Research Report
UKTRP-87-20

EVALUATION OF EPOXY THERMOPLASTIC PAVEMENT MARKING MATERIAL

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16. Abstract

The objective of this study was to evaluate the field performance of epoxy thermoplastic (ETP) as a pavement marking material and to compare it to a control marking material, which was alkyd traffic paint. A test installation of ETP along with the regular traffic paint was placed on KY 841 in Jefferson County and evaluated over an 18-month period. Data collection consisted of daytime observations and rating of the material's appearance and durability and nighttime observations and rating of its nighttime visibility. Reflectivity measurements were also collected using a portable retroreflectometer.

The appearance (color) of the ETP remained good over the evaluation period. The night visibility of the ETP was satisfactory but was not much better than the traffic paint. Significant durability problems were found with the ETP relating to the loss of adhesion between the pavement and the material. Due to the durability problem and its cost as compared to alkyd traffic paint, no future use of epoxy thermoplastic is recommended.

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in cooperation with
Transportation Cabinet
Commonwealth of Kentucky

and

Federal Highway Administration
US Department of Transportation

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August 1987

INTRODUCTION

Traffic paints, typically an alkyd formulation, have been used as lane delineation on Kentucky highways for decades. In the past few years, more durable marking materials have been developed and have received increased use. These include epoxy and polyester paints, preformed tapes, and thermoplastics. Each material has advantages and disadvantages in the areas of cost, durability, visibility, and ease of application. There is a need to field test the various available materials and evaluate their performances.

An epoxy resin based thermoplastic pavement marking material has been developed through a Federal Highway Administration (FHWA) research effort by the Southwest Research Institute. It is commonly called epoxy thermoplastic (ETP). It is a 100-percent solid material consisting of epoxy resins, glass beads, pigments, and calcium carbonate filler. Field tests have shown the material has potential to provide cost-effective lane delineation. While the projected cost of ETP would be considerably higher than typical traffic paint, increased durability and resulting service life could made it a cost-effective marking material.

The Federal Highway Administration initiated Demonstration Project No. 60 to provide states and local agencies the opportunity to evaluate the performance of ETP. Problems were initially encountered with durability of the material, which resulted in modification of the equipment and development of a new material formulation. A test installation of ETP was placed in Kentucky and the objective of this study was to evaluate the field performance of ETP and to compare it to other available pavement marking materials. The modified equipment and material were used.

TEST INSTALLATIONS

On October 9 and 10, 1985, a test installation of ETP was placed in the

westbound lanes of KY 841 in Jefferson County, Kentucky, from KY 1020 to US 31W. This is a four-lane divided section of portland cement concrete highway. ETP was placed on both edge lines and on the lane line over the approximate 7- to 8-mile section for a total installation of about 17 lane miles. The material was placed directly on the pavement since this was the original striping on this unopened section of roadway. The eastbound lanes were striped at the same time with regular alkyd traffic paint and served as the control section. The roadway was opened to traffic the day after placement of the markings. The average daily traffic (ADT) for this section of KY 841 is about 12,000. The ETP was placed by FHWA personnel. The control section of alkyd traffic paint was placed by Kentucky Department of Highways personnel.

The air temperature was about 75 degrees Fahrenheit during installation. Bead embedment for both the ETP and control sections was good. The no-track time for the ETP was about 5 to 10 seconds.

Installation of the ETP is shown in Figure 1. The ETP was applied by a hot spray process at a temperature of 450 to 500 degrees Fahrenheit. Beads were sprayed onto the line so they contacted the pavement about 1 inch behind the paint. Beads were also incorporated into the material. No primer was applied before striping. The application rate of glass beads was 4 to 6 pounds per gallon compared to 4 pounds per gallon for conventional traffic paint. The ETP is a 100-percent solid formulation applied at a thickness of 15 to 20 mils. The alkyd traffic paint was applied at 15 mils and would dry to slightly under 10 mils. The new ETP line is shown in Figure 2.

DATA COLLECTION

Data were collected on a periodic basis over an 18-month period. Data were collected immediately after installation to provide initial data. Additional data were collected 1 month, 3 months, 6 months, 12 months, and 18

months after installation. The data collection period was originally scheduled to last for 24 months, but because of durability problems, it was necessary to restripe the ETP material after 18 months. The control section of alkyd traffic paint was not restriped until after the same 18-month period.

Data collection consisted of daytime observations and ratings of the appearance and durability of the ETP and control test sections along with reflectivity measurements using a portable retroreflectometer (PRR). Reflectivity data for the first six months were collected with a PRR that was constructed in house. A PRR was then purchased (the Mirolux 12) and used for data collection after that date. In early 1987, the Mirolux 12 was adapted so that measurements were in terms of millicandelas per square foot per footcandle. Reflectivity data for the 18-month after-installation period were in these units. Nighttime observations also were conducted. Photographs were taken to document results.

The data collection form recommended to be used in the evaluation process was used. This form is presented in Figure 3. The appearance evaluation considered color of the white or yellow lines as compared to their original colors and as compared to desirable colors. The appearance rating also concerned cleanliness of the stripe. The durability evaluation related to the ability of the material to remain on the surface. The subjective night visibility rating related to the number of stripes or distance the stripes could be seen. Each of the ratings were on a scale from 0 to 10, with a description of the various ratings given on Figure 3. Weighting factors were used to yield a total rating for both the ETP and control material for each evaluation period. This method of conducting road service tests is described in ANSI/ASTM D 713-69. The same two evaluators performed each evaluation and the ratings listed were an average of their ratings.

RESULTS

APPEARANCE

The appearance of both the ETP and alkyd traffic paint were originally rated as excellent and maintained a fair appearance to the end of the 18-month evaluation period. Appearance ratings are presented in Table 1. After the 1-month rating, appearance ratings for the ETP were slightly higher than those for the traffic paint. This was the result of a brighter color for the ETP. Both materials still were rated as fair in appearance at the end of the evaluation period.

DURABILITY

Durability ratings are presented in Table 2. As described in Figure 3, durability rating corresponds to the percentage of material intact, with a rating of 10 representing 100 percent intact and a rating of 0 representing all the material missing. The ratings show that the regular traffic paint had no durability problem. However, the ETP started to show signs of a durability problem after 3 months, with a significant problem existing after 12 months.

The durability problem with the ETP material, as illustrated in Figure 4, appeared to be related to a loss of bond between the material and the pavement. The durability problem was not consistent. There would be sections of surface with almost 100 percent of the material missing followed by a section having no problem. The durability problem resulted in the decision to restripe the ETP with regular traffic paint after 18 months in service, before the planned 24-month evaluation period was completed.

REFLECTIVITY

Reflectivity ratings and PRR measurements are summarized in Table 3. As noted, the variation in PRR measurements resulted from changing instruments and then adapting the Mirolux 12 to yield readings in terms of millicandelas per square foot per footcandle.

The subjective ratings and PRR data showed that nighttime reflectivity of the ETP was slightly higher than that for traffic paint. Neither material failed in terms of reflectivity after the 18-month evaluation period.

SUMMARY

Total ratings for the ETP and regular traffic paint considering appearance, durability, and night visibility are presented in Table 4. The ETP total rating was slightly higher than the total rating for traffic paint until the 18-month evaluation period, when the traffic paint rating was slightly higher.

The appearance (color) of the ETP remained good over the evaluation period. Night visibility of the ETP was satisfactory but was not much better than that of the traffic paint. Significant durability problems were observed with the ETP, relating to the loss of adhesion between the pavement and the material.

RECOMMENDATION

The field performance of the ETP revealed the material does not have the necessary durability to provide reliable lane delineation. Approximate costs figures also indicate that ETP would be considerably more expensive than alkyd traffic paint. No future use of epoxy thermoplastic (ETP) is recommended.

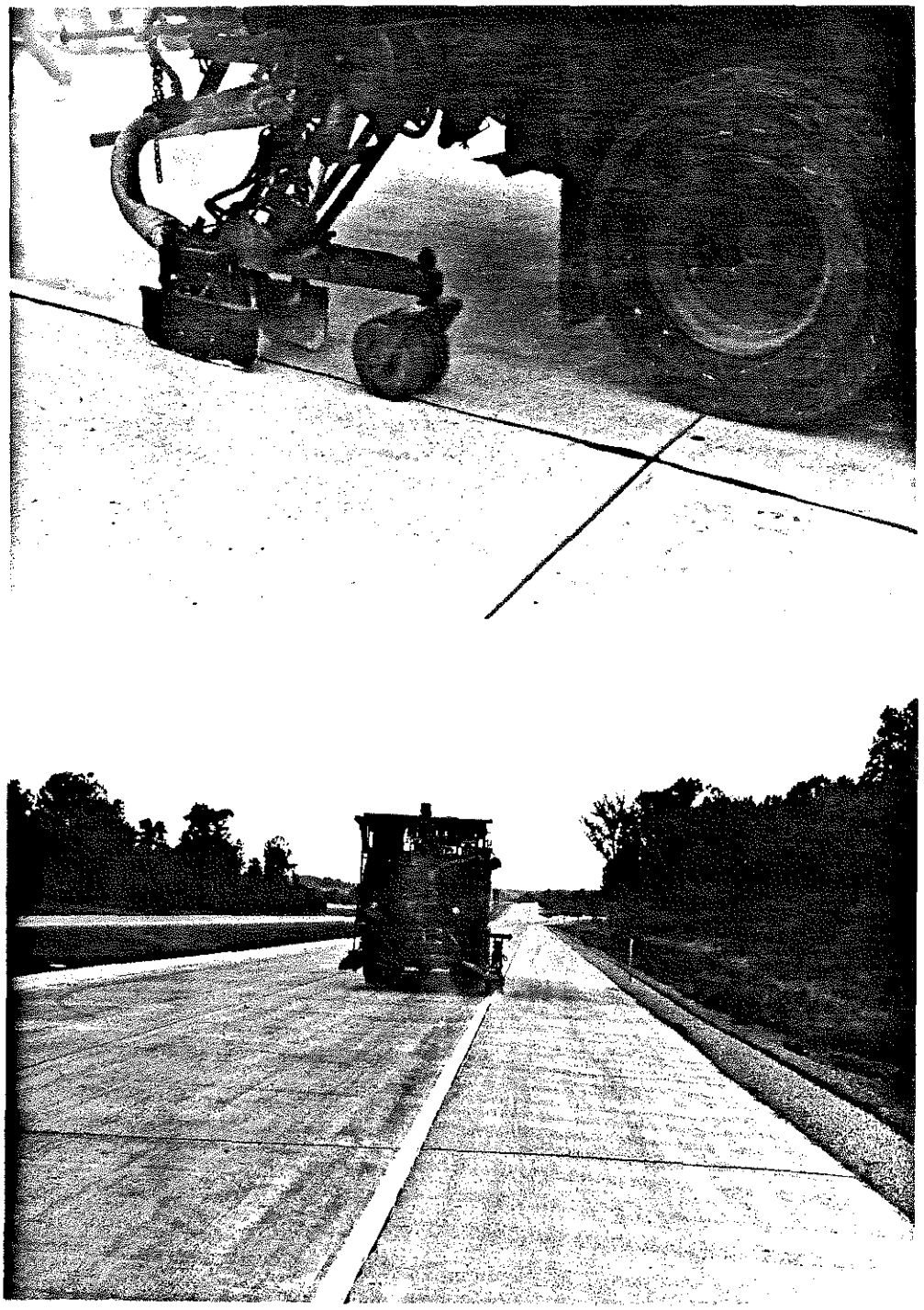

Figure 1. Installation of ETP.

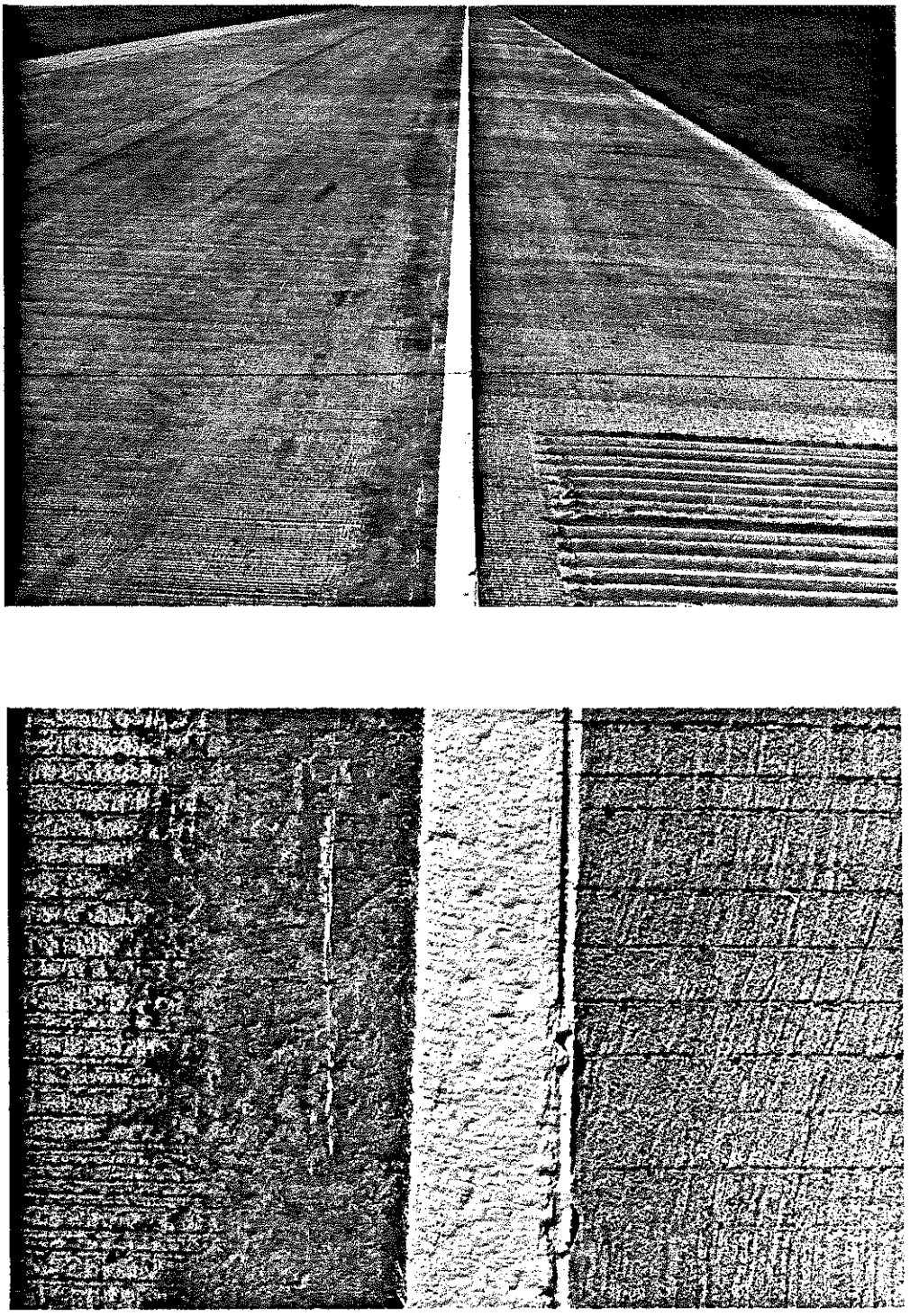

Figure 2. New ETP Line.

Figure 3. Data Collection Form.

Demonstration Project No. 60
Epoxy Thermoplastic Pavement Marking Material

Evaluation Form

Project Site:_____ State:_____

Demonstration Project Work Order No.:_____

Name of Evaluator:_____ Date:_____

Evaluation Type: Initial 1 Month 3 Month 6 Month
(circle one) 12 Month 18 Month 24 Month Other:_____

Weather Conditions:_____

Pavement Type:_____ Marking Pattern:_____

Control Material:_____

Number of times control material restriped to date: (circle one)
0 1 2 3 4 5 6 7 8 9 10

FACTORS: Each factor shall be averaged over the project site for that material.

	ETP	Control
I. APPEARANCE (daytime; to include color and cleanliness)	_____	_____

10 = Excellent
7 = Good (minor distress, appearance unaffected)
5 = Fair (detraction from appearance up close)
3 = Poor (visibility suffers)
0 = Unsatisfactory

II. DURABILITY (daytime; material retention)	_____	_____

10 = 100% intact
7 = 70% intact
5 = 50% intact
3 = 30% intact
0 = all gone

III. NIGHT VISIBILITY	_____	_____

10 = Excellent (clearly visible some distance ahead)
7 = Good (more than 7 stripes or equivalent distance visible)
5 = Fair (4 to 7 stripes or equivalent distance visible)
3 = Poor (3 or less stripes or equivalent distance visible)
0 = Unsatisfactory (invisible)

IV. TOTAL RATING (20I + 30II + 50III) / (100)	_____	_____

Indicate weighing factors if different ones used:

Current status as an agency standard material (check one):

_____1. Adopted
_____2. Allowed as alternative
_____3. Conditional adoption
_____4. Pending
_____5. Rejected
_____6. Not applicable elsewhere

Comments:

Attach photo of representative sections for ETP and for control material (taken date of this evaluation).

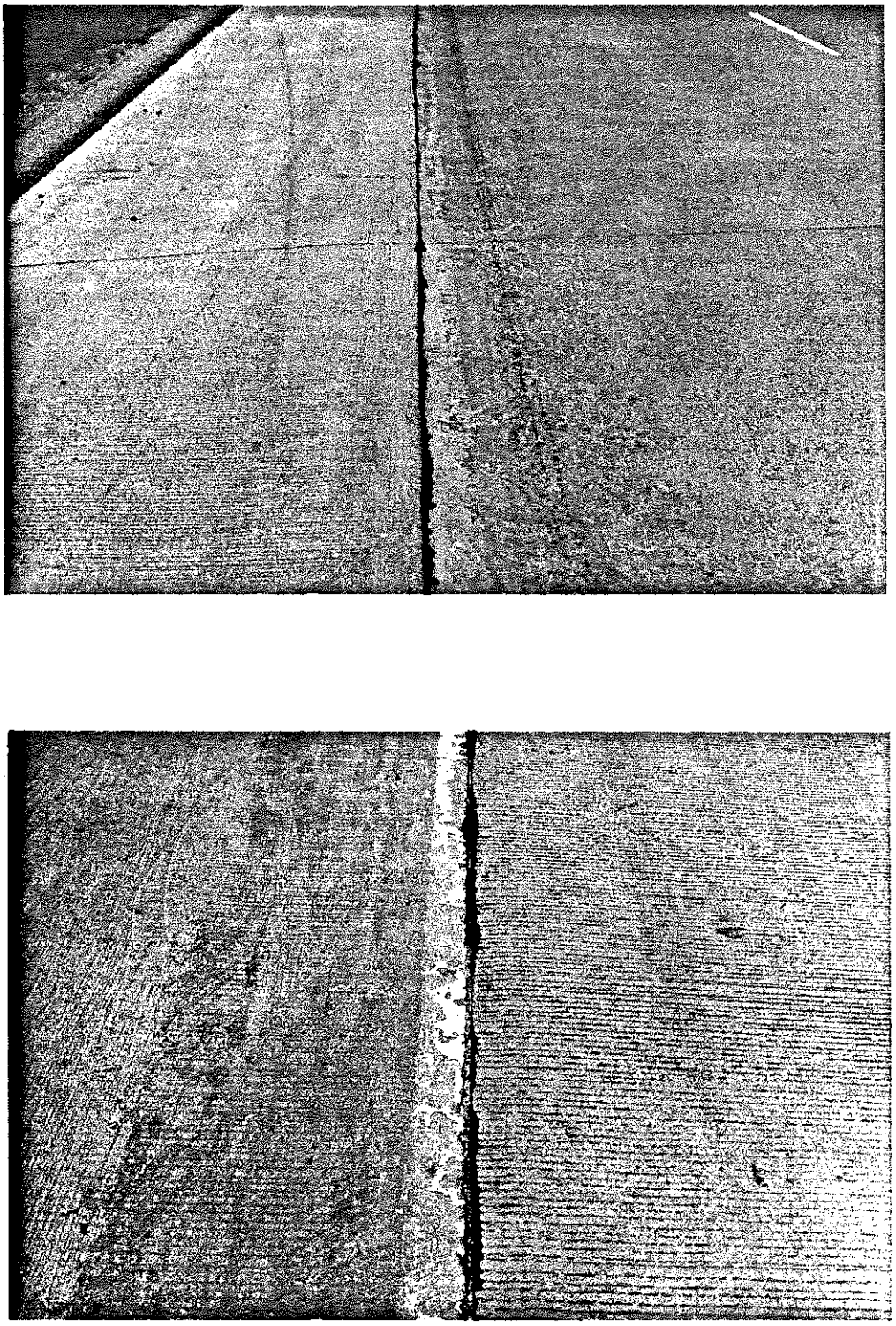

Figure 4. ETP Durability Problem.

TABLE 1. APPEARANCE RATINGS

EVALUATION PERIOD	APPEARANCE RATING	
	ETP	TRAFFIC PAINT
Initial	10	10
1 Month	10	10
3 Months	10	9
6 Months	7	6
12 Months	6	6
18 Months	6	5

TABLE 2. DURABILITY RATINGS

EVALUATION PERIOD	APPEARANCE RATING	
	ETP	TRAFFIC PAINT
Initial	10	10
1 Month	10	10
3 Months	9	9.5
6 Months	8.5	9
12 Months	7.5	9
18 Months	6	9

TABLE 3. REFLECTIVITY RATINGS AND PRR MEASUREMENTS

EVALUATION PERIOD	VISIBILITY RATING		PRR MEASUREMENTS*			
			ETP		TRAFFIC PAINT	
	ETP	TRAFFIC PAINT	WHITE	YELLOW	WHITE	YELLOW
Initial	9	9	250	140	180	120
1 Month	7	6	240	130	180	120
3 Months	7	6	250	160	210	160
6 Months	7	5	180	130	180	130
12 Months	5	4	130	80	100	80
18 Months	4	3	160	110	120	120

* The initial, 1-month, 3-month, and 6-month PRR measurements were taken with a PRR built in house. A Mirolux 12 PRR was used for the 12-month and 18-month measurements with the PRR adapted so that the 18-month measurement was measured in terms of millicandelas per square foot per footcandle.

TABLE 4. TOTAL RATING

EVALUATION PERIOD	TOTAL RATING	
	ETP	TRAFFIC PAINT
Initial	9.5	9.5
1 Month	8.5	8.0
3 Months	8.2	7.6
6 Months	7.4	6.4
12 Months	6.1	5.7
18 Months	5.0	5.2