Comparison of Pavement Marking Systems
Berlin, Vermont

March 2002

Reporting on Work Plan 2000-R-3

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16. Abstract

In 2000, the Vermont Agency of Transportation (VAOT) constructed a pavement marking test deck in the town of Berlin, VT. A total of six materials were installed, five permanent pavement marking tapes and one epoxy pavement marking material.

This report documents the performance of the pavement marking materials for a 15-month period. Performance comparison focused on retroreflectivity, wear, and durability.

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INTRODUCTION

The evaluation of pavement markings may be completed by monitoring actual markings placed for traffic control or by use of an experimental test deck. The creation of a test deck enables an evaluation of accelerated wear characteristics due to the geometry of the markings. The Agency has relied on both types of installations to guide product selection and specifications.

In 1992, the Vermont Agency of Transportation constructed a pavement marking test deck on US Route 302 in Berlin, VT. This test deck examined a total of 20 pavement marking materials. These materials consisted of 14 tapes (permanent, referred to as Type I and temporary, referred to as Type II), 6 thermoplastics (hot applied and preformed) and one temporary raised pavement marker. The study resulted in the acceptance of 8 products for use in the state.

With the advent of new construction materials and methods, a new pavement test deck was established in 2000. A total of six materials were installed, five permanent Type I tapes, one of which is currently on the Agency's Approved Product List, and one epoxy pavement marking material. The purpose of the test deck is twofold; to evaluate the performance of the pavement marking material and to evaluate material compatibility when rehabilitated with a different material.

PROJECT LOCATION

The 2000 pavement marking test deck is located on US Route 302 in Berlin, VT, in the same location as the 1992 test deck. The installation of the marking materials was coordinated with the Berlin STP 9413(1)S project. The Berlin STP 9413(1)S project included cold planing and resurfacing the existing road with a total of 2" bituminous concrete pavement, including leveling and wearing courses.

The section of road selected is representative of the pavements on which the marking materials would typically be placed. The site has full exposure to the sun during the day and has good drainage. The traffic is moderate with a reported annual average daily traffic (AADT) flow of 14100 in 2000 and is free rolling with no curves, intersections, or access points near enough to cause excessive braking or turning movements.

The speed limit for this section of road is posted at 40 miles per hour.

PROJECT LAYOUT

The test deck was laid out in accordance with ASTM D713. Pavement markings were placed transverse in the travel lane to provide an accelerated evaluation of bead retention and wear characteristics. A total of four lines, two white and two yellow, were placed for each product, as shown in Figure 1.

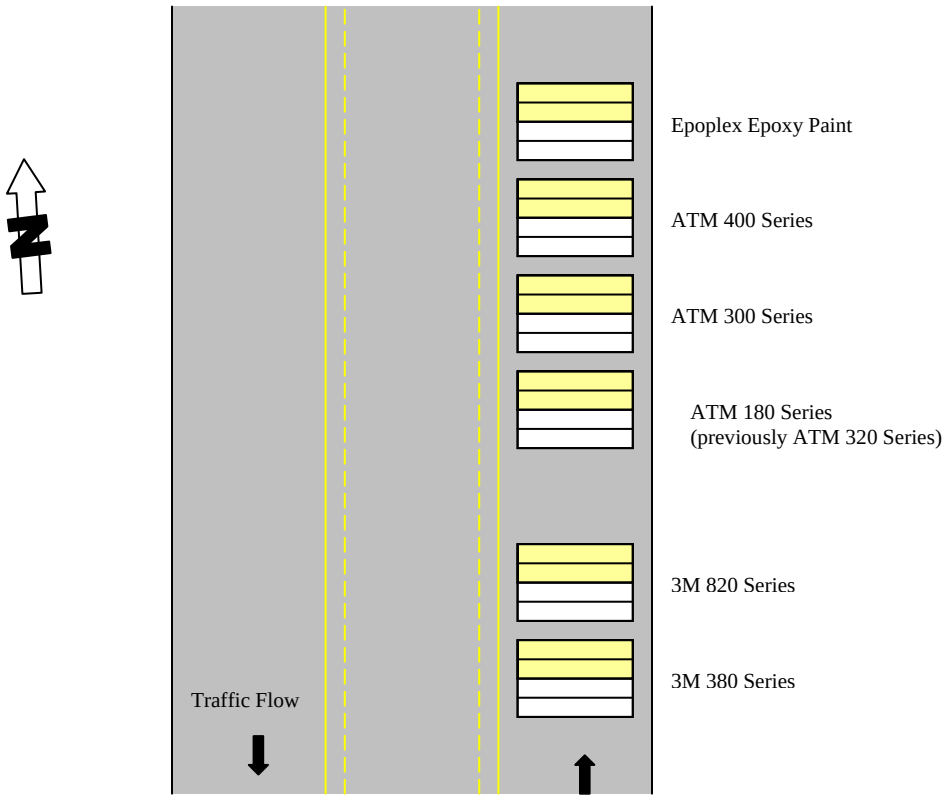

Figure 1. Test Deck Layout

PRODUCT DESCRIPTIONS

3M Stamark™ High Performance Tape Series 380

This product is a raised-patterned marking material intended for longitudinal and transverse lines in both inlaid and overlaid durable applications on cementious and asphaltic surfaces. The product, designed with ceramic beads applied to the vertical face of the embossed area is finished with a polyurethane topcoat and has a pressure sensitive adhesive bottom. The product is 65 mils thick at the pattern heights.

The manufacturer recommends an application air temperature of 60^{o}F and rising, pavement temperature of 70^{o}F and rising, and an overnight low air temperature of 40^{o}F. Traffic may pass over the material immediately after it is placed.

3M Stamark™ Wet Reflective Tape Series 820

This product is a profiled pavement marking material intended for overlaid applications of longitudinal lines on cementious and asphaltic surfaces. It may be applied on the pavement surface or in a grooved surface. It is composed of an abrasion resistant polymeric film with skid resistant particles on a thin, flexible conformable backing, and a pressure sensitive

adhesive. The product is designed as a highly reflective pavement marking in both dry and wet conditions, with a special optic layer to enhance wet reflective performance.

The manufacturer recommends an application air temperature of 60°F and rising, pavement temperature of 70°F and rising, and an overnight low air temperature of 40°F. Traffic may pass over the material immediately after it is placed.

ATM 180 Rugged Permanent Grade Tape

This product was installed on the test deck under the product name, **ATM 320 Durable Grade Tape**. According to the manufacturer the product name has since changed to ATM 180 Rugged Permanent Grade Tape, but the material composition remained the same.

The product, designed to be inlaid or overlaid in areas with moderate, well-channelized traffic volumes, can be placed on cementious or asphaltic pavement surfaces. It is 45 mils thick and constructed with a pre-applied, pressure sensitive adhesive with polymeric materials, pigments, and glass beads on the surface and embedded in the base material.

The manufacturer recommends a minimum pavement temperature of 40°F for application. Traffic may pass over the material immediately after it is placed.

ATM 300 Long-Line & Intersection Striping Tape

This product, designed to be inlaid or overlaid in longitudinal and transverse applications, can be placed on cementious or asphaltic pavement surfaces. It is 60 mils thick and constructed with a pre-applied, pressure sensitive adhesive with polymeric materials, pigments, and glass beads on the surface and embedded in the base material.

The manufacturer recommends a minimum pavement temperature of 40°F for application. Traffic may pass over the material immediately after it is placed.

ATM 400 Intersection Grade Tape

This product, designed to be inlaid or overlaid in longitudinal, transverse, and legend symbol applications, can be placed on cementious or asphaltic pavement surfaces. It is 90 mils thick and constructed with a pre-applied, pressure sensitive adhesive with polymeric materials, pigments, and glass beads on the surface and embedded in the base material.

The manufacturer recommends a pavement temperature of 40°F for application. Traffic may pass over the material immediately after it is placed.

Epoplex LS50 Epoxy Pavement Marking Material

This product is a two component (two parts resin to one part curing agent) 100% solids epoxy material which can be applied to both cementious and asphalt highway surfaces. Glass beads are applied to the material as it cures; the manufacturer specifies a double drop method at an application rate of 10-13 pounds per gallon of resin (minimum total application – 25 pounds per gallon). It is applied at 25 mils (+/- 1 mil) for old or open graded bituminous concrete surfaces and at 20 mils (+/- 1 mil) for new asphalt or portland cement concrete surfaces.

The manufacturer recommends a minimum air application temperature of 35°F and a minimum pavement application temperature of 40°F. The time at which traffic may pass over the material depends on the weather conditions. The no track time at 20 mils (+/- 0.5 mil) with a wet film thickness at 75°F (+2°F) and correct glass bead distribution, is said to take no longer than 10 minutes. The product can cure under a constant surface temperature of 32°F and above.

INSTALLATION

On October 26, 2000, five tape products were inlaid in coordination with the bituminous pavement placement on the Berlin STP 9413(1)S project. The pavement marking subcontractor for the project, Scott's Line Striping, installed all of the tape products. The manufacturer's representative for Advanced Traffic Markings (ATM) was on-site during the placement of their products. All the products were installed as recommended by the manufacturer's representatives as shown in Figures 2, 3, and 4.

The weather on the day of the Type I tape installations was dry and sunny with the air temperature ranging from 68-72° F. The pavement temperature ranged between 135-164 ° F during the inlaid process. Due to the road width, a pavement joint was constructed three feet from the pavement marking material's edge. This required the tape products be placed in two separate sections.

Shortly after the placement of the tape products, the Technical Service Department of 3M informed us that the 820 Series product was designed to be overlaid on the pavement with an adhesive bonding agent. A communication error resulted in an application not desirable for the material; as a result, the 820 Series product installed may not represent its expected performance.

On November 2, 2000, Epoplex epoxy pavement marking material was placed on the test deck using a handcart operated off the back of a long line truck as shown in Figure 5a. The two white test strips were placed first, followed by an application of glass beads, in two sizes, using the double drop method as shown in Figure 5b. This sequence was repeated for the two yellow test strips. The material was placed at an approximate thickness of 20 mils. The weather during the placement of the material was sunny with an air temperature of 48 ° F. The pavement temperature was approximately 54 ° F.

Figure 2. **Placement of permanent tape.**
(Photo taken October, 2000)

Figure 3. **Securing tape with hand tamper.**
(Photo taken October, 2000)

Figure 4. **Compacting tape with roller.**
(Photo taken October, 2000)

Figure 5a. **Application of epoxy pavement markings.**
(Photo taken November, 2000)

Figure5b. **Application of glass beads to epoxy pavement markings.**
(Photo taken November, 2000)

Figure 6. **Overview of test deck.**
(Photo taken January, 2001)

PERFORMANCE

Retroreflectivity

Retroreflectivity data was collected in accordance to ASTM 1710-97 with one exception; data collected was perpendicular to traffic flow due to the transverse placement of the markings to the roadway. Results of testing the white and yellow marking materials are presented in Tables 1 and 2, respectively. A total of four readings were taken along each strip following installation, and then five readings were taken thereafter to monitor the performance at each end, the center, and in the wheel paths. The overall average value for both the white and yellow materials was calculated from a total of 8-10 readings. Detailed values collected for each material are presented in Appendix A. Data was collected with an LTL 2000 retroreflectometer. The equipment was calibrated to a standard block prior to taking readings on each date.

Retroreflectivity data represented in Appendix A indicates that all the products being monitored deviate more when they are first installed then after they are exposed to traffic. After 15 months, four of the five tape products (3M 320, ATM 180, ATM 300, ATM 400) performed similarly after being subjected to wear. These same four tapes also exhibit more variation in the white material then the yellow material, both when new and as they aged.

Retroreflectivity Values
$(mcd)(lux^{-1})(m^{-2})$

Material	White Material			
	Test Date	Overall Average	Average excluding Wheel Paths	Average in Wheel Paths Only
3M – 380 Tape [1]	2000 Oct 28[2]	691		
	2001 May 21	49	52	44
	2002 Jan 28	38	42	32
3M – 820 Tape	2000 Oct 28[2]	788		
	2001 May 21	14	17	11
	2002 Jan 28	15	10	7
ATM – 180 Tape	2000 Oct 28[2]	621		
	2001 May 21	34	34	33
	2002 Jan 28	24	28	20
ATM – 300 Tape	2000 Oct 28[2]	606		
	2001 May 21	29	30	28
	2002 Jan 28	26	27	25
ATM – 400 Tape	2000 Oct 28[2]	738		
	2001 May 21	29	29	29
	2002 Jan 28	25	25	25
Epoplex – LS50 Epoxy Pavement Marking Material	2000 Nov 3 [2]	371		
	2001 May 21	42	43	41
	2002 Jan 28	20	27	10

[1] Product is currently on the Vermont Agency of Transportation's 2001 Approved Product List.
[2] A total of (4) readings were taken along each test strip; an overall of (8) readings per color.

Table 1. Retroreflectivity Results for White Marking Materials

Retroreflectivity Values (mcd)(lux^{-1})(m^{-2})				
Material	**Yellow Material**			
	Test Date	**Overall Average**	**Average excluding Wheel Paths**	**Average in Wheel Paths Only**
3M – 380 Tape [1]	2000 Oct 28[2]	476		
	2001 May 21	28	30	24
	2001 Jan 28	23	25	19
3M – 820 Tape	2000 Oct 28[2]	379		
	2001 May 21	14	15	12
	2001 Jan 28	13	13	13
ATM – 180 Tape	2000 Oct 28[2]	495		
	2001 May 21	21	22	20
	2001 Jan 28	20	22	18
ATM – 300 Tape	2000 Oct 28[2]	505		
	2001 May 21	18	18	17
	2001 Jan 28	19	19	19
ATM – 400 Tape	2000 Oct 28[2]	548		
	2001 May 21	18	19	18
	2001 Jan 28	18	19	18
Epoplex – LS50 Epoxy Pavement Marking Material	2000 Nov 3 [2]	230		
	2001 May 21	33	34	32
	2001 Jan 28	22	25	17

[1] Product is currently on the Vermont Agency of Transportation's 2001 Approved Product List.
[2] A total of (4) readings were taken along each test strip; an overall of (8) readings per color.

Table 2. Retroreflectivity Results for Yellow Marking Materials

After seven months of performance, the overall retroreflectivity value for all the pavement marking materials fell below 50 mcd/(lux)(m^2). Further reduction of these values continued into the 15th month. Overall, after 15 months, the areas outside the wheel paths and those in the wheel paths are not significantly different, as can also be concluded between the white and yellow material.

The test results for the ATM 300 and ATM 400 material compare similarly to values obtained on an AASHTO National Transportation Product Evaluation test deck in Minnesota established in 1997, refer to Appendix B for details. Data collected on this test deck was obtained using the same type of retroreflectometer, an LTL 2000. Data for this asphalt test deck was monitored for two years. Values for the these two materials, in both white and yellow, after 15 months ranged between 37-51 mcd/(lux)(m^2) in the center line area and ranged 21-24 mcd/(lux)(m^2) in the left wheel track.

Weather conditions for the days on which retroreflectivity data was collected were as follows:

Date	Temperature (+/-)	Conditions
2000 October 28	70°F	Clear / Dry
2000 November 3	39°F	Clear / Dry
2001 May 22	70°F	Clear /Dry
2002 January 28	50°F	Cloudy /Dry

Data collected on January 28, 2002 was gathered during the winter maintenance season, which necessitated cleaning the marking materials prior to taking readings. This procedure involved washing each test strip individually with an antifreeze solution (windshield washer fluid) followed by a warm water rinse (Figure 7). Each line was then blotted dry with cloth rags, but due to the curvature of the road runoff from the washing procedure drained across the test strips (Figure 8). A wait period of about 20 minutes was observed to allow the pavement to drain excess fluid, and the strips were again wiped dry before readings were taken.

Although this cleaning method aided in removing residual sand and salt from the marking's surface, it failed to clean any material embedded in the irregularities of material. Modifications to this cleaning procedure will be made for future testing to create a process which is more time effective and cleans the material more thoroughly.

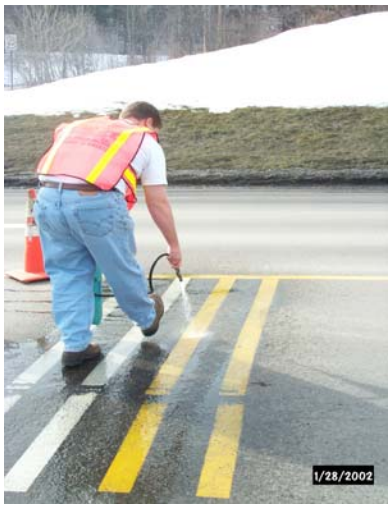

Figure 7. Cleaning markings on test deck. (Photo taken January, 2002)

Figure 8. Drying markings on test deck. (Photo taken January, 2002)

Wear and Durability

The following photographs represent the wear and durability performance of each pavement marking material placed on the test deck on US Route 302. Photos were taken after three months, four months, six months, seven months, and 15 ½ months of exposure to traffic.

Performance of Pavement Marking Materials – Three Months Old

Photographs taken January 25, 2001

Figure 9a. 3M Stamark™ High Perfomance Tape Series 380

Figure 9b. 3M Stamark™ Wet Reflective Tape Series 820

Figure 9c. ATM 180 Rugged Permanent Grade Tape

Figure 9d. ATM 300 Durable Grade Tape

Figure 9e. ATM 400 Extended Life Grade Tape

Figure 9f. Epoplex LS50 Epoxy Pavement Markings

Performance of Pavement Marking Materials – Four Months Old

Photographs taken March 3/9/2001

Figure 10a. 3M Stamark™ High Perfomance Tape Series 380

Figure 10b. 3M Stamark™ Wet Reflective Tape Series 820

Figure 10c. ATM 180 Rugged Permanent Grade Tape

Figure 10d. ATM 300 Durable Grade Tape

Figure 10e. ATM Extended Life Grade Tape

Figure 10f. Epoplex LS50 Epoxy Pavement Markings

Performance of Pavement Marking Materials – Six Months Old

Photographs taken April 24, 2001

Figure 11a. **3M Stamark™ High Perfomance Tape Series 380**

Figure 11b. **3M Stamark™ Wet Reflective Tape Series 820**

Figure 11c. **ATM 180 Rugged Permanent Grade Tape**

Figure 11d. **ATM 300 Durable Grade Tape**

Figure 11e. **ATM 400 Extended Life Grade Tape**

Figure 11f. **Epoplex LS50 Epoxy Pavement Markings**

Performance of Pavement Marking Materials –Seven Months Old

Photographs taken May 21, 2001

Figure 12a. 3M Stamark™ High Perfomance Tape Series 380

Figure 12b. 3M Stamark™ Wet Reflective Tape Series 820

Figure 12c. ATM 180 Rugged Permanent Grade Tape

Figure 12d. ATM 300 Durable Grade Tape

Figure 12e. ATM 400 Extended Life Grade Tape

Figure 12f. Epoplex LS50 Epoxy Pavement Markings

Performance of Pavement Marking Materials – 15 ½ Months Old

Photographs taken January 14, 2002

Figure 13a. 3M Stamark™ High Perfomance Tape Series 380

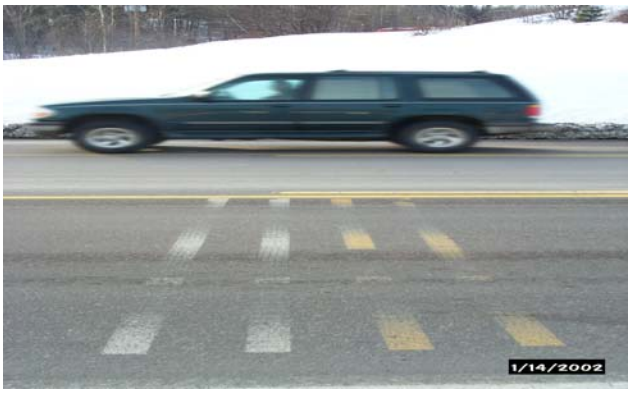

Figure 13b. 3M Stamark™ Wet Reflective Tape Series 820

Figure 13c. ATM 180 Rugged Permanent Tape

Figure 13d. ATM 300 Durable Grade Tape

Figure 13e. ATM 400 Extended Grade Tape

Figure 13f. Epoplex LS50 Epoxy Pavement Markings

During construction, the width of the road required the need for a longitudinal paving joint. The placement of this joint, three feet from the right edge of the test strips, created a higher profile across all the marking materials that expedited the wear of all the marking materials at this point. For the purpose of evaluating durability performance, material loss exhibited at this location is not considered a failure of the material since this condition is unique to the test deck. But, the early loss of all the marking materials at this location is an indicator of what may happen to transverse markings in this type of situation.

An overview of the pavement marking materials placed on the test deck indicates that four out of the five Type I tapes are performing similarly. One of the products, 3M Stamark™ High Performance Tape, Series 380, has been approved for use in Vermont for several years and has traditionally exhibited good wear and durability characteristics. In comparison, all three ATM products: 180, 300, and 400, have performed similar to the currently approved product. With the exception of one localized area (excluding the area around the pavement joint) on one of the ATM 400 test strips, the current durability of these marking materials is encouraging. These three products, with thicknesses varying between 45-90 mils, have all remained fully visible and intact within and outside of the wheel path areas after 15 ½ months of service.

The 3M Stamark™ Wet Reflective Tape, Series 820 has experienced excessive loss. This product was installed via the hot inlaid method, an installation procedure not recommended by the manufacturer. After 15 ½ months the material is nearly non-existent in the wheel paths and is showing wear outside these areas as well. According to the manufacturer, the early failure of this foil product is likely attributed to the installation procedure. Foil products are not recommended for hot inlay because the material expands and contracts as the hot asphalt cools. Also, this material does not stretch like inlaid designed tapes, and the passing of the roller causes the material to buckle approximately every 6-10 inches.

The Epoplex epoxy pavement markings have exhibited extensive wear in the wheel paths after 15 ½ months of performance. But, the material, placed at a 20 mil thickness, continues to provide visible delineation in the center and on the edges of the travel lane.

SUMMARY

The performance of the three ATM Type I tapes and the currently approved 3M Type I tape, Series 380, exhibit similar wear, durability, and retroreflective performance. These four products continue to provide clear daytime delineation and have held up well to plow abrasion and wear due to traffic. As a result, these materials may be desirable in perpendicular-to-traffic applications. Further monitoring will better indicate the time to failure, which may be proportional to the material's thickness.

The 3M Type I tape, Series 820, exhibited signs of failure early in the monitoring stage of the test deck. As the result of the application method, it is believed that this product was damaged during the installation, causing it to wear rapidly. The product is designed to be applied as an overlaid material to retain its designed physical properties.

The Epoplex epoxy pavement markings has experienced over a 50% loss of material in the wheel paths of all four test strips after 15 ½ months. This material has remained intact in the areas outside the wheel paths, which indicates that this product may be more suitable for areas with limited exposure to continuous wear due to traffic, such as long line applications.

Based on the results of product performance represented in this study, ATM 180, 300, 400, and Epoplex epoxy pavement marking material have been approved for use in Vermont.

FOLLOW-UP

The test deck will continue to be monitored for a total of 2.5 to 3 years. Retroreflectivity data will continue to be gathered as well as photographic documentation. Physical deformations including those caused by wear due to traffic and plow abrasion will continued to be monitored.

References

Danchetz, Frank and Gee, Jim, "*Two Year Results of Field Evaluations of Pavement Marking Materials, 1997 Minnesota Test Deck at Mn/Road Research Facility,"* Report 99 NTPEP 157. AASHTO's National Transporation Product Evaluation Program, Washington, D.C. (1999).

APPENDIX A

Retroreflectivity - Field Data

3M Stamark High Performance Tape Series 380									
		1	2	3	4	5	Average of Line	Average of Mat'l	Stnd Dev
2000 Oct 28	White -L1	773	821	627	574		**699**		
	White -L2	797	793	609	536		**684**	**692**	**116**
	Yellow-L1	483	505	452	480		**480**		
	Yellow-L2	491	492	452	450		**471**	**476**	**21**
2001 May 21	White -L1	58	45	49	40	46	**48**		
	White -L2	59	44	51	46	49	**50**	**49**	**6**
	Yellow-L1	31	22	35	25	24	**27**		
	Yellow-L2	34	24	35	25	23	**28**	**28**	**5**
2002 Jan 28	White -L1	43	29	42	35	45	**39**		
	White -L2	42	30	43	35	38	**38**	**39**	**6**
	Yellow-L1	23	18	26	20	25	**22**		
	Yellow-L2	23	18	27	21	27	**23**	**23**	**3**

3M Stamark Wet Reflective Tape Series 820									
		1	2	3	4	5	Average of Line	Average of Mat'l	Stnd Dev
2000 Oct 28	White -L1	977	772	711	763		**806**		
	White -L2	826	868	792	591		**769**	**788**	**113**
	Yellow-L1	347	307	592	306		**388**		
	Yellow-L2	379	406	417	281		**371**	**380**	**99**
2001 May 21	White -L1	17	10	20	11	14	**14**		
	White -L2	16	11	19	12	14	**14**	**14**	**4**
	Yellow-L1	15	12	23	14	15	**16**		
	Yellow-L2	14	11	15	11	13	**13**	**15**	**3**
2002 Jan 28	White -L1	15	10	9	7	8	**10**		
	White -L2	13	6	9	6	7	**8**	**9**	**3**
	Yellow-L1	14	11	11	8	6	**10**		
	Yellow-L2	20	15	14	17	14	**16**	**13**	**4**

ATM 180 Rugged Permanent Grade Tape									
		1	2	3	4	5	Average of Line	Average of Mat'l	Stnd Dev
2000 Oct 28	White -L1	647	573	697	567		**621**		
	White -L2	629	594	701	559		**621**	**621**	**57**
	Yellow-L1	479	474	544	485		**496**		
	Yellow-L2	476	445	530	530		**495**	**496**	**35**
2001 May 21	White -L1	35	33	32	32	32	**33**		
	White -L2	33	34	38	32	34	**34**	**34**	**2**
	Yellow-L1	22	21	23	20	23	**22**		
	Yellow-L2	21	20	21	20	21	**21**	**22**	**1**
2002 Jan 28	White -L1	23	20	30	16	28	**23**		
	White -L2	25	22	31	21	28	**25**	**24**	**5**
	Yellow-L1	19	19	25	18	24	**21**		
	Yellow-L2	18	17	21	18	22	**19**	**20**	**3**

ATM 300 Long-Line & Intersection Striping Tape									
		1	2	3	4	5	Average of Line	Average of Mat'l	Stnd Dev
2000 Oct 28	White -L1	624	542	699	524		**597**		
	White -L2	653	590	653	560		**614**	**606**	**62**
	Yellow-L1	550	493	552	412		**502**		
	Yellow-L2	544	517	559	411		**508**	**505**	**61**
2001 May 21	White -L1	31	29	29	27	30	**29**		
	White -L2	30	29	32	28	29	**30**	**30**	**1**
	Yellow-L1	18	17	20	18	18	**18**		
	Yellow-L2	18	17	19	17	17	**18**	**18**	**1**
2002 Jan 28	White -L1	24	24	26	24	29	**25**		
	White -L2	22	23	32	28	28	**27**	**26**	**3**
	Yellow-L1	18	21	22	21	19	**20**		
	Yellow-L2	19	17	20	18	18	**18**	**19**	**2**

ATM 400 Intersection Grade Tape									
		1	2	3	4	5	Average of Line	Average of Mat'l	Stnd Dev
2000 Oct 28	White -L1	812	612	777	705		**727**		
	White -L2	830	671	716	779		**749**	**738**	**75**
	Yellow-L1	562	527	526	542		**539**		
	Yellow-L2	575	550	534	569		**557**	**548**	**19**
2001 May 21	White -L1	32	29	33	29	26	**30**		
	White -L2	30	31	24	26	26	**27**	**29**	**3**
	Yellow-L1	19	18	19	17	18	**18**		
	Yellow-L2	19	17	18	18	18	**18**	**18**	**1**
2002 Jan 28	White -L1	28	27	14	24	29	**24**		
	White -L2	26	24	23	23	28	**25**	**25**	**4**
	Yellow-L1	19	18	20	18	17	**18**		
	Yellow-L2	18	18	19	18	19	**18**	**18**	**1**

Epoplex LS50 Epoxy Pavement Marking Material									
		1	2	3	4	5	Average of Line	Average of Mat'l	Stnd Dev
2000 Oct 28	White -L1	409	389	347	262		**352**		
	White -L2	426	426	433	275		**390**	**371**	**69**
	Yellow-L1	290	274	202	130		**224**		
	Yellow-L2	279	262	225	176		**236**	**230**	**57**
2001 May 21	White -L1	38	52	40	34	49	**43**		
	White -L2	42	49	43	29	48	**42**	**43**	**7**
	Yellow-L1	38	38	31	32	40	**36**		
	Yellow-L2	31	39	25	17	38	**30**	**33**	**7**
2002 Jan 28	White -L1	17	5	18	4	23	**13**		
	White -L2	33	18	33	11	35	**26**	**20**	**11**
	Yellow-L1	23	15	26	16	27	**21**		
	Yellow-L2	25	20	27	18	23	**23**	**22**	**4**

Appendix B

Report 99 NTPEP 157

this report is a companion document to Report 98 NTPEP148 on first year field evaluation and laboratory test results.

TWO YEAR RESULTS OF FIELD EVALUATION OF PAVEMENT MARKING MATERIALS

1997 Minnesota Test Deck at Mn/Road Research Facility

AASHTO's National Transportation Product Evaluation Program

Report Prepared for AASHTO/NTPEP by:

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TABLE 11: SECOND YEAR REFLECTIVITY DATA - LEFT WHEEL TRACK ASPHALT DECK (LTL 2000)

NTPEP #	PRODUCT ID	Aug-98	Nov-98	Mar-99	May-99	Aug-99
133		NOT	APPLIED	NOT	APPLIED	NOT
134		NOT	APPLIED	NOT	APPLIED	NOT
135		NOT	APPLIED	NOT	APPLIED	NOT
136	EE100W	103	98	30	73	90
137	EE100Y	17	20	16	9	8
138	EP100W2	one	year	evaluation	only	
139	EP100W3	one	year	evaluation	only	
140	EP100W4	one	year	evaluation	only	
141	WP100W5	one	year	evaluation	only	
142	EP100Y2	one	year	evaluation	only	
143	EP100Y3	one	year	evaluation	only	
144	EP100Y4	one	year	evaluation	only	
145	EP100Y5	one	year	evaluation	only	
146	EP100Y6	one	year	evaluation	only	
147	W102-97	one	year	evaluation	only	
148	Y203-97	one	year	evaluation	only	
149	Series 100, Yellow	six	month	evaluation	only	
150	Series 100, White	six	month	evaluation	only	
151	ATM 200 W	six	month	evaluation	only	
152	ATM 200 Y	six	month	evaluation	only	
153	ATM 280 B	six	month	evaluation	only	
154	ATM 300 W	41	34	34	29	25
155	ATM 300 Y	36	21	21	17	16
156	ATM 400 W	26	22	34	31	27
157	ATM 400 Y	21	24	22	21	15
158	A400 NP W	25	20	24	20	20
159	A400 NP B	one	year	evaluation	only	
160	ATM 120 W	six	month	evaluation	only	
161	ATM 120 Y	six	month	evaluation	only	

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TABLE 12: SECOND YEAR REFLECTIVITY DATA - CENTER LINE ASPHALT DECK (LTL 2000)

NTPEP #	PRODUCT ID	Aug-98	Nov-98	Mar-99	May-99	Aug-99
133		NOT	APPLIED	NOT	APPLIED	NOT
134		NOT	APPLIED	NOT	APPLIED	NOT
135		NOT	APPLIED	NOT	APPLIED	NOT
136	EE100W	174	91	142	272	170
137	EE100Y	53	76	23	58	17
138	EP100W2	one	year	evaluation	only	
139	EP100W3	one	year	evaluation	only	
140	EP100W4	one	year	evaluation	only	
141	WP100W5	one	year	evaluation	only	
142	EP100Y2	one	year	evaluation	only	
143	EP100Y3	one	year	evaluation	only	
144	EP100Y4	one	year	evaluation	only	
145	EP100Y5	one	year	evaluation	only	
146	EP100Y6	one	year	evaluation	only	
147	W102-97	one	year	evaluation	only	
148	Y203-97	one	year	evaluation	only	
149	Series 100, Yellow	six	month	evaluation	only	
150	Series 100, White	six	month	evaluation	only	
151	ATM 200 W	six	month	evaluation	only	
152	ATM 200 Y	six	month	evaluation	only	
153	ATM 280 B	six	month	evaluation	only	
154	ATM 300 W	59	51	42	117	82
155	ATM 300 Y	59	45	40	91	66
156	ATM 400 W	87	44	41	86	82
157	ATM 400 Y	63	37	39	98	49
158	A400 NP W	56	38	35	135	57
159	A400 NP B	one	year	evaluation	only	
160	ATM 120 W	six	month	evaluation	only	
161	ATM 120 Y	six	month	evaluation	only	