as a basis of comparison instead of Service Factors and weighted ratings.
3. Tolerances were developed for acceptance testing for certain basic physical properties.

Performance paints were applied as transverse stripes May 14 and 15, 1979 on US-27 south of St. Johns and the 50 gallon drum samples were applied with production equipment May 23, 1979.

In addition to the regular performance samples, samples of Baltimore regular dry made to the Department formula specification and samples of the Aeronautic regular dry paints were applied.

Because Potter silane treated beads had previously performed somewhat better than standard beads, beads treated with Dow Corning Z-6020 and Z-6030 in the laboratory were applied to the white control paint along with Potter silane for comparison.

The regular dry paints performed equal to or better than the best performing fast dry paint as would be expected.

The silane treated beads all performed better than standard beads by significant amounts.

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Service factors were compared after 176 days to select bidders for 1980 purchases (ultimate useful life obviously could not be used for this short period of time). Evaluation was continued until ultimate useful life was determined, these ratings to be used for determining bidders for 1981 purchases. Tables 7 and 8 are summaries of the data obtained.

TABLE 7

1979 WHITE FAST DRY PERFORMANCE TEST RESULTS

Company Identification	Non-Volatile Matter, %	Consistency, KU	Luminous Directional Reflectivity, %	Dry Time, Minutes		Settling	SERVICE FACTOR, % OF MAX	Useful Life, Days
				Lab.	Trans.			
				70 Min	80 Min		2 Max	2 Max
Specification Requirement		95-125	80 Min					
** Baltimore Paint & Chemical TM-9372	69.26	112	83.2	3	5-1/2	3-1/4	100	317
Baltimore Paint & Chemical TM-9374	75.06	101	85.7	2	4-1/2	4-1/4	96	332
** De Santis Coatings, Inc. 12W-D68	70.13	115	83.9	2	3	2-1/2	87	252
** De Santis Coatings, Inc. 12W-D89	70.31	113	82.3	2	3-1/2	1-1/2	90	299
** Prismo Universal E-5125	70.68	108	82.6	5	6-1/2	3-1/2	96	423*
** Prismo Universal E-5126	73.40	102	82.7	9	7	3-1/2	94	342
Control (Prismo B-4417)					4		87	302
Control W/Potters Silane Treated Beads							99	341
Control W/Z6020 Treated Beads							96	323
Control W/Z6030 Treated Beads							100	327
Baltimore Reg. Dry	75.42	106	90.1	14		9	108	354
Aeronautics Reg. Dry	71.1	67	85.7	36	14	8	100	370

* Useful life was extrapolated.

** Selected for request to bid for 1980 purchases, and again for 1981 purchases except for De Santis 12W-D68 which was deleted.

TABLE 8

1979 YELLOW FAST DRY PERFORMANCE TEST RESULTS

Company Identification	Non-Volatile Matter, %	Consistency, KU	Lightness, %	Dry Time, Minutes		Settling	Color	SERVICE FACTOR, % OF MAX 176 Days	Useful Life, Days
				Lab.	Trans. Long.				
Specification Requirements	70 Min	95-125	50.7 Min	2 Max	6 Min				
* Baltimore Paint & Chemical TM-9381	70.31	104	51.8	3	3	8-1/2	Satis.	97	310
* Baltimore Paint & Chemical TM-9383	74.01	98	54.8	2	4	3-1/2	Satis.	97	312
* De Santis Coatings, Inc. 12Y-D73	69.90	122	51.3	1	3	1-1/2	Satis.	89	294
* De Santis Coatings, Inc. 12Y-D74	70.28	119	51.5	1	3	2	Satis.	96	310
* Prismo Universal E-5127	71.31	104	57.2	7	4-1/2	4-1/2	Over Green Limit	100	466*
* Prismo Universal E-5128	70.94	103	53.9	5	6-1/2	3	Satis.	93	344
Control (Baltimore TM-9343)					6-1/2			100	355
Baltimore Reg. Dry		95	54.2		15	6	Satis.	115	526*
Aeronautics Reg. Dry	74.02	72	48.7	36	28	6-1/2	Satis	104	547*

* Useful life was extrapolated
 * Selected for request to bid for 1980 purchases, and again for 1981 purchases.

1980 PERFORMANCE TESTS

Changes in both equipment for applying and methods for evaluating the transverse test stripes, were made for the 1980 performance tests.

A retroreflectometer was designed and built by the Research Laboratory. The purpose was to do away with the necessity of making night ratings using up to six raters and the inherent variability between raters. The 1979 performance stripes were rated with the instrument and comparison with visual rating showed very good correlation (Table 9). The specification was revised to utilize the reflectometer in place of visual night raters. Since there had been few problems with visual ratings for appearance and durability, raters from Testing and Research only, were required.

New application equipment was purchased from Binks Manufacturing which was capable of applying both alkyd and polyester materials. Features include an airless paint pump, airless catalyst pump (for peroxide catalyst for polyester), air compressor, tank for glass beads, improved bead gun, electric heat exchanger for heating paint, and mechanical drive to propel the machine. Five gallon sample pails are placed on the machine and paint is pumped directly from them. The equipment has performed satisfactorily although many modifications have been necessary. Subsequently it has been found that the paint pump performs best when an air supply from a large capacity trailer mounted compressor is used.

The transverse test stripes were applied July 7 and 8, 1980, on US-27 south of St. Johns.

The 50 gallon samples were put down as longitudinal lines by production equipment August 18 and 19, 1980. Laboratory evaluations except for settling had been completed so several "out of specification" yellow paints were not put down. In addition, because markings on some drums was poor, one sample of Ennis paint could not be identified and was not put down.

The transverse stripes were rated until they had reached their end of useful life as defined by ASTM D 713. The compiled data is shown in Tables 10 and 11. The Paint Committee selected only two paints, one white and one yellow, for the 1982 bid list. All others were rejected. To provide additional bidders, three products were taken from the 1979 list for both white and yellow paints. The 1982 bid list is shown below.

<u>Yellow</u>		<u>White</u>	
<u>Company</u>	<u>Paint No.</u>	<u>Company</u>	<u>Paint No.</u>
Baltimore	TM-9423	Baltimore	TM-9420
Baltimore*	TM-9381	Baltimore*	TM-9372
De Santis*	12Y-D74	De Santis*	12W-D89
Prismo*	E-5128	Prismo*	E-5125

* Approved from the 1979 samples

TABLE 9

USEFUL LIFE, COMPARISON OF NIGHT RATERS AND RETROREFLECTOMETER

<u>Paint Identification</u>	<u>Visual, Days</u>	<u>Instrument, Days</u>	<u>Ranking, Visual</u>	<u>Ranking, Instrument</u>
<u>Yellow</u>				
Baltimore Paint & Chemical Corp. TM-9381	310	425	7	6
Baltimore Paint & Chemical Corp. TM-9383	312	343	6	8
De Santis Coatings, Inc. 12Y-D73	294	307	9	9
De Santis Coatings, Inc. 12Y-D74	310	395	8	7
Prismo Universal Corp. E-5127	466	497	3	3
Prismo Universal Corp. E-5128	344	454	5	4
Control (Baltimore)	350	427	4	5
Baltimore Paint & Chemical Corp. Reg. Dry	526	542	2	2
Aeronautics Reg. Dry	547	590	1	1
<u>White</u>				
Baltimore Paint & Chemical Corp. TM-9372	317	318	9	8
Baltimore Paint & Chemical Corp. TM-9374	332	274	6	9
De Santis Coatings, Inc. 12W-D68	252	247	12	12
De Santis Coatings, Inc. 12W-D69	299	268	11	11
Prismo Universal Corp. E-5125	423	386	1	5
Prismo Universal Corp. E-5126	342	346	4	7
Control (Prismo)	302	274	10	10
Control W/Potters Silane Treated Beads	374	403	5	4
Control W/Z-6020 Treated Beads	323	368	8	6
Control W/Z-6030 Treated Beads	327	416	7	2
Baltimore Paint & Chemical Corp. Reg. Dry	354	428	3	1
Aeronautics Reg. Dry	370	404	2	3

TABLE 10

1980 WHITE FAST DRY PERFORMANCE TEST RESULTS

Company Identification	Non-Volatile Matter, %	Consistency, KU	Luminous Directional Reflectivity, %	Dry Time, Minutes			Settling	Useful Life, Days
				Laboratory	Transverse	Longitudinal		
Specification Requirement		95-125					6 Min	
Ennis Paint Manufacturing EXM102 FDW	76.0	88	82.1	19	7	4-1/2	2	348
Ennis Paint Manufacturing EXM101 FDW	76.1	100	81.2	6	7	> 5	6	293
IBIS 40-3295	73.4	106	80.8	16	6	> 5	6	244
IBIS 40-3293	69.3	102	86.0	2	5	5	8	250
Prismo Universal E-5194	70.3	112	86.0	1	2	2	6	203
Prismo Universal E-5195	73.5	108	86.7	11	4-1/2	> 5	7-1/2	310
* Baltimore Paint & Chemical TM-9420	73.0	106	82.9	3	3-1/2	2	7	274
Baltimore Paint & Chemical TM-9422	71.4	111	84.4	3	4	> 5	8	275
De Santis Coatings, Inc. 12W-D74	72.3	93	82.7	1	3	2	6-1/2	237
De Santis Coatings, Inc. 12W-D75	72.9	94	84.2	3	4	5	6	167
Control (Baltimore TM-9372)								255

* Selected for request to bid for 1982 purchases

TABLE 11

1980 YELLOW FAST DRY PERFORMANCE TEST RESULTS

Company Identification	Non-Volatile Matter, %	Consistency, KU	Lightness, %	Dry Time, Minutes		Settling	Color	Useful Life, Days
				Lab.	Trans. Long.			
Specification Requirement	70 Min	95-125	50.7 Min	2 Max	6 Min			
Ennis Paint Manufacturing EXMI01 FDY	75.6	98	54.8	20	10-1/2	6-1/2	Satisfactory	348
Ennis Paint Manufacturing EXMI02 FDY	75.0	98	55.5	10	6-3/4	5-1/2	Satisfactory	323
IBIS 40-3294/B52D80	66.8	129	53.9	2	4-1/2	6-1/2	At Green Limit	282
IBIS 40-3296/B54D80	74.2	108	54.0	14	16-1/2	8-1/2	Exceeds Green Limit	282
Prismo Universal E-5196	74.3	108	58.8	13	8-1/2	6	Exceeds Gray Limit	350
Prismo Universal E-5193	70.6	109	58.4	1	2-1/2	7	Exceeds Gray Limit	301
Baltimore Paint & Chemical TM-9421	72.6	107	55.8	4	5-3/4	8	Satisfactory	307
* Baltimore Paint & Chemical TM-9423	73.4	117	54.0	2	4-3/4	3-1/2	Satisfactory	291
De Santis Coatings, Inc. 12Y-D84	73.2	101	53.7	5	5-1/2	5	Satisfactory	242
De Santis Coatings, Inc. 12Y-D83	70.6	96	52.2	1	4-3/4	3-1/4	Satisfactory	192
Control (Baltimore TM-9381)								282

* Selected for request to bid for 1982 purchases

1981 PERFORMANCE TESTS

The test areas on US-27 south of St. Johns had become badly worn in the wheel tracks of the traffic lanes where the ratings are made. These areas of the portland cement concrete were so badly worn that they consisted of mostly larger aggregate surfaces. This was true to a lesser degree for the bituminous concrete.

For the above reasons, new test areas were selected on east bound M-43 just east of Grand Ledge. This particular area on M-43 was selected because portland cement concrete and bituminous concrete sections were adjacent. With this arrangement, only one traffic closure was required for application of test materials and subsequent evaluations. Also, this permitted the application of test paints on both surface types with only one introduction of each sample into the striping equipment. This resulted in reducing the time required for application of test paints by about one half.

The transverse test stripes were applied July 20, 1981. The 50 gallon samples were applied as longitudinal stripes by production equipment August 18, 1981.

The transverse stripes were evaluated until they reached their end of useful life as defined by ASTM D 713. The compiled data is shown in Tables 12 and 13. The Paint Committee selected one yellow and four whites for the 1983 bid list. The entire 1982 bid list was combined with the above to make up the 1983 bid list as shown in Table 14.

TABLE 12

1981 WHITE FAST DRY PERFORMANCE TEST RESULTS

Company Identification	Non-Volatile Matter, %	Consistency, KU	Luminous Directional Reflectivity, %	Dry Time, Minutes			Settling**	Useful Life, Days
				Lab.	Trans.	Long.		
Specification Requirement	70 Min	95-125	80 Min			2 Max	6 Max	
** Baltimore Paint & Chemical Corp. TM-9450	73.8	101	81.5	9	5	2	6	197
Baltimore Paint & Chemical Corp. TM-9452	71.8	103	81.4	9	5	3*	4	190
De Santis Coatings, Inc. 12W-D94	73.7	100	82.7	12	6	4-3/4	6	140
De Santis Coatings, Inc. 12W-D95	74.1	85	83.6	6	3	2*	1	227
Ennis Paint Manufacturing EN-1039	77.3	112	80.7	14	9-1/2	>5	6	239
** Ennis Paint Manufacturing EN-1041	74.1	111	81.6	7	9	2-1/2	4-1/2	220
** Prismo Universal Corp. 110-53W	71.2	96	81.1	8	8-1/2	1-3/4	6-1/2	246
** Prismo Universal Corp. 110-54W	70.9	96	81.1	8	8	2	6-1/2	248
Control (Baltimore TM-9372)						2-1/4	2-3/4	227

* Clogs gun

** After one year

** Selected for invitation to bid for 1983 purchases

TABLE 13

1981 YELLOW FAST DRY PERFORMANCE TEST RESULTS

Company Identification	Non-Volatile Matter, %	Consistency, KU	Lightness, %	Dry Time, Minutes		Settling**	Color	Useful Life, Days
				Lab. Trans.	Long.			
Specification Requirement	70 Min	95-125	50.7 Min	2 Max	6 Max			
* Baltimore Paint & Chemical Corp. TM-9451	71.1	100	59.4	6	2-1/2	5	Satisfactory	288
Baltimore Paint & Chemical Corp. TM-9453	70.9	102	60.4	7	2*	6	Satisfactory	286
De Santis Coatings, Inc. 12Y-100	73.0	90	56.1	7	6-1/2	5	Satisfactory	290
De Santis Coatings, Inc. 12Y-101	74.0	105	61.2	3-1/2	2-1/4	1-1/2	Over Green & Gray Limits	268
Ennis Paint Manufacturing EN-1040	73.5	95	60.1	11	4-1/2	4-3/4	Satisfactory	295
Ennis Paint Manufacturing EN-1042	71.2	85	64.1	7	1-1/4	1	Over Green & Gray Limits	250
Prismo Universal Corp. 110-55Y	71.1	90	57.5	12	2-1/4	6-1/4	Satisfactory	239
Prismo Universal Corp. 110-56Y	70.4	83	59.1	14	3-1/4	6-1/2	Satisfactory	231
Control (Baltimore TM-9381)				6-1/2	2			296

* Did not spray well

** After one year

** Selected for invitation to bid for 1983 purchases

TABLE 14
ELIGIBLE FAST-DRY PAINTS
(1983 BID LIST)

<u>Yellow</u>		<u>White</u>	
<u>Company</u>	<u>Paint No.</u>	<u>Company</u>	<u>Paint No.</u>
Baltimore	TM-9423	Baltimore	TM-9450
Baltimore	TM-9381	Baltimore	TM-9420
Baltimore	TM-9451	Baltimore	TM-9372
De Santis	12Y-D74	De Santis	12W-D89
Prismo	E-5128	Prismo	E-5125
		Prismo	110-53W
		Prismo	110-54W
		Ennis	EN-1041

1982 PERFORMANCE TESTS

There were no changes in application equipment or rating procedures for the transverse test stripes other than the use of a truck mounted air compressor to supply air to the paint pump and bead gun. This was done to minimize pressure variations which are more pronounced when using the small compressor mounted on the applicator.

The transverse stripes were applied July 28, 29, and August 5, 1982. Three days were required because of problems with the paint pump. The laboratory paint pump was ultimately installed to finish on August 5, 1982. No white control paint was put down because the sample brought in from the field was in poor condition.

The 50 gallon samples were applied with production equipment August 25, 1982. Paints furnished by B-B Paint Corporation were not applied because of exceptionally long dry times in the laboratory and when applied as transverse stripes. One Prismo yellow paint was not applied because the color was out of specification.

The transverse test stripes were evaluated for 320 days. The last rating was done just before a widening and resurfacing project began on the roadway. At that time, all but three paints had reached their end of useful life. Data for these three were extrapolated to obtain final ratings. The compiled data is shown in Tables 14 and 15.

At the November 30, 1983, meeting of the Paint Committee, six white paints and one yellow paint were selected as eligible for the 1984 bid list. It was decided to add these to the 1983 bid list, but to limit the number of formulations per color for each producer to four.

All producers were advised of this policy and those with more than four approved formulations per color were asked to choose which ones they wished to have deleted.

The bid list for 1984 was ultimately as shown in Table 17.

TABLE 15

1982 WHITE FAST DRY PERFORMANCE TEST RESULTS

Company Identification	Non-Volatile Matter, %	Consistency, KU	Luminous Directional Reflectivity, %	Dry Time, Minutes		Settling Days	Useful Life, Days
				Laboratory	Transverse Longitudinal		
Specification Requirement	70 Min	95-125	80 Min	2 Max	6 Min		
Baltimore Paint & Chemical TM-9482	71.4	100	83.1	2	3	3	177
Baltimore Paint & Chemical TM-9484	72.3	109	86.8	4	3	1-1/2	202
B-B Paint Corporation SBW-1	67.9	96	89.3	20	14-1/2	8-1/2	272
B-B Paint Corporation ALW-2	73.7	88	89.4	45	18	6-3/4	350
De Santis Coatings, Inc. 12W-D118	73.0	102	82.4	4	3-1/2	8	171
De Santis Coatings, Inc. 12W-D119	75.9	101	81.1	8	5	5-1/2	230
Ennis Paint Manufacturing EN 1122	74.1	86	87.5	1	3	7-1/2	224
Ennis Paint Manufacturing EN 1124	72.6	101	85.6	6	3-1/2	7-1/2	246
Prismo Universal 82-106A	72.0	104	89.9	2	3	7-1/2	220
Prismo Universal 82-106B	73.4	100	89.3	4	3-1/2	7	287

Globs in film

Selected for request to bid from 1982 performance

TABLE 16

1982 YELLOW FAST DRY PERFORMANCE TEST RESULTS

Company Identification	Non-Volatile Matter, %	Consistency, KU	Lightness, %	Dry Time, Minutes		Settling	Color	Useful Life, Days	
				Lab.	Trans. Long.				
Specification Requirement	70 Min	95-125	50.7 Min	2 Max	6 Min				
Baltimore Paint & Chemical TM-9491	70.9	103	51.1	4	4-1/2	2*	4-3/4	Satisfactory	269
** Baltimore Paint & Chemical TM-9493	71.0	102	55.0	2	6	2	7-1/4	Satisfactory	261
B-B Paint Corporation SBY-1	72.5	83	57.8	33	12-1/2		8-1/2	Satisfactory	342
B-B Paint Corporation ALY-2	70.3	94	58.1	20	11		7-1/2	Satisfactory	358
De Santis Coatings, Inc. 12Y-D123	73.3	94	50.6	11	5-1/2	>5	7-3/4	Satisfactory	292
De Santis Coatings, Inc. 12Y-D124	75.3	102	53.6	5	3	5	6	Satisfactory	280
Ennis Paint Manufacturing EN-1123	75.0	87	53.6	4			7-3/4	Borderline Gray	
Ennis Paint Manufacturing EN-1125	74.3	110	54.8	7	7	5	7-3/4	Borderline Gray	308
Prismo Universal 82-106C	71.5	106	59.0	3	6-1/2		7-1/4	Over Gray Limit	281
Prismo Universal 82-106D	73.2	98	57.3	5	5-1/2	5	7	Slightly Over Gray Limit	334
Control (Baltimore TM-9381)									298

* Globes in film

** Selected for request to bid

TABLE 17
 ELIGIBLE FAST-DRY PAINTS
 (1984 BID LIST)

Company	Performance Test Year	Identification
<u>WHITE</u>		
Baltimore Paint & Chemical Co.	1982	TM-9484
Baltimore Paint & Chemical Co.	1981	TM-9450
Baltimore Paint & Chemical Co.	1980	TM-9420
Baltimore Paint & Chemical Co.	1979	TM-9372
De Santis Coatings, Inc.	1982	12W-D119
De Santis Coatings, Inc.	1979	12W-D89
Ennis Paint Manufacturing, Inc.	1982	EN-1124
Ennis Paint Manufacturing, Inc.	1981	EN-1041
Prismo Universal Corporation	1982	82-106B
Prismo Universal Corporation	1981	110-53W
Prismo Universal Corporation	1981	110-54W
Prismo Universal Corporation	1979	E-5125
<u>YELLOW</u>		
Baltimore Paint & Chemical Co.	1981	TM-9451
Baltimore Paint & Chemical Co.	1980	TM-9423
Baltimore Paint & Chemical Co.	1979	TM-9381
Baltimore Paint & Chemical Co.	1979	TM-9383
De Santis Coatings, Inc.	1979	12Y-D73
De Santis Coatings, Inc.	1979	12Y-D74
Prismo Universal Corporation	1979	E-5127
Prismo Universal Corporation	1979	E-5128

APPENDIX

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MICHIGAN
DEPARTMENT OF STATE HIGHWAYS AND TRANSPORTATION

SPECIFICATION
FOR
FAST-DRY PAVEMENT MARKING PAINTS
WHITE, YELLOW, AND BLACK

8.17(3b)P.O.

Description.-This specification covers fast drying, white, yellow, and black pavement marking paints. The paint will be heated, applied to the pavement, with the white and yellow paints reflectorized with glass beads applied by spray gun. The black paint will not be reflectorized.

The paint as furnished shall contain no premixed glass beads as part of the pigment or for reflectorization purposes.

These specifications require road performance evaluations.

General Requirements.-It is the intent of these specifications to procure for use by the Department the best traffic paint possible, as determined by application and drying-time, service, and cost. The composition of the paint is left entirely to the manufacturer, and it is his responsibility to produce a paint meeting the requirements specified herein.

The paint must be suitable for application in the Department's striping equipment designed for this purpose. The paint shall be furnished for use without thinning or other modifications. It shall be uniformly ground, shall not settle badly, skin, gel, or thicken in the sealed container during a period of one year of storage. After storage it shall be capable of reincorporation by normal methods, for satisfactory application.

Specific Requirements.-Samples submitted for performance tests shall meet all of the following specific requirements. Paints not meeting one or more of the specific requirements will not be field evaluated nor considered for bids.

a. Color:

1. White.-The luminous directional reflectivity shall be not less than 80 percent relative to magnesium oxide when tested in accordance with the current ASTM E 97.
2. Yellow.-Shall be within the limits of the Color Tolerance Chart for Highway Yellow, PR Color #1 of the Federal Highway Administration, except that the green tolerance limit shall have C.I.E. coordinates of $x=0.491$ and $y=0.460$ and except that the minimum lightness shall be 50.7 percent. Tests will be conducted in accordance with ASTM E 308, using Standard Illuminant C. Fluorescence in paints will not be permitted.
3. Black.-Shall be a flat black, matching Color No. 37038 of Federal Standard No. 595.

b. Consistency.-The paint shall have a viscosity of 95 to 125 Krebs Units at 77 F as determined by Method 4281 of Federal Standard 141.

3-12-68
4-14-71
11-15-74
11-18-76

c. Drying Time.—The paint shall dry to a "no-tracking" condition in 2 minutes or less when applied on an unpainted roadway. The "no-tracking" condition shall be determined on applied paint stripes, with the paint preheated by the striping equipment to a temperature of 160 to 170 F at the spray gun and the air temperature at 75 ± 10 F and the relative humidity under 80 percent. The "no-tracking" time shall be determined by a passenger car in a simulated passing maneuver.

For this and other applicable tests, the paint will be applied at the rate of 15 gallons per mile of 4-inch stripe, with MDSHT beads applied at the rate of 6 pounds per gallon of white or yellow paint.

d. Bleeding.—The paint shall have a numerical rating of not less than 4, when tested in accordance with ASTM D 969. The test shall be performed on beaded strips.

e. Settling.—The paint shall have a numerical rating of not less than 6, when tested in accordance with ASTM D 869.

f. Paint Non-Volatile.—The paint shall have a minimum of 70 percent non-volatile when tested by Method 4041 of Federal Standard 141.

Samples for Performance Tests.—A sample of paint will be purchased from each prequalified producer, packaged in one open-headed drum, of the 30 or 55-gallon size indicated on the Purchase Order. For laboratory evaluation, the producer shall also furnish a 5-gallon container and 8 one-quart containers filled with the same paint.

The producer shall furnish the name of the solvent recommended for clean-up of striping equipment.

Service Test.—The service test will include application of paint to the roadway, (a) as transverse stripes to determine appearance, durability, and night visibility, and (b) as longitudinal stripes to determine suitability for application in roadway striping equipment, and drying time. Because of inherent variability of evaluation conditions and results, producers of paints exceeding the drying time requirement may be requested to bid at the discretion of the Department.

Bids.—All producers whose samples meet the Specific Requirements and receive a satisfactory rating on the service test will be given an invitation to bid. Each bidder shall file an affidavit that the paint which he proposes to furnish is identical with that submitted for service tests.

Packaging and Marking.—The size of the containers will be indicated on the Purchase Order. All containers shall be filled by weight. Each container shall plainly show, in weather resistant markings, the name of the producer, description of material, purchase order number, date of packaging, and volume of contents. The containers shall conform to U.S. Department of Transportation's specification No. 17 H covering steel drums—single trip, removable head.

Sampling and Testing.—Paint purchased under these specifications will be sampled and tested by Department methods. The sample, taken by the Department's representative, shall consist of 3 pints taken from each production batch. A production batch shall consist of at least 2000 gallons.

The Department shall have the right to require the manufacturer or seller to withhold shipment of the paint until all tests have been conducted. In general, the time required before laboratory and field tests can be reported will be four weeks for the initial batch, and two weeks for subsequent batches.

3-12-68
4-14-71
11-15-74
11-18-76

MICHIGAN
DEPARTMENT OF TRANSPORTATION

SPECIFICATION
FOR
WHITE AND YELLOW FAST-DRY
PAVEMENT MARKING PAINTS

8.17(3d)P.O.

Description. -This specification covers fast-drying white and yellow pavement marking paints. The paint will be heated, applied to the pavement, and reflectorized with glass beads applied by spray gun.

The paint as furnished shall contain no premixed glass beads as part of the pigment or for reflectorization purposes.

These specifications require road performance evaluations.

General Requirements. -It is the intent of these specifications to procure for use by the Department the best traffic paint possible as determined by application and drying time, service, and cost. The composition of the paint is left entirely to the manufacturer, and it is his responsibility to produce a paint meeting the requirements specified herein.

The paint must be suitable for application in the Department's striping equipment designed for this purpose. The paint shall be furnished for use without thinning or other modifications. It shall be uniformly ground, shall not settle badly, skin, gel, or thicken in the sealed container during a period of one year of storage. After storage it shall be capable of reincorporation by normal methods for satisfactory application.

Specific Requirements. -Samples submitted for performance tests shall meet all of the following requirements. Paints not meeting one or more of the specific requirements will not be field evaluated nor considered for bids.

a. Color

1. White. -The luminous directional reflectivity shall not be less than 80 percent relative to magnesium oxide when tested in accordance with the current ASTM E 97.

3-12-68
4-14-71
11-15-74
11-18-76
2-6-79

8.17(3d)P.O.

- 2. Yellow. - Shall be within the limits of the Color Tolerance Chart for Highway Yellow, PR Color #1 of the Federal Highway Administration, except that the green tolerance limit shall have C.I.E. coordinates of $x = 0.491$ and $y = 0.460$, and except that the minimum lightness shall be 50.7 percent. Tests will be conducted in accordance with ASTM E 308, using Standard Illuminant C. Fluorescence in paints will not be permitted.
- b. Consistency. - The paint shall have a viscosity of 95 to 125 Krebs Units at 77 F as determined in accordance with ASTM D 562.
- c. Drying Time. - The paint shall dry to a 'no-tracking' condition in 2 minutes or less when applied on an unpainted roadway. The "no-tracking" condition shall be determined on applied paint stripes with the paint preheated by the striping equipment to a temperature of 160 to 170 F at the spray gun, the air temperature at 75 ± 10 F, and the relative humidity under 80 percent. The "no-tracking" time shall be determined by a passenger car in a simulated passing maneuver.

For this and other applicable tests, the paint will be applied at the rate of 15 gallons per mile of 4-inch stripe, with MDOT beads applied at the rate of 6 pounds per gallon of paint.

- d. Bleeding. - The paint shall have a numerical rating of not less than 4 when tested in accordance with ASTM D 969. The test shall be performed on beaded stripes.
- e. Settling. - The paint shall have a numerical rating of not less than 6 when tested in accordance with ASTM D 869.
- f. Paint Non-Volatile. - The paint shall have a minimum of 70 percent non-volatile when tested in accordance with ASTM D 2369.

Samples for Performance Tests. - Samples of each color of paint will be purchased from each prequalified producer. Each sample shall be packaged in a 55 gallon open-headed drum as indicated on the Purchase Order. For laboratory evaluation, the producer shall also furnish a 5 gallon container and 8 one-quart containers filled with the same paint. Statement of Characteristics forms will be provided to be submitted with paint samples.

The producer shall furnish the name of the solvent recommended for clean-up of striping equipment.

- 3-12-68
- 4-14-71
- 11-15-74
- 11-18-76
- 2-6-79

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Service Test.-The service test will consist of application of paint to the roadway, (a) as transverse stripes to determine appearance, durability, and night visibility, and (b) as longitudinal stripes to determine suitability for application in roadway striping equipment and drying time. Because of inherent variability of evaluation conditions and results, producers of paints exceeding the drying time requirement may be requested to bid at the discretion of the Department.

Test stripes will be applied and evaluated in accordance with ASTM D 713 unless otherwise specified. Transverse stripes will be applied by Department personnel to two areas of highway, one of which will be portland cement concrete and the other bituminous concrete.

Periodic field inspections will be made at six-week intervals by two raters each from the Traffic and Safety Division, the Maintenance Division, and the Testing and Research Division.

Service tests will be conducted for one year or until all paints have reached their ends of "Useful Life" (whichever occurs first) as defined by paragraph 2.4.3 of ASTM D 713.

Bids.-All producers whose samples meet the Specific Requirements and receive a satisfactory rating on the service tests will be given an invitation to bid. Each bidder shall file an affidavit that the paint which he proposes to furnish is identical with that submitted for service tests.

Packaging and Marking.-The size of the containers will be indicated on the Purchase Order. All containers shall be filled by weight. Each container shall plainly show in weather resistant markings the name of the producer, description of material, purchase order number, date of packaging, and volume of contents. The containers shall conform to U.S. Department of Transportation's Specification No. 17 H covering steel drums-single trip, removable head.

Sampling and Testing.-Paint purchased under these specifications will be sampled and tested by Department methods. The sample, taken by the Department's representative, shall consist of three pints taken from each production batch. A production batch shall consist of at least 2,000 gallons.

Properties of the paint shall not deviate by more than the following amounts from the properties of the sample submitted for the service tests,

3-12-68
4-14-71
11-15-74
11-18-76
2-6-79

but in all cases, the paint furnished on the Purchase Order shall comply with the Specific Requirements of this specification:

Viscosity, Krebs units	<u>+ 10</u>
Weight per Gallon, pounds	<u>+ 0.20</u>
Percent Pigment, percentage points	<u>+ 2.0</u>
Percent Non-Volatile in Vehicle, percentage points	<u>+ 3.0</u>

The Department shall have the right to require the manufacturer or seller to withhold shipment of the paint until all tests have been conducted. In general, the time required before laboratory tests can be reported will be four weeks for the initial batch and two weeks for subsequent batches.

3-12-68
4-14-71
11-15-74
11-18-76
2-6-79

STATEMENT OF CHARACTERISTICS OF PAVEMENT MARKING
PAINT FOR USE WITH GLASS REFLECTORIZING BEADS

(To be filled out by paint manufacturer)

Manufacturer _____

Manufacturer's Address _____

Manufacturer's Code Number _____ Color _____

Paint Composition:

Pigment, percent by weight	-----	_____
Vehicle, percent by weight	-----	_____
Weight, pounds per gallon at 77 F	-----	_____
Non-Volatile, percent by weight	-----	_____

Consistency in Krebs Units, 77 F _____

Color, daylight illumination

Chromaticity coordinate x	_____
Chromaticity coordinate y	_____

Luminous Directional Reflectivity, percent _____

Drying time on concrete pavement when atmospheric temperature is between 70° and 80° F, and the relative humidity is between 40 and 60 percent.

Free from pick-up under traffic, minutes _____

Dry and free from tackiness, minutes _____

Recommended Solvent for Clean-Up of Equipment _____

Send to: Michigan Department of Transportation
 Research Laboratory Section, Materials Research Unit
 Secondary Governmental Complex
 P. O. Box 30049
 Lansing, Michigan 48909

MICHIGAN
DEPARTMENT OF TRANSPORTATION

SPECIFICATION
FOR
WHITE AND YELLOW FAST-DRY
PAVEMENT MARKING PAINTS

8.17(3d)P.O.

Description. -This specification covers fast-drying white and yellow pavement marking paints. The paint will be heated, applied to the pavement, and reflectorized with glass beads applied by spray gun.

The paint as furnished shall contain no premixed glass beads as part of the pigment or for reflectorization purposes.

These specifications require road performance evaluations.

General Requirements. -It is the intent of these specifications to procure for use by the Department the best traffic paint possible as determined by application and drying time, service, and cost. The composition of the paint is left entirely to the manufacturer, and it is his responsibility to produce a paint meeting the requirements specified herein.

The paint must be suitable for application in the Department's striping equipment designed for this purpose. The paint shall be furnished for use without thinning or other modifications. It shall be uniformly ground, shall not settle badly, skin, gel, or thicken in the sealed container during a period of one year of storage. After storage it shall be capable of reincorporation by normal methods for satisfactory application.

Specific Requirements. -Samples submitted for performance tests shall meet all of the following requirements. Paints not meeting one or more of the specific requirements will not be field evaluated nor considered for bids.

a. Color

1. White. -The luminous directional reflectivity shall not be less than 80 percent relative to magnesium oxide when tested in accordance with the current ASTM E 97.

3-12-68
 4-14-71
 11-15-74
 11-18-76
 2-6-79
 5-5-80

8.17(3d)P.O.

- 2. Yellow. - Shall be within the limits of the Color Tolerance Chart for Highway Yellow, PR Color #1 of the Federal Highway Administration, except that the green tolerance limit shall have C.I.E. coordinates of $x = 0.491$ and $y = 0.460$, and except that the minimum lightness shall be 50.7 percent. Tests will be conducted in accordance with ASTM E 308, using Standard Illuminant C. Fluorescence in paints will not be permitted.
- b. Consistency. - The paint shall have a viscosity of 95 to 125 Krebs Units at 77 F as determined in accordance with ASTM D 562.
- c. Drying Time. - The paint shall dry to a 'no-tracking' condition in 2 minutes or less when applied on an unpainted roadway. The 'no-tracking' condition shall be determined on applied paint stripes with the paint preheated by the striping equipment to a temperature of 160 to 170 F at the spray gun, the air temperature at 75 ± 10 F, and the relative humidity under 80 percent. The 'no-tracking' time shall be determined by a passenger car in a simulated passing maneuver.

For this and other applicable tests, the paint will be applied at the rate of 15 gallons per mile of 4-inch stripe, with MDOT beads applied at the rate of 6 pounds per gallon of paint.

- d. Bleeding. - The paint shall have a numerical rating of not less than 4 when tested in accordance with ASTM D 969. The test shall be performed on beaded stripes.
- e. Settling. - The paint shall have a numerical rating of not less than 6 when tested in accordance with ASTM D 869.
- f. Paint Non-Volatile. - The paint shall have a minimum of 70 percent non-volatile when tested in accordance with ASTM D 2369.

Samples for Performance Tests. - Samples of each color of paint will be purchased from each prequalified producer. Each sample shall be packaged in a 55 gallon open-headed drum as indicated on the Purchase Order. For laboratory evaluation, the producer shall also furnish a 5 gallon container and 8 one-quart containers filled with the same paint. Statement of Characteristics forms will be provided to be submitted with paint samples.

The producer shall furnish the name of the solvent recommended for clean-up of striping equipment.

- 3-12-68
- 4-14-71
- 11-15-74
- 11-18-76
- 2-6-79
- 5-5-80

Service Test. -The service test will consist of application of paint to the roadway, (a) as transverse stripes to determine appearance, durability, and night visibility, and (b) as longitudinal stripes to determine suitability for application in roadway striping equipment and drying time. Because of inherent variability of evaluation conditions and results, producers of paints exceeding the drying time requirement may be requested to bid at the discretion of the Department.

Test stripes will be applied and evaluated in accordance with ASTM D 713 unless otherwise specified. Transverse stripes will be applied by Department personnel to two areas of highway, one of which will be portland cement concrete and the other bituminous concrete.

Periodic field inspections will be made at six-week intervals by raters from the Testing and Research Division. Night visibility will be determined by a Departmental photometric method.

Service tests will be conducted for one year or until all paints have reached their ends of "Useful Life" (whichever occurs first) as defined by paragraph 2.4.3 of ASTM D 713.

Bids. -All producers whose samples meet the Specific Requirements and receive a satisfactory rating on the service tests will be given an invitation to bid. Each bidder shall file an affidavit that the paint which he proposes to furnish is identical with that submitted for service tests.

Packaging and Marking. -The size of the containers will be indicated on the Purchase Order. All containers shall be filled by weight. Each container shall plainly show in weather resistant markings the name of the producer, description of material, purchase order number, date of packaging, and volume of contents. The containers shall conform to U. S. Department of Transportation's Specification No. 17 H covering steel drums-single trip, removable head.

Sampling and Testing. -Paint purchased under these specifications will be sampled and tested by Department methods. The sample, taken by the Department's representative, shall consist of three pints taken from each production batch. A production batch shall consist of at least 2,000 gallons.

Properties of the paint shall not deviate by more than the following amounts from the properties of the sample submitted for the service tests,

- 3-12-68
- 4-14-71
- 11-15-74
- 11-18-76
- 2-6-79
- 5-5-80

but in all cases, the paint furnished on the Purchase Order shall comply with the Specific Requirements of this specification:

Viscosity, Krebs units	<u>+ 10</u>
Weight per Gallon, pounds	<u>+ 0.20</u>
Percent Pigment, percentage points	<u>+ 2.0</u>
Percent Non-Volatile in Vehicle, percentage points	<u>+ 3.0</u>

The Department shall have the right to require the manufacturer or seller to withhold shipment of the paint until all tests have been conducted. In general, the time required before laboratory tests can be reported will be four weeks for the initial batch and two weeks for subsequent batches.

- 3-12-68
- 4-14-71
- 11-15-74
- 11-18-76
- 2-6-79
- 5-5-80

STATEMENT OF CHARACTERISTICS OF PAVEMENT MARKING
PAINT FOR USE WITH GLASS REFLECTORIZING BEADS

(To be filled out by paint manufacturer)

Manufacturer _____

Manufacturer's Address _____

Manufacturer's Code Number _____ Color _____

Paint Composition:

Pigment, percent by weight - - - - - _____

Vehicle, percent by weight - - - - - _____

Weight, pounds per gallon at 77 F - - - - - _____

Non-Volatile, percent by weight - - - - - _____

Consistency in Krebs Units, 77 F _____

Color, daylight illumination

Chromaticity coordinate x _____

Chromaticity coordinate y _____

Luminous Directional Reflectivity, percent _____

Dryingtime on concrete pavement when atmospheric temperature is between
70° and 80° F, and the relative humidity is between 40 and 60 percent.

Free from pick-up under traffic, minutes _____

Dry and free from tackiness, minutes _____

Recommended Solvent for Clean-Up of Equipment _____

Send to: Michigan Department of Transportation
Research Laboratory Section, Materials Research Unit
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