



B. E. KING  
COMMISSIONER OF HIGHWAYS

COMMONWEALTH OF KENTUCKY  
DEPARTMENT OF HIGHWAYS  
FRANKFORT, KENTUCKY 40601

November 1, 1971

ADDRESS REPLY TO  
DEPARTMENT OF HIGHWAYS  
DIVISION OF RESEARCH  
533 SOUTH LIMESTONE STREET  
LEXINGTON, KENTUCKY 40508  
TELEPHONE 606-254-4475

H-2-19

MEMORANDUM TO: J. R. Harbison  
State Highway Engineer  
Chairman, Research Committee

SUBJECT: Research Report Submission; "Durability of Traffic Paint on  
Portland Cement Concrete Pavements"; KYHPR-64-19; HPR-1(6), Part II

In preparation for the dedication and opening of portions of I 64 between Frankfort and Louisville, late in 1961, there was considerable haste and urgency involved in striping the (concrete) pavement. About a month later, considerable mileage there appeared to need restriping. The date of the first restriping is now vague; but I recall that the pavement was restriped three times during the first year. We were already aware of differences in the durability of paints on portland cement concrete and asphalt pavements. In 1949, we began studies toward developing a performance basis for purchasing traffic paints -- which is the procedure now being used by the Division of Traffic (and Division of Materials). Differences with respect to pavement type were recognized from the very beginning. Of course, others had reported similar observations previously. In the beginning and for several years afterwards, sample paints were applied in transverse lines on both asphalt and concrete pavements. This plan necessitated selection of a roadway site where the two types of pavement abutted. The plan became too burdensome, and it was decided to rely solely on the performance of paints on asphalt pavements. The early distressful performance of paints on I 64 (Louisville-Frankfort) had some bearing on the selection of that site for extensive, experimental installations of so-called permanent, thermoplastic lines in 1962 (cf, "Final Performance Report...", February 1970).

The aforementioned circumstances inspired us in 1964 to initiate an HPR study to discover which generic types of paint and (or) pretreatments might provide assurances of more dependable performance on concrete. No specific hypothesis was conceived; the intent was to rely mostly upon "trial" and "discovery." About 1951, in the first series of transverse lines we applied, there was a lacquer (presumably a nitro-cellulose) which persisted in a noticeable degree for about five years; we dismissed it from consideration because the solids content was not sufficient to hold glass beads. Unfortunately, the lacquer employed in the current trials (Line 31) was not like the original material mentioned.

We have witnessed many times severe losses of paint stripes during snowy and icy conditions. Dry snow appears to be very abrasive; cinders and sand are very damaging. Although the effect of studded tires is intuitively assumed to be critical, we have not studied the problem specifically.

Edge-lines tend to persist through several seasons (even two to four years); whereas, center-lines tend to be abraded and worn away by traffic. Paints which adhere well and cure to a high degree of hardness -- without loosening because of shrinkage -- seem to be more resistant to wear. Consequently, the life of such stripes depends on their thickness.

Multi-coat applications of paint have provided extended life in high-wear zones; however, the economic and practical ramifications associated with two- and three-coat striping have not been tested. We have observed that the glass beads (reflectorizing) tend to wear flat and become ineffective if the stripe persists too long in a wear zone. Unfortunately, some wear is needed on edge stripes and zone



Memorandum

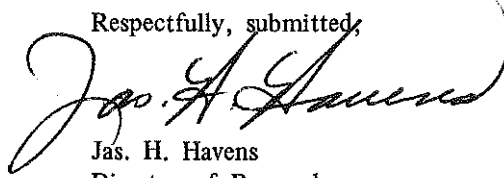
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markings in order to keep them clean of dirt and road scum. Frequent renewal of lines (and attendant re-beading) in severe-wear zones is believed to enhance wet-night visibility.

Cost-per-mile-per-day-of-useful-life is the current basis for purchasing traffic paints. Samples are invited each year; they are applied in transverse lines which are periodically rated. The paint purchased, a year later, presumably represents the "best buy" available. Some very high quality paints (particularly chlorinated rubber) won the competition despite their comparatively high cost. Performance testing and evaluations of cost (now in terms of cost-per-mile-per-day-of-useful-life) continues to be a satisfactory basis for purchasing traffic paint. Conceptually, it provides opportunities for high-quality paints to prove their worth -- while also respecting the concept of obtaining the "best buy" without regard to composition of the paint.

I do not believe we have made any significant discoveries relative to the durability of paints on very new concrete. Nevertheless, hard-drying, solvent-resin paints and epoxies seem to provide exceptional resistance to wear. So-called "fast solvents" in synthetic resin paints make instant drying almost achievable.

Respectfully, submitted,

A handwritten signature in black ink, appearing to read "Jas. H. Havens", written in a cursive style.

Jas. H. Havens

Director of Research

Attachment

cc's: Research Committee

JHH:sg



## ABSTRACT

Performance of a series of transverse lines applied to a relatively new concrete pavement, utilizing primes and pretreatments, is reported. The report includes descriptions of the location of test lines and types of paint and pretreatments, performance histories, and analysis of results. Chlorinated rubber, epoxy, and urethane paints were the most durable. Neither pretreatment nor the use of primes significantly increased durability.



Research Report  
315

**DURABILITY OF TRAFFIC PAINT ON  
PORTLAND CEMENT CONCRETE PAVEMENTS**

KYHPR-64-19  
HPR-1(6), Part II

by

Assaf S. Rahal  
Research Engineer

Division of Research  
DEPARTMENT OF HIGHWAYS  
Commonwealth of Kentucky

in cooperation with the  
U.S. Department of Transportation  
Federal Highway Administration

The opinions, findings and conclusions  
in this report are not necessarily those of  
the Department of Highways or  
the Federal Highway Administration.

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## INTRODUCTION

Under traffic conditions of today, drying time, wet-night visibility, and durability have become essential qualities sought in traffic paints. It is apparent that some traffic paints are superior to others. This report is mainly concerned with durability of traffic paints on portland cement concrete pavements and includes various methods of pretreating the pavement prior to painting.

It is especially difficult to achieve good adhesion of paint on concrete pavements as compared to bituminous pavements and more so on new pavements than on old ones. The difficulty on new pavements is attributed partly to poor wetting and penetrating of the paint and to surface laitance which brings about flaking of thin surface layers causing the paint to flake off with it. Moreover, concrete is alkaline and tends to saponify fatty acid oils used in some paints and causes loss of adhesion. Paints compounded entirely of synthetic resins and solvents therefore seem to be more compatible with concrete. Quick-drying qualities are obtained, but the solids content of the paint is lessened because more solvent is needed. Various types of pretreatments have been used to inhibit the alkaline reactions and to remove laitance. Some of these methods include sandblasting, acid washes, and primes.

## DESCRIPTION OF TEST LINE INSTALLATION

The test site (Figure 1) was in the northbound lane of I 75 starting at Sta 246+75 (line 1).

The following stripes (Figure 2) were applied on September 4, 1964, a hot and clear day. The air temperature was 86°F and pavement temperature was 116°F.

1. **Parlon, White Masonry Paint;** Transverse lines 1 and 2, skip-dash center-line from Sta 252+75 to Sta 256+50. Two 1-gallon containers (coded X11245-98-2) were received from the Hercules Powder Company on June 28, 1961. The paint was extremely lumpy and could not be dispersed by mixing, and before the paint was poured into the striper, screening was necessary. The paint, having a specific gravity of 1.45, was applied with a small hand striper at a rate of 24.8 gallons per mile for a 5-inch line. Drying time was 45 minutes. After drying, the lines were satisfactory in appearance. Mineral spirits was an effective solvent for cleaning the equipment.
2. **Parlon, White Varnish Traffic Paint;** Transverse lines 3 and 4, skip-dash center-line from Sta 246+75 to Sta 252+50. Two 1-gallon containers (coded X11245-98-1) were received from the

Hercules Powder Company on June 28, 1961. After a thorough mixing, the paint was screened and only a few lumps were noted. The small hand striper was used to apply the paint (specific gravity 1.45), and the application rate was 31.4 gallons per mile for a 4 1/2-inch line. After 25 minutes, the paint was still wet, and after 2 hours, the paint was slightly tacky. It was noticed that, as the line dried, a surface film would form -- thereby blocking further evaporation of volatiles -- some air bubbles formed on the surface of the line. After drying, all lines had a satisfactory appearance. Mineral spirits was an effective solvent.

3. **White Traffic Paint with Busan 11-MI;** Transverse lines 5 and 6, skip-dash center-line from Sta 257+25 to Sta 259+03. A 1-gallon container (coded D-18, 23-JJ-II) was received from the Buckman Laboratories on July 17, 1963. Some sediment was in the bottom of the container but was redispersed by stirring. The paint had a specific gravity of 1.52 and was applied with the hand striper at a rate of 22.5 gallons per mile for a 4 3/4-inch line. After 30 minutes drying time, the paint was still tacky, and after 40 minutes, the paint was almost dry. The painted lines were completely dry after 60 minutes. Of samples 1 through 4, this paint was adjudged to have the highest gloss. Mineral spirits was used to clean the equipment.
4. **White Traffic Paint;** Transverse lines 7 and 8, skip-dash center-line from Sta 259+28 to Sta 293+30. A 5-gallon container (coded FA 7445) was received from Sherwin-Williams on September 17, 1963. This paint, having a specific gravity of 1.83, was applied with the large hand striper at a rate of 17.0 gallons per mile for a 3 3/4-inch line. Although this paint had premixed beads, surface drop-on beads were used. The paint was almost dry after 15 minutes and completely dry after 30 minutes. This paint, being of the chlorinated rubber type, dried to an "off-white" color which appeared to be pale yellow. Toluene was used to clean the equipment.

The following stripes (Figure 2) were applied on September 8, 1964, a hot and clear day. The air temperature was 86°F and pavement temperature was 103°F.

5. **White, Catalyzed Epoxy Traffic Paint;** Transverse lines 9 and 10, skip-dash center-line from Sta 293+55 to Sta 294+93. A 1-gallon container (coded FA 7443) was received from Sherwin-Williams on September 17, 1963. Upon opening, it was noticed that the pigment had separated from the vehicle, but only minor stirring was needed. Also supplied

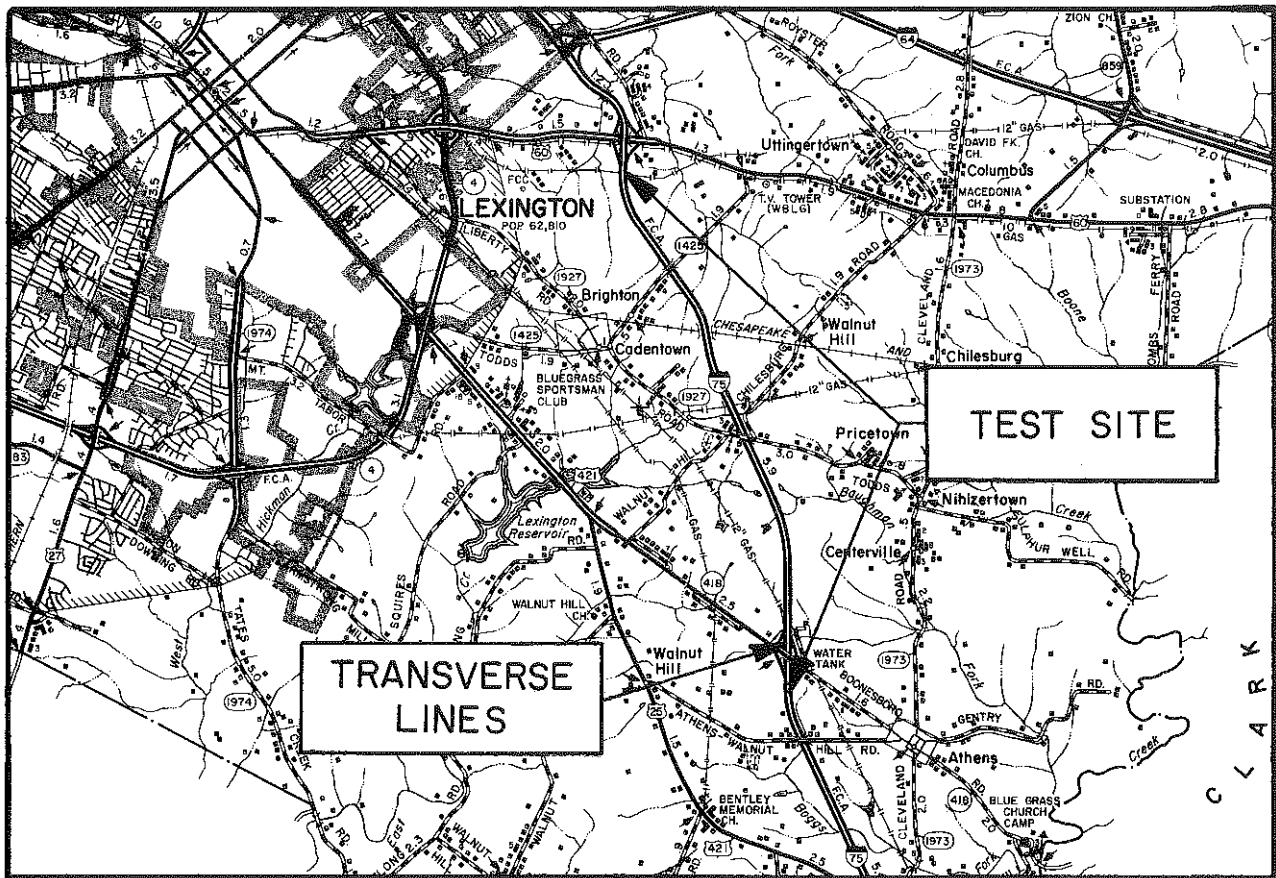


Figure 1. Location of Test Site on I 75.

was a catalyst (60 grams of diethylene triamine) which was slowly blended into the 1-gallon container; pot life was 6 hours. This material was applied by brush because the effectiveness of toluene as a solvent was unknown. It was later discovered that toluene was a fairly effective solvent, and it was felt that in all probability no difficulty would have been encountered if the epoxy had been applied with the hand striper. The application rate was 6.0 gallons per mile; the width of the line was 4 1/4 inches. After 1 1/2 hours drying time, the epoxy was almost dry; and after 2 hours, the lines were completely dry. Drop-on beads were applied in the usual manner, but it was noticed that the beads had not adhered. The specific gravity of the epoxy was 2.04. Good coverage at a low application rate was obtained with this material, and the lines painted with this material had the best appearance of any of the lines.

6. **Yellow, Catalyzed Expoy Traffic Paint;** Transverse lines 11 and 12. A 1-gallon container (coded FA 7444) was recieved from Sherwin-Williams on

September 17, 1963. No separation of pigment and vehicle was noticed, and the same type and amount of catalyst as in Number 5 was added. The specific gravity could not be determined exactly because a hydrometer with a range greater than 2.0 was not at hand; but it was estimated that the specific gravity was 2.1. The application rate, by brush, was approximately 8.6 gallons per mile; the width of the line was 4 1/2 inches. The painted lines were tacky after 1 hour and dry after 2 hours. Pot life of the material was 6 hours. Good coverage was obtained, and the bright yellow color of the line was very pleasing and was very similar to the highway yellow paint currently used by the Department. Drop-on beads did not adhere to the lines; toluene was used as a solvent.

7. **White, Urethane Coating;** Transverse lines 13 and 14, skip-dash center-line from Sta 295+18 to Sta 296+50. Two 1-quart containers of Bostik S175-702-1A and two 1-quart containers of Bostik S175-702-1B were received from the United Shoe Machinery Corporation on June 1, 1964. The A and B components, of which one was clear and

the other was white, were combined in equal proportions and thoroughly mixed. The resulting mixture had a specific gravity of 1.135 and was very thin and watery. The coating was applied by brush, and the coverage was very poor. The application rate was 7.2 gallons per mile, and the line width was 4 1/2 inches. After 2 hours of drying, the lines were still tacky, and after 2 hours and 30 minutes, the lines were dry. Pot life of this material was 4 hours. Acetone was used as a solvent.

8. **Yellow, Urethane Coating;** Transverse lines 15 and 16. Two 1-quart containers of Bostik S175-703-1A and two 1-quart containers of Bostik S175-703-1B were received from the United Shoe Machinery Corporation on June 1, 1964. The clear component was combined, in equal proportions, with the yellow component; and the resulting mixture was thin. This material was applied by brush and the coverage obtained was only fair. The application rate was 4.5 gallons per mile; the width of the line was 4 1/4 inches; the specific gravity was 1.200. The painted lines were slightly tacky after 1 hour and 15 minutes and were dry after 1 hour and 45

minutes. Pot life of this coating was 8 hours. Acetone was an effective solvent.

9. **Rhoplex, Acrylic Latex Primer;** Transverse lines 17 and 18, skip-dash center-line from Sta 296+75 to Sta 298+12. A 1-gallon container (Lot 1153, 8 ) was received from Rohm and Haas Company on June 8, 1964. This primer was milky white in color; and, after being applied by brush at a rate of 5.6 gallons per mile, the primer dried to a clear color in 5 to 10 minutes. This material was soluble in water; the specific gravity was 1.065. The width of the lines was 4 1/4 inches. These lines were overcoated with Kentucky white on September 9, 1964.
10. **Chlorinated Rubber Primer;** Transverse lines 19 and 20, skip-dash center-line from Sta 298+37 to Sta 335+25. A quantity of this material, labeled Parlon Concrete Sealer, was originally obtained from the American Marietta Company and was applied to the Goose Creek Bridge on I 64 in Shelby County. Some surplus of this material remained and a 5-gallon container was procured for use as paint primer. The clear tan primer was applied with the large hand striper at a rate of 28.3 gallons per mile.

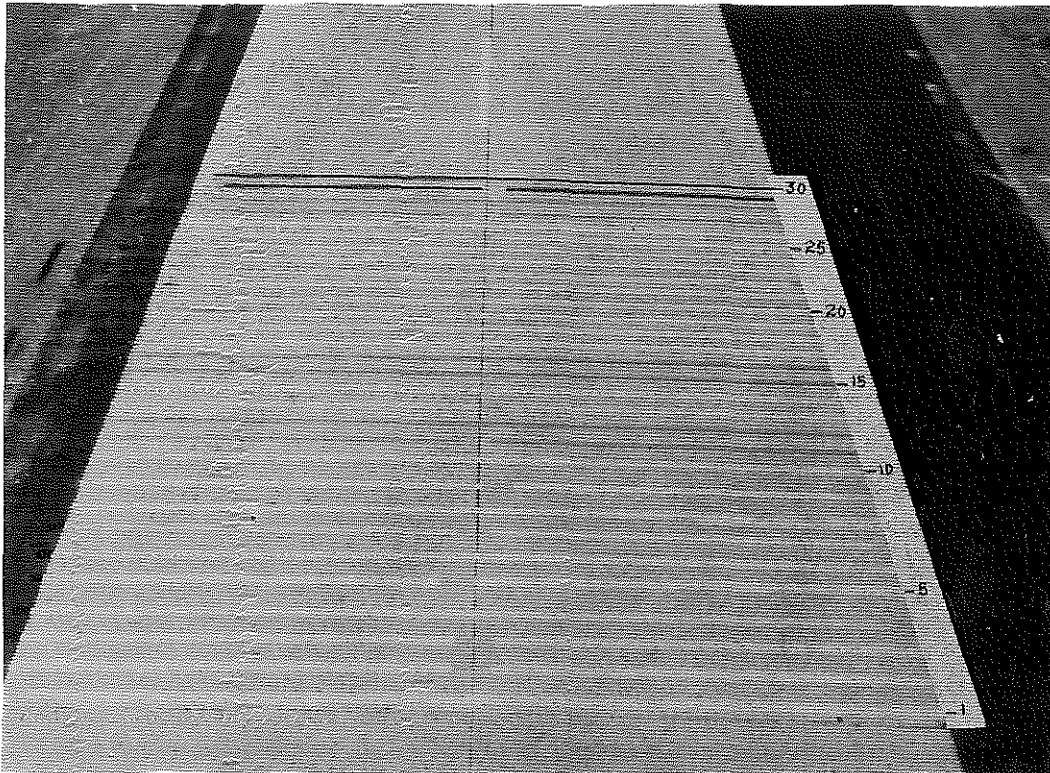


Figure 2. Transverse Lines 1 - 30.

The line width was 3 1/2 inches; and the specific gravity was 1.03. The application rate was probably too great because some running of the paint was noted. The edges of the lines were also stringy. Toluene was an effective solvent. After 2 hours and 20 minutes, the painted lines were still tacky, and on the next day, September 9, 1964, the lines were soft and pliable. At that time, the lines were overcoated with Kentucky white; and, as the paint dried, shrinkage cracks, which were probably caused by further drying of the primer, were noted.

11. **Polystyrene Primer**; Transverse lines 21 and 22, skip-dash center-line from Sta 335+50 to Sta 392+00. A 5-gallon container of George W. Whitesides Company's concrete hardener (coded 56-E-2) was obtained on September 1, 1964. The specific gravity could not be determined exactly because a hydrometer with a range of less than 1.0 was not at hand, but it was estimated that the specific gravity was between 0.9 and 0.95. The brownish black primer was applied with the large hand striper at a rate of approximately 19 gallons per mile, and the width of the line was 5 inches. Benzene was used as a solvent. The lines were still tacky after 20 minutes and were dry after 35 minutes. The lines were overcoated with Kentucky white on September 9, 1964.
12. **Black Center-Line Paint Primer**; Transverse lines 23 and 24, continuous center-line from Sta 392+00 to Sta 418+75. One 5-gallon container (coded MHD Spec. 3586, M14 DP 1146-168, GL 74761) was received from the Glidden Company on April 24, 1964. The primer was applied with the large hand striper at a rate of 14.2 gallons per mile. The width of the lines averaged 3 3/4 inches; and the specific gravity of the paint was 1.151. Good coverage was obtained and the line was practically dry in 10 minutes and was completely dry in 20 minutes. There was a slight tendency for the primer to harden in the spray nozzle. The paint dried to a dull black. In a well aligned manner, the continuous black line was overlain with Kentucky white paint on September 9, 1964.

The following stripes (Figure 2) were applied on September 9, 1964, a hot and clear day. The air temperature was 95°F and pavement temperature was 117°F.

13. **Kentucky White Paint**; Transverse lines 25 and 26, skip-dash center-line from Sta 418+90 to Sta 440+65. A quantity of white paint of the type currently used for striping in the state was obtained from the District 7 traffic paint stores. The paint, as originally supplied by the vendor, did not have

certain specified physical properties, and the vendor was allowed to drill a 1/4-inch hole in the lid of each 5-gallon container supplied, and through this hole, additives were made. A small cork was used to reseal the container. Because of the probable less-than-air tightness of the cork stopper and the consequential air exposure, all of the white paint was lumpy and partially congealed, and screening was required before it could be used in the striper. The paint was applied with the large hand striper at the rate of 19.0 gallons per mile. The width of the lines was 4 inches; the specific gravity of the paint was 1.42; and the paint dried in 20 minutes. The Kentucky white had a high gloss but would be ranked second to the gloss of the epoxy white.

In addition to the above test lines, Kentucky white was used to repaint all of the primers. All of the primers covered well.

14. **Kentucky Yellow Paint**; Transverse lines 27 and 28. A 5-gallon container of yellow paint was obtained from the District 7 traffic stores. The paint was applied with the small hand striper at a rate of 14.3 gallons per mile. The width of the lines was 4 inches; the specific gravity of the paint was 1.785; and the paint dried in 20 minutes. Good coverage was obtained.
15. **Black Tar Paint Primer**; Transverse lines 29 and 30, continuous center-line from Sta 440+65 to Sta 545+40. On August 9, 1964, a drum of black tar paint was received from the Western Tar Products Corporation. At a rate of 25.1 gallons per mile, the paint was applied, full strength, with the large hand striper; the width of the lines was 4 inches; and the specific gravity of the paint was 1.080. The edges of the lines were very stringy. As the line dried, a thick surface film formed; large air bubbles formed on the surface of the line. After 3 hours of drying time, the stripes were still tacky; but the traffic cones were removed and the lines did not track. On the following day, the lines were still soft and tacky but had not tracked. This paint, when applied full strength, was very slow in drying; to have decreased the drying time, 1 gallon of benzene should have been added per 15 gallons of tar paint. This formulation was tried on the Frankfort-Versailles Road and proved to be very beneficial inasmuch as the drying time was reduced to 45 minutes and the application rate was reduced to 6.8 gallons per mile (see memorandum June 1, 1964, Research Division File H.1.64.19).

After allowing time for complete curing, the black tar paint was over-painted, in the form of skip-dash, with Kentucky white paint in early

October 1964.

The following lines were applied on November 10, 1965, an overcast and cool day. The air temperature was 50°F and humidity was 55 percent.

16. **Kentucky White Paint**; Transverse lines 31 and 32. The pavement was scarified with a Tennant router before paint was applied. The paint was obtained from Reliance Chemical Company and was applied at the rate of 16.0 gallons per mile of 4-inch line with a hand applicator. The specific gravity of the paint was 1.75.
17. **Kentucky White Paint**; Transverse lines 33 and 34. The pavement was acid etched before paint was applied. The paint used was the same type as for lines 31 and 32 and was obtained from Reliance Chemical Company. It was applied with a hand applicator at a rate of 18.9 gallons per mile of 4-inch line. The specific gravity was 1.75.
18. **Kentucky White Paint**; Transverse lines 35 and 36. The paint was applied to an untreated pavement surface. It was the same paint used for lines 31-34. A hand applicator was used for producing a 4-inch line at a rate of 15.3 gallons per mile.
19. **Kentucky White Paint Plus Hydrochloric Acid**; Transverse lines 37 and 38. The Reliance Chemical Company paint was mixed with hydrochloric acid and applied to the untreated surface of the pavement. The paint, having a specific gravity of 1.75 before mixing, was applied with a hand applicator to produce a 4-inch wide and 20-mil thick line.
20. **Kentucky Yellow Paint**; Transverse lines 39 and 40. The paint was obtained from the Reliance Chemical Company and was applied with a hand applicator at the rate of 18.6 gallons per mile to produce a 4-inch wide line. The specific gravity of the material was 1.83. After a period of 30 minutes, the material was tacky; it was still soft after 1 1/2 hours.
21. **Parlon Varnish Traffic Paint**; Transverse lines 41 and 42. The paint (coded X124-20-93-1), was obtained from the Hercules Powder Company on May 3, 1962. It was applied at the rate of 18.9 gallons per mile of 4-inch line. The paint had a specific gravity of 1.455. Glass beads would not adhere to the paint five minutes after application.
22. **White Pigmented Floor Paint**; Transverse lines 43 and 44. The paint (coded AC 61), was received from Rohm and Haas on March 26, 1965. The material having a specific gravity of 1.56, was applied at the rate of 6.1 gallons per mile of 4-inch line with a hand applicator. It took about 3 hours for the material to dry to brittle hardness. After

drying, the stripes had a purplish hue.

23. **White, Bostik, Urethane**; Transverse lines 45 and 46. The material, having a specific gravity of 1.25, was obtained from the United Shoe Machinery Corporation. The paint was applied with a hand applicator at the rate of 10.5 gallons per mile of 4-inch line. The lines were still tacky after 5 1/2 hours.
  24. **Yellow, Bostik, Urethane**; Transverse lines 47 and 48. The material was obtained from the United Shoe Machinery Corporation; its specific gravity was 1.56. Using the hand applicator, the material was applied at a rate of 13.7 gallons per mile of 4-inch line. The painted stripes were slightly tacky after 5 1/2 hours.
  25. **White Epoxy**; Transverse line 49. The material, labeled Resiweld Epoxy 7004, was obtained from the H. B. Fuller Company; its specific gravity was 1.07. The material was applied with a hand applicator at the rate of 16.25 gallons per mile of 4-inch line. The drying time was 6 1/2 hours.
  26. **Gray Epoxy**; Transverse line 50. The material, Resiweld Epoxy 140, having a specific gravity of 1.01, was obtained from H. B. Fuller Company. The application rate was 16.5 gallons per mile, using a hand applicator and producing a 4-inch wide line. The drying time was 5 hours.
- The following lines (Figure 3) were applied on April 11, 1967, a cool and clear day. The air temperature was 50°F and pavement temperature 69-74°F.
27. **Yellow, Hot-Melt Sulfur-Type Compound**; Transverse lines 51, 52, and 53. This material (coded 12Y11), was obtained from Phillips Petroleum Company. It was applied at a pot temperature of 250°F using equipment developed by Phillips Petroleum. The application rate was 19.7 gallons per mile of 4 1/2-inch line; the drying time was 10 seconds.
  28. **White, Hot-Melt Sulfur-Type Compound**; Transverse lines 54, 55, and 56. This material (coded 14W10), was obtained from Phillips Petroleum Company. Using equipment developed by Phillips Petroleum, the material was applied at a pot temperature of 250°F and a 19.8 gallons per mile rate to produce a 4 1/4-inch line. The drying time for the three stripes varied between 40 and 42 seconds.
  29. **White, Hot-Melt Sulfur-Type Compound**; Transverse lines 57, 58, and 59. The material was obtained and applied in the same manner as lines 51-56. It was coded 12W5 and had an application rate of 20.8 gallons per mile for a 4 1/8-inch line.

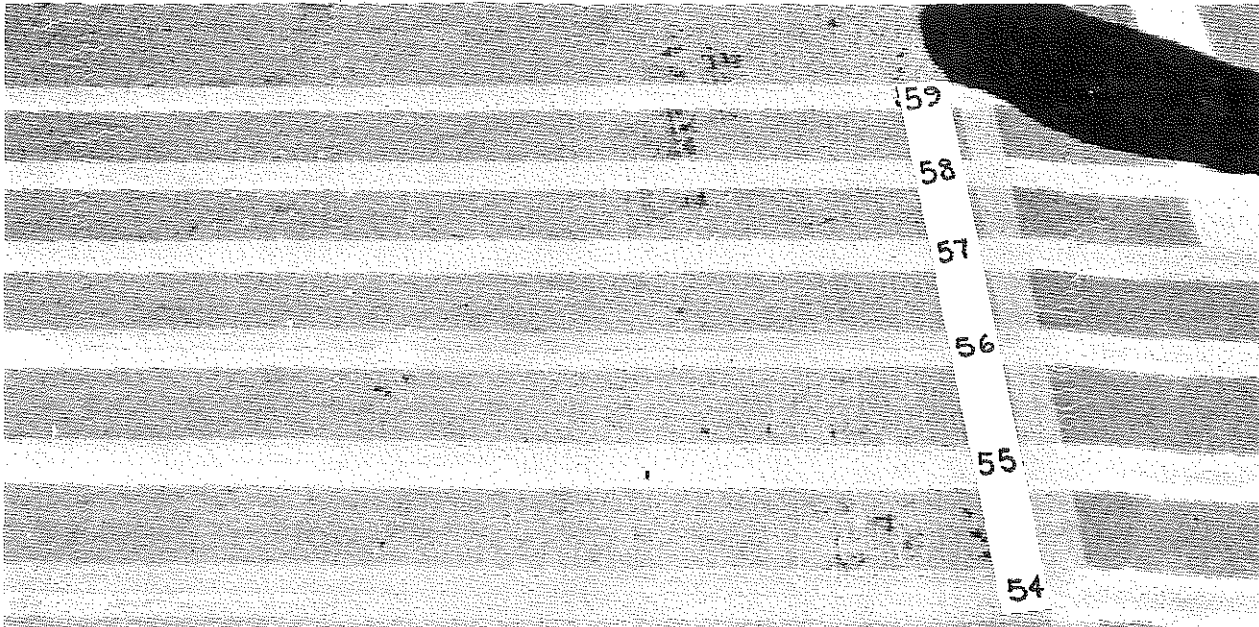


Figure 3. Hot-Melt Sulfur Lines 54 - 59.

Drying time was 45 seconds for line 57 and 70 seconds for line 59.

The following lines were applied on September 12, 1967.

30. **White, Colma Epoxy**; Transverse lines 60 and 61. This material was obtained from Sika Chemical Company and had a specific gravity of 1.26. The rate of application was 5.6 gallons per mile of 4-inch line.
31. **White, Dupont, Lucite Acrylic Lacquer**; Transverse lines 62 and 63. This material, designated 4024L, was applied in 3 1/4-inch stripes at the rate of 15.7 gallons per mile. The specific gravity was 1.08, and the drying time was 30 minutes.
32. **Kentucky Yellow Over Lacquer**; Transverse lines 64 and 65. The lacquer, same as in lines 62 and 63, was applied first and allowed to dry; then Kentucky yellow paint was applied over it in 4-inch stripes. The drying time was 2 hours.
33. **Kentucky White Over Lacquer**; Transverse lines 66 and 67. Dupont Lucite lacquer and Kentucky white were applied in the same manner as line 32.
34. **Kentucky Yellow**; Transverse lines 68 and 69. Kentucky yellow paint for the year 1967 was applied in 4-inch stripes over existing untreated pavement for comparison.
35. **Kentucky White**; Transverse lines 70 and 71. Kentucky white paint was applied in the same manner as lines 68 and 69.

#### PRETREATMENTS AND PRIMES

One method of surface pretreatment was sandblasting. Lest sandblasting not prove to be sufficient, a Tennant router was also used to scarify to greater depth; the paint (Kentucky white obtained from the Reliance Chemical Company in 1965) was applied in the usual manner (lines 31 and 32).

To reduce alkalinity, the pavement was acid etched; and the paint was then applied (lines 33 and 34). In another procedure, hydrochloric acid was added to the paint itself (lines 37 and 38). Kentucky white paint was applied on untreated surfaces for comparison (lines 35 and 36).

The primes used were:

1. Rhoplex acrylic latex paint (lines 17 and 18),
2. Chlorinated rubber (lines 19 and 20),
3. Polystyrene primer (lines 21 and 22),
4. Black paint primer (lines 23 and 24),
5. Black tar paint primer (lines 29 and 30),
6. Dupont Lucite acrylic lacquer (lines 64, 65, 66, and 67).

After complete curing of a primer, Kentucky white or yellow paint was applied over it. Two Kentucky yellow transverse lines were applied on the untreated surface for comparison (lines 27 and 28).

In summary, acid etching increased the durability; but none of the other pretreatments or primes had any

favorable effects.

## EVALUATION PROCEDURES AND PERFORMANCE

During all installations, air and pavement surface temperatures, rates of application in gallons per mile, and drying time were recorded. In most cases, two transverse stripes were applied. Both white and yellow colors were used when available.

The application rates were determined by placing a preweighed, 12- by 10-inch strip of impermeable paper in the painting path. The strip was removed from the pavement and folded to prevent escape of volatiles and was then weighed to the nearest 0.01 gram.

The application rate was thus obtained from

$$R = 11.63 W_p/U$$

or

$$R = 1.395 W_p/G_s$$

where  $R$  = application rate in gallons per mile,  
 $W_p$  = weight in grams of paint on 12-inch strip,  
 $U$  = unit weight of paint, and  
 $G_s$  = specific gravity of paint.

Normally, the application rate for Kentucky paint is 15 gallons per mile for solid 4-inch line.

Periodic surveys were made at 6, 12, 18, 24, 36, and 48 months; and percent deterioration in the stripes was adjudged by loss of paint from the width, length, and thickness. All results are summarized in Table 1. Deterioration was predominant in the tire tracks.

The criterion of performance was the percent of stripe missing as adjudged by visual surveys. There was no definite criterion for termination of observations.

Figure 4 shows that acid etching increased paint durability on concrete. This increase was greater in the early stages of performance and ranged from 20 percent increase over the untreated surface after 6 months to about 5 percent after 12 months. Scarifying the pavement did not produce a favorable effect on durability; adding hydrochloric acid to the paint decreased durability by 40 percent after 6 months as compared to the untreated paint and surfaces.

Of six primers used, black paint primer (paint No. 12) performed best through 18 months. None of the primers enhanced durability of the paint to any noticeable degree (see Figure 5). It is apparent that primers in most cases reduced bond between the paint and concrete. Since the primer was allowed to cure before the paint was applied, its surface was generally

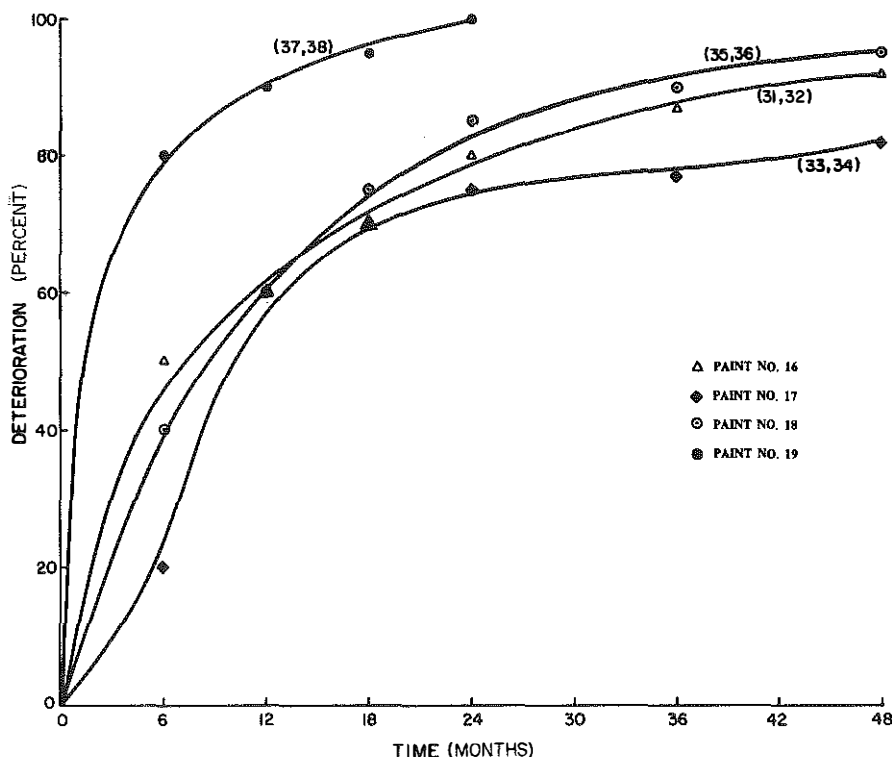


Figure 4. Comparison of Pretreatments.

TABLE 1. HISTORY AND PERFORMANCE SURVEY

LINE NUMBER	DATE OF APPLICATION	PERCENT MISSING					
		ELAPSED TIME AFTER APPLICATION					
		6 MO	12 MO	18 MO	24 MO	36 MO	48 MO
1,2	9-4-64	5	7	10	15	45	85
3,4	9-4-64	2	4	5	10	35	70
5,6	9-4-64	10	25	35	45	60	70
7,8	9-4-64	0	2	5	8	30	60
9,10	9-8-64	10	20	30	35	55	70
11,12	9-8-64	5	10	20	25	55	70
13,14	9-8-64	2	30	50	60	75	85
15,16	9-8-64	2	30	50	60	80	90
17,18	9-8-64	60	80	90	95	100	--
19,20	9-8-64	60	80	90	95	100	--
21,22	9-8-64	10	50	75	85	95	100
23,24	9-8-64	10	20	40	70	85	87
25,26	9-9-64	10	30	50	70	90	100
27,28	9-9-64	10	20	30	40	65	90
29,30	9-9-64	10	35	45	50	65	85
31,32	11-10-65	50	60	70	80	87	92
33,34	11-10-65	20	60	70	75	77	82
35,36	11-10-65	40	60	75	85	90	95
37,38	11-10-65	80	90	95	100	--	--
39,40	11-10-65	30	50	65	75	90	98
41,42	11-10-65	30	50	60	70	80	85
43,44	11-10-65	1	100	--	--	--	--
45,46	11-10-65	1	5	10	15	25	45
47,48	11-10-65	1	5	10	15	25	45
49	11-10-65	0	5	10	20	40	55
50	11-10-65	1	30	40	45	50	55
51,52,53	4-11-67	10	25	45	60	70	80
54,55,56	4-11-67	10	25	45	60	70	80
57,58,59	4-11-67	10	25	45	60	70	80
60,61	9-12-67	1	2	5	10	25	35
62,63	9-12-67	80	95	100	--	--	--
64,65	9-12-67	45	65	80	95	98	100
66,67	9-12-67	35	60	80	98	100	--
68,69	9-12-67	50	65	80	90	95	98
70,71	9-12-67	50	70	80	82	85	87



**TABLE 2. BEST PERFORMING PAINTS**

PERFORMANCE RATING*	ELAPSED TIME AFTER APPLICATION					
	6 MONTHS	12 MONTHS	18 MONTHS	24 MONTHS	36 MONTHS	48 MONTHS
A	4, 25	4, 30	2, 4, 30	4	23, 24, 30	30
B	30	2	1, 23, 24, 25	2, 30	4	23, 24
C	23, 24, 25, 26	23, 24, 25		1, 23, 24	2	2
D	2, 7, 8	1				
E	1, 6					

\*Performance rating, listed in descending order from A to E, as adjudged by the least percent deterioration.

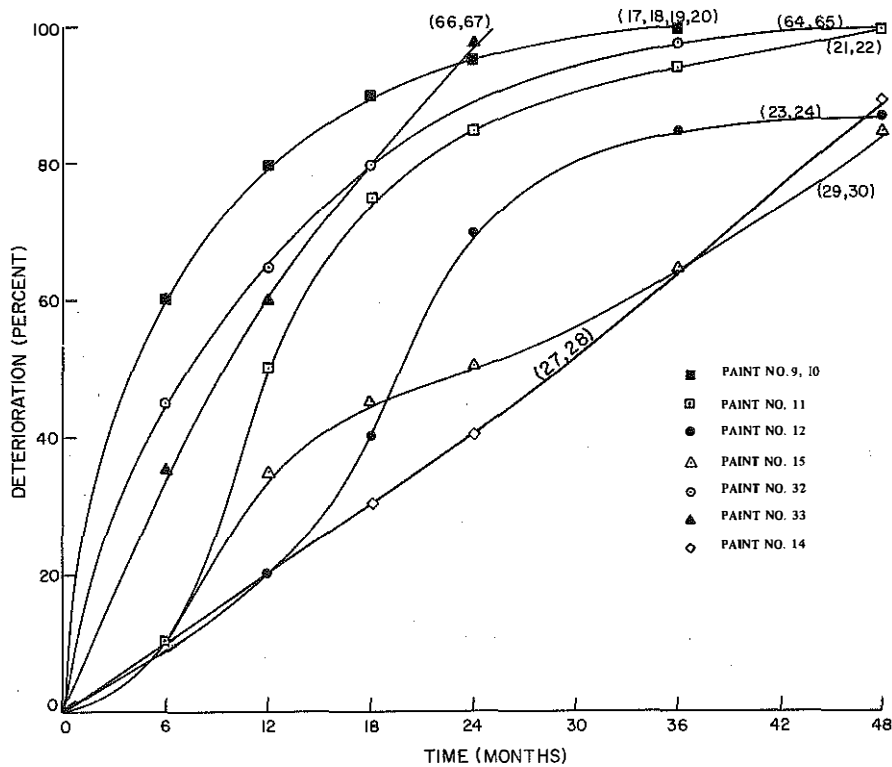
smooth. The primer also tends to fill irregularities and pores in the pavement surface into which paint normally flows.

Figures 6 through 11 summarize performances of all 35 paints tested -- including pretreatments and primes. A summary is contained in Table 2. Three types of paint excelled throughout the testing period: namely the epoxy, chlorinated rubber and urethane paints.

After a year, the chlorinated rubber and epoxy paints rated identically. Each showed a loss of not more than 2 percent of the total paint applied -- compared to 5 percent for urethane paints. After 2 years, the chlorinated rubber paint rated slightly better than the epoxy paints -- that is, a loss of 8 percent compared

to 10 percent for epoxy and 15 percent for urethane paints. During the third year, the epoxy paint had 35 percent deterioration compared to 45 percent for urethane and 60 percent for chlorinated rubber.

In summary, it was noted that chlorinated rubber, epoxy, and urethane paints excelled other paints in durability. The chlorinated rubber paint performed slightly better than epoxy paints after 2 years. In general, neither pretreatments nor the use of primes were effective in increasing service life. Although paint placed over acid-etched pavements performed slightly better, the difference in performance was not sufficient to justify the use of etching. Resistance to wear appears to be related to hardness of the paint film.



**Figure 5. Comparison of Primers.**

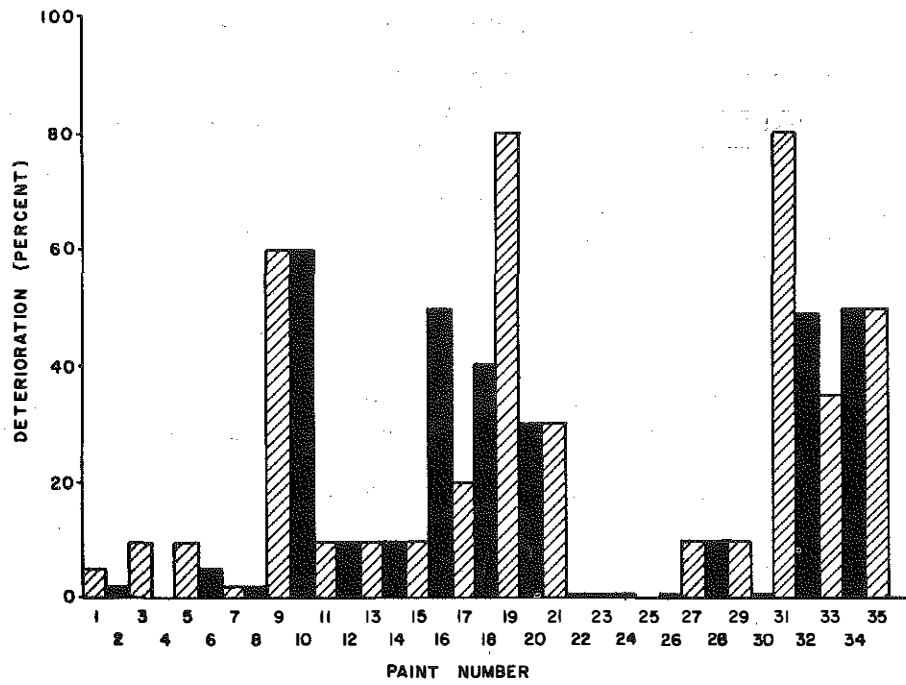


Figure 6. Performance after 6 Months.

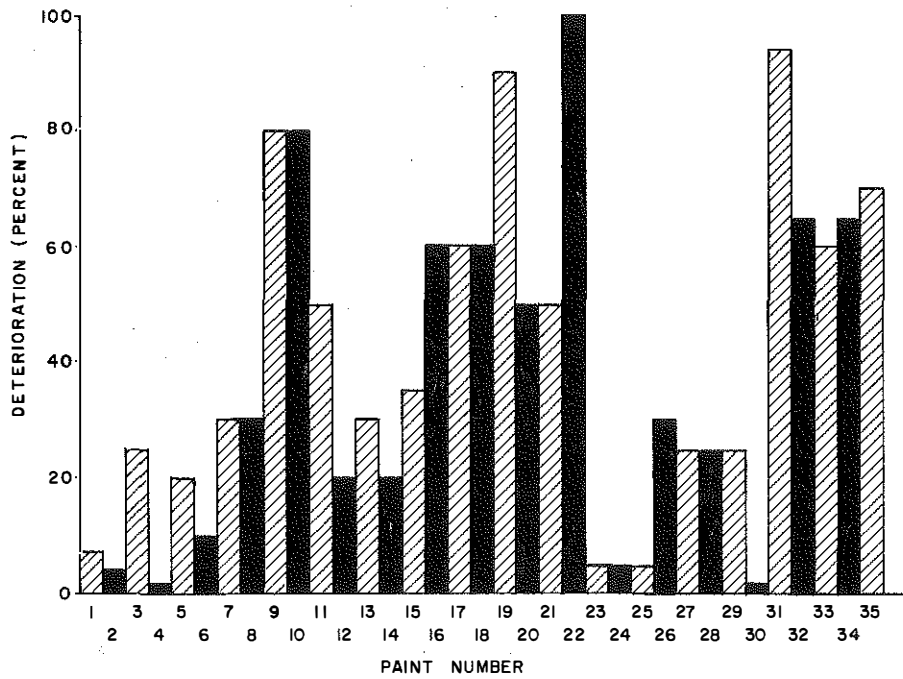


Figure 7. Performance after 12 Months.

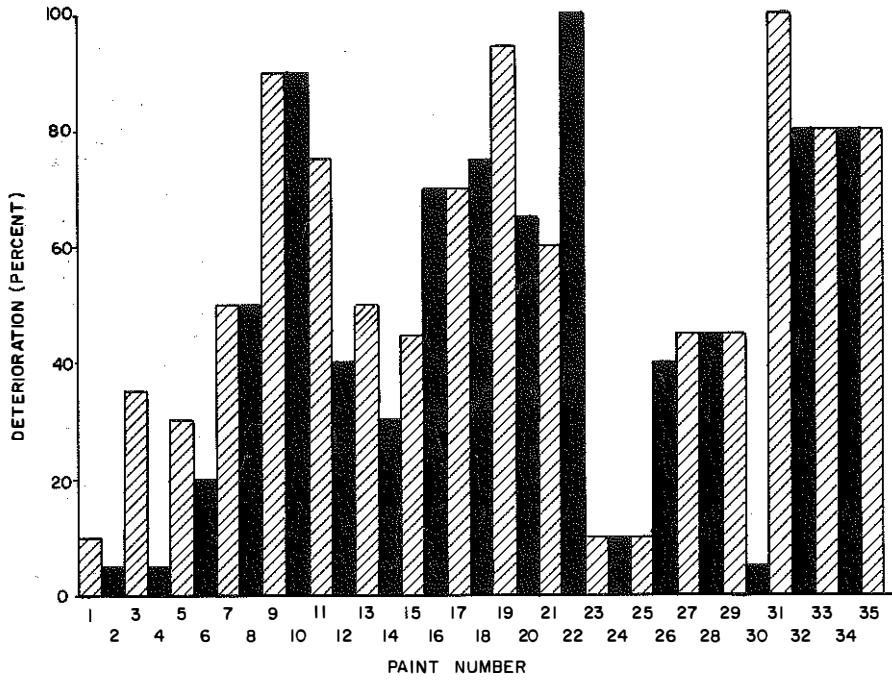


Figure 8. Performance after 18 Months.

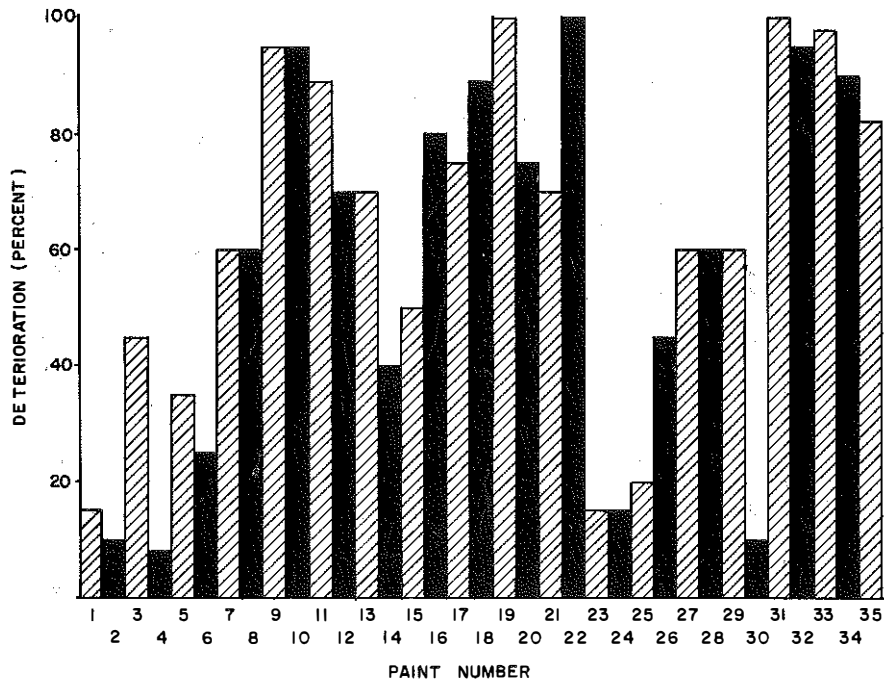


Figure 9. Performance after 24 Months.

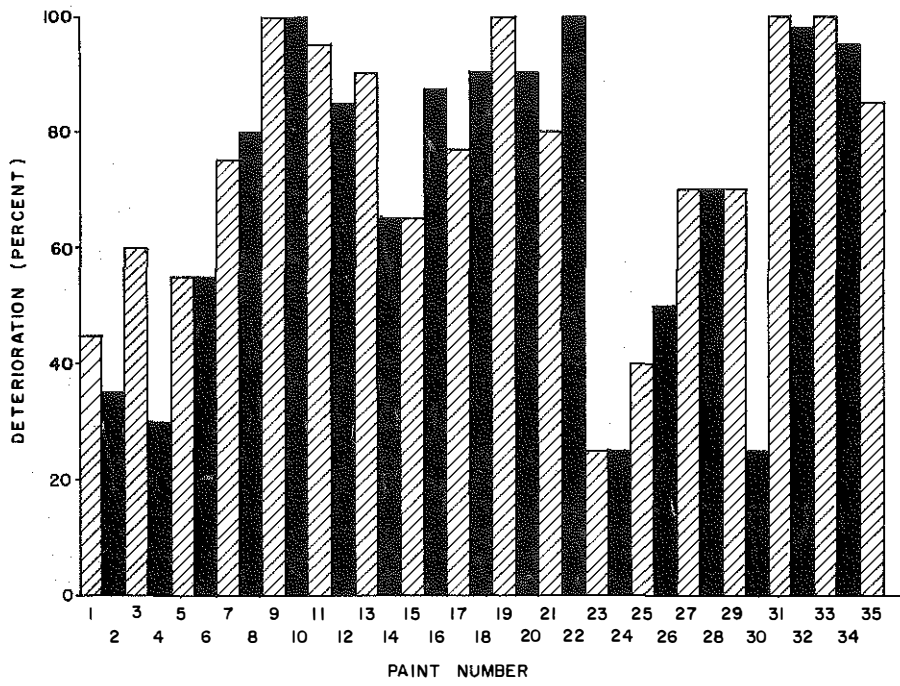


Figure 10. Performance after 36 Months.

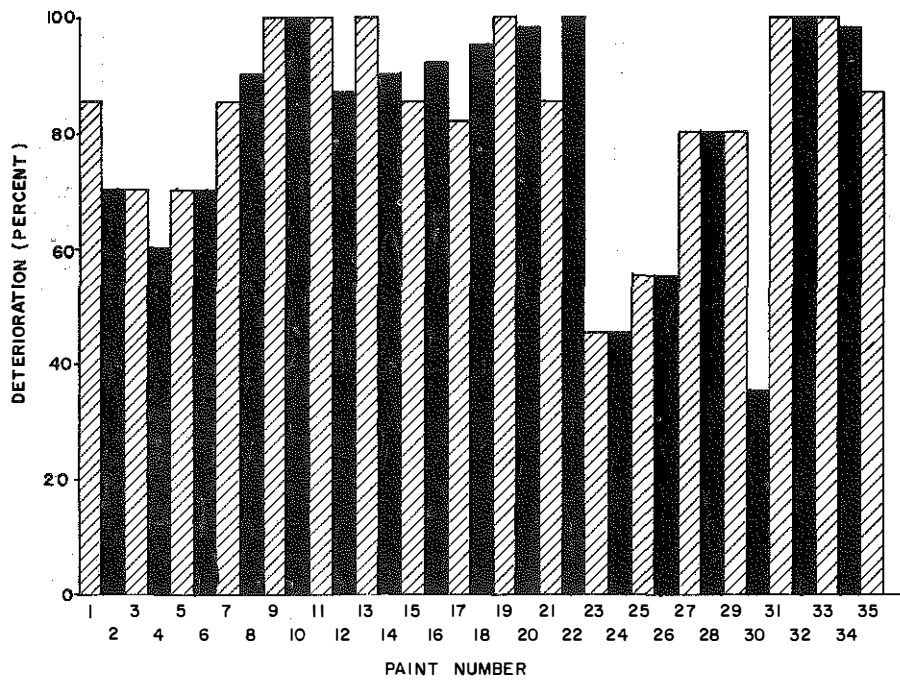


Figure 11. Performance after 48 Months.

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