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EPOXY THERMOPLASTIC PAVEMENT MARKING MATERIAL

A Construction Report

By

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16. Abstract

This report covers the installation phase of a research study (FHWA Demonstration Project No. 60) which will evaluate the placement and performance of ETP, a promising new epoxy resin based thermoplastic pavement marking material. The study will compare the performance of the ETP installation to that of a control (consisting of conventional traffic paint) over a two-year period on both bituminous and portland cement concrete pavements.

Although delayed at the start by minor equipment problems, once underway, the experimental striping operation proceeded without difficulty and was accomplished in about six man-hours (2-man crew). A total of approximately 21,130 linear feet of white (skipline and edgeline) marking material was applied.

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1.0 INTRODUCTION

In April 1983, the Federal Highway Administration launched Demonstration Project No. 60 to promote the benefits and application of a promising new epoxy resin based thermoplastic pavement marking material known as ETP (or EPOFLEX). This material was jointly developed by the FHWA's Office of Research and the Southwest Research Institute of Texas.

ETP has been field tested around the country for more than two years and results and operating experience have shown it to be superior in several aspects to most other currently available durable marking materials (e.g., thermoplastics, two-component epoxy and polyester). Reported benefits of ETP are:

- good durability and night visibility on both bituminous and portland cement concrete surfaces
- fast drying time (can be exposed to traffic in less than six seconds)
- application versatility (can be applied over a wide range of air temperatures)
- overall life-cycle costs comparable to conventional traffic paint.

New Jersey considers this demonstration project to be particularly timely, since the development of a durable pavement marking material for high volume roadways is deemed a critical need in our state. At about the time the demonstration project began, the Department formed a task force on long-life lines to address this specific problem. In addition to developing an interim policy to govern the Department's use of durable markings, this task force is currently evaluating the performance of several materials (including two-component epoxy and thermoplastic) to determine if modification of that policy is warranted.

2.0 OBJECTIVE OF THE STUDY

The primary objectives of this research are to compare the durability and cost-effectiveness of ETP marking material to conventional traffic paint currently used in New Jersey.

3.0 NATURE OF THE TEST INSTALLATION

3.1 Materials Used

ETP is a 100 percent solid formulation (containing no solvents or other volatile components) and is a generic material consisting of a blend of two epoxy resins, pigment, filler, and glass beads in the following proportions:

Solid resin:	30 parts by weight solid epoxy resin,
Liquid resin:	20 parts by weight liquid epoxy resin,
Pigment:	10 parts by weight titanium dioxide (white formulation) or 9.26 parts by weight silica encapsulated lead chromate, medium yellow pigment (yellow formulation)
Filler:	10 parts by weight calcium carbonate
Beads:	14 parts by weight standard premixed glass beads

Reportedly, the above components have equivalents readily available from several manufacturers.*

ETP is sometimes confused with epoxy paints (resin systems) because both materials contain epoxy resins. However, ETP is quite different in that it is manufactured in a homogeneous block which must be heated to about 460°F prior to application. The two-component epoxy resin is heated separately, then blended with a hardener prior to application.

Approximately 63 gallons of white ETP formulation was used on the subject project. Time and manpower restrictions prevented the planned application of yellow striping.

Application of the control material consisting of conventional New Jersey, Type IV white traffic paint was delayed due to equipment problems.

3.2 Test Site Description

The northbound roadway of Alternate Route U.S. 1 in the City of Trenton and Lawrence Township was selected for the ETP trial installations.

*Niessner, Charles W., "Epoxy Thermoplastic Marking Material," Report No. FHWA-IP-82-14, July, 1982.

Specific locations of the ETP striping on each pavement type follows:

Location	Pavement Type
Milepost 2.30 to 4.00· S of Olden Avenue to N of Whitehead Road	Portland Cement Concrete
Milepost 4.00 to 5.50; N of Whitehead Road to Vicinity of Carnegie Road	Bituminous Concrete

Although in service for some 32 years, the portland cement concrete surface is in fair to good condition. The existing traffic markings (paint) were also in reasonably good condition.

The ten year old bituminous surface is in fair to good condition except for essentially continuous longitudinal joint separation (narrow width) at the center-line and along the outer pavement edge. The condition intermittently passed through both the skip-line and edgeline markings. Although the existing markings were in good condition, some were partially covered by an excess of recently applied rubberized asphalt sealant material.

3.3 Equipment

The striping equipment used on this project was built by the Redland Prismo Corporation. The basic vehicle was a 1982 Ford truck Model F-900. The general configuration was similar to the Illinois striper described in the previously cited FHWA report except for two notable features. First, the ETP striper employed an atomized spray system as opposed to the Southwest Research Institute (SWRI) recommended low-pressure airless (nonatomized) spray process. Use of an atomized system was encouraged by the striping industry who contended it would enhance stripe uniformity. That is, the atomized system increases spray velocity which should eliminate/alleviate the "fluttery" pattern (characterized by void spots within the center portion of a stripe) frequently encountered with the airless system.

The second major difference between the two stripers was in the melter volume. The FHWA striper was modified (elongated) to accommodate the second melter tank. The two melter tanks had a total capacity equivalent to about twice that of the Illinois striper.

The ETP unit also differs from a conventional paint striper in that it requires the following components:

- melting equipment - melter tanks (with a 1-inch oil jacket on the sides and bottom), heating furnace, oil transfer pumps and plumbing, and a small gasoline driven motor-generator
- jacketed pressurized application tank
- surge tank
- temperature indicator
- ETP thermostats

Like most conventional stripers, the ETP striper is equipped with a center control console (at the rear of the vehicle) with carriage operator seats and a steering wheel on either side. Vertically telescoping right and left gun carriages (power-steered horizontally) are located just behind the rear truck wheels. Access steps are provided at the rear portion of the platform and on either side. A metal shade canopy covers the rear-facing, lighted flashing arrowboard which is controlled from the truck cab. The vehicle is also equipped with a collapsible pointer/striping guide castoring wheel attached to the front bumper.

More detailed equipment information including schematics and major component/manufacturer data is provided in the previously cited FHWA report.

4.0 CONSTRUCTION SEQUENCE

4.1 Surface Preparation

About 24 hours prior to the ETP application, all pavement surfaces were cleaned with compressed air to remove dirt, dust, and loose foreign materials.

It should be noted here that since the successful application and long-term performance of ETP is dependent upon the bond between the marking material and the pavement surface, the FHWA recommends that ETP not be applied over deposits of painted or other types of markings that exhibit chipping or delamination. However, as previously mentioned, the existing markings on the study test site were in good condition (i.e., no indication of bond failure), thus their removal was not considered necessary.

4.2 Application

4.21 Experimental Striping (ETP)

The subject striping installation employed a three-man striping crew from the FHWA Demonstration project staff. The crew included a driver, operator and a third member who assisted in the equipment preparation and monitoring the operation of various components of the application system. Although the striper is designed/equipped to simultaneously apply edgelines and skip-lines of the same color, equipment problems (i.e., clogged spray gun nozzles) prevented that operation. As a result, two passes were required to complete the installation.

Pertinent ETP application data are presented in the Appendix.

4.22 Control Striping (NJ Traffic Paint, Type IV)

The control striping was applied within five inches of and parallel to the ETP edgelines (pavement side) from milepost 3.0 to 5.0. Skip-line control markings were similarly applied adjacent to the first ten lines of ETP on each section for each pavement type (i.e., M.P. 2.3 to 2.7 on PCC and M.P. 4.00 to 4.40 on the bituminous section).

5.0 PROBLEMS ENCOUNTERED

The start of the actual striping operation was delayed due to a minor equipment problem (i.e., a defective drive belt) on the generator supplying power to the pumps, valves, tank agitators and controls. A spare drive belt was not immediately available and subsequent replacement efforts resulted in at least 1½ hours downtime. Once a new belt was installed, the pre-heating (melting) function was resumed.

When the material was reheated to the recommended application temperature of 460°F, efforts to begin striping were interrupted by clogged spray gun nozzles. It was speculated (by the crew chief) that this may have been caused by deposits of partially polymerized material.* Fortunately, this situation was easily remedied by dissassembling and cleaning the nozzles and the striping installation was completed without further problems.

6.0 MONITORING PROGRAM

In accordance with the guidelines provided in the Demonstration Project prospectus, the evaluation of the ETP installation will include the following:

1. The placement and performance of ETP installations will be monitored and compared to that of a control consisting of

*It has been reported that reheating can adversely affect ETP material characteristics and promote polymerization.

conventional traffic paint over a 2-year period on both bituminous and portland cement concrete pavement surfaces.

2. The project will be inspected at least seven times (after an initial assessment) during the evaluation period at intervals of 1, 3, 6, 12, 18, and 24 months.

3. At each inspection, the markings will be subjectively rated using the following performance criteria:

   a. appearance (including color and cleanliness)

   b. durability (material retention)

   c. night visibility

4. Photographic documentation of representative sections of ETP and the control material (conventinal traffic paint) will be made at each inspection.

5. A final report containing a discussion of the results, cost comparisons, and recommendations will be prepared.

7.0 COSTS

Since the study striping was installed under FHWA Demonstration Project No. 60, no material and/or labor costs per se were incurred by the Department. However, if this ETP installation had been made at the current estimated/average unit price of $0.12 per linear foot (as indicated by FHWA), the striping would have to provide about 1.5 years service to be considered cost comparable to our conventionally used traffic paint.*

8.0 SUMMARY OF OBSERVATIONS AND CONCLUSIONS

8.1 Equipment

a. The clogging of the spray gun nozzles is believed to have been

*This projection is made by converting the unit costs of the two materials to annual linear foot costs using an estimated average life for our traffic paint of 4.5 months (about 0.38 years). On that basis, both ETP (at $0.12 per foot per 1.5 years) and the traffic paint (at $0.03 per foot per 0.38 years) would cost $0.08 per lineal foot per year.

caused by partially polymerized material lodged in the nozzles.

b. A substantial deposit of polymerized "flakes" was observed in the bottom of the melter tank after unused ETP was disposed of following the striping installation. This partial material polymerization was probably the result of reheating the material following a shutdown to replace a defective drive belt.

8.2 Application

a. Since ETP's almost instant (4-6 seconds) "no-track" drying virtually eliminates the necesity for coning, its use (ETP's) should affect a reduction in traffic control costs.

b. The application thickness was significantly affected by variation in the striping unit's travelling speed. For example, the measured line thicknesses (dry) of 13 to 15 mils was accomplished at a striper speed of about 7.0 mph, while an 18-20 mil thicknesses was applied at about 4.5 mph.

c. The spray gun (nozzle clogging) problem was similar to that encountered in an earlier New Jersey study of a two-component epoxy system. The recommendation made in that study (use of an additional spray gun with line filters to facilitate cleaning) may well be applicable to the ETP system.

APPENDIX: SUMMARY OF ETP APPLICATION DATA

MARKING	DATE APPLIED	DESCRIPTION	APPROX. LINEAR FT. APPLIED	START / STOP	TEMPERATURE °F			APPROX. MAT'L APPL. RATE (ft/gal)	APPROX. BEAD APPL. RATE (lbs/gal)	DRYING TIME No Track	FILM THICK-NESS (mils)	LINE APPEARANCE
					AIR	PAV'T	MAT'L (appl)					
ETP	4-4-84	4" Solid 4" Skip (White)	16,900 2,130	11 am 2 pm	65	68	460	343 254	2.2	4-6 (secs)	13-15 18-20	Very good; extremely bright during the daytime and very good initial nighttime reflectivity as determined by visual observation.
CONTROL (NJ Type IV Traffic Paint)	7-16-84	4" Solid 4" Skip (White)	16,900 250	-- --	75	80	---	330	5	4 (min)	15-17	Very good; good initial nighttime reflectivity.

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