STATE HIGHWAY ADMINISTRATION

RESEARCH REPORT

EVALUATION OF SNOWPLOWABLE, RETROREFLECTIVE RAISED PAVEMENT MARKERS

UNIVERSITY OF MARYLAND

FINAL REPORT
SP208B4G

April 2004

Technical Report Documentation Page

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.
MD-04-SP208B4G		

4. Title and Subtitle	5. Report Date
Evaluation of Snowplowable, Retroreflective Raised Pavement Markers	April 2004
	6. Performing Organization Code

7. Author/s	8. Performing Organization Report No.
Ed Stellfox	

9. Performing Organization Name and Address	10. Work Unit No. (TRAIS)
University of Maryland Transportation Technology Transfer Center College Park, MD 20742	11. Contract or Grant No. SP208B4G

12. Sponsoring Organization Name and Address	13. Type of Report and Period Covered
Maryland State Highway Administration Office of Policy & Research 707 North Calvert Street Baltimore MD 21202	Final Report
	14. Sponsoring Agency Code

15. Supplementary Notes

16. Abstract

The Maryland State Highway Administration (SHA) participated in the AASHTO National Transportation Product Evaluation Program's (NTPEP) evaluation of snowplowable raised pavement markers (SRPM). The NTPEP evaluates products to determine their applicability for use by the various Departments of Transportation. The scope of work for this study included both laboratory and field testing. Field tests were conducted on eighty of each SRPM model. Forty of each SRPM model were installed on a Portland cement concrete (PCC) section of roadway and forty were installed on a Hot Mix Asphalt (HMA) section of roadway. The laboratory potion of the study, reported by the Georgia Department of Transportation, included tests of the coefficient of luminous intensity, abrasion resistance, compressive strength of reflectors, and bond strength. This report details the field study and its results. The report also summarizes the major findings of the Evaluation.

17. Key Words	18. Distribution Statement: No restrictions
Pavement Markers, retroreflectivity, snowplowable, night visibility, winter maintenance	This document is available from the Maryland State Highway Research Division upon request.

19. Security Classification (of this report)	20. Security Classification (of this page)	21. No. Of Pages	22. Price
None	None	155	

Form DOT F 1700.7 (8-72) Reproduction of form and completed page is authorized.

AASHTO – Maryland NTPEP

Final Report

Evaluation of Snowplowable, Retroreflective Raised Pavement Markers

Date: April 2004

Plowing MD 100, January 2002

Table of Contents

List of Figures

List of Tables

I. INTRODUCTION AND OVERVIEW

The Maryland State Highway Administration (MD SHA) volunteered to participate in the AASHTO National Transportation Product Evaluation Program (NTPEP) of Snow-plowable Raised Pavement Markers (SRPM). The purpose of the NTPEP Program is to provide an efficient, cost-effective way of evaluating the products that are used by member transportation departments in the construction of transportation facilities. Manufacturers and suppliers who wish to have their products considered for use on transportation projects submit their material to a lead agency, who coordinates a testing program using one or more testing facilities. A report is generated showing the results of the testing, and is distributed to member departments for their use in determining the applicability of the product(s) for use in their states. The NTPEP reports the results of these evaluations but does not accept or reject products. Transportation officials may use the results of the evaluations in the development and maintenance of an approved products list.

The study requirements and approach are described in the AASHTO "Work Plan for Snow-plowable RPM's" approved June 2001 by the NTPEP Oversight Committee (See Appendix A). Testing procedures are reviewed each year at the annual Oversight NTPEP committee meeting and are modified to respond to the changing needs of member departments and technical improvements provided by the industry. The Maryland SHA team proposed further modifications to the field study work plan that were presented to the NTPEP committee and approved. These included the number and placement of SRPM's to be evaluated during the course of this study. These modifications were implemented.

The scope involved laboratory and field-testing. Field tests were conducted on eighty of each SRPM model. Forty of each SRPM model were installed on a Portland cement concrete (PCC) section of roadway and forty were installed on a Hot Mix Asphalt (HMA) section of roadway. The test sites selected for the field study were fully access-controlled, did not require crack sealing or extensive patching during the evaluation period; had Annual Average Daily Traffic (AADT) over 20,000; were generally free of horizontal and vertical curves, and had a minimum average snowfall of 635mm (25 inches) per year controlled by a combination of plowing, salt, and a combination of deicing agents. Biannual SRPM field evaluations included inspection of SRPM housing and lens, retroreflectivity readings taken before and after cleaning, and nighttime visibility studies conducted during darkness at a distance of 122 meters (400 feet) using low-beam headlights.

The laboratory portion of the study, reported by the Georgia Department of Transportation, includes tests of the coefficient of Luminous Intensity (ASTM D4383, Section 10.1) , abrasion resistance (ASTM D4383, Section 10.2), compressive strength of reflectors (ASTM D 4383 Section 10.6) and holders (ASTM D 4383, Section 10.7); and bond strength (ASTM D4383.3). Bond strength would not be tested if the reflector was attached to its housing (holder) by mechanical means such as pop rivets or screws.. Lenses were subject to lens impact testing and temperature cycling (ASTM D4383 Section 10.5); markers that had a mounting hole in the center of the reflectors were impacted in accordance with ASTM D4383, Section 10.5.2 at a point that was one quarter of its total length from either end of the reflector. The color of the reflective lens was tested and reported in accordance with ASTM D4383, section 10.3.

Participating Manufacturers

The participating manufacturers and the products that were tested are listed below). Detailed information on the SRPM's and the manufactures is included in Table **1-3**

Table I-1: Participating Manufacturers and Products

Company	Product Trade Name	Product #
3M Company	3M Series 190 Marker	190-H960HP
Avery-Dennison Corp	Stimsonite	Model 101
Avery-Dennison Corp.	Stimsonite	Model 96
Hallen Products, Ltd.	Ironstar	1W664
Astucia (UK), Ltd.	Astucia Intelligent Flush Stud	F-Series ND
Nightline Markers, Inc.	NightLine	B-400
Pac-Tec, Inc.	Ray-O-Lite Snow-Lite	Model 100

The Study Sites

Two sites were selected for the study, one with Hot Mix Asphalt, and the other with Portland Cement Concrete pavement.

Hot Mix Asphalt The HMA deck was located on Maryland 100 eastbound (See Figure II-1)

Portland-Cement Concrete. The concrete pavement deck was located on northbound I-97 (See Figure II-1)

The characteristics of the study sites and those recommended in the AASHTO study plan are summarized in Table 1-2

Table I-2: Study Site Characteristics

	Requirements	I- 97		MD 100	
Pavement Type		**PCC**		**HMA**	
Speed Limit		**65 MPH**		**55 MPH**	
Type of De-icing Chemicals		**Salt/ Salt Brine**		**Salt/ Salt Brine**	
Type of snow blade		**Steel**		**Steel**	
Normal angle of blade		**30°**		**30°**	
Traffic Characteristics		**2002**	**2003**	**2002**	**2003**
AADT		**61,800**	**61,800**	**37,200**	**37,200**
% Trucks		**8.4%**	**8.4%**	**6.4%**	**6.4%**
Weather & Snow Events		**2001-02**	**2002-03**	**2001-02**	**2002-03**
Air temperature range		**15-100**	**15-100**	**15-100**	**15-100**
Inches of Snow	**1**	**2.3**	**58.2**	**2.3**	**58.2**
# of Snow Days		**1**	**20**	**1**	**20**

1 NOTE: HISTORICAL SNOWFALL AVERAGES AT THESE SITES EXCEEDED REQUIREMENTS IN THE STUDY DESIGN. SNOW FALL IN THE 2001-2002 SEASON WAS EXTREMELY LOW.

MD SHA Study Team

The study was conducted by a team designated by MD SHA that included several MD SHA offices and the University of Maryland. The MD SHA offices participating in the study were MD SHA District 5 (traffic personnel and "snow-duty" personnel), Office of Maintenance (OOM), Office of Traffic and Safety (OOTS), Office of Materials and Technology, and MD SHA's Public Affairs. The University of Maryland T2 Center assisted MD SHA with the tasks needed to conduct and complete this study in accordance with the requirements of the work plan, compiled and analyzed the data, and prepared study documentation and reports. Contact information for this study is as follows:

Lead State	Gil Rushton Maryland SHA	Maryland State Highway Administration 2323 W. Joppa Road Lutherville, Maryland 21093 Phone: 410-321-3170 FAX: 410-321-3099 grushton@sha.md.state.us
Laboratory Testing	Don Wishon Georgia DOT	Georgia Department of Transportation 15 Kennedy Drive Forest Park, Georgia 30050-2599 Phone: 404-362-2545 Donald.Wishon@dot.state.ga.us
NTPEP Coordinator	Mujeeb Basha, PE AASHTO	AASHTO, 444 North Capital Street, N.W., Suite 249 Washington, DC 20001 Phone: 202-624-5800 FAX:202-624-5806 Mujeebb@aashto.org

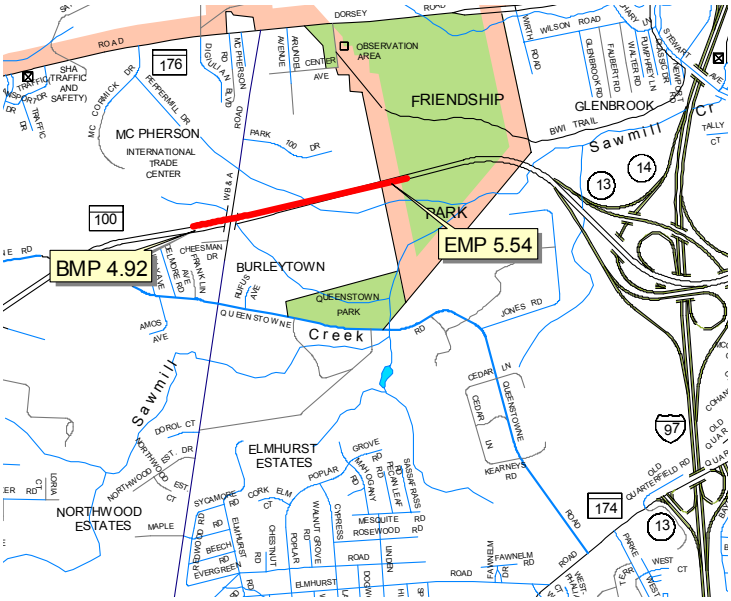
Referenced Documents

ASTM D4383 "Specification for Plowable, Raised Retroreflective Pavement Markers"
ASTM E 1696 "Test Method for Field Measurement of Raised Retroreflective Pavement Markers Using a Portable Retroreflectometer"

Figure I: Location Map- MD 100 and I-97

Baltimore

BWI



I-95

Eastbound MD 100

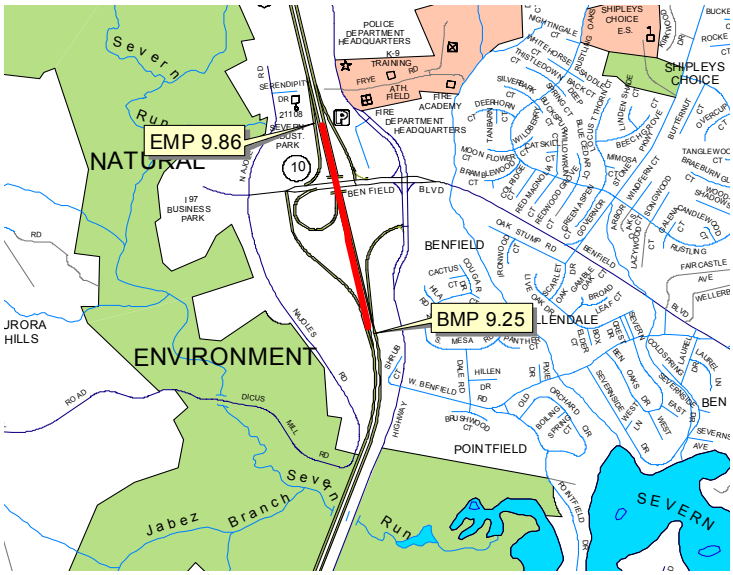
Hot Mix Asphalt

From: 4.92 To: 5.54

Total Length: .62 miles (3274 ft)

Washington, D.C.

Baltimore



Washington, D.C.

Northbound I-97

Portland Cement Concrete

From: 9.25 To: 9.86

Total Length: .61 miles (3221 ft)

Product Information

- Seven snow-plowable raised pavement markers were included in the study from six manufacturers. Participating manufacturers supply all materials, labor and equipment needed to completely install their products. Participating manufacturers and the products included in this study are presented below.

Table I-3: Product Information

	**3M series 190 Marker** http://www.3m.com	Sample: RPM(2001-MD)-2 Installed: 10/3-4/01 MD 100 Milepoint:4.92 – 4.99 I-97 Milepoint: 9.25 – 9.41
	**Stimsonite Model 96** http://www.stimsonite.com/	Sample: RPM(2001-MD)-4 Installed: 10/3-4/01 MD 100 Milepoint:5.10 – 5.17 I-97 Milepoint: 9.43 – 9.50
	**Stimsonite Model 101** http://www.stimsonite.com/snow.html	Sample: RPM(2001-MD)-3 Installed: 10/3-4/01 MD 100 Milepoint:5.01 – 5.08 I-97 Milepoint: 9.34 – 9.41
	**Hallen Products, Ltd. Ironstar Model 1W664** http://www.ironstar.com/	Sample: RPM(2001-MD)-5 Installed: 10/3-4/01 MD 100 Milepoint:5.19 – 5.26 I-97 Milepoint: 9.52 – 9.59
	**Astucia (UK) Ltd., Astucia Intelligent Flush Stud, F-Series** http://www.itemltd.com/index.html	Sample: RPM(2001-MD)-6 Installed: 10/3-5/01 MD 100 Milepoint:5.28 – 5.35 I-97 Milepoint: 9.61 – 9.9.68

	**Nightline Markers, Inc., Nightline, Model B-400**	Sample: RPM(2001-MD)-7 Installed: 10/3/01 MD 100 Milepoint:5.38 – 5.45 I-97 Milepoint: 9.70 – 9.77
	**Pac-Tec, Inc., Ray-O-Lite Snowlite, Model 100** http://www.rayolite.com/	Sample: RPM(2001-MD)-8 Installed: 10/3/01 MD 100 Milepoint:5.47– 5.54 I-97 Milepoint: 9.79 – 9.86

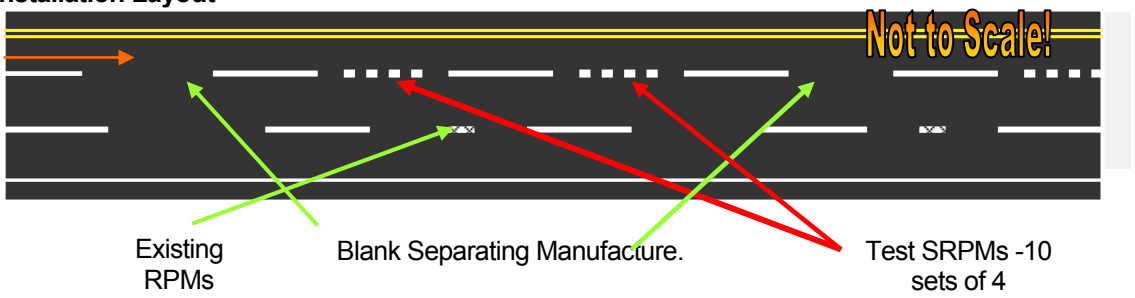
Sampling and Installation

Manufacturers provided 80 complete units (housings and reflectors) for MD SHA field tests2. The testing laboratories in Georgia received 250 samples of each product, 50 reflectors (not the housings) and 5 metal housings to be used for laboratory testing. Manufacturers provided a report to MD SHA that included all applicable documents, including certifications and product specifications.

R.W. Hunt, an independent contractor, was engaged to ensure the proper sampling of products. Hunt randomly selected and inspected products at the manufacturers' plants. As a courtesy, Hunt also selected and prepared samples at the manufacturers for other SRPM test decks that required laboratory testing in Georgia. The samples that were selected by Hunt were sealed by the manufacturers and shipped directly to their respective installers. The seal was broken at the installation site in the presence of an MD SHA inspector. The SRPM's were then installed under the supervision of the inspector.

Prior to SRPM installation, test sections for each product were marked on the roadway for both test decks. (October 1, 2001). Each manufacturer then installed 40 SRPM's (10 groups of 4) on each test section (40 of each product type). There was a space of approximately 50 feet (1 skip and 2 line segments) maintained between each manufacturer's SRPM's. Normally, only one RPM would be installed in each skip. In this case, tighter spacing (4 SRPM's per skip) was used to reduce the total length of the study site. SRPM's were installed in the same order and with the same spacing at both sites. Figure II shows the typical layout of a section of test deck.

Figure II: Installation Layout



Designation	Milepoint I-97	Milepoint MD 100	Manufacturer/Product
RPM(2001MD) – 2	9.25 – 9.32	4.92 – 4.99	3M Company, 3M Series 190 Marker
RPM(2001MD) – 3	9.34 – 9.41	5.01 – 5.08	Avery-Dennison Corp
RPM(2001MD) – 4	9.43 – 9.50	5.10 – 5.17	Avery-Dennison Corp.
RPM(2001MD) – 5	9.52 – 9.59	5.19 – 5.26	Hallen Products, Ltd.
RPM(2001MD) – 6	9.61 – 9.68	5.28 – 5.35	Astucia (UK), Ltd.
RPM(2001MD) – 7	9.70 – 9.77	5.38 – 5.45	Nightline Markers, Inc.
RPM(2001MD) – 8	9.79 – 9.86	5.47 – 5.54	Pac-Tec, Inc.

Installations were conducted at night October 3-5, 2001. Manufacturers and their installers met with MD SHA prior to beginning installations each evening. The installations went smoothly. Following installation, signs were erected in the median to indicate the start and end position of the test deck and the locations of each of the seven test sites.

2 THE NUMBER OF SAMPLES WAS REDUCED FROM 100 IN THE ORIGINAL AASHTO WORK PLAN TO 80 FOR THE MARYLAND FIELD STUDY.

Initial Inspection

The newly installed SRPM's were inspected prior to beginning the retroreflectivity and nighttime visibility data collection. Visual inspection showed that large amounts of residue (pavement or concrete powder) remained on the lens faces of some SRPM's immediately after installation. The installers and manufactures were informed and were given the opportunity to verify that the lens faces were clean before initial reflectivity readings were taken. Manufacturers verified that devices were properly installed according to their specifications.

Retroreflectivity Equipment Testing and Calibration

Retroreflectivity readings were collected using two Model 1200SP Retroreflectometers, manufactured by Gamma Scientific of San Diego, California. Both devices are the property of AASHTO. One device was used previously for the study completed by the Ohio Department of Transportation; the second device is new for this study. Specifications for the device are included in Appendix B.

The retroreflectometers were calibrated according to manufacturers directions using a known reference RPM. The display/data logger measures RPM retroreflectivity to a precision of 0.01 candelas per foot-candle or 1 mcd/lux when properly calibrated against the reference standard.

Prior to beginning initial data collection, field training and briefings were conducted to familiarize the team with study procedures and proper use of the equipment. Examination of preliminary field data showed that the retroreflectometers are very sensitive to external factors such as road surface characteristics, the size and shape of the SRPM lens and housing, and the precise position of the retroreflectometer over the SRPM. Subsequent ratings of the same SRPM varied as much as 0.25 cd/lx from the average.

Retroreflectivity Data Collection Procedures

Retroreflectivity data collection procedures performed for this study followed those described in the AASHTO Work plan (Appendix A), with modifications designed to minimize variations in readings due to external factors.

- **A template and paint were used to create a positioning guide for placement of the retroreflectometer.** Spray paint marks on the pavement were lined up with tape marks placed on the retroreflectometers.
- **Following the "dirty reading", the retroreflectometer** was rotated on its edge to allow the lens to be cleaned; and rotated back into place as close as possible to the location of the original dirty reading
- **Two teams collected retroreflectivity data and conducted visual evaluations of the lens and housings.** Each team consisted of a data recorder, a data reader, and an individual who cleaned each SRPM for the 2nd (clean) reading. In order to minimize the affect that differences between machines and teams might have on readings, teams read every other set of four for each manufacturer. For example, team one read odd-numbered sets of four, the other team took readings on the "even" numbered sets of four.
- **Dirty and clean readings were taken for the 2nd, 3rd and 4th RPM in each group of four.** No clean reading was taken for the first SRPM in each group (it is not cleaned during the study).
- **Identical procedures were followed at each site**. A team was assigned and used the same piece of equipment throughout data collection at each site.

Changes in the procedures are documented in the Work Plan (Appendix A) and are discussed in more detail in other sections of this report as appropriate. Retroreflectivity data are reported as cd/lux as specified by ASTM E809. Summary data and a discussion of the results will be provided in sections III and IV. Raw data will be provided in Appendix C.

Night Visibility Studies

Night visibility was assessed from a slow-moving vehicle traveling in lane 2 (the center lane), utilizing low-beam headlight strength. Visibility was rated following the 0-5 scale outlined in the project work plan and was reported in a column on the retroreflectivity study data sheet. Each SRPM was reviewed by a team of three to four observers in the same vehicle. The score recorded represents a consensus of the reviewers. All observations were made from a Ford Aerostar.

NIGHT DRIVE-THROUGH RATERS		
Evaluation	I97	MD100
Initial	G. Rushton, R. Smith, R. Wray, D. Nelson	G. Rushton, R. Smith, R. Wray, D. Nelson
6 months	G. Rushton, R. Smith, R. Wray, D. Robbins, C. Schreiber	G. Rushton, R. Smith, R. Wray, D. Robbins, C. Schreiber
12 months	G. Rushton, R. Smith, R. Wray, F. Lees, P. Murray	G. Rushton, R. Smith, R. Wray, F. Lees, P. Murray, D. Tisdale
18 months	G. Rushton, R. Smith, R. Wray, S. Zanetti, D. Maye, M. Basha	G. Rushton, R. Smith, R. Wray, S. Zanetti, D. Maye
24 months	G. Rushton, R. Smith, R. Wray, M. Basha	G. Rushton, R. Smith, R. Wray, S. Zanetti

Weather and Snow-Fall Data

Weather and snow fall information was obtained from a weather station located close to the test deck (within 5 miles of the actual test deck). Weather data was collected from the Baltimore/Washington National Weather Service Forecast Office's web site (http://205.156.54.206/er/lwx/climate.htm) for the weather station located at BWI airport (approximately 150 feet above sea level). The data from each month was summarized to determine high, low and average temperatures. Snowfall amounts, the number of days of snow and total accumulation for the month were also recorded. A summary of the weather results are provided in Table III-5 in the Study Results section of this report. The area which includes the test decks averages 22 inches of snowfall based on data recorded from 1883 to 2002.

Snow Event /Snow Plow Pass Data

Prior to the beginning of the snow season, representatives from the study team met with snow plow operators to discuss the study. A data recording card (below) was developed for use by snow plow operators during snow events. On it drivers enter a tick mark for each pass and record information on the date, chemicals used, and any notes they feel are important to the evaluation.

Due to the unusually warm 2001-2 winter with insufficient snowfall, trucks using steel-bladed plows were utilized in rainy conditions to generate the required number of hits on the RPMs. Plowing in rainy conditions more closely resembles the hits encountered during snow removal than dry plowing.

Mobile Laser Test

On an experimental basis, the Precision Scan Company conducted retroreflectivity tests with their mobile laser equipment. The tests were run on the MD 100 test deck. Although the geometry is different, peaks were recognized and indicated relative brightness of the RPM lenses. This research may lead to an improved data acquisition system for testing all RPMs and would especially help states analyze RPM effectiveness. This would also assist researchers quantify lens retroreflectivity in a more timely safe and efficient manner. (See Appendix D)

RPM Study
(Please return to Ralph Smith @ OMT-Rm223 by SHA internal Mail)

Location (circle): Interstate 97 Route 100

Start Time: Finish Time: Date:

Temperature: Truck#: Driver:

De-icing Chemicals (circle): YES NO Salt (circle): YES NO

# of Passes (Tick Marks)

Total # of Passes:_____

Any damaged or missing RPM's? (Please comment):

Any additional comments (use back for additional space):

[redacted]

[redacted]*Please contact Ralph Smith at (cellular) 443-695-0946, (office) 410-321-3166 or by email at rsmith3@sha.state.md.us with any questions concerning data collection.*

III. STUDY RESULTS

Laboratory Test Data

Table III-1: Test Data from Georgia Department of Transportation

Field Studies Data

Table III-1: Summary of Field Data
Table III-2: Graphs of Retroreflectivity

Table III-1 Laboratory Test Data

Georgia Department of Transportation
Office of Materials and Research
Miscellaneous Sample Report

Sample Number: DARD3044-04-009328
Date Received: 1/12/2004 **Project** IRON STAR
County Number:
Contract No.: **Sample** Testing Management
Producer Code:
Material Code: MARKERSRPM3R Raised Pvmt Markers, Tp 3, 2 Way,Red
Date Sampled: 9/27/2001 **Sampled** Stockpile
Quantity: 50 **Unit:** EACH
Location: SCOTT CARPENTER **Examined** 919
Vendor:
Date Completed: 1/23/2004
Remarks: Material Code for marker is Raised Pavement Marker, Type 3, Two-way Amber/Amber (R.W. Hunt Tag No.272754)
PRODUCER; Hallen Products LTD , @ Gurnee, Illinois, 60031
MATERIAL; Pavement Marker, Type 3, two way, two color , size 4" x 2 " with a bitumen adhesive base.

Meets Requirements: **Passed** **Sample Used for Source Evaluation**

Test Data:

Bond Strength: The test in ASTM Specification D 4383-02 for bond strength does not apply to the pavement markers received. The pavement markers received have a bitumen adhesive base. (Test not applicable).

Impact Test: Satisfactory. No detectable radial cracks or delamination.
(Meets ASTM Specification D 4383-02).

Compressive Strength: Satisfactory. No breakage or significant deformation detected at 6000 lbs.
(Meets ASTM Specification D 4383-02).

Specific Intensity: Satisfactory. 50 Amber/Amber Markers Tested. 49 Amber/Amber Markers Passed.
(Meets ASTM Specification D 4383-02).

Temperature Cycling: Satisfactory. No detectable radial cracks or delamination after 3 cycles of 60 degrees C for 4 hours followed by -7 degrees C for 4 hours.
(Meets ASTM Specification D 4383-02).

STATE MATERIALS AND RESEARCH ENGINEER
Thursday, February 26, 2004 Page 1 of 1

Georgia Department of Transportation
Office of Materials and Research
Miscellaneous Sample Report

Sample Number: DARD3044-04-009329
Date Received: 1/12/2004 **Project** IRON STAR
County Number:
Contract No.: **Sample** Testing Management
Producer Code:
Material Code: MARKERSRPM3R Raised Pvmt Markers, Tp 3, 2 Way,Red
Date Sampled: 9/27/2001 **Sampled** Stockpile
Quantity: 50 **Unit:** EACH
Location: SCOTT CARPENTER **Examined** 919
Vendor:
Date Completed: 1/23/2004
Remarks: Material Code for marker is Raised Pavement Marker, Type 3, 2 way Red/White (R.W. Hunt Tag No.272754)
PRODUCER; Hallen Products LTD , @ Gurnee, Illinois, 60031
MATERIAL; Pavement Marker, Type 3, two way, two color , size 4" x 2 " with a bitumen adhesive base.

Meets Requirements: **Passed** **Sample Used for Source Evaluation**

Test Data:

Bond Strength: The test in ASTM Specification D 4383-02 for bond strength does not apply to the pavement markers received. The pavement markers received have a bitumen adhesive base. (Test not applicable).

Impact Test: Satisfactory. No detectable radial cracks or delamination.
(Meets ASTM Specification D 4383-02).

Compressive Strength: Satisfactory. No breakage or significant deformation detected at 6000 lbs.
(Meets ASTM Specification D 4383-02).

Specific Intensity: Satisfactory. 50 Red/White Markers Tested. 48 Red/White Markers Passed.
(Meets ASTM Specification D 4383-02).

Temperature Cycling: Satisfactory. No detectable radial cracks or delamination after 3 cycles of 60 degrees C for 4 hours followed by -7 degrees C for 4 hours.
(Meets ASTM Specification D 4383-02).

STATE MATERIALS AND RESEARCH ENGINEER
Thursday, February 26, 2004 Page 1 of 1

Georgia Department of Transportation
Office of Materials and Research
Miscellaneous Sample Report

Sample Number: MURP7838-04-00011737
Date Received: 1/12/2004 **Project** IRONSTAR
County Number:
Contract No.: **Sample** Testing Management
Producer Code:
Material Code:
Date Sampled: 9/27/2001 **Sampled** Stockpile
Quantity: 5 **Unit:** EACH
Location: SCOTT CARPENTER **Examined** 919
Vendor:
Date Completed: 1/23/2004
Remarks: PRODUCER; Hallen Products LTD, Gurnee, Illinois 60031
MATERIAL; Snowplowable Marker Holder Ramp / 664 Ironstar Markers from Hallen Products Ltd. (R.W. Hunt Tag No.272754)

Meets Requirements: **Passed** **Sample Used for Source Evaluation**

Test Data:

Holder Ramp Hardness Test: Satisfactory. Hardness tested 52C.
(Meets ASTM Specification D 4383-02).

STATE MATERIALS AND RESEARCH ENGINEER
Thursday, February 26, 2004 Page 1 of 1

Georgia Department of Transportation
Office of Materials and Research
Miscellaneous Sample Report

Sample Number: MURP7838-04-00011738
Date Received: 1/12/2004 **Project** 3M CORP.
County Number:
Contract No.: **Sample** Testing Management
Producer Code:
Material Code: MARKERSRPM3R Raised Pvmt Markers, Tp 3, 2 Way,Red
Date Sampled: 9/27/2004 **Sampled** Stockpile
Quantity: 50 **Unit:** EACH
Location: SCOTT CARPENTER **Examined** 919
Vendor:
Date Completed: 1/23/2004
Remarks: Material Code for marker is Raised Pavement Marker, Type 3, Two-way Amber/Amber (R.W. Hunt Tag No.272753)
PRODUCER; 3M Corp., St. Paul, MN
MATERIAL; Pavement Marker, Type 3, two way, two color , size 4" x 2 " with a bitumen adhesive base.

Meets Requirements: **Passed** **Sample Used for Source Evaluation**

Test Data:

Bond Strength: The test in ASTM Specification D 4383-02 for bond strength does not apply to the pavement markers received. The pavement markers received have a bitumen adhesive base. (Test not applicable).

Impact Test: Satisfactory. No detectable radial cracks or delamination.
(Meets ASTM Specification D 4383-02).

Compressive Strength: Satisfactory. No breakage or significant deformation detected at 6000 lbs.
(Meets ASTM Specification D 4383-02).

Specific Intensity: Satisfactory. 50 Amber/Amber Markers Tested. 49 Amber/Amber Markers Passed.
(Meets ASTM Specification D 4383-02).

Temperature Cycling: Satisfactory. No detectable radial cracks or delamination after 3 cycles of 60 degrees C for 4 hours followed by -7 degrees C for 4 hours.
(Meets ASTM Specification D 4383-02).

STATE MATERIALS AND RESEARCH ENGINEER
Thursday, February 26, 2004 Page 1 of 1

Georgia Department of Transportation
Office of Materials and Research
Miscellaneous Sample Report

Sample Number: MURP7838-04-00011739
Date Received: 1/12/2004 **Project** 3M CORP.
County Number:
Contract No.: **Sample** Testing Management
Producer Code:
Material Code: MARKERSRPM3R Raised Pvmt Markers, Tp 3, 2 Way,Red
Date Sampled: 9/27/2001 **Sampled** Stockpile
Quantity: 50 **Unit:** EACH
Location: SCOTT CARPENTER **Examined** 919
Vendor:
Date Completed: 1/23/2004
Remarks: Material Code for marker is Raised Pavement Marker, Type 3, 2 way Red/White (R.W. Hunt Tag No.272753)
PRODUCER; 3M Corp., St. Paul, MN
MATERIAL; Pavement Marker, Type 3, two way, two color , size 4" x 2 " with a bitumen adhesive base.

Meets Requirements: **Passed** **Sample Used for Source Evaluation**

Test Data:

Bond Strength: The test in ASTM Specification D 4383-02 for bond strength does not apply to the pavement markers received. The pavement markers received have a bitumen adhesive base. (Test not applicable).

Impact Test: Satisfactory. No detectable radial cracks or delamination.
(Meets ASTM Specification D 4383-02).

Compressive Strength: Satisfactory. No breakage or significant deformation detected at 6000 lbs.
(Meets ASTM Specification D 4383-02).

Specific Intensity: Satisfactory. 50 Red/White Markers Tested. 48 Red/White Markers Passed.
(Meets ASTM Specification D 4383-02).

Temperature Cycling: Satisfactory. No detectable radial cracks or delamination after 3 cycles of 60 degrees C for 4 hours followed by -7 degrees C for 4 hours.
(Meets ASTM Specification D 4383-02).

STATE MATERIALS AND RESEARCH ENGINEER
Thursday, February 26, 2004 Page 1 of 1

Georgia Department of Transportation
Office of Materials and Research
Miscellaneous Sample Report

Sample Number: MURP7838-04-00011740
Date Received: 1/12/2004 **Project** 3M CORP.
County Number:
Contract No.: **Sample** Testing Management
Producer Code:
Material Code:
Date Sampled: 9/27/2004 **Sampled** Stockpile
Quantity: 5 **Unit:** EACH
Location: SCOTT CARPENTER **Examined** 919
Vendor:
Date Completed: 1/23/2004
Remarks: PRODUCER; 3M Corp., St. Paul, MN
MATERIAL; Snowplowable Marker Holder Ramp / H960HP Markers from 3M Corp. (R.W. Hunt Tag No.272753)

Meets Requirements: **Passed** **Sample Used for Source Evaluation**

Test Data:

Holder Ramp Hardness Test: Satisfactory. Hardness tested 53C.
(Meets ASTM Specification D 4383-02).

STATE MATERIALS AND RESEARCH ENGINEER
Thursday, February 26, 2004 Page 1 of 1

Georgia Department of Transportation
Office of Materials and Research
Miscellaneous Sample Report

Sample Number: MURP7838-04-00011741
Date Received: 1/12/2004 **Project** RAY-O-LITE (DIV. OF PAC-TEC)
County Number:
Contract No.: **Sample** Testing Management
Producer Code:
Material Code:
Date Sampled: 9/27/2001 **Sampled** Stockpile
Quantity: 5 **Unit:** EACH
Location: SCOTT CARPENTER **Examined** 919
Vendor:
Date Completed: 1/23/2004
Remarks: PRODUCER; Ray-O-Lite (A Division of Pac-Tec)
MATERIAL; Snowplowable Marker Holder Ramp / 5 Castings from Ray-O-Lite - Model 100

Meets Requirements: **Passed** **Sample Used for Source Evaluation**

Test Data:

Holder Ramp Hardness Test: Satisfactory. Hardness tested 52C.
(Meets ASTM Specification D 4383-02).

STATE MATERIALS AND RESEARCH ENGINEER

Thursday, February 26, 2004 Page 1 of 1

Table III-2 Summary of Field Data – MD-100

Install Date: 10/3/2001

NTPEP Sample	Manufacturer/Model	Pavement	Rating number	Date	Age	Lab .2/0 Avg	Lab .2/20 Avg	Housing Avg	Lens Avg	Dirty Avg cd/lx	Clean Avg cd/lx	Visability Avg*
RPM(2001MD)-2	3M Series 190 Marker	Asphalt	Rating 1	11/13/01	41			5.0	5.0	0.216	0.298	5.0
RPM(2001MD)-2	3M Series 190 Marker	Asphalt	Rating 2	4/15/02	194			4.3	4.4	0.182	0.217	5.0
RPM(2001MD)-2	3M Series 190 Marker	Asphalt	Rating 3	10/7/02	369			4.5	3.6	0.183	0.259	4.1
RPM(2001MD)-2	3M Series 190 Marker	Asphalt	Rating 4	4/15/03	559			4.6	3.7	0.083	0.118	3.5
RPM(2001MD)-2	3M Series 190 Marker	Asphalt	Rating 5	10/7/03	734			4.5	3.4	0.047	0.060	3.3

Install Date: 10/3/2001

NTPEP Sample	Manufacturer/Model	Pavement	Rating number	Date	Age	Lab .2/0 Avg	Lab .2/20 Avg	Housing Avg	Lens Avg	Dirty Avg cd/lx	Clean Avg cd/lx	Visability Avg*
RPM(2001MD)-3	A-D Stimsonite Model 101	Asphalt	Rating 1	11/13/01	41			5.0	5.0	0.238	0.331	5.0
RPM(2001MD)-3	A-D Stimsonite Model 101	Asphalt	Rating 2	4/15/02	194			4.5	4.8	0.201	0.266	5.0
RPM(2001MD)-3	A-D Stimsonite Model 101	Asphalt	Rating 3	10/7/02	369			4.5	3.9	0.338	0.469	2.9
RPM(2001MD)-3	A-D Stimsonite Model 101	Asphalt	Rating 4	4/15/03	559			4.5	4.2	0.200	0.263	3.7
RPM(2001MD)-3	A-D Stimsonite Model 101	Asphalt	Rating 5	10/7/03	734			4.5	3.5	0.103	0.128	3.0

Install Date: 10/4/2001

NTPEP Sample	Manufacturer/Model	Pavement	Rating number	Date	Age	Lab .2/0 Avg	Lab .2/20 Avg	Housing Avg	Lens Avg	Dirty Avg cd/lx	Clean Avg cd/lx	Visability Avg*
RPM(2001MD)-4	A-D Stimsonite Model 96	Asphalt	Rating 1	11/13/01	40			5.0	5.0	0.204	0.309	5.0
RPM(2001MD)-4	A-D Stimsonite Model 96	Asphalt	Rating 2	4/15/02	193			4.5	4.7	0.192	0.293	4.8
RPM(2001MD)-4	A-D Stimsonite Model 96	Asphalt	Rating 3	10/7/02	368			4.8	4.0	0.407	0.449	4.4
RPM(2001MD)-4	A-D Stimsonite Model 96	Asphalt	Rating 4	4/15/03	558			4.4	4.2	0.193	0.270	3.9
RPM(2001MD)-4	A-D Stimsonite Model 96	Asphalt	Rating 5	10/7/03	733			4.5	4.0	0.103	0.148	3.6

Table III-2 Summary of field Data – MD 100

(contd)

Install Date: 10/3/2001

NTPEP Sample	Manufacturer/Model	Pavement	Rating number	Date	Age	Lab .2/0 Avg	Lab .2/20 Avg	Housing Avg	Lens Avg	Dirty Avg cd/lx	Clean Avg cd/lx	Visability Avg*
RPM(2001MD)-5	Hallen Products / Ironstar	Asphalt	Rating 1	10/17/01	14			5.0	5.0	0.223	0.296	5.0
RPM(2001MD)-5	Hallen Products / Ironstar	Asphalt	Rating 2	4/15/02	194			4.5	4.5	0.125	0.208	5.0
RPM(2001MD)-5	Hallen Products / Ironstar	Asphalt	Rating 3	10/7/02	369			4.5	3.8	0.165	0.228	4.3
RPM(2001MD)-5	Hallen Products / Ironstar	Asphalt	Rating 4	4/15/03	559			4.0	3.8	0.088	0.116	4.0
RPM(2001MD)-5	Hallen Products / Ironstar	Asphalt	Rating 5	10/7/03	734			4.4	3.3	0.041	0.050	3.3

Install Date: 10/4/2001

NTPEP Sample	Manufacturer/Model	Pavement	Rating number	Date	Age	Lab .2/0 Avg	Lab .2/20 Avg	Housing Avg	Lens Avg	Dirty Avg cd/lx	Clean Avg cd/lx	Visability Avg*
RPM(2001MD)-6	Astucia Intelligent Flush Stud	Asphalt	Rating 1	10/17/01	13			5.0	5.0	N/A	N/A	5.0
RPM(2001MD)-6	Astucia Intelligent Flush Stud	Asphalt	Rating 2	4/15/02	193			5.0	4.1	N/A	N/A	3.8
RPM(2001MD)-6	Astucia Intelligent Flush Stud	Asphalt	Rating 3	10/7/02	368			5.0	4.2	N/A	N/A	3.2
RPM(2001MD)-6	Astucia Intelligent Flush Stud	Asphalt	Rating 4	4/15/03	558			4.7	3.3	N/A	N/A	3.9
RPM(2001MD)-6	Astucia Intelligent Flush Stud	Asphalt	Rating 5	10/7/03	733			4.5	3.5	N/A	N/A	1.0

Install Date: 10/4/2001

NTPEP Sample	Manufacturer/Model	Pavement	Rating number	Date	Age	Lab .2/0 Avg	Lab .2/20 Avg	Housing Avg	Lens Avg	Dirty Avg cd/lx	Clean Avg cd/lx	Visability Avg*
RPM(2001MD)-7	Nightline Markers	Asphalt	Rating 1	10/17/01	13			5.0	5.0	0.318	0.565	5.0
RPM(2001MD)-7	Nightline Markers	Asphalt	Rating 2	4/15/02	193			5.0	4.6	0.157	0.397	5.0
RPM(2001MD)-7	Nightline Markers	Asphalt	Rating 3	10/7/02	368			5.0	3.6	0.213	0.388	5.0
RPM(2001MD)-7	Nightline Markers	Asphalt	Rating 4	4/15/03	558			4.5	3.9	0.146	0.224	4.0
RPM(2001MD)-7	Nightline Markers	Asphalt	Rating 5	10/7/03	733			4.5	3.4	0.056	0.077	3.8

Table III-2 Summary of Field Data MD 100 (contd)

Install Date: 10/3/2001

NTPEP Sample	Manufacturer/Model	Pavement	Rating number	Date	Age	Lab .2/0 Avg	Lab .2/20 Avg	Housing Avg	Lens Avg	Dirty Avg cd/lx	Clean Avg cd/lx	Visability Avg*
RPM(2001MD)-8	Pac-tec/ Ray-O-Lite Snow-Lite	Asphalt	Rating 1	10/17/01	14			5.0	5.0	0.161	0.278	5.0
RPM(2001MD)-8	Pac-tec/ Ray-O-Lite Snow-Lite	Asphalt	Rating 2	4/15/02	194			4.9	4.8	0.048	0.109	4.0
RPM(2001MD)-8	Pac-tec/ Ray-O-Lite Snow-Lite	Asphalt	Rating 3	10/7/02	369			4.5	4.0	0.088	0.134	3.9
RPM(2001MD)-8	Pac-tec/ Ray-O-Lite Snow-Lite	Asphalt	Rating 4	4/15/03	559			4.6	4.0	0.052	0.072	3.0
RPM(2001MD)-8	Pac-tec/ Ray-O-Lite Snow-Lite	Asphalt	Rating 5	10/7/03	734			4.5	3.5	0.021	0.025	2.6

Table III-2 Summary of Field Data – I97

Install Date: 10/4/2001

NTPEP Sample	Manufacturer/Model	Pavement	Rating number	Date	Age	Lab .2/0 Avg	Lab .2/20 Avg	Housing Avg	Lens Avg	Dirty Avg cd/lx	Clean Avg cd/lx	Visability Avg*
RPM(2001MD)-2	3M Series 190 Marker	Concrete	Rating 1	10/24/01	20			5.0	5.0	0.249	0.344	5.0
RPM(2001MD)-2	3M Series 190 Marker	Concrete	Rating 2	4/15/02	193			4.0	4.5	0.127	0.190	5.0
RPM(2001MD)-2	3M Series 190 Marker	Concrete	Rating 3	10/7/02	368			4.5	3.7	0.098	0.126	4.8
RPM(2001MD)-2	3M Series 190 Marker	Concrete	Rating 4	4/14/03	557			4.7	3.4	0.051	0.088	3.8
RPM(2001MD)-2	3M Series 190 Marker	Concrete	Rating 5	10/6/03	732			4.3	3.1	0.035	0.048	3.8

Install Date: 10/3/2001

NTPEP Sample	Manufacturer/Model	Pavement	Rating number	Date	Age	Lab .2/0 Avg	Lab .2/20 Avg	Housing Avg	Lens Avg	Dirty Avg cd/lx	Clean Avg cd/lx	Visability Avg*
RPM(2001MD)-3	A-D Stimsonite Model 101	Concrete	Rating 1	10/24/01	21			5.0	5.0	0.308	0.397	5.0
RPM(2001MD)-3	A-D Stimsonite Model 101	Concrete	Rating 2	4/15/02	194			4.5	4.4	0.204	0.260	5.0
RPM(2001MD)-3	A-D Stimsonite Model 101	Concrete	Rating 3	10/7/02	369			4.5	4.0	0.286	0.357	5.0
RPM(2001MD)-3	A-D Stimsonite Model 101	Concrete	Rating 4	4/14/03	558			4.7	4.4	0.219	0.357	3.7
RPM(2001MD)-3	A-D Stimsonite Model 101	Concrete	Rating 5	10/6/03	733			4.5	3.2	0.080	0.106	1.9

Install Date: 10/4/2001

NTPEP Sample	Manufacturer/Model	Pavement	Rating number	Date	Age	Lab .2/0 Avg	Lab .2/20 Avg	Housing Avg	Lens Avg	Dirty Avg cd/lx	Clean Avg cd/lx	Visability Avg*
RPM(2001MD)-4	A-D Stimsonite Model 96	Concrete	Rating 1	10/24/01	20			5.0	5.0	0.263	0.354	5.0
RPM(2001MD)-4	A-D Stimsonite Model 96	Concrete	Rating 2	4/15/02	193			4.3	4.5	0.186	0.287	4.9
RPM(2001MD)-4	A-D Stimsonite Model 96	Concrete	Rating 3	10/7/02	368			4.5	3.9	0.248	0.343	4.9
RPM(2001MD)-4	A-D Stimsonite Model 96	Concrete	Rating 4	4/14/03	557			4.9	4.0	0.174	0.298	3.7
RPM(2001MD)-4	A-D Stimsonite Model 96	Concrete	Rating 5	10/6/03	732			4.5	3.1	0.077	0.094	2.0

Table III-2 Summary of Field Data I97 (contd)

Install Date: 10/3/2001

NTPEP Sample	Manufacturer/Model	Pavement	Rating number	Date	Age	Lab .2/0 Avg	Lab .2/20 Avg	Housing Avg	Lens Avg	Dirty Avg cd/lx	Clean Avg cd/lx	Visability Avg*
RPM(2001MD)-5	Hallen Products / Ironstar	Concrete	Rating 1	10/24/01	21			5.0	5.0	0.224	0.329	5.0
RPM(2001MD)-5	Hallen Products / Ironstar	Concrete	Rating 2	4/15/02	194			3.6	4.3	0.109	0.172	5.0
RPM(2001MD)-5	Hallen Products / Ironstar	Concrete	Rating 3	10/7/02	369			4.3	3.6	0.090	0.123	5.0
RPM(2001MD)-5	Hallen Products / Ironstar	Concrete	Rating 4	4/14/03	558			4.2	3.9	0.056	0.095	4.0
RPM(2001MD)-5	Hallen Products / Ironstar	Concrete	Rating 5	10/6/03	733			3.7	3.2	0.035	0.045	3.7

Install Date: 10/5/2001

NTPEP Sample	Manufacturer/Model	Pavement	Rating number	Date	Age	Lab .2/0 Avg	Lab .2/20 Avg	Housing Avg	Lens Avg	Dirty Avg cd/lx	Clean Avg cd/lx	Visability Avg*
RPM(2001MD)-6	Astucia Intelligent Flush Stud	Concrete	Rating 1	10/24/01	19			5.0	5.0	N/A	N/A	5.0
RPM(2001MD)-6	Astucia Intelligent Flush Stud	Concrete	Rating 2	4/15/02	192			5.0	4.0	N/A	N/A	3.5
RPM(2001MD)-6	Astucia Intelligent Flush Stud	Concrete	Rating 3	10/7/02	367			5.0	5.0	N/A	N/A	2.5
RPM(2001MD)-6	Astucia Intelligent Flush Stud	Concrete	Rating 4	4/14/03	556			5.0	4.0	N/A	N/A	1.4
RPM(2001MD)-6	Astucia Intelligent Flush Stud	Concrete	Rating 5	10/6/03	731			4.5	3.4	N/A	N/A	1.2

Install Date: 10/5/2001

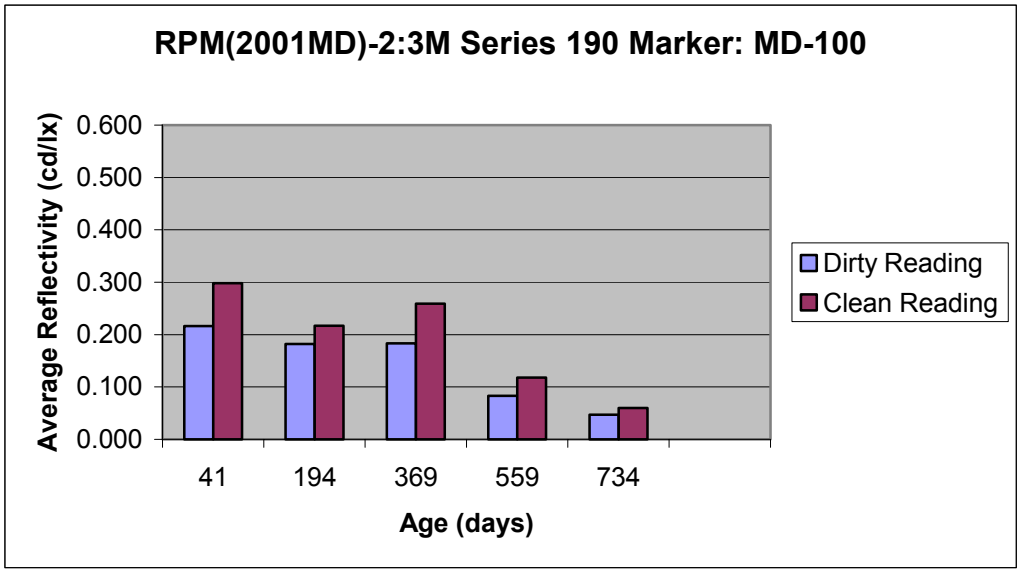
NTPEP Sample	Manufacturer/Model	Pavement	Rating number	Date	Age	Lab .2/0 Avg	Lab .2/20 Avg	Housing Avg	Lens Avg	Dirty Avg cd/lx	Clean Avg cd/lx	Visability Avg*
RPM(2001MD)-7	Nightline Markers	Concrete	Rating 1	10/24/01	19			5.0	5.0	0.316	0.442	5.0
RPM(2001MD)-7	Nightline Markers	Concrete	Rating 2	4/15/02	192			4.6	4.0	0.182	0.256	5.0
RPM(2001MD)-7	Nightline Markers	Concrete	Rating 3	10/7/02	367			4.5	3.3	0.130	0.198	5.0
RPM(2001MD)-7	Nightline Markers	Concrete	Rating 4	4/14/03	556			5.0	3.9	0.072	0.152	4.0
RPM(2001MD)-7	Nightline Markers	Concrete	Rating 5	10/6/03	731			4.5	3.5	0.035	0.051	3.7

Table III-2 Summary of Field Data I97 (contd)

Install Date: 10/3/2001

NTPEP Sample	Manufacturer/Model	Pavement	Rating number	Date	Age	Lab .2/0 Avg	Lab .2/20 Avg	Housing Avg	Lens Avg	Dirty Avg cd/lx	Clean Avg cd/lx	Visability Avg*
RPM(2001MD)-8	Pac-tec/ Ray-O-Lite Snow-Lite	Concrete	Rating 1	10/24/01	21			5.0	5.0	0.137	0.176	5.0
RPM(2001MD)-8	Pac-tec/ Ray-O-Lite Snow-Lite	Concrete	Rating 2	4/15/02	194			4.7	4.2	0.052	0.080	4.0
RPM(2001MD)-8	Pac-tec/ Ray-O-Lite Snow-Lite	Concrete	Rating 3	10/7/02	369			4.5	3.9	0.052	0.075	4.0
RPM(2001MD)-8	Pac-tec/ Ray-O-Lite Snow-Lite	Concrete	Rating 4	4/14/03	558			5.0	4.1	0.035	0.068	3.0
RPM(2001MD)-8	Pac-tec/ Ray-O-Lite Snow-Lite	Concrete	Rating 5	10/6/03	733			4.5	3.2	0.020	0.023	1.9

Table III-3 Graphs of Retroreflectivity – MD-100



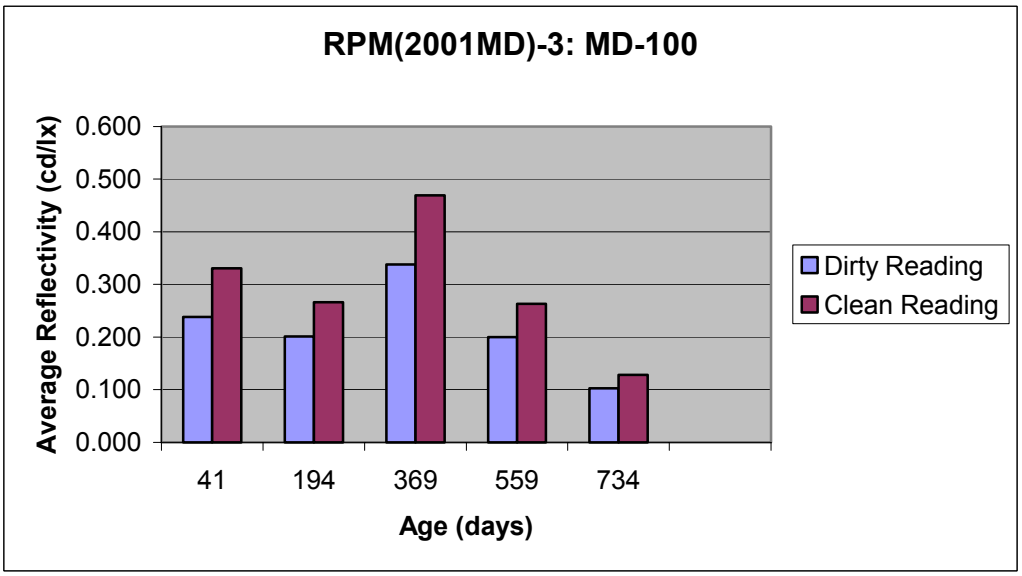
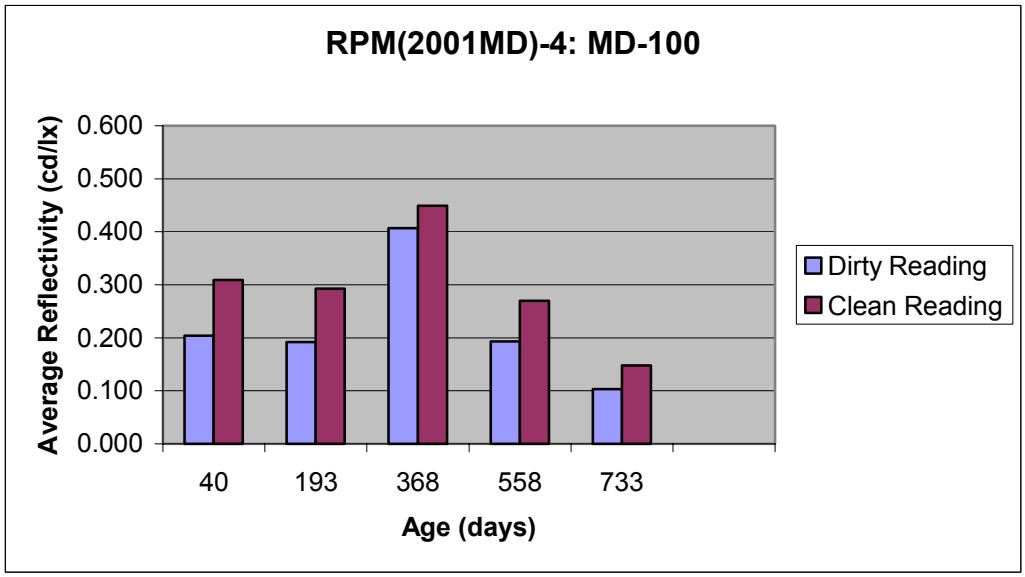


Table III-3 Graphs of Retroreflectivity – MD-100 (contd)



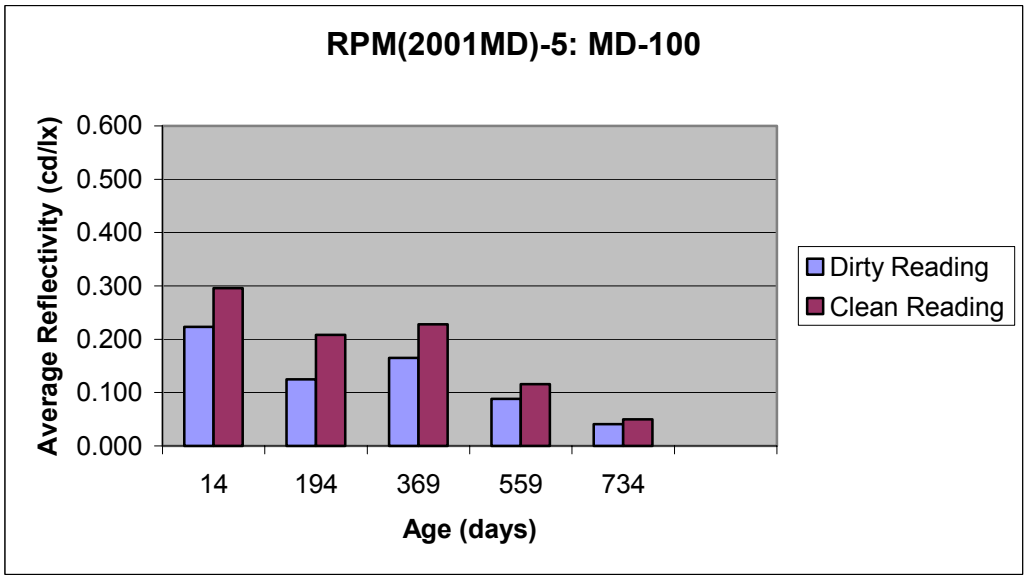
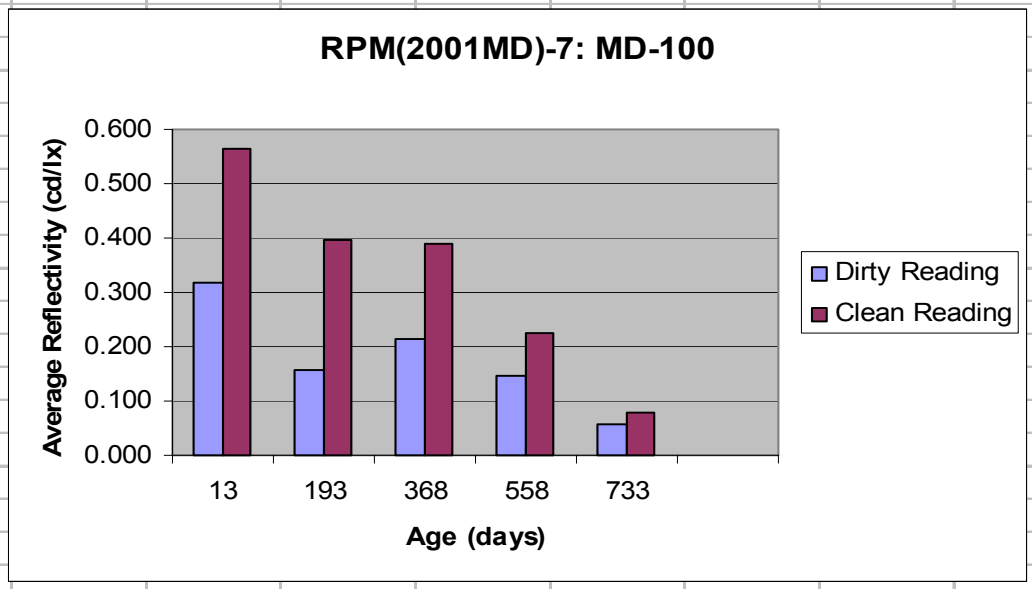


Table III-3 Graphs of Retroreflectivity (contd)



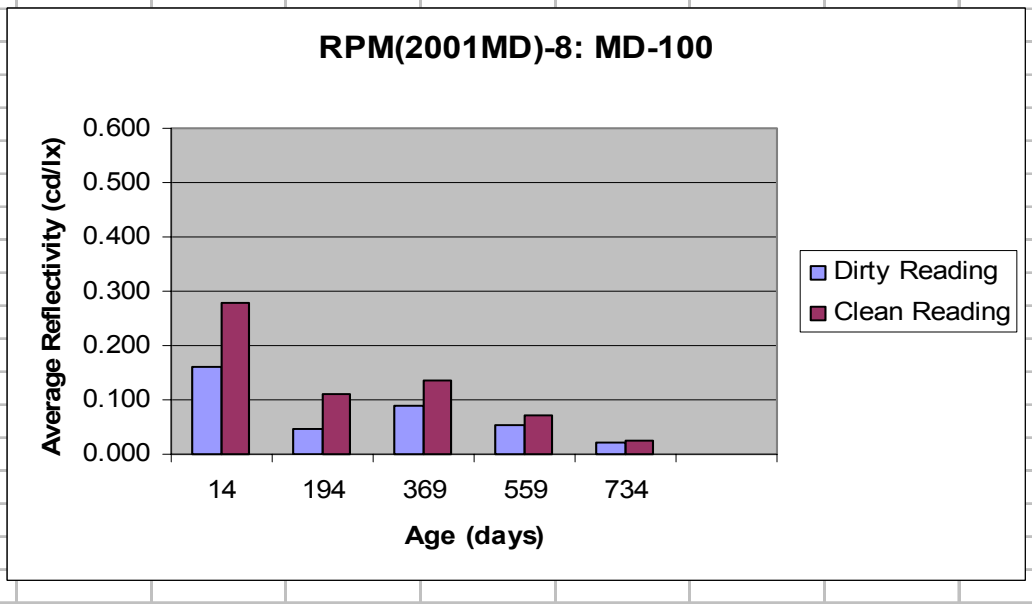
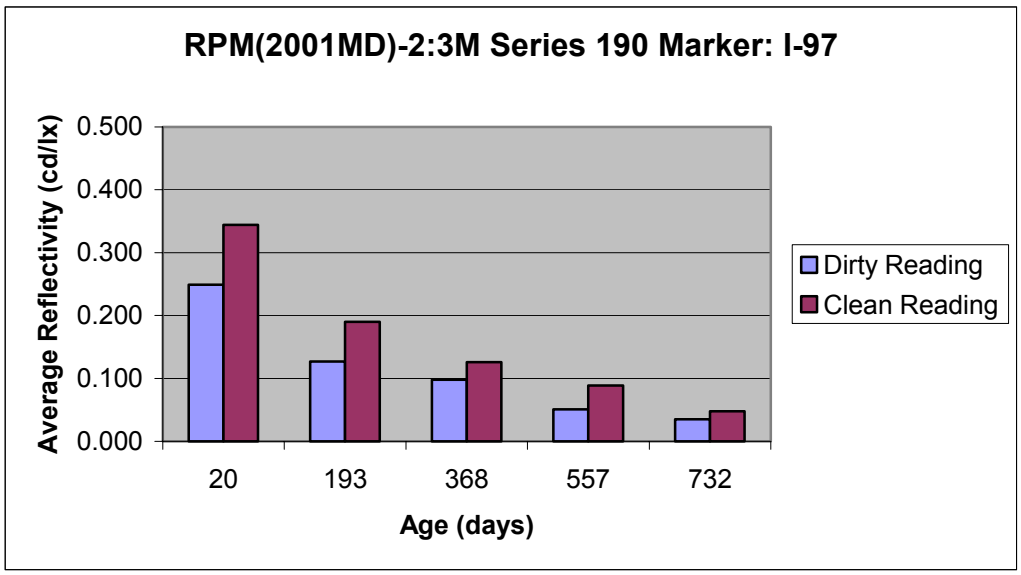


Table III-3 Graphs of Retroreflectivity – I-97



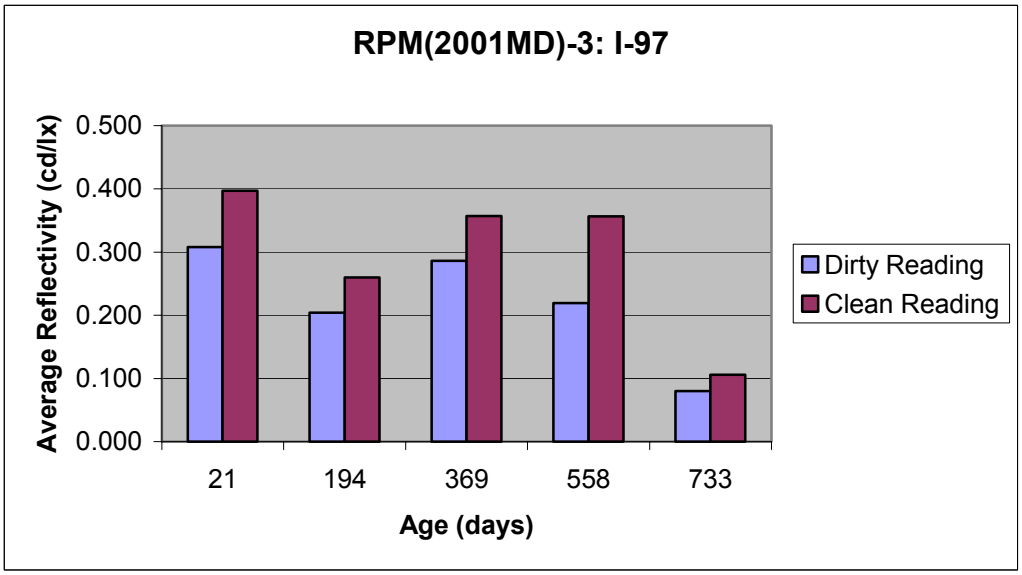
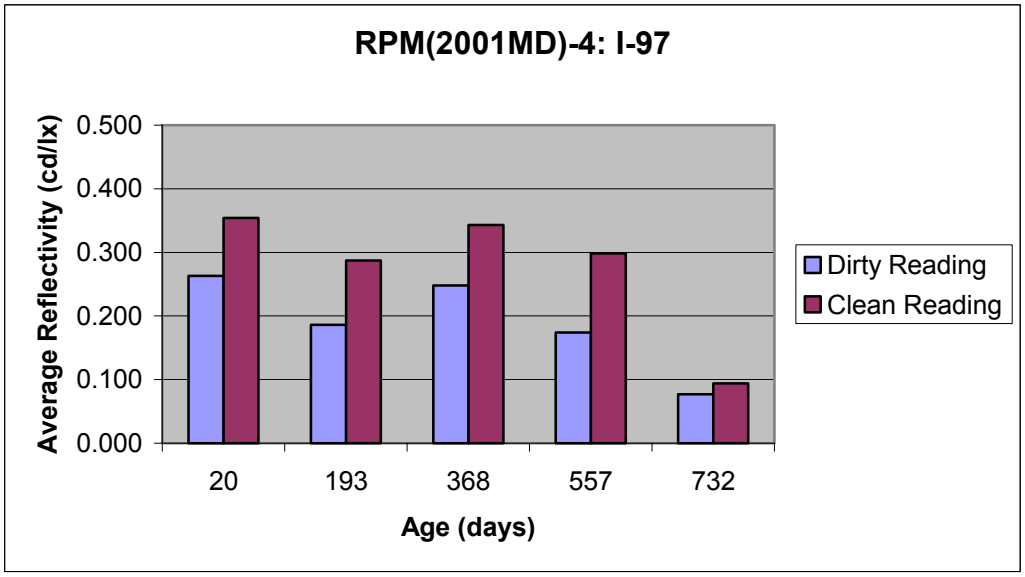


Table III-3 Graphs of Retroreflectivity – I-97 (contd)



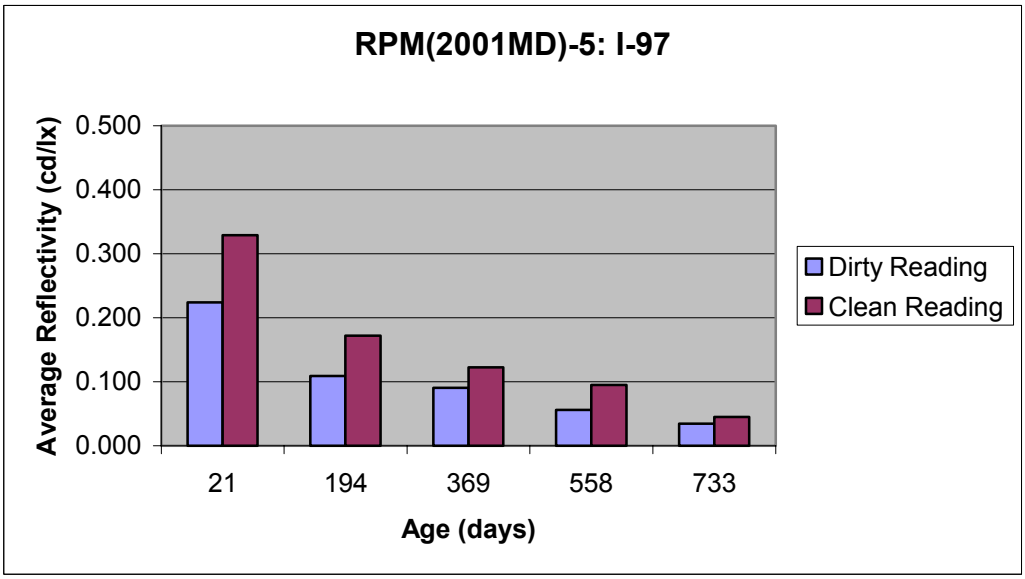
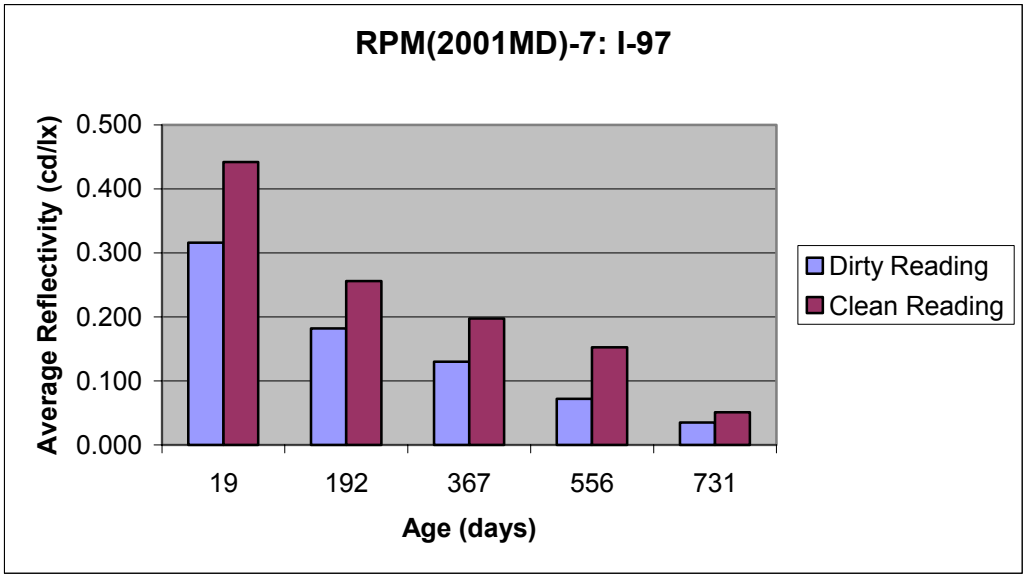


Table III-3 Graphs of Retroreflectivity – I-97



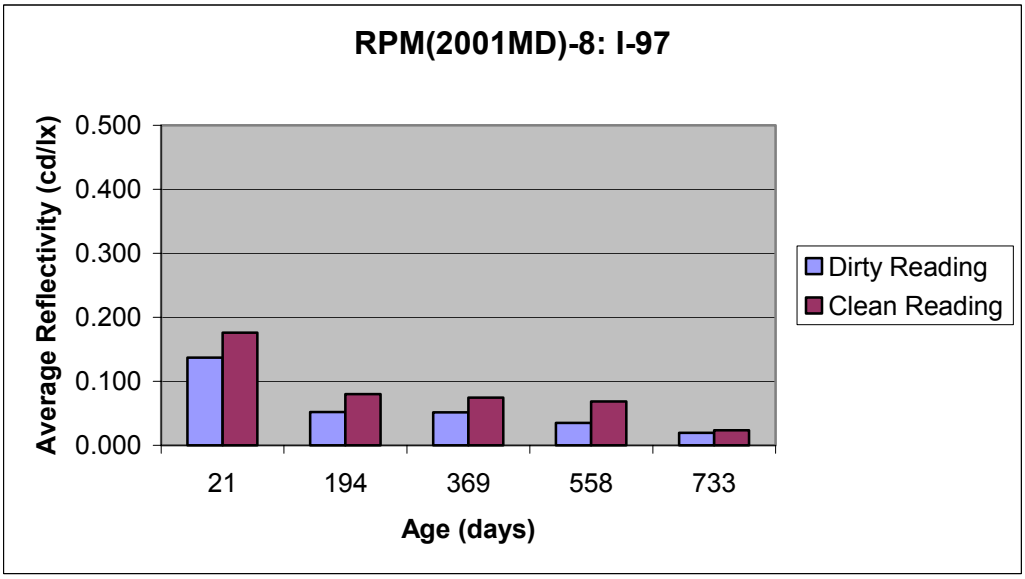


Table III-4: Summary Weather Conditions & Snowfall Data

		Temperature Data			Snow Data	
	Month	Avg. High (F)	Avg. (F)	Avg. Low (F)	Total Snow Fall (in)	# of Snow Days
2001	*August*	87.0	77.0	67.0	0.00	0
	September	76.0	65.2	54.4	0.00	0
	October	69.2	56.0	42.7	0.00	0
	November	63.4	50.7	37.9	0.00	0
	December	51.7	42.1	32.5	0.00	0
2002	*January*	48.9	39.3	29.6	2.30	1
	February	51.1	39.3	27.4	0.00	0
	March	55.7	45.0	34.3	0.00	0
	April	68.1	56.7	45.3	0.00	0
	May	73.8	62.1	50.4	0.00	0
	June	85.0	73.8	62.5	0.00	0
	July	89.3	78.6	67.9	0.00	0
	August	88.9	78.4	67.9	0.00	0
	September	80.3	69.5	58.7	0.00	0
	October	63.9	56.0	48.1	0.00	0
	November	53.8	44.4	34.9	0.00	0
	December	42.6	34.3	25.9	9.70	3
2003	*January*	35.3	28.3	21.3	5.40	6
	February	37.5	30.2	22.8	40.50	10
	March	54.6	43.9	33.1	2.60	1
	April	63.5	52.7	41.8	0.00	0
	May	67.1	59.3	51.5	0.00	0
	June	78.6	69.8	61.0	0.00	0
	July	84.5	75.6	66.6	0.00	0
	August	84.7	76.4	68.1	0.00	0
	September	76.6	68.0	59.3	0.00	0
	October	65.8	55.1	44.4	0.00	0
	November		0.0			
	December		0.0			

* Test Sites Average 22" of Snow per Year

Table III-5: Snow Plowing Activity Summary

Winter 2001-2002

Date of Snow Event	Location	Number of Plow Passes	Salt / Salt Brine Application
1/19-20/2002	I-97	15	Yes
1/19-20/2002	MD 100	18	Yes
3/26/2002*	I-97	24	No
3/26/2002*	MD 100	24	No

- Due to unusually mild winter, required passes were made during rain

Winter 2002-2003

Date of Snow Event	Location	Number of Plow Passes	Salt / Salt Brine Application
12/5-6/2002	I-97	12	Yes
12/5-6/2002	MD 100	20	Yes
1/16-17/2003	I-97	0	Yes
1/16-17/2003	MD 100	0	Yes
2/6-7/2003	I-97	20	Yes
2/6-7/2003	MD 100	13	Yes
2/15-23/2003	I97	44	Yes
2/15-23/2003	MD 100	33	Yes
2/27-28/2003	I97	0	Yes
2/27-28/2003	MD 100	0	Yes

IV. DISCUSSION

Field Data Collection

Field retroreflectivity, nighttime visibility and field inspection data was collected at the time of installation and 6 month intervals thereafter. Procedures for the data collection were completed according to the procedures outlined in section II.

The dates for data collection were as follows:

	I-97	MD 100
Initial	**10/24/01**	**11/13/01 and 10/17/01**
6-month	**4/15/02**	**4/16/02**
12-month	**10/7/02**	**10/7/02**
18-month	**4/14/03**	**4/15/03**
24-month	**10/6/2003**	**10/8/2003**

Retroreflectivity

There were two testing machines that were utilized for collecting retroreflectivity data. There were notable differences observed between the retroreflectivity readings of the two machines. The variance in the readings on any one machine brought the overall averages of the two machines within a reasonable range. Inconsistency problems of this type are sometimes indicative of new technologies. Utilizing retroreflectometers to evaluate SRPM's will become more effective as techniques and equipment continue to develop. Past experience has found similar difficulty with reproducing consistent retroreflectivity data.

Summary data is presented as an average of all 40 pavement makers (one model) for each section of the test deck. Averages were reported for both dirty and clean readings. A summary of the data can be seen in Section III. In general there was a decrease in reflectivity readings over the first 6 months of the study. The graphs showing this trend are provided for each model of pavement marker (Section III). Retroreflectivity data for the Astucia Intelligent Flush Stud is not presented because the reflectometers being utilized were unable to take readings due to the reflectors unique shape and design.

After cleaning the lenses, the reflectivity readings were significantly higher on average. This can be attributed to a large accumulation of road dirt and/or pavement or concrete dust. This was observed by the increased retroreflectivity readings after cleaning and by the accumulation of dirt on the cloth used for cleaning.

Nighttime Visibility

A summary of the nighttime visibility data is presented as an average of all 40 pavement makers (one model) for each section of the test deck. A summary of the data can be seen in Section III . Nighttime visibility remained high (4.8 or greater on average) after the first 6 months for all reflectors excluding the Astucia Intelligent Flush Stud which had a larger drop (5.0 to 3.8 on pavement and 5.0 to 3.5 on concrete).

Inspection

A summary of the inspection data is presented as an average of all 40 pavement markers (one model) for each section of the test deck. A summary of the data can be seen in Section III. Some damage to the housing and lenses was noted during the data collection. This damage was most likely caused by plows or objects (stones, etc.) impacting the lens. In some cases, epoxy from installation had hardened on the lens which may cause a decrease in overall reflectivity. After 6 months, hardened epoxy and damage caused by foreign objects had occurred in a limited number of cases and had no significant impact on the study results. It should be noted that housings that were not flush with the road or were incorrectly installed showed a higher level of damage during field investigations of the raised pavement markers.

Snow Plow Passes Data

The winter in Maryland between the initial and 6-month observations was unusually warm and dry. It was not possible to obtain the required number of plow hits for one season as outlined in the work plan. To meet the requirement, a vigorous plowing operation was completed in rainy conditions. This technique was considered to most closely resemble plowing in snowy conditions. The plowing operation was completed on March 26th. Each marker received 24 hits and all markers remained intact. The trucks had steel-bladed plows and were traveling at approximately 30 miles per hour. There were no chemicals applied during this operation. There were no additional plow hits made from actual snow plowing. There were 15-20 passes of de-icing chemical application (on both test decks) on January 19, 2002.

Weather Data Collection

The first winter of the study was unseasonably warm. The weather data (see table III-5) shows a minimum average temperature in February 2002 of 39.3 (F) with an average low of 27.4 (F) and an average high of 51.1 (F). This was the coldest month of the first 6 of the study. The only snowfall during the first 6 months was 2.30 inches that fell on the 19th of January, 2002. The snowfall occurred steadily over multiple hours so rigorous plowing was not necessary. De-icing chemicals were applied to maintain the roads during this storm. The snows of February 2003, 40.5 inches, brought the year's total to 58.2. The amount of snow this season required more plow passes then the previous two years. The average yearly snowfall based on data collected from 1883-2002 is 22 inches a year.

General

Over the course of the first 6 months of study, multiple inquiries were made by regional politicians and civilians into the raised pavement markers. Due to the proximity of the study sites to Baltimore- Washington International airport , many people were questioning if the reflectors were part of the airport control system. Others questioned if they were an additional airport security measure. This interest emphasizes the fact that drivers are noticed the raised pavement markers and that there was both public and private interest in the study.

APPENDICES

A. AASHTO Snowplowable Pavement Markers Project Work Plan

B. Retroreflectometer Specifications

C. Field data

   a. Visual Survey

   b. Quantitative Testing Results

D. Precision Scan Data

Appendix A

Work Plan

Development of Technical Assistance in Research and Technology Transfer

FRS: 430452
SP707A41

Task

NTPEP Test of Plowable, Retroreflective Raised Pavement Markers

Evaluation of

Snowplowable, Retroreflective Raised Pavement

Prepared by:
Donna C. Nelson
Director, Maryland T2 Center
University of Maryland
Building 806, Suite 3103
College Park, MD 20742-6601
Phone: 301-403-4597
dcnelson@eng.umd.edu

Prepared For:
Mr. Jeffrey Smith

Maryland State Highway Administration
707 N. Calvert Street
Baltimore, MD

Technical Contact:
Gil Rushton
Maryland State Highway Administration

Study Duration	2 years	Estimated Start Date	October 1, 2001

Markers

Draft Date: Sept 18, 2001

V. INTRODUCTION AND SCOPE OF STUDY

The Maryland State Highway Administration (MDSHA) has volunteered to participate in the AASHTO National Transportation Product Evaluation Program (NTPEPP) of Plowable, Retro-reflective Raised Pavement Markers (SRPMs).

The study requirements and approach for are described in the AASHTO "Work Plan for Snow Plowable RPMs" approved May 2000 by the NTPEP Oversight Committee. The scope involves laboratory and field-testing. Maryland and Ohio will each conduct field tests at two locations. Laboratory testing will be conducted by the Georgia Department of Transportation.

The MDSHA has designated a Study Team charged with guiding the study. The role of the University of Maryland T^2 Center is to assist MD SHA (and the Study Team) with the tasks needed to plan for and conduct this study in accordance with the requirements of the work plan, compile and analyze the data, and prepare study documentation and reports. The first year of the Ohio Study has recently been completed. The MD SHA Study Team and the T2 Center will contact the Ohio Study Team. The University of Maryland and the MDSHA Study Team may be able to learn from their experiences.

The following sections describe the tasks and deliverables for this project, a time-table, and an estimated budget for the project. This project is being defined as a task under the project Development of Technical Assistance in Research and technology Transfer.

VI. TASKS AND DELIVERABLES

The tasks described below are based on the AASHTO Work Plan. The three major tasks include study planning and preparation, installation support, data collection, and data analysis and presentation. The University of Maryland will work with the SHA to further define and refine these tasks as needed.

Task 1: Study Planning and Preparation

The University of Maryland will work with the SHA Study team to prepare preliminary study documentation, data collection procedures, and RPM installation.

1) **Preliminary study documentation.** Preliminary study documentation includes description of the site, the project, the testing equipment to be used, and any other information the Study Team feels is relevant. The site description will include the location and characteristics of the selected sites as required in the AASHTO Workplan. Documentation will include a general location map, geometric characteristics, traffic characteristics, speed limits, and notations on any other elements or conditions that may affect the study results or their interpretation. The product descriptions will summarize relevant information for the manufacturers and products to be tested. Information included for the testing equipment (Reflectometers) includes manufacturer, model number, data format, accuracy, operating specifications and any other relevant information.

2) **Data Collection Plan(s)**. The data collection plan will include a list and definition of all data items and rating scales required for the study and the source of those data; the data format used by the RPM reflectomoeters; an appropriate labeling scheme to identify specific RPMs; factors or conditions that may impact the collection of data or the results of the study, and possible conditions under which devices may be excluded from the study. These activities also include the development of clear procedures for the collection of all data associated with the study and for down-loading and storing data from RPM reflectometers, a time schedule for data collection, and other items as determined by the MDSHA Study Team.

3) **RPM Installation Plan**. Document and describe the installation process developed by SHA, including location and spacing of RPMs for each manufacturer, installation date & times, traffic control, participating manufacturers and their contact information, relevant product information, documentation of installation procedures, and other appropriate details as determined by the SHA Study Team.

Task 2: RPM Installation Support

This proposal assumes that the Maryland State Highway Administration will coordinate and supervise the installation process, and the RPMs will be installed by the manufacturers. A preliminary list of potential tasks the Center may perform for SHA that relate to RPM installation include the following:

4) **Observe RPM installation**. SHA and the Center agree that the PI and graduate assistant from the University of Maryland will observe as much of the installation process as is practical. This will be valuable as they conduct the data analysis and prepare the study reports.

5) **Coordinating Manufacturers Requirements**. The AASHTO Workplan requires that manufacturers submit written instructions for the installation of their devices and within one week following installation; certify that the devices were installed in accordance with their instructions and to their satisfaction. The Center can assist the SHA with this process, by tracking manufacturers responses and documenting compliance.

6) **Document installation details**. This activity involves formally documenting the installation procedure, as well as ensuring that RPMs are correctly identified with their manufacturer as installed.

Task 3: Data Collection Participation

The Maryland T^2 Center will participate in the data collection effort as follows:

7) **Provide assistance collecting field data**. The Maryland T2 Center will provide staff to assist SHA staff with field data collection, as needed. Field data (reflectometer readings) will be collected at both study sites immediately following installation, and twice more at intervals to be determined by the SHA Study Team.

8) **Describe any problems or challenges** encountered during data collection and document any other relevant information regarding the study.

9) **Compile other information** required as part of the study including snowfall, treatments applied, AADT, and other data the SHA Study Team deems necessary to properly support the study.

Task 4: Data Analysis and Presentation

Maryland SHA will perform the biannual field observations. These data will be compiled and analyzed by the T^2 Center.

10) **Study Report Format and Preliminary Report.** Develop an outline for the Study Report and the tables that will be used to present study data and submit it to the study team for their review and comment. Draft a preliminary report that includes the background material and documentation collected in Tasks 1 & 2, and templates for the data tables with any modifications suggested by the MD SHA Study Team.

11) **Year 1 Study Report**. Draft a report based upon the results of the study during the 1st year. Distribute the preliminary report to the study team for review and comment; incorporate revisions.

12) **Final Study Report**. Prepare final study report and compile data for transmission as required in Section 6 of the NTPEP Project Work Plan

VII. DELIVERABLES AND SCHEDULE

Target dates for major project deliverables are shown below. This schedule is expected to change as dates are set for data collection and other major activities. An updated schedule will be included in each Quarterly

Task	Deliverable	Start Date	Due Date
1	Draft Preliminary Study Documentation, data collection plan, & RPM Installation Plan.	10/01	10/04/01
2	Initial Data Collection		10/05/01
2	Draft Preliminary Study Documentation and Report for review by Study Team		11/15/01
	Quarterly Progress Report for the period 10.01.01 – 12.31.01.		1/31/02
2	Field Data Collection Participation (Year 1)		TBD
	Quarterly Progress Report for the period January – March 2002		4/30/02
	Quarterly Progress Report for the period April – June 2002		7/31/02
3	Year 1 Study Report		9/28/02
	Quarterly Progress Report for the period July – September 2002		10/31/02
	Quarterly Progress Report for the period October – December 2002		01/31/02
	Field Data Collection (Year 2)		TBD
	Quarterly Progress Report for the period January – March 2003		4/30/03
	Draft Final Report		TBD
3	Final Study Report		9/28/03
3	Final Project Report		12/31/03

Appendix C; Visual Data

Raised Pavement Marker Ratings

I-97 Test Deck

NTPEP # RPM (2001 MD) - 2 3M Compa **3m Series 190 Marker** **190 - H960HP**

Installed: 10/4/2001 by Priceless Industries from milepoint 9.25 to 9.32

Marker No.	Housing*	Lens	Dirty Reading (mcd/lux)	Clean Reading (mcd/lux)	Night Visability
1	5	5	248	n/a	5
2	5	5	267	494	5
3	5	5	178	260	5
4	5	5	226	427	5
5	5	5	251	n/a	5
6	5	5	246	400	5
7	5	5	227	264	5
8	5	5	313	449	5
9	5	5	325	n/a	5
10	5	5	195	231	5
11	5	5	213	273	5
12	5	5	407	415	5
13	5	5	244	n/a	5
14	5	5	223	343	5
15	5	5	223	304	5
16	5	5	290	448	5
17	5	5	133	n/a	5
18	5	5	189	263	5
19	5	5	181	262	5
20	5	5	324	342	5
21	5	5	248	n/a	5
22	5	5	235	372	5
23	5	5	234	356	5
24	5	5	306	417	5
25	5	5	334	n/a	5
26	5	5	312	353	5
27	5	5	295	397	5
28	5	5	331	381	5
29	5	5	345	n/a	5
30	5	5	317	473	5
31	5	5	211	359	5
32	5	5	231	382	5
33	5	5	254	n/a	5
34	5	5	189	197	5
35	5	5	* *	* *	5
36	5	5	143	174	5
37	5	5	243	n/a	5
38	5	5	261	425	5
39	5	5	277	419	5
40	5	5	282	447	5

* = all housings were zinc plated

** = old housing in the way

Retroreflectometers

Form Filled Out By : R. wray

Date: 10/24/2001

= Meter 214

= Meter 208

Raised Pavement Marker Ratings

I-97 Test Deck

NTPEP # RPM (2001 MD) - 3 **Avery- Dennison Corp.** **Stimsonite Model 101**

Installed: 10/3/2001 by Highway Safety Services from milepoint 9.34 to 9.41

Marker No.	Housing*	Lens	Dirty Reading (mcd/lux)	Clean Reading (mcd/lux)	Night Visability
1	5	5	358	n/a	5
2	5	5	383	413	5
3	5	5	* *	* *	5
4	5	5	333	412	5
5	5	5	284	n/a	5
6	5	5	265	367	5
7	5	5	316	378	5
8	5	5	260	350	5
9	5	5	375	n/a	5
10	5	5	452	563	5
11	5	5	321	448	5
12	5	5	410	558	5
13	5	5	374	n/a	5
14	5	5	248	290	5
15	5	5	215	288	5
16	5	5	264	407	5
17	5	5	335	n/a	5
18	5	5	289	348	5
19	5	5	341	442	5
20	5	5	409	429	5
21	5	5	203	n/a	5
22	5	5	183	234	5
23	5	5	316	451	5
24	5	5	267	426	5
25	5	5	289	n/a	5
26	5	5	300	316	5
27	5	5	222	395	5
28	5	5	258	281	5
29	5	5	278	n/a	5
30	5	5	390	455	5
31	5	5	241	304	5
32	5	5	329	474	5
33	5	5	343	n/a	5
34	5	5	457	641	5
35	5	5	316	449	5
36	5	5	449	598	5
37	5	5	285	n/a	5
38	5	5	384	479	5
39	5	5	344	431	5
40	5	5	237	295	5

* = several housings were not flush with the paver

**= old housng as in way

Retroreflectometers

Form Filled Out By : R. wray

Date: 10/24/2001

= Meter 214

= Meter 208

Raised Pavement Marker Ratings

I-97 Test Deck

NTPEP # RPM (2001 MD) - 4 **Avery- Dennison Corp.** **Stimsonite Model 96**

Installed: 10/4/2001 by Midlantic Marketing Co. from milepoint 9.43 to 9.50

Marker No.	Housing	Lens	Dirty Reading (mcd/lux)	Clean Reading (mcd/lux)	Night Visability
1	5	5	57 *	n/a	5
2	5	5	370	453	5
3	5	5	261	278	5
4	5	5	541	630	5
5	5	5	315	n/a	5
6	5	5	300	455	5
7	5	5	263	455	5
8	5	5	227	322	5
9	5	5	367	n/a	5
10	5	5	184	330	5
11	5	5	* *	* *	5
12	5	5	307	329	5
13	5	5	257	n/a	5
14	5	5	229	378	5
15	5	5	156	228	5
16	5	5	231	315	5
17	5	5	420	n/a	5
18	5	5	422	594	5
19	5	5	* *	* *	5
20	5	5	401	486	5
21	5	5	280	n/a	5
22	5	5	322	412	5
23	5	5	327	448	5
24	5	5	138	156	5
25	5	5	241	n/a	5
26	5	5	268	318	5
27	5	5	* *	* *	5
28	5	5	225	236	5
29	5	5	272	n/a	5
30	5	5	381	479	5
31	5	5	275	388	5
32	5	5	289	488	5
33	5	5	197	n/a	5
34	5	5	218	280	5
35	5	5	320	359	5
36	5	5	305	364	5
37	5	5	279	n/a	5
38	5	5	363	499	5
39	5	5	334	532	5
40	5	5	217	395	5

* = housing installed too deep

** = old housing in way

Form Filled Out By : R. wray

Date: 10/24/2001

Retroreflectometers

= Meter 214

= Meter 208

Raised Pavement Marker Ratings

I-97 Test Deck

NTPEP # RPM (2001 MD) - 5 **Hallen Products, Ltd.** **Ironstar** **1W664**

Installed: 10/3/2001 by Highway Safety Services from milepoint 9.52 to 9.59

Marker No.	Housing*	Lens	Dirty Reading (mcd/lux)	Clean Reading (mcd/lux)	Night Visability
1	5	5	177	n/a	5
2	5	5	254	291	5
3	5	5	181	185	5
4	5	5	169	215	5
5	5	5	197	n/a	5
6	5	5	234	327	5
7	5	5	254	484	5
8	5	5	286	413	5
9	5	5	151	n/a	5
10	5	5	243	288	5
11	5	5	218	237	5
12	5	5	167	207	5
13	5	5	263	n/a	5
14	5	5	317	570	5
15	5	5	308	534	5
16	5	5	379	511	5
17	5	5	125	n/a	5
18	5	5	145	185	5
19	5	5	156	241	5
20	5	5	168	207	5
21	5	5	244	n/a	5
22	5	5	311	406	5
23	5	5	318	428	5
24	5	5	237	338	5
25	5	5	150	n/a	5
26	5	5	186	254	5
27	5	5	143	242	5
28	5	5	289	334	5
29	5	5	227	n/a	5
30	5	5	204	290	5
31	5	5	243	303	5
32	5	5	238	391	5
33	5	5	154	n/a	5
34	5	5	185	285	5
35	5	5	236	388	5
36	5	5	179	222	5
37	5	5	283	n/a	5
38	5	5	267	445	5
39	5	5	232	294	5
40	5	5	229	351	5

* = all housings were zinc plated

Retroreflectometers

Form Filled Out By : R. wray

Date: 10/24/2001

= Meter 214

= Meter 208

Raised Pavement Marker Ratings

I-97 Test Deck

NTPEP # RPM (2001 MA) 6 **Astucia(UK), Ltd.** **Astucia Intelligent Flush Stud** **F-Series ND**

Installed: 10/5/2001 by Statewide Striping from milepoint 9.61 to 9.68

Marker No.	Housing	Lens	Dirty Reading* (mcd/lux)	Clean Reading* (mcd/lux)	Night Visability
1	5	5	n/a	n/a	5
2	5	5	n/a	n/a	5
3	5	5	n/a	n/a	5
4	5	5	n/a	n/a	5
5	5	5	n/a	n/a	5
6	5	5	n/a	n/a	5
7	5	5	n/a	n/a	5
8	5	5	n/a	n/a	5
9	5	5	n/a	n/a	5
10	5	5	n/a	n/a	5
11	5	5	n/a	n/a	5
12	5	5	n/a	n/a	5
13	5	5	n/a	n/a	5
14	5	5	n/a	n/a	5
15	5	5	n/a	n/a	5
16	5	5	n/a	n/a	5
17	5	5	n/a	n/a	5
18	5	5	n/a	n/a	5
19	5	5	n/a	n/a	5
20	5	5	n/a	n/a	5
21	5	5	n/a	n/a	5
22	5	5	n/a	n/a	5
23	5	5	n/a	n/a	5
24	5	5	n/a	n/a	5
25	5	5	n/a	n/a	5
26	5	5	n/a	n/a	5
27	5	5	n/a	n/a	5
28	5	5	n/a	n/a	5
29	5	5	n/a	n/a	5
30	5	5	n/a	n/a	5
31	5	5	n/a	n/a	5
32	5	5	n/a	n/a	5
33	5	5	n/a	n/a	5
34	5	5	n/a	n/a	5
35	5	5	n/a	n/a	5
36	5	5	n/a	n/a	5
37	5	5	n/a	n/a	5
38	5	5	n/a	n/a	5
39	5	5	n/a	n/a	5
40	5	5	n/a	n/a	5

* = RPM's not compatible with current reflectivity measuring equipment

Retroreflectometers

Form Filled Out By : R. wray

Date: 10/24/2001

= Meter 214

= Meter 208

Raised Pavement Marker Ratings

I-97 Test Deck

NTPEP # RPM (2001 MD) - 7 Nightline Markers, Inc. **NightLine** **B-400**

Installed: 10/5/2001 by Priceless Industries from milepoint 9.70 to 9.77

Marker No.	Housing	Lens	Dirty Reading (mcd/lux)	Clean Reading (mcd/lux)	Night Visability
1	5	5	258	n/a	5
2	5	5	478	618	5
3	5	5	490	553	5
4	5	5	457	564	5
5	5	5	278	n/a	5
6	5	5	331	443	5
7	5	5	327	470	5
8	5	5	288	440	5
9	5	5	348	n/a	5
10	5	5	204	234	5
11	5	5	417	485	5
12	5	5	182	201	5
13	5	5	324	n/a	5
14	5	5	277	450	5
15	5	5	452	862	5
16	5	5	262	289	5
17	5	5	371	n/a	5
18	5	5	267	300	5
19	5	5	227	297	5
20	5	5	130	151	5
21	5	5	300	n/a	5
22	5	5	373	585	5
23	5	5	366	580	5
24	5	5	378	732	5
25	5	5	283	n/a	5
26	5	5	459	544	5
27	5	5	241	264	5
28	5	5	225	326	5
29	5	5	270	n/a	5
30	5	5	320	556	5
31	5	5	239	385	5
32	5	5	253	437	5
33	5	5	146	n/a	5
34	5	5	405	548	5
35	5	5	400	436	5
36	5	5	142	177	5
37	5	5	539	n/a	5
38	5	5	269	388	5
39	5	5	409	552	5
40	5	5	269	391	5

Retroreflectometers

Form Filled Out By : R. wray

Date: 10/24/2001

= Meter 214

= Meter 208

Raised Pavement Marker Ratings

I-97 Test Deck

NTPEP # RPM (2001 MD) - 8 Pac-Tec, In **Ray-O-Lite** **Snow-Lite Model 100**

Installed: 10/3/2001 by Priceless Industries from milepoint 9.79 to 9.86

Marker No.	Housing*	Lens	Dirty Reading (mcd/lux)	Clean Reading (mcd/lux)	Night Visability
1	5	5	91	n/a	5
2	5	5	209	363	5
3	5	5	114	135	5
4	5	5	118	120	5
5	5	5	107	n/a	5
6	5	5	153	212	5
7	5	5	117	148	5
8	5	5	188	227	5
9	5	5	176	n/a	5
10	5	5	145	152	5
11	5	5	224	263	5
12	5	5	163	232	5
13	5	5	139	n/a	5
14	5	5	158	177	5
15	5	5	257	369	5
16	5	5	129	183	5
17	5	5	132	n/a	5
18	5	5	135	157	5
19	5	5	134	145	5
20	5	5	125	244	5
21	5	5	128	n/a	5
22	5	5	182	270	5
23	5	5	113	115	5
24	5	5	78	114	5
25	5	5	82	n/a	5
26	5	5	97	107	5
27	5	5	*	*	5
28	5	5	179	191	5
29	5	5	136	n/a	5
30	5	5	135	204	5
31	5	5	88	123	5
32	5	5	95	97	5
33	5	5	133	n/a	5
34	5	5	146	168	5
35	5	5	*	*	5
36	5	5	170	209	5
37	5	5	212	n/a	5
38	5	5	225	259	5
39	5	5	132	149	5
40	5	5	123	144	5

* = old housing was in the way

Retroreflectometers

Form Filled Out By : R. wray

Date: 10/24/2001

= Meter 214

= Meter 208

Raised Pavement Marker Ratings

MD 100 Test Deck

NTPEP # RPM (2001 MD) - 2 3M Com **3m Series 190 Marker** **190 - H960HP**

Installed: 10/3/2001 by Priceless Industries from milepoint 4.92 to 4.99

Marker No.	Housing*	Lens	Dirty Reading (mcd/lux)	Clean Reading (mcd/lux)	Night Visability
1	5	5	162	n/a	5
2	5	5	252	343	5
3	5	5	217	331	5
4	5	5	174	289	5
5	5	5	234	n/a	5
6	5	5	208	263	5
7	5	5	183	251	5
8	5	5	139	185	5
9	5	5	224	n/a	5
10	5	5	139	166	5
11	5	5	200	353	5
12	5	5	190	306	5
13	5	5	252	n/a	5
14	5	5	222	419	5
15	5	5	188	320	5
16	5	5	244	306	5
17	5	5	171	n/a	5
18	5	5	194	234	5
19	5	5	196	248	5
20	5	5	237	267	5
21	5	5	232	n/a	5
22	5	5	149	190	5
23	5	5	226	303	5
24	5	5	273	363	5
25	5	5	243	n/a	5
26	5	5	208	259	5
27	5	5	212	313	5
28	5	5	274	434	5
29	5	5	284	n/a	5
30	5	5	244	355	5
31	5	5	235	303	5
32	5	5	237	402	5
33	5	5	190	n/a	5
34	5	5	231	312	5
35	5	5	193	269	5
36	5	5	203	244	5
37	5	5	240	n/a	5
38	5	5	272	323	5
39	5	5	249	286	5
40	5	5	242	307	5

* = all housings were zinc plated

Retroreflectometers

Form Filled Out By : R. Wray

Date: 11/13/2001

= Meter 214

= Meter 208

Raised Pavement Marker Ratings

MD 100 Test Deck

NTPEP # RPM (2001 MD) - 3 **Avery- Dennison Corp.** **Stimsonite Model 101**

Installed: 10/3/2001 by Highway Safety Services from milepoint 5.01 to 5.08

Marker No.	Housing*	Lens	Dirty Reading (mcd/lux)	Clean Reading (mcd/lux)	Night Visability
1	5	5	123	n/a	5
2	5	5	202	498	5
3	5	5	205	283	5
4	5	5	345	428	5
5	5	5	389	n/a	5
6	5	5	243	288	5
7	5	5	270	369	5
8	5	5	273	361	5
9	5	5	111	n/a	5
10	5	5	268	358	5
11	5	5	248	392	5
12	5	5	222	314	5
13	5	5	252	n/a	5
14	5	5	246	354	5
15	5	5	289	355	5
16	5	5	285	411	5
17	5	5	203	n/a	5
18	5	5	215	233	5
19	5	5	258	289	5
20	5	5	227	235	5
21	5	5	252	n/a	5
22	5	5	266	396	5
23	5	5	222	361	5
24	5	5	266	346	5
25	5	5	205	n/a	5
26	5	5	283	317	5
27	5	5	175	208	5
28	5	5	266	281	5
29	5	5	251	n/a	5
30	5	5	180	249	5
31	5	5	267	441	5
32	5	5	218	318	5
33	5	5	301	n/a	5
34	5	5	190	297	5
35	5	5	155	227	5
36	5	5	249	279	5
37	5	5	228	n/a	5
38	5	5	195	306	5
39	5	5	222	357	5
40	5	5	281	382	5

* = several housings were not flush with the

Retroreflectometers

Form Filled Out By : R. Wray

Date: 11/13/2001

= Meter 214

= Meter 208

Raised Pavement Marker Ratings

MD 100 Test Deck

NTPEP # RPM (2001 MD) - 4 **Avery- Dennison Corp.** **Stimsonite Model 96**

Installed: 10/4/2001 by Midlantic Marketing Co. from milepoint 5.10 to 5.17

Marker No.	Housing	Lens	Dirty Reading (mcd/lux)	Clean Reading (mcd/lux)	Night Visability
1	5	5	198	n/a	5
2	5	5	205	352	5
3	5	5	218	297	5
4	5	5	217	279	5
5	5	5	171	n/a	5
6	5	5	290	422	5
7	5	5	250	350	5
8	5	5	246	307	5
9	5	5	199	n/a	5
10	5	5	214	250	5
11	5	5	128	167	5
12	5	5	265	382	5
13	5	5	141	n/a	5
14	5	5	228	296	5
15	5	5	205	298	5
16	5	5	241	392	5
17	5	5	195	n/a	5
18	5	5	190	316	5
19	5	5	118	205	5
20	5	5	151	176	5
21	5	5	147	n/a	5
22	5	5	235	302	5
23	5	5	197	311	5
24	5	5	235	352	5
25	5	5	145	n/a	5
26	5	5	204	245	5
27	5	5	221	320	5
28	5	5	187	299	5
29	5	5	67	n/a	5
30	5	5	197	304	5
31	5	5	320	495	5
32	5	5	269	384	5
33	5	5	265	n/a	5
34	5	5	219	365	5
35	5	5	203	321	5
36	5	5	196	264	5
37	5	5	187	n/a	5
38	5	5	228	303	5
39	5	5	231	323	5
40	5	5	148	183	5

Retroreflectometers

Form Filled Out By : R. Wray

Date: 11/13/2001

= Meter 214

= Meter 208

Raised Pavement Marker Ratings

MD 100 Test Deck

NTPEP # RPM (2001 MD) - 5 **Hallen Products, Ltd.** **Ironstar** **1W664**

Installed: 10/3/2001 by Highway Safety Services from milepoint 5.19 to 5.26

Marker No.	Housing*	Lens	Dirty Reading (mcd/lux)	Clean Reading (mcd/lux)	Night Visability
1	5	5	234	n/a	5
2	5	5	221	347	5
3	5	5	236	319	5
4	5	5	307	543	5
5	5	5	280	n/a	5
6	5	5	197	227	5
7	5	5	297	452	5
8	5	5	188	267	5
9	5	5	279	n/a	5
10	5	5	165	339	5
11	5	5	189	209	5
12	5	5	368	594	5
13	5	5	154	n/a	5
14	5	5	234	274	5
15	5	5	201	294	5
16	5	5	209	229	5
17	5	5	246	n/a	5
18	5	5	320	420	5
19	5	5	229	286	5
20	5	5	170	217	5
21	5	5	225	n/a	5
22	5	5	271	320	5
23	5	5	133	132	5
24	5	5	205	220	5
25	5	5	186	n/a	5
26	5	5	167	139	5
27	5	5	219	270	5
28	5	5	236	218	5
29	5	5	266	n/a	5
30	5	5	239	311	5
31	5	5	161	239	5
32	5	5	144	213	5
33	5	5	225	n/a	5
34	5	5	224	331	5
35	5	5	240	332	5
36	5	5	240	353	5
37	5	5	219	n/a	5
38	5	5	144	199	5
39	5	5	196	247	5
40	5	5	241	342	5

* = all housings were zinc plated

Retroreflectometers

Form Filled Out By : R. Wray

Date: 10/17/2001

= Meter 214

= Meter 208

Raised Pavement Marker Ratings

MD 100 Test Deck

NTPEP # RPM (2001MD2a) Astucia (UK), Ltd. **Astucia Intelligent Flush Stud** **F-Series ND**

Installed: 10/4/2001 by Statewide Striping from milepoint 5.28 to 5.35

Marker No.	Housing	Lens	Dirty Reading* (mcd/lux)	Clean Reading* (mcd/lux)	Night Visability
1	5	5	n/a	n/a	5
2	5	5	n/a	n/a	5
3	5	5	n/a	n/a	5
4	5	5	n/a	n/a	5
5	5	5	n/a	n/a	5
6	5	5	n/a	n/a	5
7	5	5	n/a	n/a	5
8	5	5	n/a	n/a	5
9	5	5	n/a	n/a	5
10	5	5	n/a	n/a	5
11	5	5	n/a	n/a	5
12	5	5	n/a	n/a	5
13	5	5	n/a	n/a	5
14	5	5	n/a	n/a	5
15	5	5	n/a	n/a	5
16	5	5	n/a	n/a	5
17	5	5	n/a	n/a	5
18	5	5	n/a	n/a	5
19	5	5	n/a	n/a	5
20	5	5	n/a	n/a	5
21	5	5	n/a	n/a	5
22	5	5	n/a	n/a	5
23	5	5	n/a	n/a	5
24	5	5	n/a	n/a	5
25	5	5	n/a	n/a	5
26	5	5	n/a	n/a	5
27	5	5	n/a	n/a	5
28	5	5	n/a	n/a	5
29	5	5	n/a	n/a	5
30	5	5	n/a	n/a	5
31	5	5	n/a	n/a	5
32	5	5	n/a	n/a	5
33	5	5	n/a	n/a	5
34	5	5	n/a	n/a	5
35	5	5	n/a	n/a	5
36	5	5	n/a	n/a	5
37	5	5	n/a	n/a	5
38	5	5	n/a	n/a	5
39	5	5	n/a	n/a	5
40	5	5	n/a	n/a	5

* = RPM's not compatible with current reflectivity measuring equipment

Retroreflectometers

Form Filled Out By : R. Wray

Date: 10/17/2001

= Meter 214

= Meter 208

Raised Pavement Marker Ratings

MD 100 Test Deck

NTPEP # RPM (2001 MD) - 7 Nightline Markers, Inc. **NightLine** **B-400**

Installed: 10/4/2001 by Priceless Industries from milepoint 5.38 to 5.45

Marker No.	Housing	Lens	Dirty Reading (mcd/lux)	Clean Reading (mcd/lux)	Night Visability
1	5	5	230	n/a	5
2	5	5	332	578	5
3	5	5	332	724	5
4	5	5	188	354	5
5	5	5	300	n/a	5
6	5	5	274	542	5
7	5	5	255	596	5
8	5	5	298	591	5
9	5	5	225	n/a	5
10	5	5	370	685	5
11	5	5	301	511	5
12	5	5	278	487	5
13	5	5	547	n/a	5
14	5	5	322	512	5
15	5	5	341	550	5
16	5	5	362	679	5
17	5	5	303	n/a	5
18	5	5	253	340	5
19	5	5	187	222	5
20	5	5	289	460	5
21	5	5	326	n/a	5
22	5	5	265	371	5
23	5	5	110	470	5
24	5	5	416	790	5
25	5	5	458	n/a	5
26	5	5	389	584	5
27	5	5	347	429	5
28	5	4 *	65	146	5
29	5	5	310	n/a	5
30	5	5	449	820	5
31	5	5	498	912	5
32	5	5	348	724	5
33	5	5	252	n/a	5
34	5	5	390	572	5
35	5	5	302	560	5
36	5	5	375	614	5
37	5	5	241	n/a	5
38	5	5	404	668	5
39	5	5	290	513	5
40	5	5	500	936	5

* scratched surface

Retroreflectometers

Form Filled Out By : R. Wray

Date: 10/17/2001

= Meter 214

= Meter 208

Raised Pavement Marker Ratings

MD 100 Test Deck

NTPEP # RPM (2001 MD) - 8 Pac-Tec, **Ray-O-Lite** **Snow-Lite Model 100**

Installed: 10/3/2001 by Priceless Industries from milepoint 5.47 to 5.54

Marker No.	Housing*	Lens	Dirty Reading (mcd/lux)	Clean Reading (mcd/lux)	Night Visability
1	5	5	171	n/a	5
2	5	5	235	381	5
3	5	5	203	324	5
4	5	5	199	298	5
5	5	5	209	n/a	5
6	5	5	126	177	5
7	5	5	161	271	5
8	5	5	170	273	5
9	5	5	96	n/a	5
10	5	5	202	329	5
11	5	5	226	328	5
12	5	5	133	213	5
13	5	5	142	n/a	5
14	5	5	124	324	5
15	5	5	135 *	184 *	5
16	5	5	146	278	5
17	5	5	143	n/a	5
18	5	5	145	283	5
19	5	5	158	288	5
20	5	5	129	203	5
21	5	5	165	n/a	5
22	5	5	247	436	5
23	5	5	246	428	5
24	5	5	233	420	5
25	5	5	115	n/a	5
26	5	5	186	332	5
27	5	5	104	159	5
28	5	5	162	268	5
29	5	5	175	n/a	5
30	5	5	159	300	5
31	5	5	187	284	5
32	5	5	153	288	5
33	5	5	142	n/a	5
34	5	5	104	152	5
35	5	5	129	261	5
36	5	5	244	371	5
37	5	5	166	n/a	5
38	5	5	147	240	5
39	5	5	176	269	5
40	5	5	96	170	5

* = old housing was partially in the way

Retroreflectometers

Form Filled Out By : R. Wray

Date: 10/17/2001

= Meter 214

= Meter 208

6 Months Readings

Raised Pavement Marker Ratings

I-97 Test Deck

NTPEP # RPM (2001 MD) - 2 **3M Compa** **3m Series 190 Marker** **190 - H960HP**

Installed: 10/4/2001 by Priceless Industries from milepoint 9.25 to 9.32

Marker No.	Housing*	Lens	Dirty Reading (mcd/lux)	Clean Reading (mcd/lux)	Night Visability
1	3	4	157	n/a	5
2	4	4	21	215	5
3	4	5	89	115	5
4	4	4	165	234	5
5	4	5	181	n/a	5
6	4	5	123	227	5
7	4	5	134	160	5
8	4	5	163	237	5
9	4	4	131	n/a	5
10	4	5	107	149	5
11	4	5	107	112	5
12	4	2	160	247	5
13	4	5	107	n/a	5
14	4	5	117	215	5
15	4	5	136	229	5
16	4	4	151	222	5
17	4	5	76	n/a	5
18	4	4	94	132	5
19	5	5	166	154	5
20	3	4	146	176	5
21	4	5	136	n/a	5
22	4	5	142	236	5
23	4	5	126	237	5
24	4	4	158	266	5
25	2	5	170	n/a	5
26	4	3	135	178	5
27	5	4	141	199	5
28	5	5	165	175	5
29	4	4	154	n/a	5
30	4	5	169	296	5
31	4	5	109	219	5
32	4	5	120	270	5
33	3	4	118	n/a	5
34	5	3	58	62	5
35	5	5	21	21	4
36	3	3	49	51	5
37	4	5	125	n/a	5
38	4	5	149	219	5
39	4	5	150	229	5
40	4	5	146	213	5

* = all housings were zinc plated

** = old housing in the way

Retroreflectometers

Form Filled Out By : R. wray

Date: 4/15/2002

= Meter 214

= Meter 208

Raised Pavement Marker Ratings

I-97 Test Deck

NTPEP # RPM (2001 MD) - 3 **Avery- Dennison Corp.** **Stimsonite Model 101**

Installed: 10/3/2001 by Highway Safety Services from milepoint 9.34 to 9.41

Marker No.	Housing*	Lens	Dirty Reading (mcd/lux)	Clean Reading (mcd/lux)	Night Visability
1	5	5	237	n/a	5
2	5	5	280	334	5
3	5	4	70	79	5
4	5	5	188	191	5
5	4	4	363	n/a	5
6	4	4	216	369	5
7	4	4	242	356	5
8	4	4	192	249	5
9	5	1	266	n/a	3
10	5	3	252	327	5
11	5	4	161	232	5
12	5	4	234	380	5
13	4	4	332	n/a	5
14	4	5	228	288	5
15	4	5	158	225	5
16	4	5	241	402	5
17	5	5	169	n/a	5
18	4	4	159	230	5
19	5	5	156	156	5
20	5	5	262	244	5
21	4	5	139	n/a	5
22	4	4	115	189	5
23	4	5	223	402	5
24	4	5	225	350	5
25	5	5	148	n/a	5
26	5	4	178	20	5
27	5	4	64	107	5
28	5	5	88	139	5
29	4	5	207	n/a	5
30	4	5	256	353	5
31	4	5	163	206	5
32	4	4	201	298	5
33	5	4	218	n/a	5
34	5	5	274	322	5
35	4	4	179	174	5
36	5	4	141	157	5
37	4	5	225	n/a	5
38	4	5	304	390	5
39	4	5	240	323	5
40	4	4	175	321	5

* = several housings were not flush with the paven

**= old housng as in way

Retroreflectometers

Form Filled Out By : R. wray

Date: 4/15/2002

= Meter 214

= Meter 208

Raised Pavement Marker Ratings

I-97 Test Deck

NTPEP # RPM (2001 MD) - 4 **Avery- Dennison Corp.** **Stimsonite Model 96**

Installed: 10/4/2001 by Midlantic Marketing Co. from milepoint 9.43 to 9.50

Marker No.	Housing	Lens	Dirty Reading (mcd/lux)	Clean Reading (mcd/lux)	Night Visability
1	5	5	32	n/a	5
2	5	5	210	289	5
3	5	4	150	155	5
4	5	5	270	406	5
5	4	4	183	n/a	5
6	4	4	235	428	5
7	4	5	208	474	5
8	4	5	229	391	5
9	5	4	220	n/a	5
10	5	5	183	175	5
11	5	4	47	61	5
12	4	5	230	325	5
13	4	5	202	n/a	5
14	4	5	192	399	5
15	4	5	138	383	5
16	4	5	235	350	5
17	4	5	295	n/a	5
18	5	4	233	259	5
19	5	5	21	21	5
20	4	4	186	210	5
21	4	5	260	n/a	5
22	4	2	204	329	5
23	4	5	255	485	5
24	4	5	98	164	5
25	4	1	82	n/a	4
26	5	5	167	216	5
27	4	2	45	36	5
28	5	4	137	155	5
29	4	5	164	n/a	3
30	4	5	218	426	5
31	4	4	220	392	5
32	4	5	188	332	5
33	4	5	115	n/a	5
34	5	4	146	146	5
35	5	5	148	140	5
36	4	4	195	240	5
37	4	4	282	n/a	5
38	4	5	309	413	5
39	3	5	320	486	5
40	4	5	181	325	5

* = housing installed too deep

** = old housing in way

Retroreflectometers

Form Filled Out By : R. wray

Date: 4/15/2002

= Meter 214

= Meter 208

Raised Pavement Marker Ratings

I-97 Test Deck

NTPEP # RPM (2001 MD) - 5 **Hallen Products, Ltd.** **Ironstar** **1W664**

Installed: 10/3/2001 by Highway Safety Services from milepoint 9.52 to 9.59

Marker No.	Housing*	Lens	Dirty Reading (mcd/lux)	Clean Reading (mcd/lux)	Night Visability
1	4	5	82	n/a	5
2	4	4	63	90	5
3	3	4	60	71	5
4	4	4	80	58	5
5	4	4	99	n/a	5
6	4	5	108	219	5
7	3	4	148	287	5
8	3	3	154	288	5
9	4	4	54	n/a	5
10	4	5	119	104	5
11	3	3	79	84	5
12	3	3	89	85	5
13	3	5	113	n/a	5
14	3	5	146	361	5
15	4	5	98	316	5
16	3	5	145	278	5
17	4	4	47	n/a	5
18	4	5	81	75	5
19	5	4	80	91	5
20	3	4	41	59	5
21	4	4	141	n/a	5
22	3	5	123	202	5
23	4	5	184	316	5
24	3	5	126	238	5
25	4	4	59	n/a	5
26	3	4	103	87	5
27	3	3	82	81	5
28	3	4	105	117	5
29	4	5	148	n/a	5
30	4	5	105	139	5
31	3	3	129	197	5
32	3	3	136	231	5
33	4	4	77	n/a	5
34	4	4	116	169	5
35	4	4	136	185	5
36	4	5	86	101	5
37	3	5	159	n/a	5
38	4	5	190	258	5
39	3	4	123	190	5
40	4	5	128	172	5

* = all housings were zinc plated

Retroreflectometers

Form Filled Out By : R. wray

Date: 4/15/2002

= Meter 214

= Meter 208

Raised Pavement Marker Ratings

I-97 Test Deck

NTPEP # RPM (2001 MD) 6 **Astucia(UK), Ltd.** **Astucia Intelligent Flush Stud** **F-Series ND**

Installed: 10/5/2001 by Statewide Striping from milepoint 9.61 to 9.68

Marker No.	Housing	Lens	Dirty Reading* (mcd/lux)	Clean Reading* (mcd/lux)	Night Visability
1	5	4	n/a	n/a	3
2	5	4	n/a	n/a	3
3	5	4	n/a	n/a	3
4	5	4	n/a	n/a	3
5	5	4	n/a	n/a	3
6	5	4	n/a	n/a	3
7	5	4	n/a	n/a	3
8	5	4	n/a	n/a	0
9	5	4	n/a	n/a	4
10	5	4	n/a	n/a	4
11	5	4	n/a	n/a	4
12	5	4	n/a	n/a	4
13	5	4	n/a	n/a	4
14	5	4	n/a	n/a	4
15	5	4	n/a	n/a	4
16	5	4	n/a	n/a	4
17	5	4	n/a	n/a	4
18	5	4	n/a	n/a	4
19	5	4	n/a	n/a	4
20	5	5	n/a	n/a	4
21	5	4	n/a	n/a	4
22	5	4	n/a	n/a	n/a
23	5	4	n/a	n/a	n/a
24	n/a	n/a	n/a	n/a	n/a
25	n/a	n/a	n/a	n/a	n/a
26	n/a	n/a	n/a	n/a	n/a
27	n/a	n/a	n/a	n/a	n/a
28	n/a	n/a	n/a	n/a	n/a
29	n/a	n/a	n/a	n/a	n/a
30	n/a	n/a	n/a	n/a	n/a
31	n/a	n/a	n/a	n/a	n/a
32	n/a	n/a	n/a	n/a	n/a
33	n/a	n/a	n/a	n/a	n/a
34	n/a	n/a	n/a	n/a	n/a
35	n/a	n/a	n/a	n/a	n/a
36	n/a	n/a	n/a	n/a	n/a
37	n/a	n/a	n/a	n/a	n/a
38	n/a	n/a	n/a	n/a	n/a
39	n/a	n/a	n/a	n/a	n/a
40	n/a	n/a	n/a	n/a	n/a

* = RPM's not compatible with current reflectivity measuring equipment

Retroreflectometers

Form Filled Out By : R. wray

Date: 4/15/2002

= Meter 214

= Meter 208

Raised Pavement Marker Ratings

I-97 Test Deck

NTPEP # RPM (2001 MD) - 7 **Nightline Markers, Inc.** **NightLine** **B-400**

Installed: 10/5/2001 by Priceless Industries from milepoint 9.70 to 9.77

Marker No.	Housing	Lens	Dirty Reading (mcd/lux)	Clean Reading (mcd/lux)	Night Visability
1	5	4	137	n/a	5
2	4	4	215	317	5
3	5	4	268	364	5
4	5	4	91	138	5
5	4	3	122	n/a	5
6	4	3	187	351	5
7	5	5	191	278	5
8	4	5	199	257	5
9	5	5	119	n/a	5
10	5	4	66	77	5
11	5	4	153	176	5
12	5	3	81	96	5
13	5	5	220	n/a	5
14	4	2	109	133	5
15	4	5	311	529	5
16	4	4	231	388	5
17	5	3	109	n/a	5
18	4	4	188	202	5
19	5	4	102	105	5
20	5	4	132	153	5
21	4	5	192	n/a	5
22	4	5	305	405	5
23	4	4	398	511	5
24	4	4	258	352	5
25	4	4	190	n/a	5
26	5	5	236	332	5
27	5	4	148	132	5
28	5	4	119	169	5
29	4	4	251	n/a	5
30	5	4	216	240	5
31	5	4	177	252	5
32	5	4	175	220	5
33	5	4	82	n/a	5
34	5	4	145	278	5
35	5	4	98	121	5
36	5	4	134	130	5
37	4	4	285	n/a	5
38	5	4	190	255	5
39	4	3	272	358	5
40	4	4	183	357	5

Retroreflectometers

Form Filled Out By : R. wray

Date: 4/15/2002

= Meter 214

= Meter 208

Raised Pavement Marker Ratings

I-97 Test Deck

NTPEP # RPM (2001 MD) - 8 **Pac-Tec, Ir** **Ray-O-Lite** **Snow-Lite Model 100**

Installed: 10/3/2001 by Priceless Industries from milepoint 9.79 to 9.86

Marker No.	Housing*	Lens	Dirty Reading (mcd/lux)	Clean Reading (mcd/lux)	Night Visability
1	5	3	37	n/a	4
2	5	5	37	29	4
3	5	5	37	26	4
4	4	4	47	50	4
5	5	2	44	n/a	4
6	5	4	60	132	4
7	5	4	43	110	4
8	4	4	79	147	4
9	5	5	57	n/a	4
10	5	4	32	33	4
11	5	4	36	38	4
12	5	4	31	30	4
13	4	4	51	n/a	4
14	5	4	59	92	4
15	4	4	87	164	4
16	4	4	50	86	4
17	5	4	34	n/a	4
18	5	5	38	39	4
19	5	5	51	37	4
20	5	4	35	38	4
21	5	4	74	n/a	4
22	5	4	77	136	4
23	4	2	35	42	3
24	5	4	58	86	4
25	5	4	25	n/a	4
26	5	5	29	30	4
27	5	5	21*	21*	4
28	5	4	51	56	4
29	5	4	74	n/a	4
30	5	4	77	174	4
31	5	5	59	99	4
32	4	4	59	96	4
33	5	4	32	n/a	4
34	5	4	43	46	4
35	5	4	21*	21*	4
36	5	5	52	56	4
37	4	5	93	n/a	4
38	4	4	93	141	4
39	4	5	61	109	4
40	4	4	52	116	4

* = old housing was in the way

Retroreflectometers

Form Filled Out By : R. wray

Date: 4/15/2002

= Meter 214

= Meter 208

Raised Pavement Marker Ratings

MD 100 Test Deck

NTPEP # RPM (2001 MD) - 2 3M Com **3m Series 190 Marker** **190 - H960HP**

Installed: 10/3/2001 by Priceless Industries from milepoint 4.92 to 4.99

Marker No.	Housing*	Lens	Dirty Reading (mcd/lux)	Clean Reading (mcd/lux)	Night Visability
1	5	5	102	n/a	5
2	5	4	143	200	5
3	5	4	146	179	5
4	5	4	144	165	5
5	4	3	116	n/a	5
6	4	5	164	232	5
7	4	5	157	180	5
8	4	5	122	157	5
9	5	4	149	n/a	5
10	5	4	69	77	5
11	5	4	178	184	5
12	4	4	98	141	5
13	4	5	206	n/a	5
14	4	4	188	268	5
15	4	5	160	163	5
16	4	5	142	223	5
17	5	4	149	n/a	5
18	4	4	118	116	5
19	4	4	136	153	5
20	5	4	196	216	5
21	4	5	264	n/a	5
22	4	5	142	170	5
23	4	5	257	295	5
24	4	4	267	334	5
25	5	4	200	n/a	5
26	4	4	158	229	5
27	5	4	193	219	5
28	4	4	284	313	5
29	4	5	317	n/a	5
30	4	5	252	317	5
31	4	5	260	339	5
32	4	5	278	330	5
33	4	3	167	n/a	5
34	5	4	194	226	5
35	4	4	184	199	4
36	5	5	169	186	5
37	4	4	240	n/a	5
38	4	5	194	234	5
39	4	5	170	196	5
40	4	5	221	282	5

* = all housings were zinc plated

Retroreflectometers

Form Filled Out By : R. Wray

Date: 4/15/2002

= Meter 214

= Meter 208

Raised Pavement Marker Ratings

MD 100 Test Deck

NTPEP # RPM (2001 MD) - 3 **Avery- Dennison Corp.** **Stimsonite Model 101**

Installed: 10/3/2001 by Highway Safety Services from milepoint 5.01 to 5.08

Marker No.	Housing*	Lens	Dirty Reading (mcd/lux)	Clean Reading (mcd/lux)	Night Visability
1	5	5	53	n/a	5
2	5	4	204	218	5
3	5	5	107	117	5
4	5	4	357	397	5
5	4	5	376	n/a	5
6	4	5	202	260	5
7	4	5	246	283	5
8	4	5	202	248	5
9	5	5	29	n/a	3
10	4	3	193	219	5
11	4	4	198	225	5
12	5	4	156	192	5
13	5	5	260	n/a	5
14	4	5	289	430	5
15	4	5	240	295	5
16	4	5	253	304	5
17	5	4	206	n/a	5
18	5	5	216	240	5
19	5	5	270	259	5
20	5	5	237	252	5
21	4	5	220	n/a	5
22	4	5	207	270	5
23	4	5	179	230	5
24	4	5	337	474	5
25	5	4	123	n/a	5
26	5	5	214	329	5
27	5	5	205	245	5
28	5	5	230	288	5
29	4	5	210	n/a	5
30	4	5	120	208	5
31	4	5	213	322	5
32	4	5	161	294	5
33	5	4	205	n/a	5
34	5	5	68	85	5
35	5	4	109	147	5
36	5	5	117	145	5
37	4	5	194	n/a	5
38	4	5	157	257	5
39	4	5	213	379	5
40	4	5	264	365	5

* = several housings were not flush with the

Retroreflectometers

Form Filled Out By : R. Wray

Date: 4/15/2002

= Meter 214

= Meter 208

Raised Pavement Marker Ratings

MD 100 Test Deck

NTPEP # RPM (2001 MD) - 4 **Avery- Dennison Corp.** **Stimsonite Model 96**

Installed: 10/4/2001 by Midlantic Marketing Co. from milepoint 5.10 to 5.17

Marker No.	Housing	Lens	Dirty Reading (mcd/lux)	Clean Reading (mcd/lux)	Night Visability
1	5	4	158	n/a	5
2	5	5	99	107	5
3	5	5	193	258	5
4	5	5	166	252	5
5	4	3	166	n/a	5
6	4	5	181	327	5
7	4	5	183	316	5
8	4	4	199	276	5
9	5	5	159	n/a	5
10	5	5	183	253	5
11	5	5	138	164	5
12	5	4	312	403	5
13	4	5	139	n/a	4
14	4	5	139	262	4
15	4	5	193	388	4
16	4	5	141	313	4
17	5	5	309	n/a	5
18	5	4	154	259	5
19	5	5	132	173	5
20	4	5	132	151	5
21	4	5	149	n/a	5
22	4	5	232	278	5
23	4	4	285	465	5
24	4	5	329	428	5
25	5	5	174	n/a	4
26	5	4	191	199	5
27	5	4	179	188	5
28	5	4	112	114	5
29	4	5	129	n/a	3
30	4	5	103	195	5
31	4	5	330	474	5
32	4	5	220	344	5
33	5	4	226	n/a	5
34	5	5	203	246	5
35	5	5	246	344	5
36	5	4	226	357	5
37	5	5	252	n/a	5
38	4	4	201	383	5
39	4	5	244	551	5
40	4	5	156	329	5

Retroreflectometers

Form Filled Out By : R. Wray

Date: 4/15/2002

= Meter 214

= Meter 208

Raised Pavement Marker Ratings

MD 100 Test Deck

NTPEP # RPM (2001 MD) - 5 **Hallen Products, Ltd.** **Ironstar** **1W664**

Installed: 10/3/2001 by Highway Safety Services from milepoint 5.19 to 5.26

Marker No.	Housing*	Lens	Dirty Reading (mcd/lux)	Clean Reading (mcd/lux)	Night Visability
1	5	5	130	n/a	5
2	5	4	102	108	5
3	5	5	137	143	5
4	5	3	208	258	5
5	4	5	175	n/a	5
6	4	5	125	214	5
7	4	5	176	355	5
8	4	5	142	238	5
9	5	4	156	n/a	5
10	5	3	167	166	5
11	5	5	94	105	5
12	5	5	196	213	5
13	4	5	144	n/a	5
14	4	5	160	361	5
15	4	4	135	279	5
16	4	4	140	327	5
17	5	4	99	n/a	5
18	5	4	119	122	5
19	5	5	103	131	5
20	5	5	87	71	5
21	4	4	125	n/a	5
22	4	5	163	361	5
23	4	4	118	25	5
24	4	5	127	249	5
25	5	4	92	n/a	5
26	5	4	75	94	5
27	5	4	84	83	5
28	5	4	92	143	5
29	4	5	114	n/a	5
30	4	5	115	326	5
31	4	5	84	249	5
32	4	5	72	215	5
33	5	4	111	n/a	5
34	5	5	96	130	5
35	5	5	97	161	5
36	5	4	120	189	5
37	4	5	175	n/a	5
38	4	4	101	300	5
39	4	5	123	315	5
40	4	5	125	304	5

* = all housings were zinc plated

Retroreflectometers

Form Filled Out By : R. Wray

Date: 4/15/2002

= Meter 214

= Meter 208

Raised Pavement Marker Ratings

MD 100 Test Deck

NTPEP # RPM (2001.01) Astucia (UK), Ltd. **Astucia Intelligent Flush Stud** **F-Series ND**

Installed: 10/4/2001 by Statewide Striping from milepoint 5.28 to 5.35

Marker No.	Housing	Lens	Dirty Reading* (mcd/lux)	Clean Reading* (mcd/lux)	Night Visability
1	5	4	n/a	n/a	4
2	5	4	n/a	n/a	4
3	5	4	n/a	n/a	4
4	5	4	n/a	n/a	4
5	5	4	n/a	n/a	4
6	5	4	n/a	n/a	4
7	5	4	n/a	n/a	4
8	5	4	n/a	n/a	4
9	5	4	n/a	n/a	3
10	5	4	n/a	n/a	3
11	5	4	n/a	n/a	3
12	5	4	n/a	n/a	3
13	5	4	n/a	n/a	3
14	5	4	n/a	n/a	3
15	5	4	n/a	n/a	3
16	5	4	n/a	n/a	3
17	5	4	n/a	n/a	4
18	5	4	n/a	n/a	4
19	5	4	n/a	n/a	4
20	5	5	n/a	n/a	4
21	5	4	n/a	n/a	4
22	5	4	n/a	n/a	4
23	5	4	n/a	n/a	4
24	5	5	n/a	n/a	4
25	5	4	n/a	n/a	4
26	5	4	n/a	n/a	4
27	5	4	n/a	n/a	4
28	5	4	n/a	n/a	4
29	5	4	n/a	n/a	4
30	5	4	n/a	n/a	4
31	5	5	n/a	n/a	4
32	5	5	n/a	n/a	4
33	5	4	n/a	n/a	4
34	5	4	n/a	n/a	4
35	5	4	n/a	n/a	4
36	5	4	n/a	n/a	4
37	5	4	n/a	n/a	3
38	5	4	n/a	n/a	4
39	5	4	n/a	n/a	4
40	5	4	n/a	n/a	3

Retroreflectometers

4

Form Filled Out By : R. Wray

Date: 4/15/2002

= Meter 214

= Meter 208

Raised Pavement Marker Ratings

MD 100 Test Deck

NTPEP # RPM (2001 MD) - 7 Nightline Markers, Inc. **NightLine** **B-400**

Installed: 10/4/2001 by Priceless Industries from milepoint 5.38 to 5.45

Marker No.	Housing	Lens	Dirty Reading (mcd/lux)	Clean Reading (mcd/lux)	Night Visability
1	5	4	111	n/a	5
2	5	5	159	268	5
3	5	5	164	224	5
4	5	4	91	164	5
5	5	5	135	n/a	5
6	5	4	121	378	5
7	5	5	119	517	5
8	5	5	152	557	5
9	5	5	105	n/a	5
10	5	4	170	306	5
11	5	4	138	236	5
12	5	5	128	247	5
13	5	5	233	n/a	5
14	5	5	127	305	5
15	5	5	209	717	5
16	5	5	172	617	5
17	5	4	112	n/a	5
18	5	4	143	233	5
19	5	4	110	147	5
20	5	5	148	278	5
21	5	5	136	n/a	5
22	5	5	119	344	5
23	5	5	169	485	5
24	5	4	151	630	5
25	5	4	172	n/a	5
26	5	4	151	271	5
27	5	5	195	258	5
28	5	5	115	209	5
29	5	5	157	n/a	5
30	5	4	214	634	5
31	4	5	254	603	5
32	5	5	162	520	5
33	5	4	139	n/a	5
34	5	4	171	374	5
35	5	4	185	350	5
36	5	5	153	292	5
37	5	5	144	n/a	5
38	5	5	215	448	5
39	4	5	169	605	5
40	5	5	254	682	5

Retroreflectometers

Form Filled Out By : R. Wray

Date: 4/15/2002

= Meter 214

= Meter 208

Raised Pavement Marker Ratings

MD 100 Test Deck

NTPEP # RPM (2001 MD) - 8 Pac-Tec, **Ray-O-Lite** **Snow-Lite Model 100**

Installed: 10/3/2001 by Priceless Industries from milepoint 5.47 to 5.54

Marker No.	Housing*	Lens	Dirty Reading (mcd/lux)	Clean Reading (mcd/lux)	Night Visability
1	5	5	43	n/a	4
2	5	5	53	84	4
3	5	5	55	93	4
4	5	5	43	73	4
5	4	5	59	n/a	4
6	4	5	51	149	4
7	5	4	45	122	4
8	5	5	55	145	4
9	5	5	30	n/a	4
10	5	5	52	92	4
11	5	5	54	79	4
12	5	5	39	58	4
13	5	5	50	n/a	4
14	5	5	45	157	4
15	5	5	50	136	4
16	5	5	46	153	4
17	5	1	42	n/a	4
18	5	5	49	93	4
19	5	4	4	70	4
20	5	5	40	72	4
21	5	5	49	n/a	4
22	5	5	73	181	4
23	4	5	64	162	4
24	5	5	67	195	4
25	5	5	46	n/a	4
26	5	5	54	77	4
27	5	5	45	63	4
28	5	4	41	55	4
29	5	5	47	n/a	4
30	5	5	47	158	4
31	4	5	56	151	4
32	5	5	51	125	4
33	5	5	45	n/a	4
34	5	5	48	50	4
35	5	5	44	64	4
36	5	5	58	85	4
37	5	2	33	n/a	4
38	5	5	42	112	4
39	5	5	45	121	4
40	5	5	40	102	4

* = old housing was partially in the way

Retroreflectometers

Form Filled Out By : R. Wray

Date: 4/15/2002

= Meter 214

= Meter 208

12 Month Readings

Raised Pavement Marker Ratings

I-97 Test Deck

NTPEP # RPM (2001 MD) - 2 **3M Comp** **3m Series 190 Marker** **190 - H960HP**

Installed: 10/4/2001 by Priceless Industries from milepoint 9.25 to 9.32

Marker No.	Housing*	Lens	Dirty Reading (mcd/lux)	Clean Reading (mcd/lux)	Night Visability
1	5	3	107	n/a	5
2	5	3	129	152	5
3	5	4	75	81	5
4	5	4	100	121	5
5	4	4	142	n/a	5
6	4	3	115	148	5
7	4	4	138	190	5
8	4	4	133	171	5
9	5	4	77	n/a	5
10	5	4	59	67	5
11	5	4	56	72	5
12	5	4	100	113	5
13	4	4	100	n/a	5
14	4	4	113	149	5
15	4	4	133	181	5
16	3	3	141	178	5
17	5	4	35	n/a	5
18	5	4	87	100	5
19	5	5	70	76	5
20	5	4	105	109	5
21	4	3	107	n/a	5
22	4	4	119	143	5
23	4	4	118	125	5
24	4	3	142	184	5
25	5	4	65	n/a	5
26	5	4	49	58	5
27	5	4	102	113	5
28	5	4	67	94	5
29	4	3	132	n/a	5
30	4	3	130	191	5
31	4	3	114	161	5
32	4	2	118	173	5
33	5	4	76	n/a	3.5
34	5	4	30	32	3.5
35	5	5	21	21	2
36	5	4	29	45	4
37	4	4	95	n/a	5
38	4	2	110	153	5
39	4	4	142	185	5
40	4	3	142	187	5

Retroreflectometers

Form Filled Out By : R. Wray

Date: 10/7/2002

= Meter 214

= Meter 208

Raised Pavement Marker Ratings

I-97 Test Deck

NTPEP # RPM (2001 MD) - 3 **Avery- Dennison Corp.** **Stimsonite Model 101**

Installed: 10/3/2001 by Highway Safety Services from milepoint 9.34 to 9.41

Marker No.	Housing*	Lens	Dirty Reading (mcd/lux)	Clean Reading (mcd/lux)	Night Visability
1	5	3	489	n/a	5
2	5	4	483	594	5
3	5	4	216	311	5
4	5	5	331	358	5
5	4	1	22	n/a	5
6	4	4	188	233	5
7	4	4	220	276	5
8	4	3	210	250	5
9	5	5	232	n/a	5
10	5	4	440	469	5
11	5	4	332	488	5
12	5	4	352	433	5
13	4	4	245	n/a	5
14	4	4	209	225	5
15	4	4	162	197	5
16	4	4	333	418	5
17	5	5	384	n/a	5
18	5	5	364	457	5
19	5	5	242	329	5
20	5	4	383	519	5
21	4	4	141	n/a	5
22	4	4	108	118	5
23	4	4	296	374	5
24	4	4	299	360	5
25	5	5	341	n/a	5
26	5	4	332	378	5
27	5	5	439	537	5
28	5	5	204	269	5
29	4	3	235	n/a	5
30	4	3	270	296	5
31	4	4	158	174	5
32	4	4	247	273	5
33	5	5	337	n/a	5
34	5	4	472	603	5
35	5	4	386	443	5
36	5	4	310	353	5
37	4	2	233	n/a	5
38	4	4	258	321	5
39	4	4	274	324	5
40	4	3	270	319	5

* = several housings were not flush with the pave

**= old housng as in way

Retroreflectometers

Form Filled Out By : R. Wray

Date: 10/7/2002

= Meter 214

= Meter 208

Raised Pavement Marker Ratings

I-97 Test Deck

NTPEP # RPM (2001 MD) - 4 **Avery- Dennison Corp.** **Stimsonite Model 96**

Installed: 10/4/2001 by Midlantic Marketing Co. from milepoint 9.43 to 9.50

Marker No.	Housing	Lens	Dirty Reading (mcd/lux)	Clean Reading (mcd/lux)	Night Visability
1	5	4	45	----------	5
2	5	4	319	347	5
3	5	4	229	286	5
4	5	4	479	605	5
5	4	4	167	----------	5
6	4	3	272	316	5
7	4	4	249	315	5
8	4	3	417	473	5
9	5	4	328	----------	5
10	5	4	414	466	5
11	5	5	87	103	5
12	5	5	337	436	5
13	4	4	211	----------	5
14	4	4	217	278	5
15	4	4	224	409	5
16	3	4	282	357	5
17	5	4	275	----------	5
18	5	4	484	660	5
19	5	4	28	29	5
20	5	4	261	299	5
21	4	4	244	----------	5
22	4	1	248	299	5
23	4	4	398	515	5
24	4	4	141	163	4
25	5	2	105	----------	4
26	5	5	321	471	5
27	5	4	32	74	5
28	5	4	163	353	5
29	4	4	174	----------	5
30	4	4	245	290	5
31	4	3	227	289	5
32	4	4	214	262	5
33	5	5	200	----------	5
34	5	4	256	311	5
35	5	4	207	370	5
36	5	4	354	477	5
37	4	2	160	----------	3
38	4	4	306	332	5
39	3	4	346	369	5
40	4	4	259	341	5

* = housing installed too deep

** = old housing in way

Form Filled Out By : R. Wray

Date: 10/7/2002

Retroreflectometers

= Meter 214

= Meter 208

Raised Pavement Marker Ratings

I-97 Test Deck

NTPEP # RPM (2001 MD) - 5 **Hallen Products, Ltd.** **Ironstar** **1W664**

Installed: 10/3/2001 by Highway Safety Services from milepoint 9.52 to 9.59

Marker No.	Housing*	Lens	Dirty Reading (mcd/lux)	Clean Reading (mcd/lux)	Night Visability
1	5	5	74	----------	5
2	5	4	102	132	5
3	5	3	79	101	5
4	5	3	71	76	5
5	4	4	73	----------	5
6	4	4	118	138	5
7	4	3	118	130	5
8	3	2	118	139	5
9	5	4	55	----------	5
10	5	3	99	161	5
11	5	3	56	100	5
12	5	4	44	80	5
13	3	3	80	----------	5
14	3	3	134	195	5
15	4	3	88	109	5
16	3	4	155	186	5
17	5	4	72	----------	5
18	5	4	49	62	5
19	5	4	82	105	5
20	5	4	91	112	5
21	4	4	91	----------	5
22	3	4	105	134	5
23	4	4	128	170	5
24	3	3	95	121	4
25	5	4	53	----------	5
26	5	5	71	121	5
27	5	4	107	110	5
28	5	4	131	186	5
29	4	4	101	----------	5
30	4	4	75	85	5
31	3	3	101	115	5
32	3	2	102	120	5
33	5	4	67	----------	5
34	5	4	81	102	5
35	5	3	65	105	5
36	5	4	83	126	5
37	3	4	106	----------	5
38	4	4	124	154	5
39	3	2	85	93	5
40	4	2	88	110	5

* = all housings were zinc plated

Retroreflectometers

Form Filled Out By : R. Wray

Date: 10/7/2002

= Meter 214

= Meter 208

Raised Pavement Marker Ratings

I-97 Test Deck

NTPEP # RPM (2001 MD-6 **Astucia(UK), Ltd.** **Astucia Intelligent Flush Stud** **F-Series ND**

Installed: 10/5/2001 by Statewide Striping from milepoint 9.61 to 9.68

Marker No.	Housing	Lens	Dirty Reading* (mcd/lux)	Clean Reading* (mcd/lux)	Night Visability
1	5	4	n/a	n/a	3
2	5	5	n/a	n/a	3
3	5	5	n/a	n/a	3
4	5	5	n/a	n/a	3
5	5	5	n/a	n/a	3
6	5	5	n/a	n/a	3
7	5	5	n/a	n/a	3
8	5	5	n/a	n/a	0
9	5	5	n/a	n/a	3
10	5	5	n/a	n/a	3
11	5	5	n/a	n/a	3
12	5	5	n/a	n/a	0
13	5	5	n/a	n/a	0
14	5	5	n/a	n/a	3
15	5	5	n/a	n/a	3
16	5	5	n/a	n/a	3
17	5	5	n/a	n/a	3
18	5	5	n/a	n/a	3
19	5	5	n/a	n/a	3
20	5	5	n/a	n/a	3
21	5	5	n/a	n/a	3
22			n/a	n/a	
23			n/a	n/a	
24			n/a	n/a	
25			n/a	n/a	
26			n/a	n/a	
27			n/a	n/a	
28			n/a	n/a	
29	5	5	n/a	n/a	0
30			n/a	n/a	
31			n/a	n/a	
32			n/a	n/a	
33			n/a	n/a	
34			n/a	n/a	
35			n/a	n/a	
36			n/a	n/a	
37			n/a	n/a	
38			n/a	n/a	
39			n/a	n/a	
40			n/a	n/a	

* = RPM's not compatible with current reflectivity measuring equipment

Retroreflectometers

Form Filled Out By : R. Wray

Date: 10/7/2002

= Meter 214

= Meter 208

Raised Pavement Marker Ratings

I-97 Test Deck

NTPEP # RPM (2001 MD) - 7 **Nightline Markers, Inc.** **NightLine** **B-400**

Installed: 10/5/2001 by Priceless Industries from milepoint 9.70 to 9.77

Marker No.	Housing	Lens	Dirty Reading (mcd/lux)	Clean Reading (mcd/lux)	Night Visability
1	5	5	154	----------	5
2	5	4	145	368	5
3	5	3	117	168	5
4	5	3	273	439	5
5	4	2	88	----------	5
6	4	3	135	162	5
7	4	4	110	140	5
8	4	3	92	124	5
9	5	3	89	----------	5
10	5	4	84	142	5
11	5	3	95	116	5
12	5	3	89	117	5
13	4	3	110	----------	5
14	4	2	88	93	5
15	4	4	164	310	5
16	4	3	101	126	5
17	5	3	92	----------	5
18	5	3	144	282	5
19	5	3	104	123	5
20	5	3	98	123	5
21	4	3	104	----------	4
22	4	2	177	240	5
23	4	2	202	290	5
24	4	3	142	204	5
25	5	5	182	----------	5
26	5	4	205	265	5
27	5	3	123	194	5
28	5	4	132	187	5
29	4	4	120	----------	5
30	4	2	102	141	5
31	4	4	107	162	5
32	4	3	107	138	5
33	5	5	105	----------	5
34	5	3	150	220	5
35	5	3	186	261	5
36	5	3	80	140	5
37	4	3	179	----------	5
38	4	4	118	158	5
39	4	3	182	230	5
40	4	4	128	266	5

Retroreflectometers

Form Filled Out By : R. Wray

Date: 10/7/2002

= Meter 214

= Meter 208

Raised Pavement Marker Ratings

I-97 Test Deck

NTPEP # RPM (2001 MD) - 8 **Pac-Tec, I** **Ray-O-Lite** **Snow-Lite Model 100**

Installed: 10/3/2001 by Priceless Industries from milepoint 9.79 to 9.86

Marker No.	Housing*	Lens	Dirty Reading (mcd/lux)	Clean Reading (mcd/lux)	Night Visability
1	5	2	80	----------	4
2	5	5	101	123	4
3	5	5	55	63	4
4	5	4	50	56	4
5	4	1	36	----------	4
6	4	3	57	82	4
7	4	3	34	45	4
8	4	3	50	66	4
9	5	5	68	----------	4
10	5	5	53	64	4
11	5	5	81	123	4
12	5	5	75	149	4
13	4	4	39	----------	4
14	4	3	39	47	4
15	4	4	54	82	4
16	4	4	35	42	4
17	5	4	54	----------	4
18	5	5	39	81	4
19	5	4	58	89	4
20	5	4	60	74	4
21	4	4	45	----------	4
22	4	4	53	71	4
23	4	2	25	34	4
24	4	4	28	34	3
25	5	4	43	----------	4
26	5	5	45	54	4
27	5	5	29	29	4
28	5	4	75	92	4
29	4	4	51	----------	4
30	4	3	57	121	4
31	4	4	47	79	4
32	4	4	48	74	4
33	5	4	46	----------	4
34	5	4	49	68	4
35	5	4	28	29	4
36	5	4	54	79	4
37	4	2	57	----------	4
38	4	4	69	115	4
39	4	3	51	92	4
40	4	4	44	84	4

* = old housing was in the way

Retroreflectometers

Form Filled Out By : R. Wray

Date: 10/7/2002

= Meter 214

= Meter 208

Raised Pavement Marker Ratings

MD 100 Test Deck

NTPEP # RPM (2001 MD) - 2 3M Comp **3m Series 190 Marker** **190 - H960HP**

Installed: 10/3/2001 by Priceless Industries from milepoint 4.92 to 4.99

Marker No.	Housing*	Lens	Dirty Reading (mcd/lux)	Clean Reading (mcd/lux)	Night Visability
1	5	4	115	n/a	5
2	5	3	152	207	5
3	5	3	161	181	5
4	5	4	168	226	5
5	4	3	153	n/a	4
6	4	4	159	236	4
7	4	4	161	286	4
8	4	4	139	213	4
9	5	3	148	n/a	4
10	5	4	65	95	4
11	5	5	162	209	4
12	5	4	115	187	4
13	4	3	259	n/a	4
14	4	4	228	416	4
15	4	3	184	276	4
16	4	4	218	276	4
17	5	4	106	n/a	4
18	5	4	140	182	4
19	5	3	162	176	4
20	5	3	117	179	4
21	4	4	262	n/a	4
22	4	4	153	225	4
23	4	3	254	343	4
24	4	4	265	360	4
25	5	3	207	n/a	4
26	5	4	159	187	4
27	5	4	180	235	4
28	5	5	223	259	4
29	4	4	241	n/a	4
30	4	3	209	299	4
31	4	3	228	411	4
32	4	4	227	349	4
33	5	4	85	n/a	4
34	5	4	207	271	4
35	5	3	161	185	4
36	5	4	115	183	4
37	4	3	270	n/a	4
38	4	3	277	383	4
39	4	3	239	293	4
40	4	3	258	446	4

* = all housings were zinc plated

Retroreflectometers

Form Filled Out By : R. Wray

Date: 10/7/2002

= Meter 214

= Meter 208

Raised Pavement Marker Ratings

MD 100 Test Deck

NTPEP # RPM (2001 MD) - 3 **Avery- Dennison Corp.** **Stimsonite Model 101**

Installed: 10/3/2001 by Highway Safety Services from milepoint 5.01 to 5.08

Marker No.	Housing*	Lens	Dirty Reading (mcd/lux)	Clean Reading (mcd/lux)	Night Visability
1	5	5	45	n/a	3.5
2	5	3	400	564	4
3	5	5	79	95	4
4	5	5	432	518	4
5	4	4	537	n/a	4
6	4	4	432	603	4
7	4	4	393	535	4
8	4	4	478	601	4
9	5	5	37	n/a	3
10	5	3	276	424	3
11	5	4	430	440	3
12	5	3	367	523	3
13	4	4	661	n/a	3
14	4	4	435	577	3
15	4	4	400	480	2
16	4	4	313	540	3.5
17	5	3	308	n/a	3.5
18	5	4	300	337	3.5
19	5	1	118	114	2
20	5	3	289	311	2
21	4	4	372	n/a	2
22	4	4	275	490	2
23	4	4	262	413	2
24				474	2
25	5	4	238	n/a	2
26	5	4	234	323	2
27	5	4	209	299	2
28	5	4	351	378	2
29	4	3	335	n/a	2
30	4	4	350	543	2
31	4	4	364	385	2
32	4	4	532	827	2
33	5	4	298	n/a	3.5
34	5	4	186	224	3.5
35	5	5	338	429	3.5
36	5	3	295	385	2
37	4	4	370	n/a	3
38	4	4	352	574	3
39	4	4	667	989	3
40	4	4	429	673	3

* = several housings were not flush with the p

Retroreflectometers

Form Filled Out By : R. Wray

Date: 10/7/2002

= Meter 214

= Meter 208

Raised Pavement Marker Ratings

MD 100 Test Deck

NTPEP # RPM (2001 MD) - 4 **Avery- Dennison Corp.** **Stimsonite Model 96**

Installed: 10/4/2001 by Midlantic Marketing Co. from milepoint 5.10 to 5.17

Marker No.	Housing	Lens	Dirty Reading (mcd/lux)	Clean Reading (mcd/lux)	Night Visability
1	5	3	327	n/a	5
2	5	4	321		5
3	5	4	407	410	5
4	5	3	367	375	5
5	4	3	404	n/a	5
6	4	3	482	703	5
7	4	4	418	597	5
8	4	3	351	418	5
9	5	4	264	n/a	5
10	5	5	466	460	5
11	5	4	276	242	5
12	5	5	546	579	5
13	4	3	346	n/a	5
14	4	4	357	447	5
15	4	3	393	714	5
16	4	4	344	499	4
17	5	4	240	n/a	4
18	5	4	356	355	4
19	5	3	223	314	4
20	5	5	187	194	4
21	5	4	190	n/a	4
22	5	4	316	467	4
23	5	4	362	660	4
24	5	5	447	656	4
25	5	4	280	n/a	4
26	5	5	181	254	4
27	5	5	198	251	4
28	5	4	89	95	4
29	5	5	270	n/a	4
30	5	4	196	250	4
31	5	4	420	522	4
32	5	4	408	618	4
33	5	4	278	n/a	4
34	5	4	359	491	4
35	5	4	385	397	4
36	5	5	3347	399	4
37	5	4	420	n/a	4
38	5	4	378	593	4
39	5	4	444	666	4
40	5	4	254	382	4

Retroreflectometers

Form Filled Out By : R. Wray

Date: 10/7/2002

= Meter 214

= Meter 208

Raised Pavement Marker Ratings

MD 100 Test Deck

NTPEP # RPM (2001 MD) - 5 Hallen Products, Ltd. **Ironstar** **1W664**

Installed: 10/3/2001 by Highway Safety Services from milepoint 5.19 to 5.26

Marker No.	Housing*	Lens	Dirty Reading (mcd/lux)	Clean Reading (mcd/lux)	Night Visability
1	5	5	175	n/a	5
2	5	4	100	84	5
3	5	5	159	168	5
4	5	5	227	372	5
5	4	4	205	n/a	5
6	4	4	178	269	5
7	4	3	223	395	5
8	4	3	205	298	5
9	5	4	164	n/a	5
10	5	3	93	101	5
11	5	4	127	136	5
12	5	5	211	234	5
13	4	4	180	n/a	4
14	4	4	185	397	4
15	4	3	156	310	4
16	4	4	165	299	4
17	5	2	184	n/a	4
18	5	5	163	175	4
19	5	4	125	124	4
20	5	4	65	96	4
21	4	3	172	n/a	4
22	4	4	195	284	4
23	4	3	171	236	4
24	4	3	192	301	4
25	5	3	121	n/a	4
26	5	2	71	95	4
27	5	4	122	135	4
28	5	3	130	149	4
29	4	4	218	n/a	4
30	4	3	181	291	4
31	4	4	172	243	4
32	4	3	119	199	4
33	5	2	159	n/a	4
34		5	113	138	4
35	5	5	191	201	4
36	5	4	183	185	4
37	4	4	208	n/a	4
38	4	3	162	246	4
39	4	4	191	315	4
40	4	5	229	360	4

* = all housings were zinc plated

Retroreflectometers

Form Filled Out By : R. Wray

Date: 10/7/2002

= Meter 214

= Meter 208

Raised Pavement Marker Ratings

MD 100 Test Deck

NTPEP # RPM (2001.03) Astucia (UK), Ltd. **Astucia Intelligent Flush Stud** **F-Series ND**

Installed: 10/4/2001 by Statewide Striping from milepoint 5.28 to 5.35

Marker No.	Housing	Lens	Dirty Reading* (mcd/lux)	Clean Reading* (mcd/lux)	Night Visability
1	5	4	n/a	n/a	3.5
2	5	4	n/a	n/a	3.5
3	5	4	n/a	n/a	3.5
4	5	5	n/a	n/a	3.5
5	5	4 OUT	n/a	n/a	0
6	5	4	n/a	n/a	3.5
7	5	4	n/a	n/a	3.5
8	5	4	n/a	n/a	3.5
9	5	4	n/a	n/a	3.5
10	5	4	n/a	n/a	3.5
11	5	5	n/a	n/a	3.5
12	5	5	n/a	n/a	3.5
13	5	4	n/a	n/a	3.5
14	5	4	n/a	n/a	3.5
15	5	4	n/a	n/a	3.5
16	5	4	n/a	n/a	3.5
17	5	4	n/a	n/a	3.5
18	5	5	n/a	n/a	3.5
19	5	4	n/a	n/a	3.5
20	5	5	n/a	n/a	3.5
21	5	4	n/a	n/a	3.5
22	5	4 OUT	n/a	n/a	0
23	5	4	n/a	n/a	3.5
24	5	4	n/a	n/a	3.5
25	5	4	n/a	n/a	3.5
26	5	4	n/a	n/a	3.5
27	5	5	n/a	n/a	3.5
28	5	5	n/a	n/a	3.5
29	5	4 OUT	n/a	n/a	0
30	5	4	n/a	n/a	3.5
31	5	4	n/a	n/a	3.5
32	5	4	n/a	n/a	3.5
33	5	5	n/a	n/a	3.5
34	5	4	n/a	n/a	3.5
35	5	4	n/a	n/a	3.53
36	5	4	n/a	n/a	3.5
37	5	4	n/a	n/a	3.5
38	5	4 OUT	n/a	n/a	0
39	5	4	n/a	n/a	3.5
40	5	4	n/a	n/a	3.5

Retroreflectometers

4

Form Filled Out By : R. Wray

Date: 10/7/2002

= Meter 214

= Meter 208

Raised Pavement Marker Ratings

MD 100 Test Deck

NTPEP # RPM (2001 MD) - 7 Nightline Markers, Inc. **NightLine** **B-400**

Installed: 10/4/2001 by Priceless Industries from milepoint 5.38 to 5.45

Marker No.	Housing	Lens	Dirty Reading (mcd/lux)	Clean Reading (mcd/lux)	Night Visability
1	5	4	96	n/a	5
2	5	4	158	231	5
3	5	4	193	242	5
4	5	3	122	140	5
5	5	3	195	n/a	5
6	5	3	188	399	5
7	5	4	206	593	5
8	5	3	203	502	5
9	5	5	136	n/a	5
10	5	4	212	319	5
11	5	3	179	232	5
12	5	3	185	238	5
13	5	4	339	n/a	5
14	5	3	217	353	5
15	5	4	294	590	5
16	5	4	240	570	5
17	5	3	120	n/a	5
18	5	4	166	189	5
19	5	4	129	172	5
20	5	5	142	196	5
21	5	3	204	n/a	5
22	5	3	199	375	5
23	5	3	216	393	5
24	5	3	244	721	5
25	5	3	260	n/a	5
26	5	2	158	218	5
27	5	5	251	315	5
28	5	3	171	183	5
29	5	3	241	n/a	5
30	5	3	338	488	5
31	5	4	369	824	5
32	5	4	289	584	5
33	5	5	182	n/a	5
34	5	4	232	254	5
35	5	4	280	366	5
36	5	4	129	181	5
37	5	3	169	n/a	5
38	5	4	308	603	5
39	5	3	237	482	5
40	5	3	312	698	4

Retroreflectometers

Form Filled Out By : R. Wray

Date: 10/7/2002

= Meter 214

= Meter 208

Raised Pavement Marker Ratings

MD 100 Test Deck

NTPEP # RPM (2001 MD) - 8 Pac-Tec, l **Ray-O-Lite** **Snow-Lite Model 100**

Installed: 10/3/2001 by Priceless Industries from milepoint 5.47 to 5.54

Marker No.	Housing*	Lens	Dirty Reading (mcd/lux)	Clean Reading (mcd/lux)	Night Visability
1	4	5	86	n/a	3.5
2	4	4	90	119	4
3	4	5	82	110	4
4	4	4	71	90	4
5	5	4	96	n/a	4
6	5	5	88	171	4
7	5	4	75	159	4
8	5	4	117	185	4
9	4	4	49	n/a	3.5
10	4	4	87	122	4
11	4	5	82	118	4
12	4	5	66	76	4
13	5	4	91	n/a	4
14	5	4	74	169	4
15	5	4	75	138	4
16	5	4	79	187	4
17	4	1	69	n/a	3.5
18	4	4	92	94	4
19	4	4	73	84	4
20	4	4	83	85	4
21	5	4	115	n/a	4
22	5	4	162	246	4
23	5	4	162	246	4
24	5	3	114	206	3.5
25	4	4	79	n/a	4
26	4	4	82	101	4
27	4	4	45	77	4
28	4	4	68	113	4
29	5	5	139	n/a	4
30	5	3	80	145	4
31	5	4	112	172	4
32	5	4	107	154	4
33	4	4	85	n/a	4
34	4	4	42	58	3.5
35	4	5	56	75	3.5
36	4	4	113	119	4
37	5	2	66	n/a	3.5
38	5	4	57	106	4
39	5	4	105	164	4
40	5	5	89	124	4

* = old housing was partially in the way

Retroreflectometers

Form Filled Out By : R. Wray

Date: 10/7/2002

= Meter 214

= Meter 208

12 Month Readings

Raised Pavement Marker Ratings

I-97 Test Deck

NTPEP # RPM (2001 MD) - 2 **3M Compa** **3m Series 190 Marker** **190 - H960HP**

Installed: 10/4/2001 by Priceless Industries from milepoint 9.25 to 9.32

Marker No.	Housing*	Lens	Dirty Reading (mcd/lux)	Clean Reading (mcd/lux)	Night Visability
1	5	3	107	n/a	5
2	5	3	129	152	5
3	5	4	75	81	5
4	5	4	100	121	5
5	4	4	142	n/a	5
6	4	3	115	148	5
7	4	4	138	190	5
8	4	4	133	171	5
9	5	4	77	n/a	5
10	5	4	59	67	5
11	5	4	56	72	5
12	5	4	100	113	5
13	4	4	100	n/a	5
14	4	4	113	149	5
15	4	4	133	181	5
16	3	3	141	178	5
17	5	4	35	n/a	5
18	5	4	87	100	5
19	5	5	70	76	5
20	5	4	105	109	5
21	4	3	107	n/a	5
22	4	4	119	143	5
23	4	4	118	125	5
24	4	3	142	184	5
25	5	4	65	n/a	5
26	5	4	49	58	5
27	5	4	102	113	5
28	5	4	67	94	5
29	4	3	132	n/a	5
30	4	3	130	191	5
31	4	3	114	161	5
32	4	2	118	173	5
33	5	4	76	n/a	3.5
34	5	4	30	32	3.5
35	5	5	21	21	2
36	5	4	29	45	4
37	4	4	95	n/a	5
38	4	2	110	153	5
39	4	4	142	185	5
40	4	3	142	187	5

Retroreflectometers

Form Filled Out By : R. Wray

Date: 10/7/2002

= Meter 214

= Meter 208

Raised Pavement Marker Ratings

I-97 Test Deck

NTPEP # RPM (2001 MD) - 3 **Avery- Dennison Corp.** **Stimsonite Model 101**

Installed: 10/3/2001 by Highway Safety Services from milepoint 9.34 to 9.41

Marker No.	Housing*	Lens	Dirty Reading (mcd/lux)	Clean Reading (mcd/lux)	Night Visability
1	5	3	489	n/a	5
2	5	4	483	594	5
3	5	4	216	311	5
4	5	5	331	358	5
5	4	1	22	n/a	5
6	4	4	188	233	5
7	4	4	220	276	5
8	4	3	210	250	5
9	5	5	232	n/a	5
10	5	4	440	469	5
11	5	4	332	488	5
12	5	4	352	433	5
13	4	4	245	n/a	5
14	4	4	209	225	5
15	4	4	162	197	5
16	4	4	333	418	5
17	5	5	384	n/a	5
18	5	5	364	457	5
19	5	5	242	329	5
20	5	4	383	519	5
21	4	4	141	n/a	5
22	4	4	108	118	5
23	4	4	296	374	5
24	4	4	299	360	5
25	5	5	341	n/a	5
26	5	4	332	378	5
27	5	5	439	537	5
28	5	5	204	269	5
29	4	3	235	n/a	5
30	4	3	270	296	5
31	4	4	158	174	5
32	4	4	247	273	5
33	5	5	337	n/a	5
34	5	4	472	603	5
35	5	4	386	443	5
36	5	4	310	353	5
37	4	2	233	n/a	5
38	4	4	258	321	5
39	4	4	274	324	5
40	4	3	270	319	5

* = several housings were not flush with the pave

**= old housng as in way

Retroreflectometers

Form Filled Out By : R. Wray

Date: 10/7/2002

= Meter 214

= Meter 208

Raised Pavement Marker Ratings

I-97 Test Deck

NTPEP # RPM (2001 MD) - 4 **Avery- Dennison Corp.** **Stimsonite Model 96**

Installed: 10/4/2001 by Midlantic Marketing Co. from milepoint 9.43 to 9.50

Marker No.	Housing	Lens	Dirty Reading (mcd/lux)	Clean Reading (mcd/lux)	Night Visability
1	5	4	45	----------	5
2	5	4	319	347	5
3	5	4	229	286	5
4	5	4	479	605	5
5	4	4	167	----------	5
6	4	3	272	316	5
7	4	4	249	315	5
8	4	3	417	473	5
9	5	4	328	----------	5
10	5	4	414	466	5
11	5	5	87	103	5
12	5	5	337	436	5
13	4	4	211	----------	5
14	4	4	217	278	5
15	4	4	224	409	5
16	3	4	282	357	5
17	5	4	275	----------	5
18	5	4	484	660	5
19	5	4	28	29	5
20	5	4	261	299	5
21	4	4	244	----------	5
22	4	1	248	299	5
23	4	4	398	515	5
24	4	4	141	163	4
25	5	2	105	----------	4
26	5	5	321	471	5
27	5	4	32	74	5
28	5	4	163	353	5
29	4	4	174	----------	5
30	4	4	245	290	5
31	4	3	227	289	5
32	4	4	214	262	5
33	5	5	200	----------	5
34	5	4	256	311	5
35	5	4	207	370	5
36	5	4	354	477	5
37	4	2	160	----------	3
38	4	4	306	332	5
39	3	4	346	369	5
40	4	4	259	341	5

* = housing installed too deep

** = old housing in way

Retroreflectometers

Form Filled Out By : R. Wray

Date: 10/7/2002

= Meter 214

= Meter 208

Raised Pavement Marker Ratings

I-97 Test Deck

NTPEP # RPM (2001 MD) - 5 **Hallen Products, Ltd.** **Ironstar** **1W664**

Installed: 10/3/2001 by Highway Safety Services from milepoint 9.52 to 9.59

Marker No.	Housing*	Lens	Dirty Reading (mcd/lux)	Clean Reading (mcd/lux)	Night Visability
1	5	5	74	----------	5
2	5	4	102	132	5
3	5	3	79	101	5
4	5	3	71	76	5
5	4	4	73	----------	5
6	4	4	118	138	5
7	4	3	118	130	5
8	3	2	118	139	5
9	5	4	55	----------	5
10	5	3	99	161	5
11	5	3	56	100	5
12	5	4	44	80	5
13	3	3	80	----------	5
14	3	3	134	195	5
15	4	3	88	109	5
16	3	4	155	186	5
17	5	4	72	----------	5
18	5	4	49	62	5
19	5	4	82	105	5
20	5	4	91	112	5
21	4	4	91	----------	5
22	3	4	105	134	5
23	4	4	128	170	5
24	3	3	95	121	4
25	5	4	53	----------	5
26	5	5	71	121	5
27	5	4	107	110	5
28	5	4	131	186	5
29	4	4	101	----------	5
30	4	4	75	85	5
31	3	3	101	115	5
32	3	2	102	120	5
33	5	4	67	----------	5
34	5	4	81	102	5
35	5	3	65	105	5
36	5	4	83	126	5
37	3	4	106	----------	5
38	4	4	124	154	5
39	3	2	85	93	5
40	4	2	88	110	5

* = all housings were zinc plated

Retroreflectometers

Form Filled Out By : R. Wray

Date: 10/7/2002

= Meter 214

= Meter 208

Raised Pavement Marker Ratings

I-97 Test Deck

NTPEP # RPM (2001 MD) 6 **Astucia(UK), Ltd.** **Astucia Intelligent Flush Stud** **F-Series ND**

Installed: 10/5/2001 by Statewide Striping from milepoint 9.61 to 9.68

Marker No.	Housing	Lens	Dirty Reading* (mcd/lux)	Clean Reading* (mcd/lux)	Night Visability
1	5	4	n/a	n/a	3
2	5	5	n/a	n/a	3
3	5	5	n/a	n/a	3
4	5	5	n/a	n/a	3
5	5	5	n/a	n/a	3
6	5	5	n/a	n/a	3
7	5	5	n/a	n/a	3
8	5	5	n/a	n/a	0
9	5	5	n/a	n/a	3
10	5	5	n/a	n/a	3
11	5	5	n/a	n/a	3
12	5	5	n/a	n/a	0
13	5	5	n/a	n/a	0
14	5	5	n/a	n/a	3
15	5	5	n/a	n/a	3
16	5	5	n/a	n/a	3
17	5	5	n/a	n/a	3
18	5	5	n/a	n/a	3
19	5	5	n/a	n/a	3
20	5	5	n/a	n/a	3
21	5	5	n/a	n/a	3
22			n/a	n/a	
23			n/a	n/a	
24			n/a	n/a	
25			n/a	n/a	
26			n/a	n/a	
27			n/a	n/a	
28			n/a	n/a	
29	5	5	n/a	n/a	0
30			n/a	n/a	
31			n/a	n/a	
32			n/a	n/a	
33			n/a	n/a	
34			n/a	n/a	
35			n/a	n/a	
36			n/a	n/a	
37			n/a	n/a	
38			n/a	n/a	
39			n/a	n/a	
40			n/a	n/a	

* = RPM's not compatible with current reflectivity measuring equipment

Retroreflectometers

Form Filled Out By : R. Wray

Date: 10/7/2002

= Meter 214

= Meter 208

Raised Pavement Marker Ratings

I-97 Test Deck

NTPEP # RPM (2001 MD) - 7 **Nightline Markers, Inc.** **NightLine** **B-400**

Installed: 10/5/2001 by Priceless Industries from milepoint 9.70 to 9.77

Marker No.	Housing	Lens	Dirty Reading (mcd/lux)	Clean Reading (mcd/lux)	Night Visability
1	5	5	154	----------	5
2	5	4	145	368	5
3	5	3	117	168	5
4	5	3	273	439	5
5	4	2	88	----------	5
6	4	3	135	162	5
7	4	4	110	140	5
8	4	3	92	124	5
9	5	3	89	----------	5
10	5	4	84	142	5
11	5	3	95	116	5
12	5	3	89	117	5
13	4	3	110	----------	5
14	4	2	88	93	5
15	4	4	164	310	5
16	4	3	101	126	5
17	5	3	92	----------	5
18	5	3	144	282	5
19	5	3	104	123	5
20	5	3	98	123	5
21	4	3	104	----------	4
22	4	2	177	240	5
23	4	2	202	290	5
24	4	3	142	204	5
25	5	5	182	----------	5
26	5	4	205	265	5
27	5	3	123	194	5
28	5	4	132	187	5
29	4	4	120	----------	5
30	4	2	102	141	5
31	4	4	107	162	5
32	4	3	107	138	5
33	5	5	105	----------	5
34	5	3	150	220	5
35	5	3	186	261	5
36	5	3	80	140	5
37	4	3	179	----------	5
38	4	4	118	158	5
39	4	3	182	230	5
40	4	4	128	266	5

Retroreflectometers

Form Filled Out By : R. Wray

Date: 10/7/2002

= Meter 214

= Meter 208

Raised Pavement Marker Ratings

I-97 Test Deck

NTPEP # RPM (2001 MD) - 8 **Pac-Tec, I** **Ray-O-Lite** **Snow-Lite Model 100**

Installed: 10/3/2001 by Priceless Industries from milepoint 9.79 to 9.86

Marker No.	Housing*	Lens	Dirty Reading (mcd/lux)	Clean Reading (mcd/lux)	Night Visability
1	5	2	80	----------	4
2	5	5	101	123	4
3	5	5	55	63	4
4	5	4	50	56	4
5	4	1	36	----------	4
6	4	3	57	82	4
7	4	3	34	45	4
8	4	3	50	66	4
9	5	5	68	----------	4
10	5	5	53	64	4
11	5	5	81	123	4
12	5	5	75	149	4
13	4	4	39	----------	4
14	4	3	39	47	4
15	4	4	54	82	4
16	4	4	35	42	4
17	5	4	54	----------	4
18	5	5	39	81	4
19	5	4	58	89	4
20	5	4	60	74	4
21	4	4	45	----------	4
22	4	4	53	71	4
23	4	2	25	34	4
24	4	4	28	34	3
25	5	4	43	----------	4
26	5	5	45	54	4
27	5	5	29	29	4
28	5	4	75	92	4
29	4	4	51	----------	4
30	4	3	57	121	4
31	4	4	47	79	4
32	4	4	48	74	4
33	5	4	46	----------	4
34	5	4	49	68	4
35	5	4	28	29	4
36	5	4	54	79	4
37	4	2	57	----------	4
38	4	4	69	115	4
39	4	3	51	92	4
40	4	4	44	84	4

* = old housing was in the way

Retroreflectometers

Form Filled Out By : R. Wray

Date: 10/7/2002

= Meter 214

= Meter 208

Raised Pavement Marker Ratings

MD 100 Test Deck

NTPEP # RPM (2001 MD) - 2 3M Comp **3m Series 190 Marker** **190 - H960HP**

Installed: 10/3/2001 by Priceless Industries from milepoint 4.92 to 4.99

Marker No.	Housing*	Lens	Dirty Reading (mcd/lux)	Clean Reading (mcd/lux)	Night Visability
1	5	4	115	n/a	5
2	5	3	152	207	5
3	5	3	161	181	5
4	5	4	168	226	5
5	4	3	153	n/a	4
6	4	4	159	236	4
7	4	4	161	286	4
8	4	4	139	213	4
9	5	3	148	n/a	4
10	5	4	65	95	4
11	5	5	162	209	4
12	5	4	115	187	4
13	4	3	259	n/a	4
14	4	4	228	416	4
15	4	3	184	276	4
16	4	4	218	276	4
17	5	4	106	n/a	4
18	5	4	140	182	4
19	5	3	162	176	4
20	5	3	117	179	4
21	4	4	262	n/a	4
22	4	4	153	225	4
23	4	3	254	343	4
24	4	4	265	360	4
25	5	3	207	n/a	4
26	5	4	159	187	4
27	5	4	180	235	4
28	5	5	223	259	4
29	4	4	241	n/a	4
30	4	3	209	299	4
31	4	3	228	411	4
32	4	4	227	349	4
33	5	4	85	n/a	4
34	5	4	207	271	4
35	5	3	161	185	4
36	5	4	115	183	4
37	4	3	270	n/a	4
38	4	3	277	383	4
39	4	3	239	293	4
40	4	3	258	446	4

* = all housings were zinc plated

Retroreflectometers

Form Filled Out By : R. Wray

Date: 10/7/2002

= Meter 214

= Meter 208

Raised Pavement Marker Ratings

MD 100 Test Deck

NTPEP # RPM (2001 MD) - 3 **Avery- Dennison Corp.** **Stimsonite Model 101**

Installed: 10/3/2001 by Highway Safety Services from milepoint 5.01 to 5.08

Marker No.	Housing*	Lens	Dirty Reading (mcd/lux)	Clean Reading (mcd/lux)	Night Visability
1	5	5	45	n/a	3.5
2	5	3	400	564	4
3	5	5	79	95	4
4	5	5	432	518	4
5	4	4	537	n/a	4
6	4	4	432	603	4
7	4	4	393	535	4
8	4	4	478	601	4
9	5	5	37	n/a	3
10	5	3	276	424	3
11	5	4	430	440	3
12	5	3	367	523	3
13	4	4	661	n/a	3
14	4	4	435	577	3
15	4	4	400	480	2
16	4	4	313	540	3.5
17	5	3	308	n/a	3.5
18	5	4	300	337	3.5
19	5	1	118	114	2
20	5	3	289	311	2
21	4	4	372	n/a	2
22	4	4	275	490	2
23	4	4	262	413	2
24				474	2
25	5	4	238	n/a	2
26	5	4	234	323	2
27	5	4	209	299	2
28	5	4	351	378	2
29	4	3	335	n/a	2
30	4	4	350	543	2
31	4	4	364	385	2
32	4	4	532	827	2
33	5	4	298	n/a	3.5
34	5	4	186	224	3.5
35	5	5	338	429	3.5
36	5	3	295	385	2
37	4	4	370	n/a	3
38	4	4	352	574	3
39	4	4	667	989	3
40	4	4	429	673	3

* = several housings were not flush with the p

Retroreflectometers

Form Filled Out By : R. Wray

Date: 10/7/2002

= Meter 214

= Meter 208

Raised Pavement Marker Ratings

MD 100 Test Deck

NTPEP # RPM (2001 MD) - 4 **Avery- Dennison Corp.** **Stimsonite Model 96**

Installed: 10/4/2001 by Midlantic Marketing Co. from milepoint 5.10 to 5.17

Marker No.	Housing	Lens	Dirty Reading (mcd/lux)	Clean Reading (mcd/lux)	Night Visability
1	5	3	327	n/a	5
2	5	4	321		5
3	5	4	407	410	5
4	5	3	367	375	5
5	4	3	404	n/a	5
6	4	3	482	703	5
7	4	4	418	597	5
8	4	3	351	418	5
9	5	4	264	n/a	5
10	5	5	466	460	5
11	5	4	276	242	5
12	5	5	546	579	5
13	4	3	346	n/a	5
14	4	4	357	447	5
15	4	3	393	714	5
16	4	4	344	499	4
17	5	4	240	n/a	4
18	5	4	356	355	4
19	5	3	223	314	4
20	5	5	187	194	4
21	5	4	190	n/a	4
22	5	4	316	467	4
23	5	4	362	660	4
24	5	5	447	656	4
25	5	4	280	n/a	4
26	5	5	181	254	4
27	5	5	198	251	4
28	5	4	89	95	4
29	5	5	270	n/a	4
30	5	4	196	250	4
31	5	4	420	522	4
32	5	4	408	618	4
33	5	4	278	n/a	4
34	5	4	359	491	4
35	5	4	385	397	4
36	5	5	3347	399	4
37	5	4	420	n/a	4
38	5	4	378	593	4
39	5	4	444	666	4
40	5	4	254	382	4

Retroreflectometers

Form Filled Out By : R. Wray

Date: 10/7/2002

= Meter 214

= Meter 208

Raised Pavement Marker Ratings

MD 100 Test Deck

NTPEP # RPM (2001 MD) - 5 **Hallen Products, Ltd.** **Ironstar** **1W664**

Installed: 10/3/2001 by Highway Safety Services from milepoint 5.19 to 5.26

Marker No.	Housing*	Lens	Dirty Reading (mcd/lux)	Clean Reading (mcd/lux)	Night Visability
1	5	5	175	n/a	5
2	5	4	100	84	5
3	5	5	159	168	5
4	5	5	227	372	5
5	4	4	205	n/a	5
6	4	4	178	269	5
7	4	3	223	395	5
8	4	3	205	298	5
9	5	4	164	n/a	5
10	5	3	93	101	5
11	5	4	127	136	5
12	5	5	211	234	5
13	4	4	180	n/a	4
14	4	4	185	397	4
15	4	3	156	310	4
16	4	4	165	299	4
17	5	2	184	n/a	4
18	5	5	163	175	4
19	5	4	125	124	4
20	5	4	65	96	4
21	4	3	172	n/a	4
22	4	4	195	284	4
23	4	3	171	236	4
24	4	3	192	301	4
25	5	3	121	n/a	4
26	5	2	71	95	4
27	5	4	122	135	4
28	5	3	130	149	4
29	4	4	218	n/a	4
30	4	3	181	291	4
31	4	4	172	243	4
32	4	3	119	199	4
33	5	2	159	n/a	4
34		5	113	138	4
35	5	5	191	201	4
36	5	4	183	185	4
37	4	4	208	n/a	4
38	4	3	162	246	4
39	4	4	191	315	4
40	4	5	229	360	4

* = all housings were zinc plated

Retroreflectometers

Form Filled Out By : R. Wray

Date: 10/7/2002

= Meter 214

= Meter 208

Raised Pavement Marker Ratings

MD 100 Test Deck

NTPEP # RPM (2001 MD) - 6 **Astucia (UK), Ltd.** **Astucia Intelligent Flush Stud** **F-Series ND**

Installed: 10/4/2001 by Statewide Striping from milepoint 5.28 to 5.35

Marker No.	Housing	Lens	Dirty Reading* (mcd/lux)	Clean Reading* (mcd/lux)	Night Visability
1	5	4	n/a	n/a	3.5
2	5	4	n/a	n/a	3.5
3	5	4	n/a	n/a	3.5
4	5	5	n/a	n/a	3.5
5	5	4 OUT	n/a	n/a	0
6	5	4	n/a	n/a	3.5
7	5	4	n/a	n/a	3.5
8	5	4	n/a	n/a	3.5
9	5	4	n/a	n/a	3.5
10	5	4	n/a	n/a	3.5
11	5	5	n/a	n/a	3.5
12	5	5	n/a	n/a	3.5
13	5	4	n/a	n/a	3.5
14	5	4	n/a	n/a	3.5
15	5	4	n/a	n/a	3.5
16	5	4	n/a	n/a	3.5
17	5	4	n/a	n/a	3.5
18	5	5	n/a	n/a	3.5
19	5	4	n/a	n/a	3.5
20	5	5	n/a	n/a	3.5
21	5	4	n/a	n/a	3.5
22	5	4 OUT	n/a	n/a	0
23	5	4	n/a	n/a	3.5
24	5	4	n/a	n/a	3.5
25	5	4	n/a	n/a	3.5
26	5	4	n/a	n/a	3.5
27	5	5	n/a	n/a	3.5
28	5	5	n/a	n/a	3.5
29	5	4 OUT	n/a	n/a	0
30	5	4	n/a	n/a	3.5
31	5	4	n/a	n/a	3.5
32	5	4	n/a	n/a	3.5
33	5	5	n/a	n/a	3.5
34	5	4	n/a	n/a	3.5
35	5	4	n/a	n/a	3.53
36	5	4	n/a	n/a	3.5
37	5	4	n/a	n/a	3.5
38	5	4 OUT	n/a	n/a	0
39	5	4	n/a	n/a	3.5
40	5	4	n/a	n/a	3.5

Retroreflectometers

4

Form Filled Out By : R. Wray

Date: 10/7/2002

= **Meter 214**

= **Meter 208**

Raised Pavement Marker Ratings

MD 100 Test Deck

NTPEP # RPM (2001 MD) - 7 Nightline Markers, Inc. **NightLine** **B-400**

Installed: 10/4/2001 by Priceless Industries from milepoint 5.38 to 5.45

Marker No.	Housing	Lens	Dirty Reading (mcd/lux)	Clean Reading (mcd/lux)	Night Visability
1	5	4	96	n/a	5
2	5	4	158	231	5
3	5	4	193	242	5
4	5	3	122	140	5
5	5	3	195	n/a	5
6	5	3	188	399	5
7	5	4	206	593	5
8	5	3	203	502	5
9	5	5	136	n/a	5
10	5	4	212	319	5
11	5	3	179	232	5
12	5	3	185	238	5
13	5	4	339	n/a	5
14	5	3	217	353	5
15	5	4	294	590	5
16	5	4	240	570	5
17	5	3	120	n/a	5
18	5	4	166	189	5
19	5	4	129	172	5
20	5	5	142	196	5
21	5	3	204	n/a	5
22	5	3	199	375	5
23	5	3	216	393	5
24	5	3	244	721	5
25	5	3	260	n/a	5
26	5	2	158	218	5
27	5	5	251	315	5
28	5	3	171	183	5
29	5	3	241	n/a	5
30	5	3	338	488	5
31	5	4	369	824	5
32	5	4	289	584	5
33	5	5	182	n/a	5
34	5	4	232	254	5
35	5	4	280	366	5
36	5	4	129	181	5
37	5	3	169	n/a	5
38	5	4	308	603	5
39	5	3	237	482	5
40	5	3	312	698	4

Retroreflectometers

Form Filled Out By : R. Wray

Date: 10/7/2002

= **Meter 214**

= **Meter 208**

Raised Pavement Marker Ratings

MD 100 Test Deck

NTPEP # RPM (2001 MD) - 8 Pac-Tec, I **Ray-O-Lite** **Snow-Lite Model 100**

Installed: 10/3/2001 by Priceless Industries from milepoint 5.47 to 5.54

Marker No.	Housing*	Lens	Dirty Reading (mcd/lux)	Clean Reading (mcd/lux)	Night Visability
1	4	5	86	n/a	3.5
2	4	4	90	119	4
3	4	5	82	110	4
4	4	4	71	90	4
5	5	4	96	n/a	4
6	5	5	88	171	4
7	5	4	75	159	4
8	5	4	117	185	4
9	4	4	49	n/a	3.5
10	4	4	87	122	4
11	4	5	82	118	4
12	4	5	66	76	4
13	5	4	91	n/a	4
14	5	4	74	169	4
15	5	4	75	138	4
16	5	4	79	187	4
17	4	1	69	n/a	3.5
18	4	4	92	94	4
19	4	4	73	84	4
20	4	4	83	85	4
21	5	4	115	n/a	4
22	5	4	162	246	4
23	5	4	162	246	4
24	5	3	114	206	3.5
25	4	4	79	n/a	4
26	4	4	82	101	4
27	4	4	45	77	4
28	4	4	68	113	4
29	5	5	139	n/a	4
30	5	3	80	145	4
31	5	4	112	172	4
32	5	4	107	154	4
33	4	4	85	n/a	4
34	4	4	42	58	3.5
35	4	5	56	75	3.5
36	4	4	113	119	4
37	5	2	66	n/a	3.5
38	5	4	57	106	4
39	5	4	105	164	4
40	5	5	89	124	4

* = old housing was partially in the way

Retroreflectometers

Form Filled Out By : R. Wray

Date: 10/7/2002

= Meter 214

= Meter 208

18 Month Readings

Raised Pavement Marker Ratings

I-97 Test Deck

NTPEP # RPM (2001 MD) - 2 3M Comp: **3m Series 190 Marker** **190 - H960HP**

Installed: 10/4/2001 by Priceless Industries from milepoint 9.25 to 9.32

Marker No.	Housing*	Lens	Dirty Reading (mcd/lux)	Clean Reading (mcd/lux)	Night Visability
1	4	3	44	n/a	4
2	5	3	42	59	4
3	5	3	36	42	4
4	5	3	44	61	4
5	5	3	89	n/a	4
6	5	2	60	118	4
7	5	3	66	128	4
8	5	4	66	147	4
9	5	3	51	n/a	4
10	5	3	38	45	4
11	4	3	36	40	4
12	4	3	45	52	4
13	5	3	44	n/a	3
14	5	4	56	130	4
15	5	4	64	143	4
16	5	3	61	124	4
17	5	3	30	n/a	3
18	4	3	39	44	4
19	5	4	41	45	4
20	4	4	51	58	4
21	5	3	76	n/a	3
22	4	4	72	137	4
23	5	4	62	121	4
24	4	3	79	157	4
25	4	4	59	n/a	4
26	5	3	42	48	4
27	5	4	49	54	4
28	5	3	54	61	4
29	4	4	61	n/a	3
30	4	3	48	155	4
31	4	4	48	123	3
32	5	3	46	100	4
33	4	3	44	n/a	3
34	5	2	25	26	4
35	5	4	22	22	4
36	4	3	No reading	No reading	3
37	5	5	62	n/a	3
38	5	4	50	144	4
39	5	5	60	120	4
40	5	4	66	150	4

Retroreflectometers

Form Filled Out By : Dan Robbins

Date: 4/14/2003

= Meter 214

= Meter 208

Raised Pavement Marker Ratings

I-97 Test Deck

NTPEP # RPM (2001 MD) - 3 **Avery- Dennison Corp.** **Stimsonite Model 101**

Installed: 10/3/2001 by Highway Safety Services from milepoint 9.34 to 9.41

Marker No.	Housing*	Lens	Dirty Reading (mcd/lux)	Clean Reading (mcd/lux)	Night Visability
1	5	4	328	n/a	4
2	4	5	217	332	4
3	4	5	281	416	2
4	5	4	228	328	2
5	5	1	24	n/a	2
6	5	4	326	519	4
7	5	4	246	328	4
8	5	4	127	182	4
9	5	4	217	n/a	2
10	4	4	253	441	4
11	5	5	361	386	4
12	5	5	198	518	4
13	5	4	177	n/a	4
14	5	4	97	133	4
15	5	5	155	236	4
16	5	5	282	449	4
17	5	5	191	n/a	2
18	5	5	274	420	4
19	5	5	341	386	4
20	4	5	297	461	4
21	5	4	149	n/a	4
22	4	5	63	82	3
23	5	5	278	396	4
24	4	5	254	382	4
25	4	4	265	n/a	4
26	4	4	307	305	4
27	5	5	245	462	4
28	5	4	289	479	4
29	4	4	118	n/a	4
30	4	4	209	288	4
31	4	4	152	252	4
32	5	5	167	320	4
33	5	4	196	n/a	4
34	5	4	178	262	4
35	5	4	199	402	4
36	4	4	449	499	4
37	5	3	46	n/a	2
38	5	5	187	308	4
39	5	5	173	310	4
40	5	5	226	420	4

* = several housings were not flush with the pave

**= old housng as in way

Retroreflectometers

Form Filled Out By : Dan Robbins

Date: 4/14/2003

= Meter 214

= Meter 208

Raised Pavement Marker Ratings

I-97 Test Deck

NTPEP # RPM (2001 MD) - 4 **Avery- Dennison Corp.** **Stimsonite Model 96**

Installed: 10/4/2001 by Midlantic Marketing Co. from milepoint 9.43 to 9.50

Marker No.	Housing	Lens	Dirty Reading (mcd/lux)	Clean Reading (mcd/lux)	Night Visability
1	5	5	83	n/a	4
2	5	2	129	232	3
3	5	4	141	216	3
4	5	5	352	524	4
5	5	2	102	n/a	4
6	5	4	171	314	4
7	4	3	72	220	4
8	5	5	113	200	4
9	5	5	228	n/a	4
10	5	5	120	253	3
11	5	5	204	267	4
12	5	4	245	387	4
13	5	2	168	n/a	4
14	5	5	219	383	4
15	5	5	182	468	4
16	5	4	217	368	4
17	5	4	250	n/a	4
18	5	4	49	107	3
19	5	4	59	66	4
20	5	4	276	388	4
21	5	5	222	n/a	4
22	5	2	156	252	4
23	4	4	47	106	4
24	5	4	195	277	4
25	5	2	59	n/a	2
26	5	3	481	621	4
27	5	4	58	104	4
28	5	4	247	441	4
29	5	5	217	n/a	4
30	5	5	330	440	4
31	5	4	113	204	3
32	5	5	193	346	4
33	5	3	51	n/a	3
34	5	4	230	381	4
35	5	4	140	239	3
36	5	4	167	324	4
37	5	3	103	n/a	3
38	5	4	245	344	4
39	4	4	291	409	4
40	5	4	39	71	2

* = housing installed too deep

** = old housing in way

Form Filled Out By : Dan Robbins

Date: 4/14/2003

Retroreflectometers

= Meter 214

= Meter 208

Raised Pavement Marker Ratings

I-97 Test Deck

NTPEP # RPM (2001 MD) - 5 **Hallen Products, Ltd.** **Ironstar** **1W664**

Installed: 10/3/2001 by Highway Safety Services from milepoint 9.52 to 9.59

Marker No.	Housing*	Lens	Dirty Reading (mcd/lux)	Clean Reading (mcd/lux)	Night Visability
1	4	4	52	n/a	4
2	4	4	54	107	4
3	4	4	37	68	4
4	4	4	36	55	4
5	4	5	53	n/a	4
6	4	3	55	102	4
7	4	3	46	76	4
8	4	3	29	74	4
9	4	4	52	n/a	4
10	5	4	57	117	4
11	4	4	52	102	4
12	4	4	65	96	4
13	4	4	56	n/a	4
14	4	4	78	169	4
15	4	4	67	128	4
16	4	4	88	135	4
17	4	4	61	n/a	4
18	5	4	51	70	4
19	5	4	64	127	4
20	5	4	60	86	4
21	5	4	70	n/a	4
22	4	4	47	85	4
23	4	4	52	109	4
24	4	4	46	77	4
25	4	4	60	n/a	4
26	4	4	74	111	4
27	4	4	60	100	4
28	4	4	68	158	4
29	5	4	56	n/a	4
30	4	4	48	61	4
31	4	4	39	51	4
32	4	3	43	58	4
33	5	4	51	n/a	4
34	4	4	73	126	4
35	5	4	61	95	4
36	4	4	57	106	4
37	4	4	70	n/a	4
38	4	4	68	113	4
39	4	4	39	40	4
40	5	4	38	51	4

* = all housings were zinc plated

Retroreflectometers

Form Filled Out By : Dan Robbins

Date: 4/14/2003

= Meter 214

= Meter 208

Raised Pavement Marker Ratings

I-97 Test Deck

NTPEP # RPM (2001 M3)-6a **Astucia(UK), Ltd.** **Astucia Intelligent Flush Stud** **F-Series ND**

Installed: 10/5/2001 by Statewide Striping from milepoint 9.61 to 9.68

Marker No.	Housing	Lens	Dirty Reading* (mcd/lux)	Clean Reading* (mcd/lux)	Night Visability
1	5	4	n/a	n/a	2
2	5	4	n/a	n/a	2
3	5	4	n/a	n/a	2
4	5	4	n/a	n/a	0
5	5	4	n/a	n/a	2
6	5	4	n/a	n/a	2
7	5	4	n/a	n/a	0
8	5	4	n/a	n/a	0
9	5	4	n/a	n/a	2
10	5	4	n/a	n/a	2
11	5	4	n/a	n/a	2
12	5	4	n/a	n/a	0
13	5	4	n/a	n/a	0
14	5	4	n/a	n/a	2
15	5	4	n/a	n/a	2
16	5	4	n/a	n/a	2
17	5	4	n/a	n/a	2
18	5	4	n/a	n/a	2
19	5	3	n/a	n/a	2
20	5	4	n/a	n/a	2
21	5	4	n/a	n/a	2
22	5	4	n/a	n/a	0
23	5	4	n/a	n/a	0
24			n/a	n/a	
25			n/a	n/a	
26			n/a	n/a	
27			n/a	n/a	
28			n/a	n/a	
29			n/a	n/a	
30			n/a	n/a	
31			n/a	n/a	
32			n/a	n/a	
33			n/a	n/a	
34			n/a	n/a	
35			n/a	n/a	
36			n/a	n/a	
37			n/a	n/a	
38			n/a	n/a	
39			n/a	n/a	
40			n/a	n/a	

* = RPM's not compatible with current reflectivity measuring equipment

Form Filled Out By : Dan Robbins

Date: 4/14/2003

Retroreflectometers

= Meter 214

= Meter 208

Raised Pavement Marker Ratings

I-97 Test Deck

NTPEP # RPM (2001 MD) - 7 Nightline Markers, Inc. **NightLine** **B-400**

Installed: 10/5/2001 by Priceless Industries from milepoint 9.70 to 9.77

Marker No.	Housing	Lens	Dirty Reading (mcd/lux)	Clean Reading (mcd/lux)	Night Visability
1	5	4	69	n/a	4
2	5	4	77	243	4
3	5	4	82	215	4
4	4	4	82	229	4
5	5	4	60	n/a	4
6	5	4	64	101	4
7	5	4	58	133	4
8	5	4	49	131	4
9	5	4	82	n/a	4
10	5	4	55	114	4
11	5	4	82	157	4
12	5	4	51	100	4
13	5	3	66	n/a	4
14	5	3	39	46	4
15	5	4	128	248	4
16	5	3	68	158	4
17	5	3	64	n/a	3
18	5	3	72	148	3
19	5	3	56	133	4
20	5	4	80	155	4
21	5	4	44	n/a	4
22	5	4	84	151	4
23	5	4	65	137	4
24	5	4	76	158	4
25	5	4	77	n/a	4
26	5	4	75	163	4
27	5	3	57	123	4
28	5	5	83	164	4
29	5	5	71	n/a	4
30	5	4	63	115	4
31	5	5	79	144	4
32	5	4	59	91	4
33	5	4	64	n/a	4
34	5	4	127	279	4
35	5	4	95	204	4
36	5	4	57	112	4
37	5	4	86	n/a	4
38	5	4	76	150	4
39	5	4	92	152	4
40	4	4	58	114	4

Retroreflectometers

Form Filled Out By : Dan Robbins

Date: 4/14/2003

= Meter 214

= Meter 208

Raised Pavement Marker Ratings

I-97 Test Deck

NTPEP # RPM (2001 MD) - 8 Pac-Tec, I **Ray-O-Lite** **Snow-Lite Model 100**

Installed: 10/3/2001 by Priceless Industries from milepoint 9.79 to 9.86

Marker No.	Housing*	Lens	Dirty Reading (mcd/lux)	Clean Reading (mcd/lux)	Night Visability
1	5	3	41	n/a	3
2	5	5	46	93	3
3	5	5	28	66	3
4	4	4	31	68	3
5	5	2	34	n/a	3
6	5	5	41	77	3
7	5	5	33	62	3
8	5	5	39	89	3
9	5	5	36	n/a	3
10	5	5	38	69	3
11	5	5	35	77	3
12	5	4	28	70	3
13	5	3	24	n/a	3
14	5	4	38	73	3
15	5	4	47	90	3
16	5	4	39	66	3
17	5	4	36	n/a	3
18	5	5	33	68	3
19	5	4	30	61	3
20	5	4	34	77	3
21	5	5	26	n/a	3
22	5	5	35	98	3
23	5	4	21	37	3
24	5	2	17	18	3
25	5	4	33	n/a	2
26	5	4	30	56	3
27	5	4	27	36	3
28	5	4	46	95	3
29	5	5	43	n/a	3
30	5	4	34	65	3
31	5	5	30	67	3
32	5	4	33	70	3
33	5	3	39	n/a	3
34	5	4	45	89	3
35	5	4	21	24	3
36	5	4	42	64	3
37	5	2	41	n/a	3
38	5	3	52	101	3
39	5	3	45	70	3
40	5	5	37	54	3

* = old housing was in the way

Retroreflectometers

Form Filled Out By : Dan Robbins

Date: 4/14/2003

= Meter 214

= Meter 208

Raised Pavement Marker Ratings

MD 100 Test Deck

NTPEP # RPM (2001 MD) - 3M Comp **3m Series 190 Marker** **190 - H960HP**

Installed: 10/3/2001 by Priceless Industries from milepoint 4.92 to 4.99

Marker No.	Housing*	Lens	Dirty Reading (mcd/lux)	Clean Reading (mcd/lux)	Night Visability
1	4	4	47	n/a	4
2	5	3	59	71	4
3	4	4	62	71	4
4	5	4	93	123	4
5	5	3	88	n/a	3
6	5	4	88	125	4
7	5	4	97	158	4
8	5	4	76	112	4
9	5	2	35	n/a	3
10	4	4	41	47	4
11	4	4	51	72	4
12	4	4	67	80	4
13	5	3	102	n/a	3
14	5	4	92	192	4
15	5	4	80	124	4
16	5	4	83	129	4
17	4	4	61	n/a	4
18	4	4	63	75	4
19	4	3	61	67	4
20	4	3	60	72	4
21	5	3	89	n/a	3
22	5	4	66	96	4
23	5	4	116	160	4
24	5	4	129	172	4
25	4	4	75	n/a	4
26	4	4	70	83	4
27	4	3	86	96	4
28	4	4	85	108	4
29	5	4	118	n/a	4
30	5	4	87	142	4
31	5	4	101	175	4
32	5	4	116	200	4
33	4	3	60	n/a	3
34	4	3	90	128	4
35	4	3	60	74	4
36	4	3	76	87	4
37	5	4	136	n/a	4
38	4	4	112	163	4
39	5	4	104	148	4
40	5	4	128	178	4

* = all housings were zinc plated

Retroreflectometers

ɔrm Filled Out By : Brian Smoot

Date: 4/15/2003

= Meter 214

= Meter 208

Raised Pavement Marker Ratings

MD 100 Test Deck

NTPEP # RPM (2001 MD) - **Avery- Dennison Corp.** **Stimsonite Model 101**

Installed: 10/3/2001 by Highway Safety Services from milepoint 5.01 to 5.08

Marker No.	Housing*	Lens	Dirty Reading (mcd/lux)	Clean Reading (mcd/lux)	Night Visability
1	4	4	97	----------	4
2	4	3	154	195	3
3	4	4	23	143	4
4	4	4	341	419	4
5	5	5	269	----------	4
6	5	5	253	322	4
7	5	5	241	286	4
8	5	4	229	314	4
9	4	4	24	----------	2
10	4	4	133	140	4
11	4	4	310	384	4
12	4	4	270	330	4
13	5	5	347	----------	4
14	5	5	294	423	4
15	5	4	194	237	4
16	5	5	166	245	4
17	4	3	139	----------	4
18	4	4	268	306	4
19	4	2	28	28	0
20	4	4	65	81	3
21	5	5	288	----------	4
22	5	5	129	186	3
23	5	5	178	258	4
24	5	5	56	99	2
25	4	4	234	----------	4
26	4	4	214	265	4
27	4	4	189	253	4
28	4	4	190	233	4
29	5	3	69	----------	2
30	5	5	254	350	4
31	5	5	199	251	4
32	5	5	337	450	4
33	4	3	216	----------	4
34	4	4	136	176	4
35	4	4	99	112	3
36	4	3	222	332	4
37	5	5	329	----------	4
38	5	4	219	339	4
39	5	5	341	528	4
40	5	5	265	387	4

* = several housings were not flush with the p

Retroreflectometers

orm Filled Out By : Brian Smoot

Date: 4/15/2003

= Meter 214

= Meter 208

Raised Pavement Marker Ratings

MD 100 Test Deck

NTPEP # RPM (2001 MD) - **Avery- Dennison Corp.** **Stimsonite Model 96**

Installed: 10/4/2001 by Midlantic Marketing Co. from milepoint 5.10 to 5.17

Marker No.	Housing	Lens	Dirty Reading (mcd/lux)	Clean Reading (mcd/lux)	Night Visability
1	4	4	233	----------	4
2	4	3	115	189	4
3	4	4	276	351	4
4	4	4	209	270	4
5	5	4	228	----------	4
6	5	4	72	108	3
7	5	5	295	431	4
8	5	4	133	207	3
9	4	4	194	----------	4
10	4	4	216	401	4
11	4	4	190	304	4
12	4	4	363	479	4
13	4	4	187	----------	4
14	5	5	131	161	4
15	5	5	275	328	4
16	5	4	145	229	4
17	4	4	295	----------	4
18	4	4	231	389	4
19	4	4	67	163	4
20	4	4	122	150	4
21	5	4	75	----------	3
22	5	5	176	249	4
23	5	5	277	453	4
24	5	5	283	381	4
25	4	4	143	----------	4
26	4	4	162	264	4
27	4	4	145	211	4
28	4	4	43	65	3
29	5	5	187	----------	4
30	5	5	88	113	4
31	5	3	153	199	4
32	5	4	250	311	4
33	4	4	235	----------	4
34	4	4	197	264	4
35	4	4	278	387	4
36	4	4	207	226	4
37	4	4	271	----------	4
38	5	5	281	419	4
39	4	4	134	189	4
40	5	4	160	198	4

Retroreflectometers

ɔrm Filled Out By : Brian Smoot

Date: 4/15/2003

= Meter 214

= Meter 208

Raised Pavement Marker Ratings

MD 100 Test Deck

NTPEP # RPM (2001 MD) - Hallen Products, Ltd. **Ironstar** **1W664**

Installed: 10/3/2001 by Highway Safety Services from milepoint 5.19 to 5.26

Marker No.	Housing*	Lens	Dirty Reading (mcd/lux)	Clean Reading (mcd/lux)	Night Visability
1	4	4	86	----------	4
2	4	4	63	79	4
3	4	4	83	105	4
4	4	4	179	250	4
5	3	4	139	----------	4
6	4	4	84	127	4
7	5	4	127	198	4
8	4	4	75	113	4
9	4	3	75	----------	4
10	4	3	52	78	4
11	4	4	59	66	4
12	4	3	118	149	4
13	4	4	101	----------	4
14	5	4	106	217	4
15	5	4	76	114	4
16	5	4	83	140	4
17	4	3	80	----------	4
18	4	4	76	88	4
19	4	4	49	62	4
20	4	4	30	34	4
21	4	4	106	----------	4
22	4	4	105	136	4
23	4	4	72	98	4
24	5	4	99	115	4
25	3	3	47	----------	4
26	4	3	45	48	4
27	4	4	55	55	4
28	4	3	72	87	4
29	5	4	139	----------	4
30	3	4	135	161	4
31	4	4	108	157	4
32	4	4	61	90	4
33	3	3	60	----------	3
34	3	4	59	64	4
35	3	4	96	112	4
36	3	4	113	134	4
37	4	4	119	----------	4
38	4	4	71	102	3
39	5	4	108	148	4
40	5	5	101	151	4

* = all housings were zinc plated

Retroreflectometers

ɔrm Filled Out By : Brian Smoot

Date: 4/15/2003

= Meter 214

= Meter 208

Raised Pavement Marker Ratings

MD 100 Test Deck

NTPEP # RPM (2001MD)a **Astucia (UK), Ltd.** **Astucia Intelligent Flush Stud** **F-Series ND**

Installed: 10/4/2001 by Statewide Striping from milepoint 5.28 to 5.35

Marker No.	Housing	Lens	Dirty Reading* (mcd/lux)	Clean Reading* (mcd/lux)	Night Visability
1	5	4	n/a	n/a	3
2	5	4	n/a	n/a	3
3	5	4	n/a	n/a	3
4	5	4	n/a	n/a	3
5	4	4	n/a	n/a	Out
6	4	4	n/a	n/a	3
7	4	4	n/a	n/a	3
8	4	4	n/a	n/a	3
9	5	4	n/a	n/a	3
10	5	4	n/a	n/a	3
11	5	4	n/a	n/a	3
12	5	4	n/a	n/a	3
13	4	4	n/a	n/a	3
14	4	4	n/a	n/a	3
15	4	4	n/a	n/a	3
16	5	4	n/a	n/a	3
17	5	4	n/a	n/a	3
18	5	4	n/a	n/a	3
19	5	3	n/a	n/a	3
20	5	4	n/a	n/a	3
21	5	2	n/a	n/a	3
22	2	2	n/a	n/a	Out
23	5	5	n/a	n/a	33
24	4	4	n/a	n/a	3
25	5	4	n/a	n/a	3
26	5	4	n/a	n/a	3
27	5	4	n/a	n/a	3
28	5	4	n/a	n/a	3
29	5	4	n/a	n/a	Out
30	5	4	n/a	n/a	Out
31	5	5	n/a	n/a	3
32	5	4	n/a	n/a	3
33	5	3	n/a	n/a	3
34	5	3	n/a	n/a	3
35	5	4	n/a	n/a	Out
36	5	4	n/a	n/a	3
37	5	4	n/a	n/a	3
38	5	4	n/a	n/a	3
39	5	4	n/a	n/a	3
40	5	4	n/a	n/a	Out

Retroreflectometers

4

orm Filled Out By : Brian Smoot

Date: 4/15/2003

= Meter 214

= Meter 208

Raised Pavement Marker Ratings

MD 100 Test Deck

NTPEP # RPM (2001 MD) - Nightline Markers, Inc. **NightLine** **B-400**

Installed: 10/4/2001 by Priceless Industries from milepoint 5.38 to 5.45

Marker No.	Housing	Lens	Dirty Reading (mcd/lux)	Clean Reading (mcd/lux)	Night Visability
1	5	4	86	----------	4
2	5	4	132	178	4
3	4	4	106	221	4
4	4	3	88	135	4
5	5	4	108	----------	4
6	5	4	137	246	4
7	5	4	169	299	4
8	4	4	153	258	4
9	5	4	91	----------	4
10	5	3	152	275	4
11	5	3	124	158	4
12	5	4	128	161	4
13	5	4	259	----------	4
14	4	4	159	232	4
15	4	4	214	311	4
16	4	4	141	258	4
17	4	3	87	----------	4
18	4	4	102	122	4
19	4	4	88	97	4
20	4	3	122	153	4
21	5	5	122	----------	4
22	5	5	101	141	4
23	4	4	132	218	4
24	5	4	175	286	4
25	4	4	148	----------	4
26	4	3	93	96	4
27	4	3	177	209	4
28	4	3	132	149	4
29	5	4	143	----------	4
30	4	4	181	250	4
31	4	5	271	413	4
32	5	4	192	298	4
33	4	4	132	----------	4
34	4	3	143	159	4
35	4	4	190	239	4
36	4	4	142	165	4
37	5	4	110	----------	4
38	5	5	246	365	4
39	5	4	176	280	4
40	5	4	192	349	4

Retroreflectometers

ɔrm Filled Out By : Brian Smoot

Date: 4/15/2003

= Meter 214

= Meter 208

Raised Pavement Marker Ratings

MD 100 Test Deck

NTPEP # RPM (2001 MD) - Pac-Tec, I **Ray-O-Lite** **Snow-Lite Model 100**

Installed: 10/3/2001 by Priceless Industries from milepoint 5.47 to 5.54

Marker No.	Housing*	Lens	Dirty Reading (mcd/lux)	Clean Reading (mcd/lux)	Night Visability
1	4	4	43	----------	3
2	4	4	59	73	3
3	4	4	52	63	3
4	4	5	54	59	3
5	5	4	70	----------	3
6	5	5	53	68	3
7	5	3	53	98	3
8	5	4	59	104	3
9	4	4	34	----------	3
10	4	4	61	78	3
11	3	4	66	78	3
12	4	3	49	50	3
13	5	4	64	----------	3
14	5	3	47	76	3
15	5	5	42	55	3
16	5	3	57	80	3
17	5	1	53	----------	3
18	5	4	51	69	3
19	5	4	57	69	3
20	5	4	46	65	3
21	5	5	50	----------	3
22	5	4	69	74	3
23	5	4	94	108	3
24	5	4	51	83	3
25	4	4	52	----------	3
26	4	4	55	74	3
27	4	4	44	53	3
28	4	4	37	44	3
29	5	5	46	----------	3
30	5	4	45	69	3
31	5	5	58	99	3
32	5	4	53	68	3
33	4	3	34	----------	3
34	4	4	39	45	2
35	4	4	44	61	3
36	4	4	63	85	3
37	5	3	32	----------	2
38	5	4	49	74	3
39	5	5	54	84	3
40	5	5	40	51	3

* = old housing was partially in the way

Retroreflectometers

orm Filled Out By : Brian Smoot

Date: 4/15/2003

= Meter 214

= Meter 208

24 Month Readings

Raised Pavement Marker Ratings

I-97 Test Deck

NTPEP # RPM (2001 MD) - 2 **3M Comp:** **3m Series 190 Marker** **190 - H960HP**

Installed: 10/4/2001 by Priceless Industries from milepoint 9.25 to 9.32

Marker No.	Housing*	Lens	Dirty Reading (mcd/lux)	Clean Reading (mcd/lux)	Night Visability
1	5	3	32	---------	4
2	4	2	36	47	4
3	5	3	32	40	4
4	4	3	36	48	4
5	4	2	37	----------	4
6	4	2	30	40	3
7	4	2	40	48	4
8	4	3	40	48	4
9	5	3	38	----------	4
10	5	4	31	31	5
11	5	4	28	28	4
12	5	4	36	44	4
13	4	2	26	----------	3
14	4	3	34	51	4
15	4	3	35	54	4
16	3	2	32	45	4
17	5	4	28	----------	3
18	5	4	36	42	5
19	5	4	36	40	4
20	5	4	31	52	4
21	4	1	42	----------	3
22	4	3	37	55	4
23	4	2	39	53	4
24	3	2	47	73	4
25	5	4	42	----------	4
26	5	4	38	41	4
27	5	4	38	43	4
28	5	4	44	50	4
29	4	2	43	----------	3
30	3	2	30	62	4
31	4	2	33	62	4
32	4	2	31	46	3
33	4	4	34	----------	3
34	5	4	25	25	2
35	5	4	23	24	4
36	5	4	27	31	3
37	4	4	34	----------	4
38	3	3	38	73	4
39	4	3	42	73	4
40	4	3	38	64	4

Retroreflectometers

Form Filled Out By : R. Wray, G. Rushton, M. Basha **= Meter 214**

Date: 10/6/2003 **= Meter 208**

Raised Pavement Marker Ratings

I-97 Test Deck

NTPEP # RPM (2001 MD) - 3 **Avery- Dennison Corp.** **Stimsonite Model 101**

Installed: 10/3/2001 by Highway Safety Services from milepoint 9.34 to 9.41

Marker No.	Housing*	Lens	Dirty Reading (mcd/lux)	Clean Reading (mcd/lux)	Night Visability
1	5	4	165	---------	4
2	5	4	46	49	1
3	5	4	24	24	0
4	5	4	27	27	0
5	4	1	13	----------	0
6	4	3	201	250	4
7	3	2	24	26	1
8	4	4	74	86	3
9	5	2	23	----------	0
10	5	5	178	186	4
11	5	4	145	199	4
12	5	4	134	160	4
13	4	2	104	----------	2
14	4	1	13	14	0
15	4	2	117	142	3
16	4	4	192	213	4
17	5	4	25	----------	1
18	5	4	121	151	3
19	5	3	34	86	1
20	5	2	26	26	1
21	4	3	73	----------	3
22	4	3	29	35	1
23	4	4	127	221	2
24	4	4	184	242	4
25	5	4	136	----------	4
26	5	3	25	26	0
27	5	4	108	147	2
28	5	4	70	80	2
29	4	2	28	----------	1
30	4	3	16	17	0
31	4	3	36	39	2
32	4	4	175	234	3
33	5	2	41	----------	1
34	5	3	28	29	1
35	5	2	31	31	1
36	5	4	132	141	3
37	4	2	27	----------	1
38	4	4	175	194	4
39	4	2	45	49	1
40	4	3	42	47	1

* = several housings were not flush with the pave

**= old housng as in way

Retroreflectometers

Form Filled Out By : R. Wray, G. Rushton, M. Basha **= Meter 214**

Date: 10/6/2003 **= Meter 208**

Raised Pavement Marker Ratings

I-97 Test Deck

NTPEP # RPM (2001 MD) - 4 **Avery- Dennison Corp.** **Stimsonite Model 96**

Installed: 10/4/2001 by Midlantic Marketing Co. from milepoint 9.43 to 9.50

Marker No.	Housing*	Lens	Dirty Reading (mcd/lux)	Clean Reading (mcd/lux)	Night Visability
1	5	4	24	---------	1
2	5	2	24	24	0
3	5	3	24	24	0
4	5	4	136	183	3
5	4	2	73	----------	3
6	4	4	93	121	4
7	4	2	14	14	0
8	4	4	63	83	2
9	5	4	99	----------	3
10	5	2	25	25	0
11	5	4	95	45	4
12	5	3	36	39	1
13	4	1	23	----------	1
14	4	4	171	223	4
15	4	4	89	108	3
16	4	3	158	217	4
17	5	4	39	----------	1
18	5	3	24	24	0
19	5	4	29	24	0
20	5	4	425	179	3
21	4	2	28	----------	1
22	4	1	106	146	3
23	3	2	18	14	0
24	4	2	38	55	1
25	5	2	31	----------	1
26	5	4	107	127	4
27	5	3	24	24	2
28	5	4	86	93	3
29	4	4	147	----------	4
30	4	4	148	216	4
31	4	2	60	72	3
32	4	4	139	254	4
33	5	4	25	----------	0
34	5	4	131	133	3
35	5	3	29	31	1
36	5	3	39	47	1
37	4	1	16	----------	0
38	4	3	69	85	3
39	3	3	151	185	3
40	4	4	14	14	0

* = housing installed too deep

** = old housing in way

Retroreflectometers

Form Filled Out By : R. Wray, G. Rushton, M. Basha = **Meter 214**

Date: 10/6/2003 = **Meter 208**

Raised Pavement Marker Ratings

I-97 Test Deck

NTPEP # RPM (2001 MD) - 5 **Hallen Products, Ltd.** **Ironstar** **1W664**

Installed: 10/3/2001 by Highway Safety Services from milepoint 9.52 to 9.59

Marker No.	Housing*	Lens	Dirty Reading (mcd/lux)	Clean Reading (mcd/lux)	Night Visability
1	4	4	37	---------	3
2	4	4	34	36	3
3	4	4	28	29	2
4	4	4	28	29	3
5	3	3	34	----------	3
6	3	2	42	57	3
7	3	2	38	62	3
8	3	2	41	24	3
9	5	4	31	----------	4
10	5	4	36	39	4
11	4	4	39	42	4
12	4	4	32	34	4
13	3	2	34	----------	4
14	3	3	48	134	4
15	3	2	34	75	3
16	3	2	46	80	4
17	5	4	32	----------	4
18	5	4	28	29	4
19	4	4	36	39	4
20	4	4	33	34	4
21	4	2	46	----------	4
22	3	2	31	52	3
23	3	2	46	68	4
24	3	3	31	37	4
25	4	4	37	----------	4
26	4	4	38	40	4
27	4	4	39	41	4
28	4	4	48	63	4
29	4	3	37	----------	4
30	3	3	23	27	4
31	3	2	23	28	4
32	3	2	21	26	4
33	5	4	28	----------	3
34	4	4	38	43	4
35	5	4	39	36	4
36	4	4	38	41	4
37	3	3	31	----------	4
38	3	2	43	64	4
39	3	2	16	17	3
40	4	2	17	20	3

* = all housings were zinc plated

Retroreflectometers

Form Filled Out By : R. Wray, G. Rushton, M. Basha **= Meter 214**

Date: 10/6/2003 **= Meter 208**

Raised Pavement Marker Ratings

I-97 Test Deck

NTPEP # RPM (2001 MD) Astucia(UK), Ltd. **Astucia Intelligent Flush Stud** **F-Series ND**

Installed: 10/5/2001 by Statewide Striping from milepoint 9.61 to 9.68

Marker No.	Housing	Lens	Dirty Reading* (mcd/lux)	Clean Reading* (mcd/lux)	Night Visability
1	5	4	n/a	n/a	2
2	5	4	n/a	n/a	2
3	5	4	n/a	n/a	2
4	5	out	n/a	n/a	0
5	4	3	n/a	n/a	2
6	4	3	n/a	n/a	2
7	4	3	n/a	n/a	0
8	4	3	n/a	n/a	0
9	5	4	n/a	n/a	2
10	5	4	n/a	n/a	2
11	5	4	n/a	n/a	2
12	5	out	n/a	n/a	0
13	4	3	n/a	n/a	0
14	4	3	n/a	n/a	2
15	4	3	n/a	n/a	2
16	4	3	n/a	n/a	2
17	5	4	n/a	n/a	2
18	5	out	n/a	n/a	2
19	5	out	n/a	n/a	0
20	5	4	n/a	n/a	0
21	4	3	n/a	n/a	2
22	4	3	n/a	n/a	n/a
23			n/a	n/a	n/a
24			n/a	n/a	n/a
25			n/a	n/a	0
26			n/a	n/a	n/a
27			n/a	n/a	n/a
28			n/a	n/a	n/a
29			n/a	n/a	0
30			n/a	n/a	n/a
31			n/a	n/a	n/a
32			n/a	n/a	n/a
33			n/a	n/a	n/a
34			n/a	n/a	n/a
35			n/a	n/a	n/a
36			n/a	n/a	n/a
37			n/a	n/a	n/a
38			n/a	n/a	n/a
39			n/a	n/a	n/a
40			n/a	n/a	n/a

* = RPM's not compatible with current reflectivity measuring equipment

Retroreflectometers

Form Filled Out By : R. Wray, G. Rushton, M. Basha = **Meter 214**

Date: 10/6/2003 = **Meter 208**

Raised Pavement Marker Ratings

I-97 Test Deck

NTPEP # RPM (2001 MD) - 7 **Nightline Markers, Inc.** **NightLine** **B-400**

Installed: 10/5/2001 by Priceless Industries from milepoint 9.70 to 9.77

Marker No.	Housing*	Lens	Dirty Reading (mcd/lux)	Clean Reading (mcd/lux)	Night Visability
1	5	4	42	---------	4
2	5	4	38	48	4
3	5	4	38	44	4
4	5	4	44	60	4
5	4	2	29	----------	4
6	4	3	27	42	4
7	4	4	23	44	4
8	4	3	27	56	4
9	5	4	39	----------	4
10	5	4	34	38	4
11	5	4	35	38	3
12	5	4	30	32	3
13	4	3	24	----------	3
14	4	2	19	22	2
15	4	3	55	121	4
16	4	3	27	66	2
17	5	4	39	----------	4
18	5	4	40	46	4
19	5	4	35	39	4
20	5	4	41	46	4
21	4	3	20	----------	3
22	4	2	39	59	4
23	4	3	32	50	3
24	4	3	30	68	3
25	5	4	44	----------	4
26	5	4	40	49	4
27	5	4	31	34	3
28	5	4	39	42	4
29	4	4	36	----------	4
30	4	2	26	38	4
31	4	4	36	69	4
32	4	3	30	44	4
33	5	5	40	----------	4
34	5	4	47	52	4
35	5	4	43	50	3
36	5	4	32	39	3
37	4	3	37	----------	4
38	4	3	41	68	4
39	3	3	40	60	4
40	3	4	34	59	4

Retroreflectometers

Form Filled Out By : R. Wray, G. Rushton, M. Basha **= Meter 214**

Date: 10/6/2003 **= Meter 208**

Raised Pavement Marker Ratings

I-97 Test Deck

NTPEP # RPM (2001 MD) - 8 **Pac-Tec, I** **Ray-O-Lite** **Snow-Lite Model 100**

Installed: 10/3/2001 by Priceless Industries from milepoint 9.79 to 9.86

Marker No.	Housing*	Lens	Dirty Reading (mcd/lux)	Clean Reading (mcd/lux)	Night Visability
1	5	3	25	---------	2
2	5	4	25	25	2
3	5	4	25	25	2
4	4	4	25	25	1
5	4	1	14	----------	2
6	4	4	14	18	2
7	4	3	15	20	2
8	4	3	15	19	2
9	5	4	25	----------	2
10	5	4	24	25	2
11	5	4	24	25	2
12	5	4	25	25	2
13	4	2	14	----------	1
14	4	2	14	20	2
15	4	2	16	30	2
16	4	4	15	24	2
17	5	4	25	----------	2
18	5	4	24	25	2
19	5	4	25	28	2
20	5	4	25	28	2
21	4	2	15	----------	2
22	4	3	15	22	2
23	4	1	14	16	1
24	4	2	13	14	0
25	5	4	24	----------	2
26	5	4	24	25	2
27	5	4	24	24	2
28	5	4	25	26	2
29	4	3	15	----------	2
30	4	2	14	18	2
31	4	3	15	25	2
32	4	3	15	21	2
33	5	4	25	----------	2
34	5	4	25	25	2
35	5	4	24	24	2
36	5	4	25	28	2
37	4	1	15	----------	1
38	4	2	16	24	2
39	4	2	15	23	2
40	4	3	15	24	2

* = old housing was in the way

Retroreflectometers

Form Filled Out By : R. Wray, G. Rushton, M. Basha = **Meter 214**

Date: 10/6/2003 = **Meter 208**

Raised Pavement Marker Ratings

MD 100 Test Deck

NTPEP # RPM (2001 MD) - 2 3M Comp **3m Series 190 Marker** **190 - H960HP**

Installed: 10/3/2001 by Priceless Industries from milepoint 4.92 to 4.99

Marker No.	Housing*	Lens	Dirty Reading (mcd/lux)	Clean Reading (mcd/lux)	Night Visability
1	5	4	31	----------	3
2	5	4	40	43	4
3	5	4	50	56	4
4	5	4	71	78	4
5	4	3	50	----------	2
6	4	3	46	66	4
7	4	3	58	94	4
8	4	2	46	65	3
9	5	3	30	----------	1
10	5	4	35	37	4
11	5	4	44	49	2
12	5	4	50	56	3
13	4	2	59	----------	2
14	4	3	61	112	4
15	3	3	59	74	3
16	4	2	49	64	4
17	5	4	39	----------	3
18	5	4	49	55	4
19	5	4	41	42	2
20	5	4	47	57	4
21	4	2	49	----------	2
22	4	4	30	52	4
23	4	3	32	40	4
24	4	2	44	55	3
25	5	4	53	----------	3
26	5	4	50	52	4
27	5	4	62	69	3
28	5	4	58	64	4
29	4	3	52	----------	4
30	4	3	31	43	4
31	4	3	29	44	4
32	4	3	61	90	4
33	5	4	26	----------	2
34	5	4	58	74	4
35	5	4	42	48	2
36	5	4	48	51	3
37	4	3	48	----------	3
38	4	3	35	46	4
39	4	3	53	58	4
40	4	2	59	72	4

* = all housings were zinc plated

Retroreflectometers

Form Filled Out By : R. Wray, G. Rushton, S. Gainer **= Meter 214**

Date: 10/7/2003 **= Meter 208**

Raised Pavement Marker Ratings

MD 100 Test Deck

NTPEP # RPM (2001 MD) - 3 **Avery- Dennison Corp.** **Stimsonite Model 101**

Installed: 10/3/2001 by Highway Safety Services from milepoint 5.01 to 5.08

Marker No.	Housing*	Lens	Dirty Reading (mcd/lux)	Clean Reading (mcd/lux)	Night Visability
1	5	5	79	----------	4
2	5	3	23	23	0
3	5	5	80	87	3
4	5	5	172	216	3
5	4	4	102	----------	4
6	4	4	190	232	4
7	4	4	179	224	4
8	4	4	191	245	3
9	5	5	24	----------	1
10	5	5	226	254	4
11	5	3	205	256	4
12	5	4	55	59	3
13	4	4	232	----------	4
14	4	2	14	14	0
15	4	3	128	154	4
16	4	3	75	90	3
17	5	3	39	----------	1
18	5	4	52	54	3
19	5	0	22	33	0
20	5	4	32	33	4
21	4	4	184	----------	4
22	4	3	60	110	4
23	4	3	105	195	4
24	4	3	25	32	2
25	5	4	152	----------	4
26	5	4	35	46	2
27	5	4	78	89	4
28	5	4	127	147	4
29	4	1	13	----------	1
30	4	3	188	278	4
31	4	1	17	20	2
32	4	2	34	50	3
33	5	4	143	----------	4
34	5	4	22	23	0
35	5	4	26	26	1
36	5	4	126	141	4
37	4	2	199	----------	4
38	4	3	131	187	4
39	4	4	158	230	4
40	4	4	191	294	4

* = several housings were not flush with the p

Retroreflectometers

Form Filled Out By : R. Wray, G. Rushton, S. Gainer **= Meter 214**

Date: 10/7/2003 **= Meter 208**

Raised Pavement Marker Ratings

MD 100 Test Deck

NTPEP # RPM (2001 MD) - 4 **Avery- Dennison Corp.** **Stimsonite Model 96**

Installed: 10/4/2001 by Midlantic Marketing Co. from milepoint 5.10 to 5.17

Marker No.	Housing	Lens	Dirty Reading (mcd/lux)	Clean Reading (mcd/lux)	Night Visability
1	5	4	151	----------	4
2	5	3	42	65	1
3	5	4	132	211	4
4	5	4	152	196	4
5	4	3	150	----------	4
6	4	3	16	19	1
7	4	4	211	358	4
8	4	3	70	97	3
9	5	5	148	----------	4
10	5	5	162	178	4
11	5	5	138	177	4
12	5	5	176	250	4
13	4	4	108	----------	4
14	4	4	56	82	4
15	4	4	162	282	4
16	4	3	44	56	4
17	5	5	124	----------	4
18	5	5	201	315	4
19	5	5	25	25	1
20	5	5	90	99	4
21	4	3	57	----------	4
22	4	4	128	184	4
23	4	4	111	150	4
24	4	4	137	229	4
25	5	5	195	----------	4
26	5	5	124	162	4
27	5	5	96	105	4
28	5	5	38	47	3
29	4	4	69	----------	4
30	4	3	42	32	4
31	4	1	27	36	1
32	4	3	154	187	4
33	5	5	158	----------	4
34	5	5	79	104	4
35	5	4	127	207	4
36	5	5	88	133	4
37	4	2	60	----------	3
38	4	4	168	253	4
39	4	2	13	13	1
40	4	4	147	192	4

Retroreflectometers

Form Filled Out By : R. Wray, G. Rushton, S. Gainer **= Meter 214**

Date: 10/7/2003 **= Meter 208**

Raised Pavement Marker Ratings

MD 100 Test Deck

NTPEP # RPM (2001 MD) - 5 **Hallen Products, Ltd.** **Ironstar** **1W664**

Installed: 10/3/2001 by Highway Safety Services from milepoint 5.19 to 5.26

Marker No.	Housing*	Lens	Dirty Reading (mcd/lux)	Clean Reading (mcd/lux)	Night Visability
1	5	5	55	----------	4
2	5	5	39	40	4
3	5	5	47	51	4
4	5	5	96	118	4
5	3	3	55	----------	4
6	4	3	33	53	4
7	4	3	52	72	4
8	4	2	25	23	3
9	5	4	63	----------	4
10	5	4	49	53	4
11	5	4	41	44	4
12	5	4	80	93	4
13	4	2	62	----------	4
14	4	2	49	77	4
15	4	2	37	49	4
16	4	3	21	40	4
17	5	4	22	----------	4
18	5	4	50	52	4
19	5	4	40	41	4
20	5	4	25	25	4
21	4	3	31	----------	4
22	4	2	25	46	4
23	4	2	17	22	4
24	4	3	34	49	4
25	5	4	38	----------	4
26	5	4	33	35	4
27	5	4	37	42	4
28	5	4	40	42	4
29	4	2	27	----------	4
30	4	2	33	66	4
31	4	3	29	35	4
32	4	2	17	31	3
33	5	4	41	----------	3
34	4	4	44	46	4
35	4	4	65	68	4
36	4	4	74	78	4
37	4	2	37	----------	4
38	4	2	12	23	3
39	4	3	18	32	4
40	4	3	29	44	4

* = all housings were zinc plated

Retroreflectometers

Form Filled Out By : R. Wray, G. Rushton, S. Gainer **= Meter 214**

Date: 10/7/2003 **= Meter 208**

Raised Pavement Marker Ratings

MD 100 Test Deck

NTPEP # RPM (2001 MD) 6 **Manufacturer: Astucia(UK), Ltd.** **Astucia Intelligent Flush Stud** **F-Series ND**

Installed: 10/4/2001 by Statewide Striping from milepoint 5.28 to 5.35

Marker No.	Housing	Lens	Dirty Reading* (mcd/lux)	Clean Reading* (mcd/lux)	Night Visability
1	5	4	n/a	n/a	0
2	5	4	n/a	n/a	2
3	5	4	n/a	n/a	2
4	5	4	n/a	n/a	2
5	4	3	n/a	n/a	0
6	4	3	n/a	n/a	0
7	4	3	n/a	n/a	2
8	4	3	n/a	n/a	2
9	5	4	n/a	n/a	2
10	5	4	n/a	n/a	1
11	5	4	n/a	n/a	0
12	5	4	n/a	n/a	0
13	4	3	n/a	n/a	1
14	4	3	n/a	n/a	1
15	4	3	n/a	n/a	0
16	4	3	n/a	n/a	2
17	5	4	n/a	n/a	1
18	5	5	n/a	n/a	2
19	5	4	n/a	n/a	0
20	5	5	n/a	n/a	1
21	4	1	n/a	n/a	0
22	4	1	n/a	n/a	0
23	4	3	n/a	n/a	1
24	4	3	n/a	n/a	0
25	5	4	n/a	n/a	1
26	5	4	n/a	n/a	2
27	5	4	n/a	n/a	2
28	5	4	n/a	n/a	2
29	4	3	n/a	n/a	0
30	4	3	n/a	n/a	0
31	4	3	n/a	n/a	2
32	4	3	n/a	n/a	2
33	5	4	n/a	n/a	2
34	5	4	n/a	n/a	0
35	5	4	n/a	n/a	0
36	5	4	n/a	n/a	2
37	4	3	n/a	n/a	2
38	4	3	n/a	n/a	0
39	4	3	n/a	n/a	2
40	4	3	n/a	n/a	0

Retroreflectometers

4

Form Filled Out By : R. Wray, G. Rushton, S. Gainer **= Meter 214**

Date: 10/7/2003 **= Meter 208**

Raised Pavement Marker Ratings

MD 100 Test Deck

NTPEP # RPM (2001 MD) - 7 Nightline Markers, Inc. **NightLine** **B-400**

Installed: 10/4/2001 by Priceless Industries from milepoint 5.38 to 5.45

Marker No.	Housing	Lens	Dirty Reading (mcd/lux)	Clean Reading (mcd/lux)	Night Visability
1	5	4	50	----------	4
2	5	4	84	106	4
3	5	5	62	75	4
4	5	4	50	55	3
5	4	3	27	----------	3
6	4	3	35	67	4
7	4	4	51	68	4
8	4	2	39	48	3
9	5	5	47	----------	4
10	5	4	59	70	3
11	5	4	56	58	4
12	5	4	54	77	3
13	4	3	90	----------	4
14	4	3	37	95	4
15	4	3	59	91	4
16	4	2	49	67	4
17	5	4	46	----------	3
18	5	5	58	69	4
19	5	4	55	63	3
20	5	3	68	88	2
21	4	2	26	----------	4
22	4	2	49	66	4
23	4	2	47	80	4
24	4	2	37	62	4
25	5	4	88	----------	4
26	5	4	81	81	4
27	5	5	82	109	4
28	5	4	79	87	4
29	4	2	19	----------	4
30	4	2	26	39	4
31	4	3	65	68	4
32	4	2	68	79	4
33	5	4	77	----------	4
34	5	4	101	119	4
35	5	4	77	120	4
36	5	4	78	86	4
37	4	2	31	----------	4
38	4	4	42	79	4
39	4	2	15	26	4
40	4	3	79	115	4

Retroreflectometers

Form Filled Out By : R. Wray, G. Rushton, S. Gainer **= Meter 214**

Date: 10/7/2003 **= Meter 208**

Raised Pavement Marker Ratings

MD 100 Test Deck

NTPEP # RPM (2001 MD) - 8 Pac-Tec,] **Ray-O-Lite** **Snow-Lite Model 100**

Installed: 10/3/2001 by Priceless Industries from milepoint 5.47 to 5.54

Marker No.	Housing*	Lens	Dirty Reading (mcd/lux)	Clean Reading (mcd/lux)	Night Visability
1	5	5	24	----------	3
2	5	4	26	28	3
3	5	5	27	29	3
4	5	4	27	29	3
5	4	3	21	----------	3
6	4	2	17	28	3
7	4	2	13	20	3
8	4	2	16	23	3
9	5	5	25	----------	3
10	5	5	27	28	3
11	5	5	24	24	3
12	5	4	23	24	1
13	4	2	18	----------	3
14	4	1	18	31	3
15	4	3	12	13	3
16	4	3	13	21	3
17	5	2	26	----------	1
18	5	5	29	30	3
19	5	5	28	30	3
20	5	5	29	31	3
21	4	3	17	----------	3
22	4	3	15	22	3
23	4	3	22	32	3
24	4	3	17	20	2
25	5	5	29	----------	2
26	5	5	32	39	3
27	5	5	27	26	3
28	5	4	27	29	3
29	4	4	17	----------	3
30	4	2	12	13	1
31	4	3	14	14	3
32	4	3	18	21	3
33	5	2	25	----------	1
34	5	5	27	31	2
35	5	5	28	33	2
36	5	5	24	28	3
37	4	1	15	----------	1
38	4	3	13	14	3
39	4	2	14	18	2
40	4	3	13	13	2

* = old housing was partially in the way

Retroreflectometers

Form Filled Out By : R. Wray, G. Rushton, S. Gainer = **Meter 214**

Date: 10/7/2003 = **Meter 208**

Appendix D “Precision Scan” study

Appendix D. Precision Scan Report

INTRODUCTION

This report describes the results of retroreflectivity measurements taken by Precision Scan, L.L.C. on a sampling of raised pavement markers (RPM's) and pavement markings in the Baltimore and Capital Beltway areas from October 7th to October 12th, 2003 using the Laserlux 30-meter geometry mobile retroreflectometer. This project was unique in several ways:

- It included the nation's first comprehensive comparison of retroreflectivity readings taken on a wide variety of RPM's with both a Laserlux mobile pavement marking retroreflectometer and a RPM 1200 handheld raised pavement marker retroreflectometer.
- It included a comparison of retroreflectivity readings taken on dry and wet pavement markings with a Laserlux mobile pavement marking retroreflectometer using the new ASTM standard E-2177… "Standard Condition of Wetness" for guidance.
- It included a mobile pavement marking retroreflectivity "scan" of the Maryland side of the Capital and Baltimore Beltways.

OBJECTIVES

The objectives of this project are listed below:

- Compare the accuracy and productivity of using the Laserlux 30-meter geometry mobile retroreflectometer to measure RPM's compared to the RPM 1200 handheld retroreflectometer.
- Collect "benchmark" pavement marking retroreflectivity data on the Capital and Baltimore Beltway, to determine if this type of data can be used in a management system to provide guidance in the selection of pavement marking materials for Maryland State Highway Administration (MD SHA).
- Better understand the available methods of measuring the "wet night' performance of pavement markings.

BACKGROUND

For more than five years, some government agencies have been measuring the retroreflectivity of pavement markings using both handheld retroreflectometers like the LTL 2000 or LTL-X and/or mobile units like the Laserlux. The Laserlux has been used increasingly for long line measurements, where it is difficult to access the pavement markings with a handheld unit. In general, it is not practical to use a handheld unit to collect hundreds if not thousands of miles of pavement marking retroreflectivity data. It

is important to note that the handheld and the mobile units are both based on 30-meter geometry viewing distances.
During the past years, some states have begun to analyze retroreflectivity data to determine how to easily and cost effectively develop statistical service life performance curves for pavement markings as well as to help establish the quality (retroreflectivity) level of new markings. In the end, the desire is to ensure that all parties get "value for money."

Government agencies are also interested in retroreflectivity data because the Federal Highway Administration (FHWA) is authorized to establish minimum nighttime visibility guidelines for signs and pavement markings. As a first step, states, such as Maryland, are determining the "current state of affairs" of some of their key road systems.

Additionally the Laserlux data presented in this report may be used to help MD SHA establish a method for performing mobile retroreflectivity measurements on long line wet pavement marking materials. While handheld technology is available to take "wet" measurements, it is neither cost effective nor practical when measuring long distances of pavement markings.

Due to the location of RPM's, there is also no "practical" and efficient method to measure the retroreflectivity of these traffic control devices with a handheld measuring unit, such as the RPM 1200. Therefore, MD SHA decided to evaluate whether the Laserlux could be used to measure RPM's. MD SHA also wanted to determine the accuracy of the mobile retroreflectivity data collected on the RPM's. It is important to note that the geometry of the Laserlux and the RPM 1200 are significantly different.

CURRENT STANDARDS

At present, there are no federally mandated minimum retroreflectivity standards for pavement markings. However, ASTM has published the standard D 6359-98, titled "Standard Specification for Minimum Retroreflectance of Newly Applied Pavement Markings Using Portable Hand-Operated Instruments." Although the procedures for collecting data in this standard apply to portable handheld instruments, the minimum values it specifies could be applied to pavement markings measured with a mobile retroreflectometer taking into consideration individual instrument tolerances.

The minimum initial retroreflectivity values from section 5.1 of ASTM D6359-98 are 250 mcd/m^2/lx for white and 175 mcd/m^2/lx for yellow. ASTM D6359-98 defines a newly applied pavement marking as a marking that was installed within 14 days prior to measurement.

Without any Federal guidance, states, including Maryland, have adopted minimum retroreflectivity guidelines, where appropriate, for the acceptance of new products etc. based on individual state requirements.

In early 2002, ASTM published two new test methods for taking wet retroreflectivity measurements: ASTM E-2177 … "Standard Condition of Wetness" and ASTM E -2176…"Standard Condition of Continuous Wetting". The "Standard Condition of Wetness" (E-2177) simulates a situation shortly after rain and the "Standard Condition of Continuous Wetting" (E-2176) simulates rain. As an ASTM test method does not exist for mobile wet retroreflectivity measurements, Precision Scan L.L.C. modified the ASTM E-2177 standard to take into consideration that the measurements would be taken with a mobile retroreflectometer.

Under ASTM E-2177, the pavement marking is wetted by the spray or bucket method. After waiting 45 seconds, a retroreflectometer is placed on the pavement marking and the retroreflectivity measurement is taken. The LTL 2000 and/or the LTL X handheld 30 meter geometry retroreflectometer can be used to accurately provide these measurements.

In order to take wet, mobile retroreflectivity measurements that correspond to ASTM E-2177, for this project, a water truck wetted the pavement marking to simulate a "standard condition of wetness." The Laserlux followed the water truck and took retroreflectivity measurements 45 seconds and 10 seconds after the water truck wetted the line.

SCOPE OF STUDY

Between October 7th and October 12th, 2003, Precision Scan L.L.C. measured the retroreflectivity of 483.1 line miles on the Baltimore and Capital Beltways, MD 100, MD 191, US 13 Salisbury Bypass and Key Bridge. These line miles consisted of white edge, white skip and yellow edge lines. In addition, Precision Scan, L.L.C. measured a RPM test location which included seven sections of RPM's, with 40 RPM's in each section.

Throughout the project, all Laserlux measurements were verified daily using the LTL 2000 handheld retroreflectometer. The weather conditions during data collection were stable and did not interfere with the retroreflectivity measurements. If early morning fog was visible, then data collection was suspended until later in the day when the fog had dissipated.

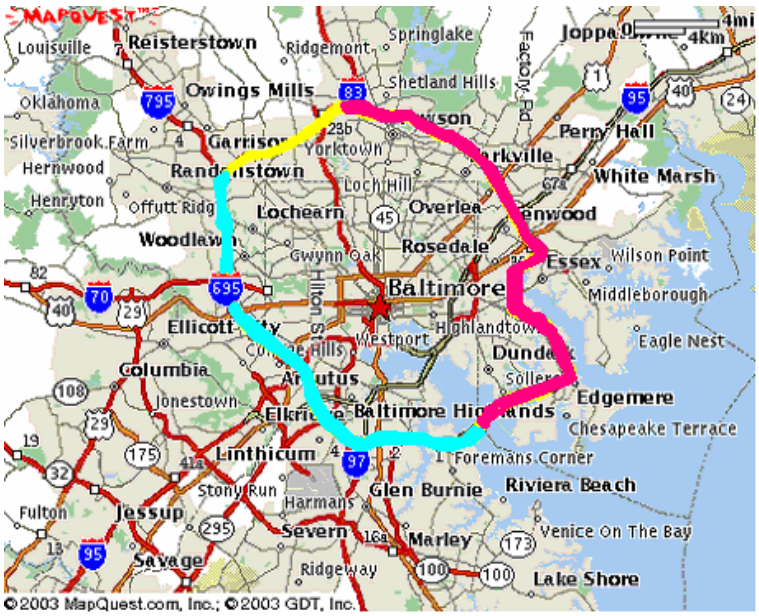
SELECTION OF TEST SITES

On the Baltimore and Capital Beltways the data collection file ended approximately 500 feet before the intersection or exit specified as the stop point so that the next data collection file could be started without exiting the highway. This typically occurred at the end of acceleration lanes.

In some cases the start and stop points, such as county lines, were difficult to exactly locate on the Beltway. In those cases, the closest exit to the start or stop point was used to begin and end the data collection files.

Baltimore Beltway

Below please find a map that indicates the retroreflectivity collection sites on the Baltimore Beltway. MD SHA divided both the inner and outer Beltway into three data collection sections. The three sections have been highlighted on the map in different colors. The Laserlux was used to measure the retroreflectivity of the white edge, white skip and yellow edge lines within each of the three Beltway sections.



Color	Start Point	Stop Point
Yellow	Reisterstown Road	Charles Street
Red	Charles Street	Key Bridge
Blue	Baltimore County/Anne Arundel County Line	Reisterstown Road

MD SHA provided the following information regarding materials placed on the Baltimore Beltway.

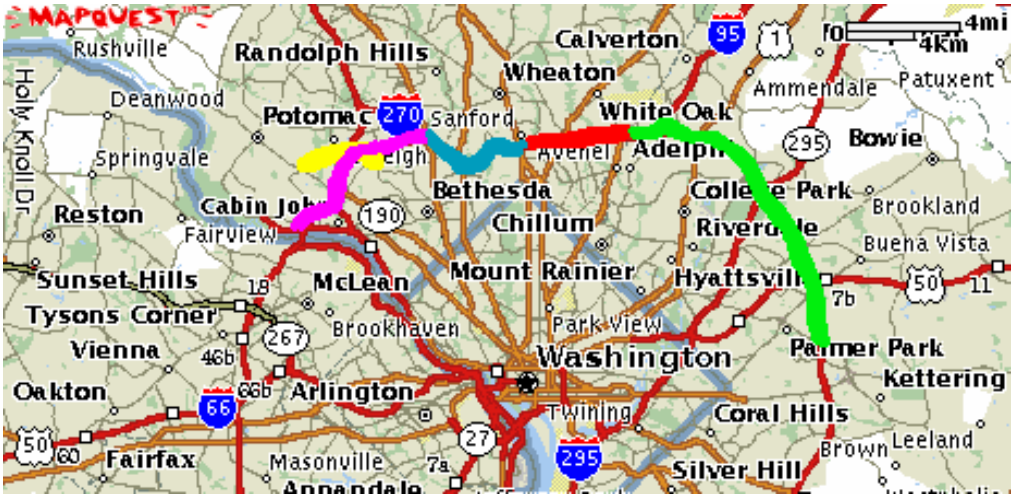
Type of Line	Material	Start Point	End Point
White Edge Line	Thermoplastic	Reisterstown Road	Charles Street
White Skip Line	Inlaid Tape	Reisterstown Road	Charles Street
Yellow Edge Line	Waterborne Paint	Reisterstown Road	Charles Street

White Edge Line	Waterborne Paint	Charles Street	Key Bridge
White Skip Line	Waterborne Paint	Charles Street	Key Bridge
Yellow Edge Line	Waterborne Paint	Charles Street	Key Bridge

White Edge Line	Waterborne Paint	Baltimore County/Anne Arundel County Line	Reisterstown Road
White Skip Line	Waterborne Paint	Baltimore County/Anne Arundel County Line	Reisterstown Road
Yellow Edge Line	Waterborne Paint	Baltimore County/Anne Arundel County Line	Reisterstown Road

Capital Beltway

Below is a map that indicates the retroreflectivity data collection sites on the Capital Beltway. MD SHA divided both the inner and outer Beltway into four data collection sections. Each of these four sections has been highlighted on the map in different colors. The Laserlux was used to measure the retroreflectivity of the white edge, white skip and yellow edge lines within each of the four Beltway sections.



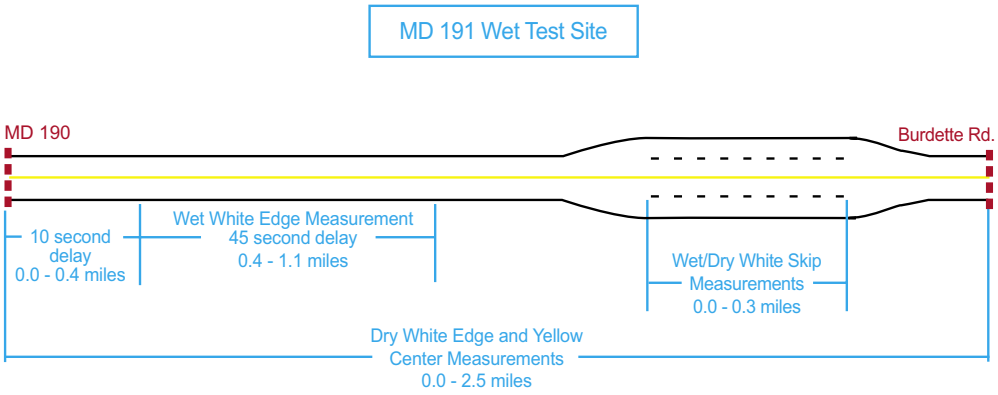
Measurement Location Color	Start Point	Stop Point
Black	Exit 41/American Legion Memorial Bridge (MD/VA Border)	Exit 35/MD 270
Blue	Exit 35/MD 270	Exit 31/MD 97 (Georgia Avenue)
Red	Exit 31/MD 97 (Georgia Avenue)	Exit 28/Montgomery County/Prince George's County Line
Green	Exit 28/Montgomery County/Prince George's County Line	Exit 15/MD 214
Yellow	MD 190/Beginning of Rainline	Burdette Road

MD SHA provided the following information regarding materials placed on the Capital Beltway.

Type of Line	Material	Start Point	End Point
White Edge Line	Thermoplastic	Exit 41/American Legion Memorial Bridge (MD/VA Border)	Exit 35/MD 270
White Skip Line	Thermoplastic	Exit 41/American Legion Memorial Bridge (MD/VA Border)	Exit 35/MD 270
Yellow Edge Line	Thermoplastic	Exit 41/American Legion Memorial Bridge (MD/VA Border)	Exit 35/MD 270
White Edge Line	Waterborne Paint	Exit 35/MD 270	Exit 31/MD 97 (Georgia Avenue)
White Skip Line	Waterborne Paint	Exit 35/MD 270	Exit 31/MD 97 (Georgia Avenue)
Yellow Edge Line	Waterborne Paint	Exit 35/MD 270	Exit 31/MD 97 (Georgia Avenue)
White Edge Line	Thermoplastic	Exit 31/MD 97 (Georgia Avenue)	Exit 28/Montgomery County/Prince George's County Line
White Skip Line	Thermoplastic	Exit 31/MD 97 (Georgia Avenue)	Exit 28/Montgomery County/Prince George's County Line
Yellow Edge Line	Thermoplastic	Exit 31/MD 97 (Georgia Avenue)	Exit 28/Montgomery County/Prince George's County Line
White Edge Line	Thermoplastic	Exit 28/Montgomery County/Prince George's County Line	Exit 15/MD 214
White Skip Line	Thermoplastic	Exit 28/Montgomery County/Prince George's County Line	Exit 15/MD 214
Yellow Edge Line	Thermoplastic	Exit 28/Montgomery County/Prince George's County Line	Exit 15/MD 214

MD 191 Wet and Dry Test Site

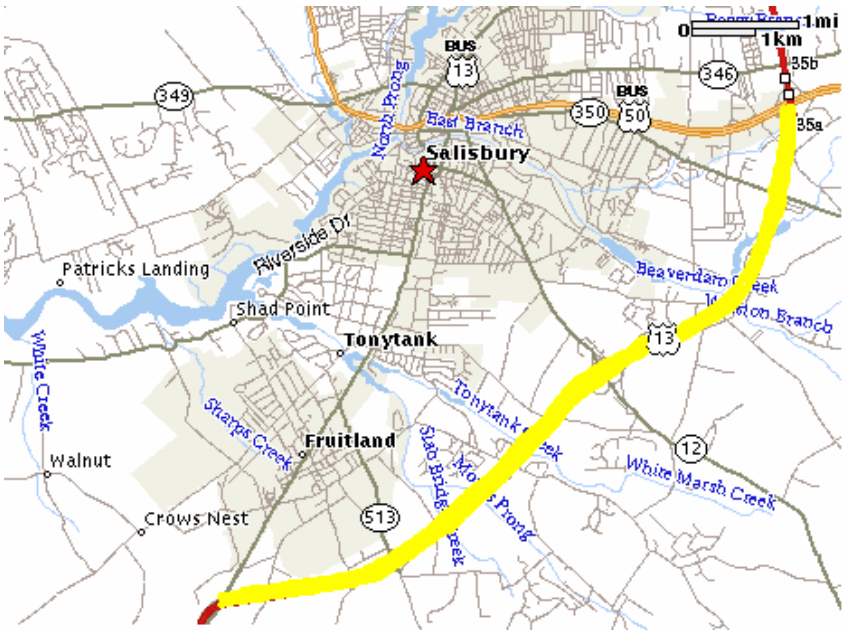
The yellow area highlighted on the map on page 5 was the MD 191 wet retroreflectivity test site. The drawing on page 7 illustrates the layout of the wet retroreflectivity test site. The Rainline white edge and white skip lines at this wet test site were measured both dry and wet in the east direction. The retroreflectivity of the remaining pavement markings within this site were measured dry.



US 13 Salisbury Bypass Wet and Dry Test Site

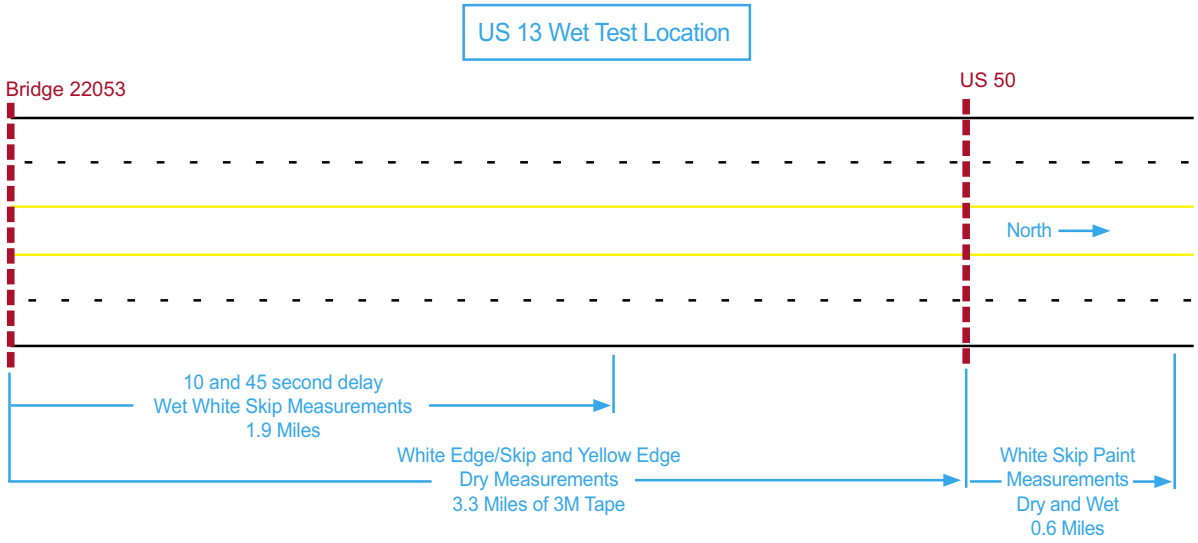
The 3M tape white skip line at this wet test site was measured both dry and wet in the north direction. The painted white skip line starting at US 50 was also measured both dry and wet in the north direction. The retroreflectivity of the remaining pavement markings within this site were measured dry.

Below is a map indicating the wet test site located on US 13, between Bridge 22053 and just beyond US 50.



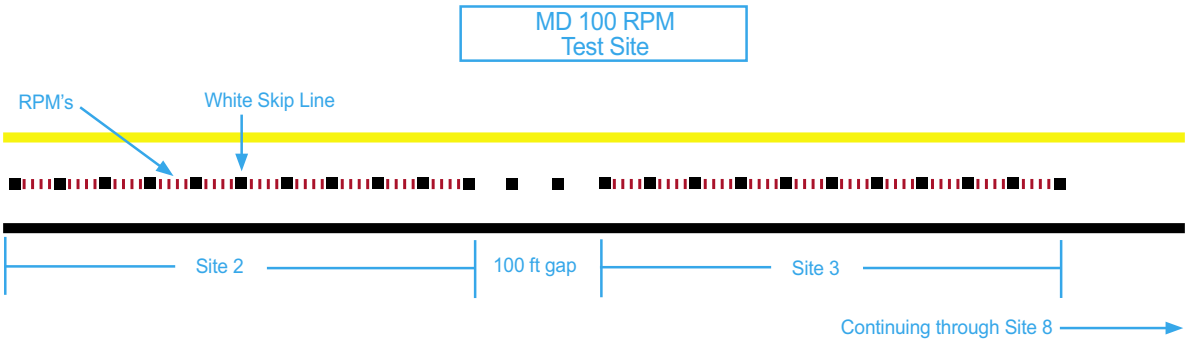
Measurement Location Color	Start Point	Stop Point
Yellow	Bridge 22053	US 50

Below is drawing of the wet test site located on US 13, between Bridge 22053 and US 50.



MD 100 RPM Test Site

MD 100 was the test site for measuring the retroreflectivity of RPM's with the Laserlux. The drawing below illustrates the layout of the RPM test location. The RPM's at the test location were installed between the white skip lines on MD 100. Four RPM's were installed between each skip line. The test location contained 7 sections of RPM's, with 40 RPM's in each section. Each section of 40 RPM's was assigned a site number. The assigned site numbers range from 2 to 8. The RPM's were installed approximately 8 feet apart within each of the 7 sites. There was a 100 foot gap between each of the 7 sites.



Site number 6 contained solar powered lights embedded in the pavement, with no retroreflective elements. The Laserlux measured site 6, but was unable to collect any retroreflective data.

EQUIPMENT, MEASURING PROCEDURES AND REPORTS

All retroreflectivity readings were done using a Laserlux 30-meter geometry mobile retroreflectometer, which has an accuracy of +/- 15%. The Laserlux is capable of gathering continuous pavement marking retroreflectivity measurements at highway speeds. The Laserlux was calibrated a minimum of once per day. The calibration devices used were in turn, calibrated on a weekly basis at the work site using an LTL 2000 handheld retroreflectometer with an accuracy of +/- 5%.

The long line retroreflectivity data was based on station intervals with average measurements recorded every 528 feet by DMI. The original raw data files will be kept and maintained for one year by Precision Scan L.L.C..

The data includes the exact route, direction, line type, color, and start and stop distance (DMI).

A VHS video of the data collection process with retroreflectivity data overlay and a corresponding videotape log has been provided. The videotapes with their corresponding data overlay provide real time documentation of the current conditions at the time of measurement.

The mobile RPM retroreflectivity measurements were compared to those measurements taken by MD SHA using the RPM 1200 handheld retroreflectometer.

Please find a series of tabs which contain the specific retroreflectivity data collected at each site.

SUMMARY

The major findings from these evaluations are summarized below:

- The retroreflectivity readings collected from the RPM 1200 and the Laserlux do not correlate for the following reasons:

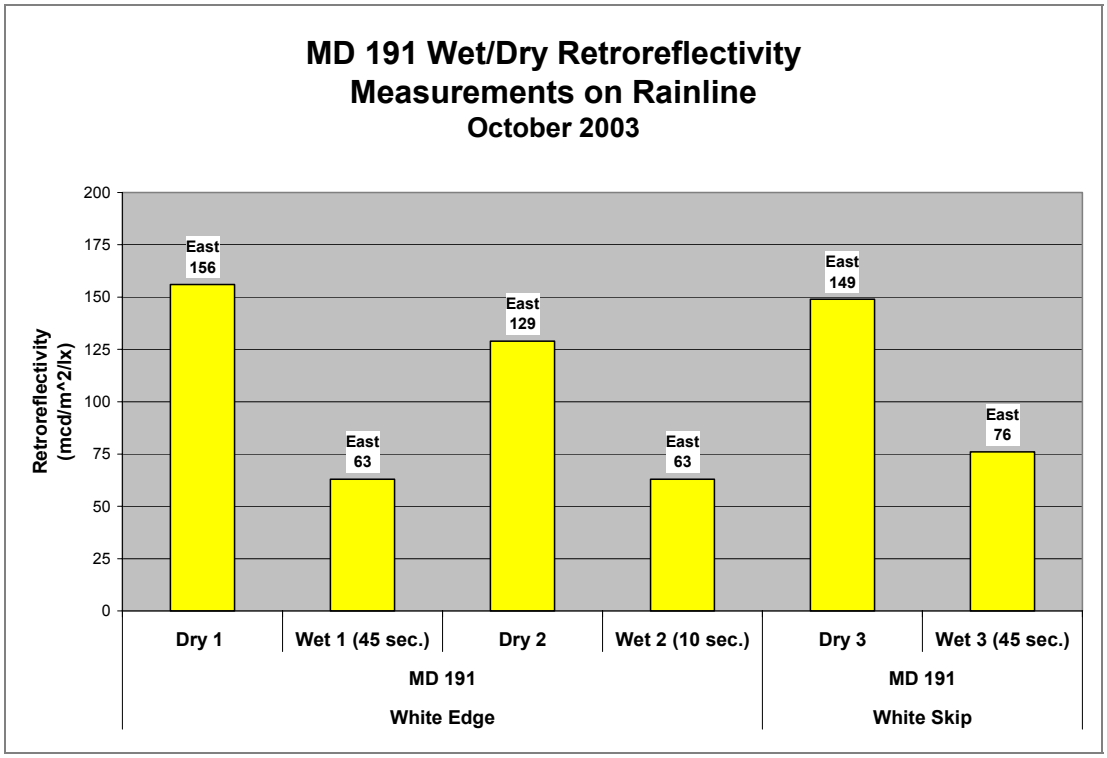
    1. The geometry used by the two retroreflectometers is different.
    2. The scanning light source used in the Laserlux may not illuminate the entire surface of each RPM, even at low vehicle speeds
    3. The modification of the Laserlux optical systems that is necessary to detect and measure the RPM's distorts the retroreflectivity readings.
    4. The adjustments made to the Laserlux software introduce unknown errors into the retroreflectivity data.

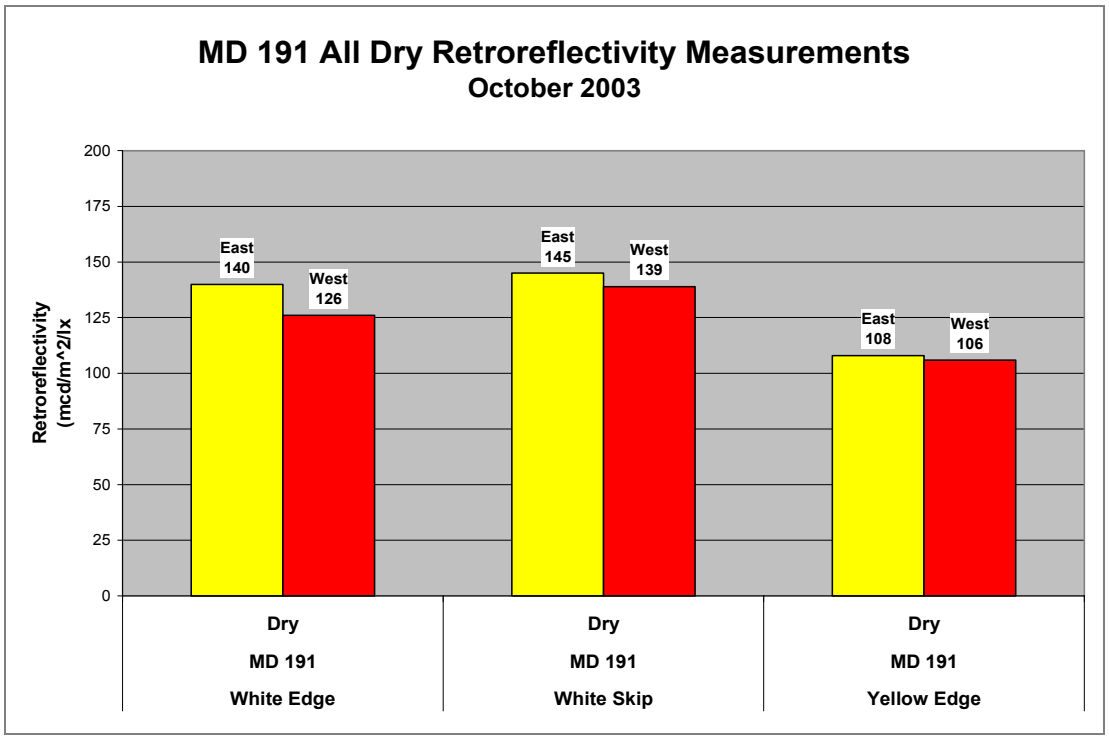
- It was demonstrated that the new ASTM standard E-2177 could be used to develop a method to measure the wet night retroreflectivity of pavement markings using mobile technology.

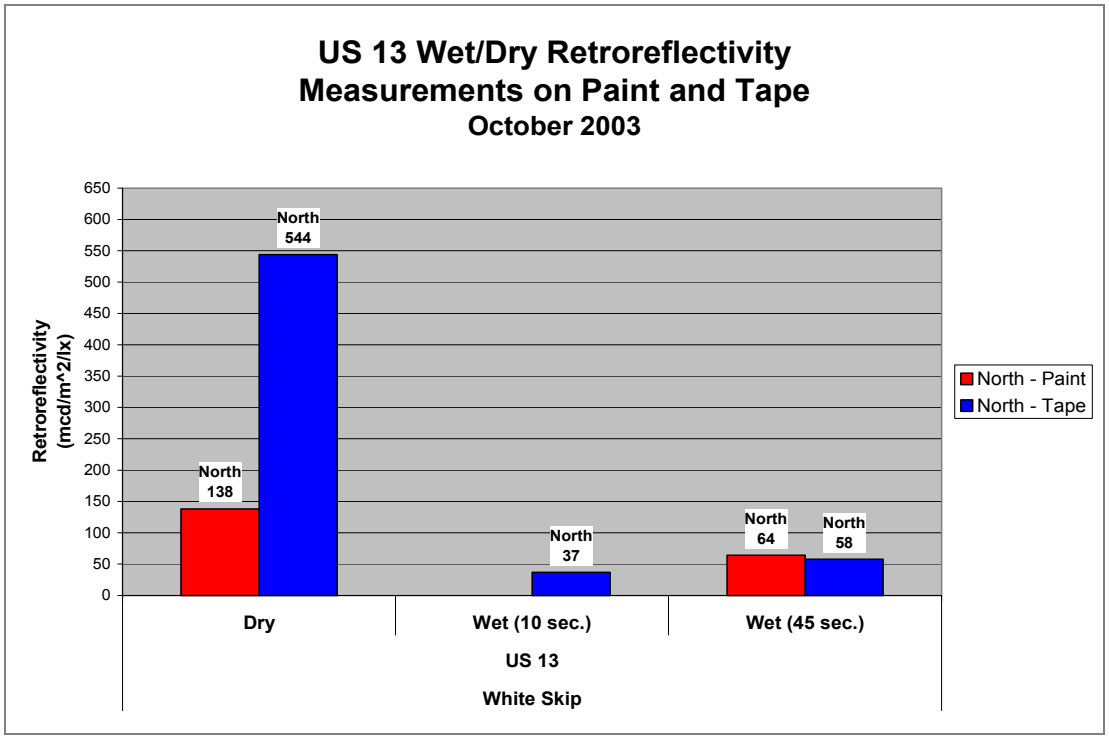
- It was demonstrated that the test sites chosen for wet performance evaluation, as well as the equipment used, can affect the outcome for the following reasons:

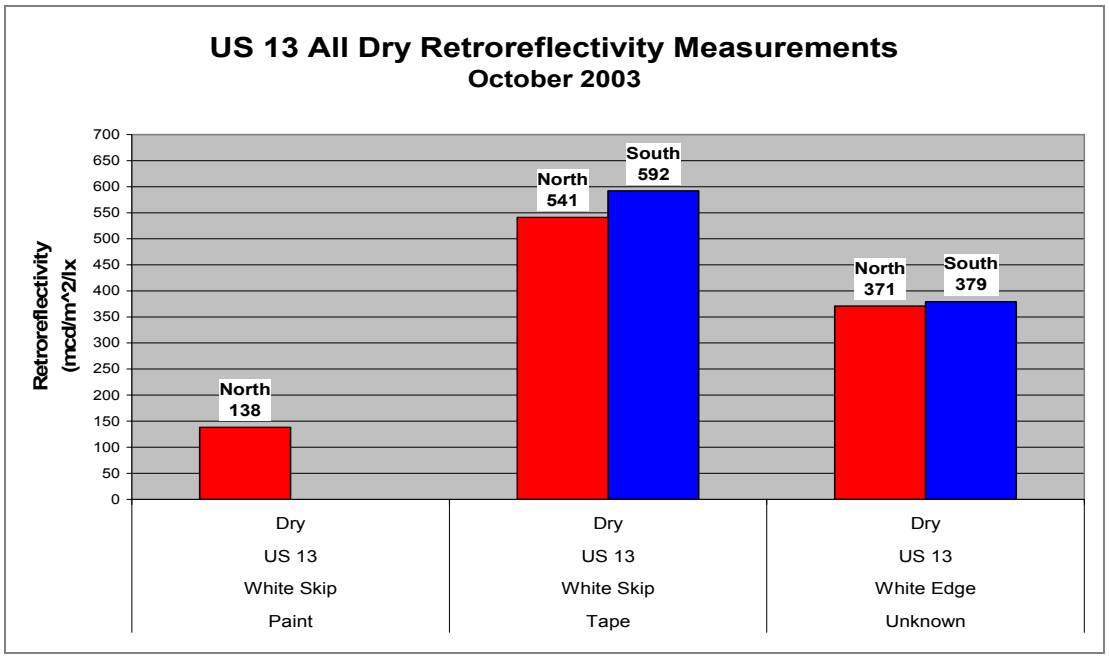
    1. On MD 191, hills, curves and the geometry of the road created different water runoff patterns. These water runoff patterns created two problems. First the water runoff patterns increased the wet retroreflectivity readings on hill peaks and high spots, as well as decreased the readings in the "valleys" where the water pooled. Second, the site location geometry allowed water spray to spread into the wheel track where the Laserlux was traveling when taking measurements. The resulting water splatter that collected on the front of the Laserlux measuring head distorted the retroreflectivity measurements.
    2. Adequate water supply and a specially designed nozzle for the water truck are instrumental to ensuring that large scale wetting of the pavement markings can happen at uniform speeds and consistency. Water was sprayed onto the pavement marking under gravity, so it was important to maintain a uniform discharge throughout the test section.

- Please note the following graphs which illustrate the retroreflectivity of the pavement markings measured in wet and dry conditions with the Laserlux on MD 191 and US 13 Salisbury Bypass.




MD 191 All Dry Retroreflectivity Measurements
October 2003
Retroreflectivity (mcd/m^2/lx)
200
175
150
125
100
75
50
25
0
East 140
West 126
East 145
West 139
East 108
West 106
Dry
MD 191
White Edge
Dry
MD 191
White Skip
Dry
MD 191
Yellow Edge


US 13 Wet/Dry Retroreflectivity Measurements on Paint and Tape
October 2003
Retroreflectivity (mcd/m^2/lx)
650
600
550
500
450
400
350
300
250
200
150
100
50
0
North 138
North 544
North 37
North 64
North 58
Dry
Wet (10 sec.)
Wet (45 sec.)
US 13
White Skip
North - Paint
North - Tape



- It was demonstrated that the collection and presentation of retroreflectivity data in a simple format to get an overview of a roadway's condition from a nighttime visibility standpoint is attainable. Based on the information collected the retroreflectivity of the Capital and Baltimore Beltway in October 2003 was as follows:

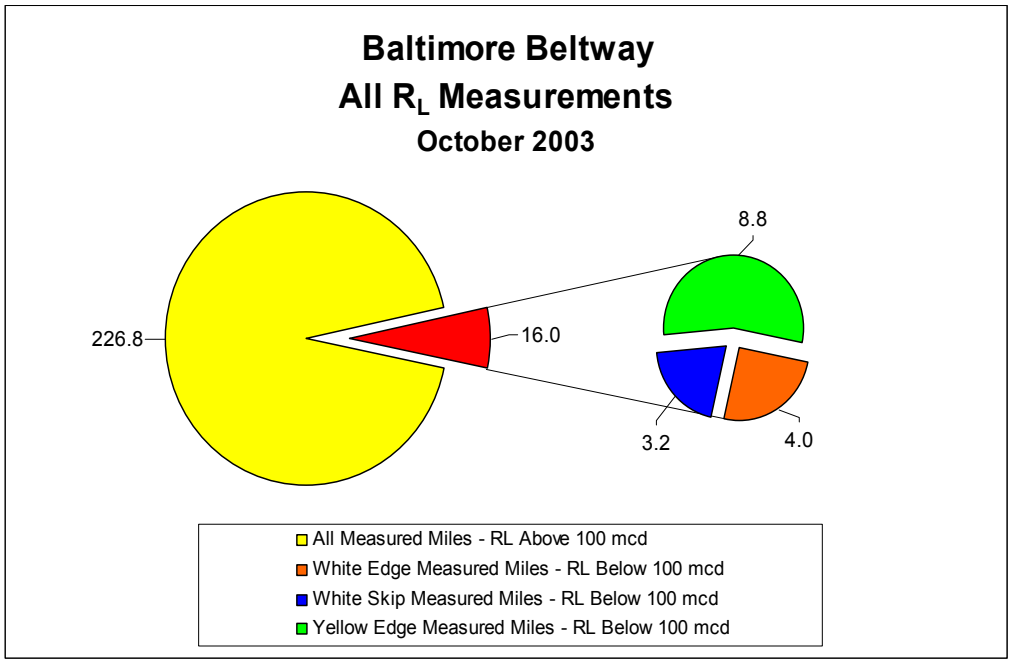
Baltimore Beltway		
Type of Line	**R_L Average**	**Chainage**
White Edge	193 mcd/m^2/lx	95.2 miles
White Skip	213 mcd/m^2/lx	94.6 miles
Yellow Edge	175 mcd/m^2/lx	100.1 miles

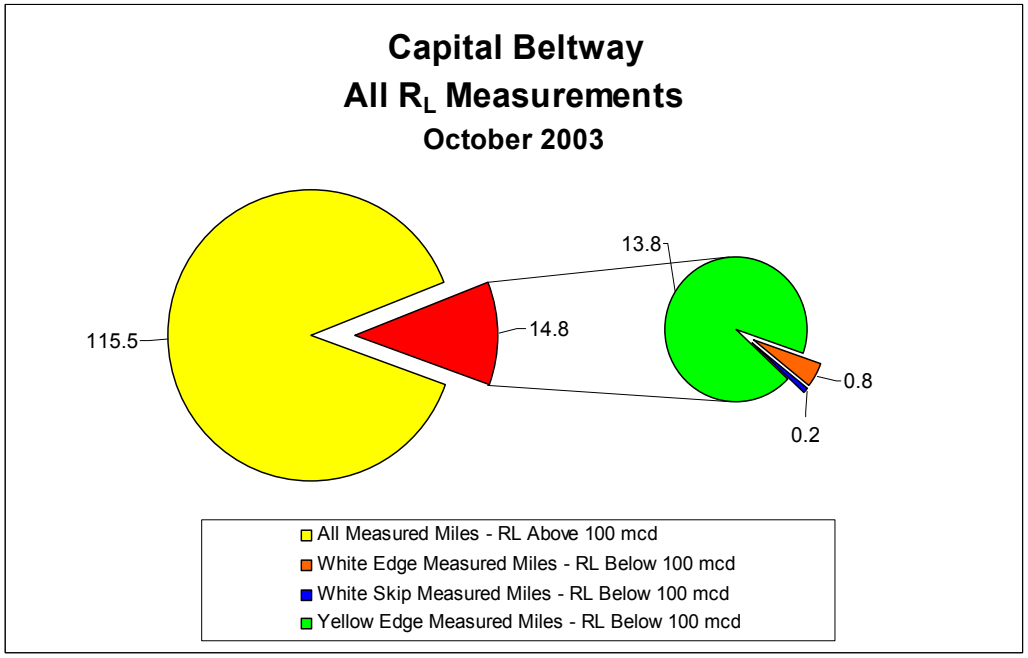
Capital Beltway		
Type of Line	**R_L Average**	**Chainage**
White Edge	229 mcd/m^2/lx	51.0 miles
White Skip	251 mcd/m^2/lx	51.6 miles
Yellow Edge	128 mcd/m^2/lx	50.9 miles

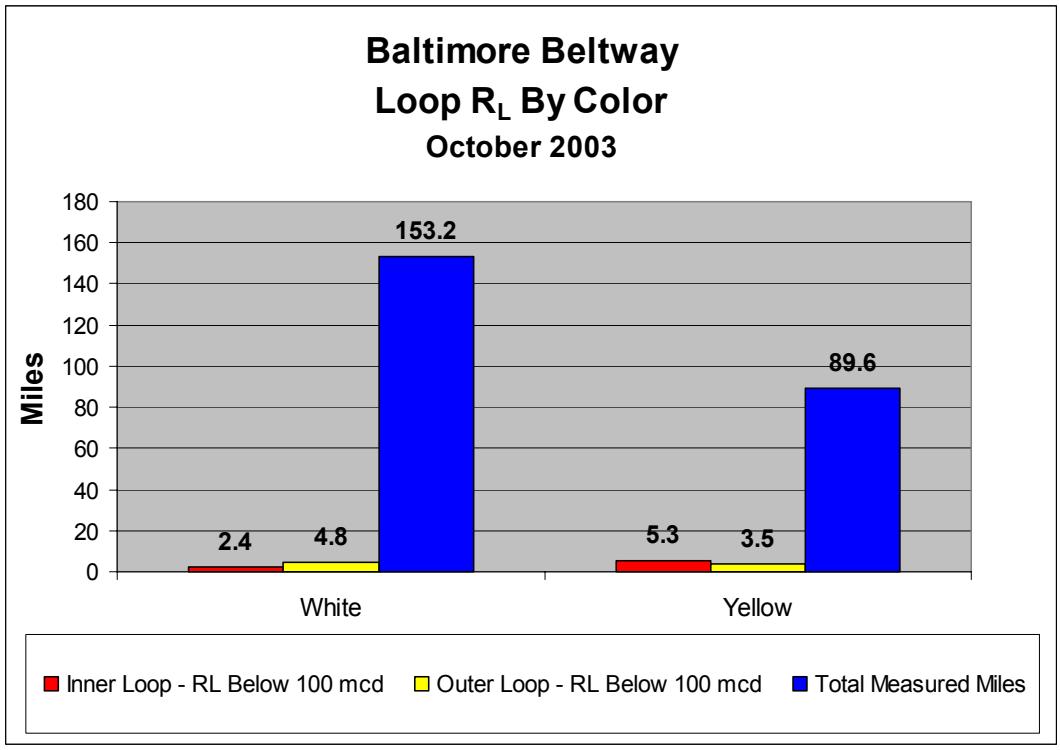
At this time, the age of the various pavement markings and the specific type of materials measured are not known. However, if the materials were "new" as defined in ASTM standard D6359-98 and retroreflectivity measurements were taken within 14 days of application minimum "initial" readings should be 250 mcd for white and 175 mcd for yellow based on the before mentioned standard.

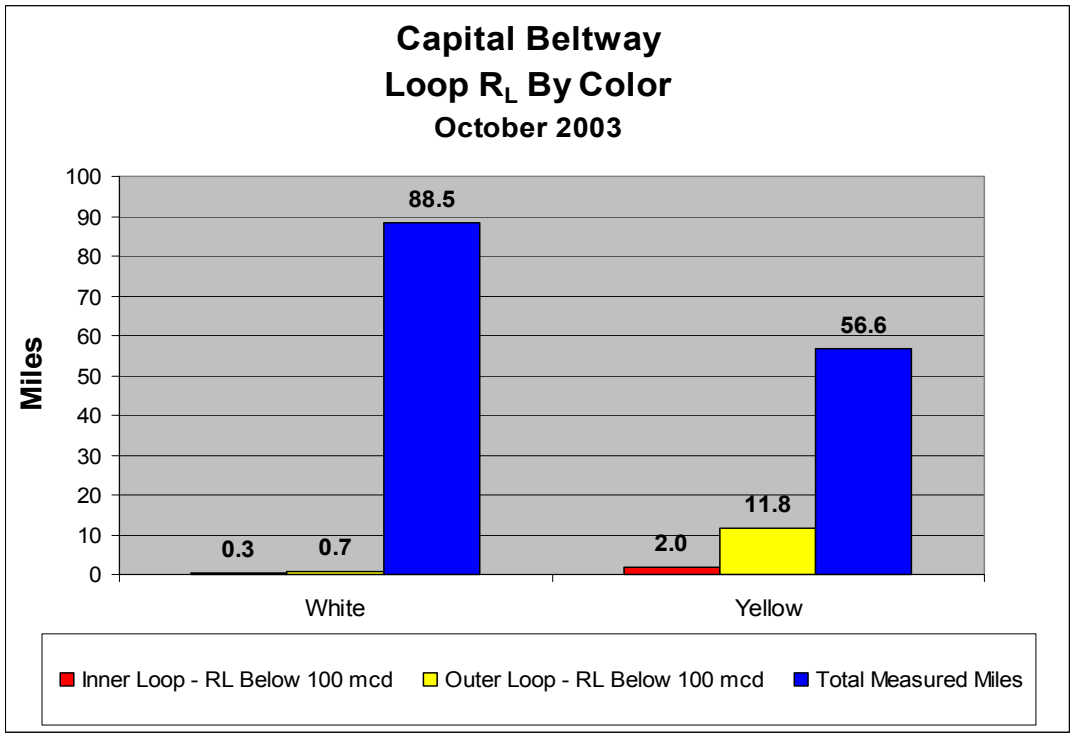
- For informational purposes only, Precision Scan, L.L.C. analyzed the retroreflectivity data to determine what percentage of the sites measured on the Baltimore and Capital Beltways would fall below a predetermined minimum level of retroreflectivity. As there are currently no Federal minimum

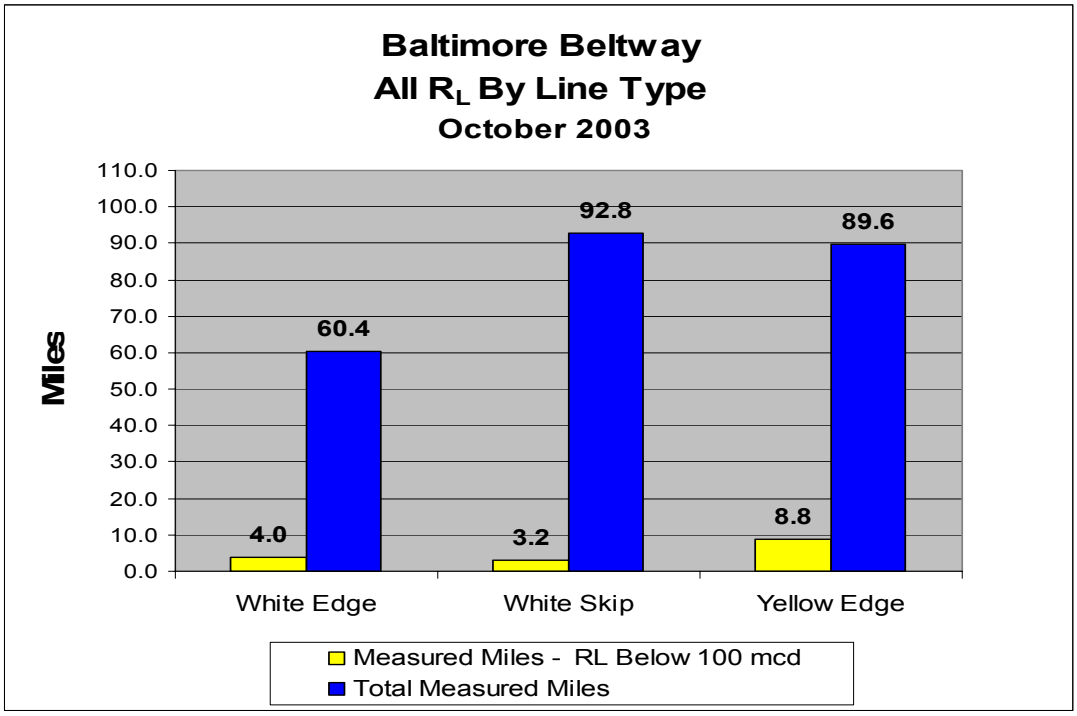
retroreflectivity guidelines in existence, for the purposes of this report, Precision Scan, L.L.C. chose 100 mcd as the minimum acceptable level of retroreflectivity. The graphs on the following pages provide the results of that analysis.

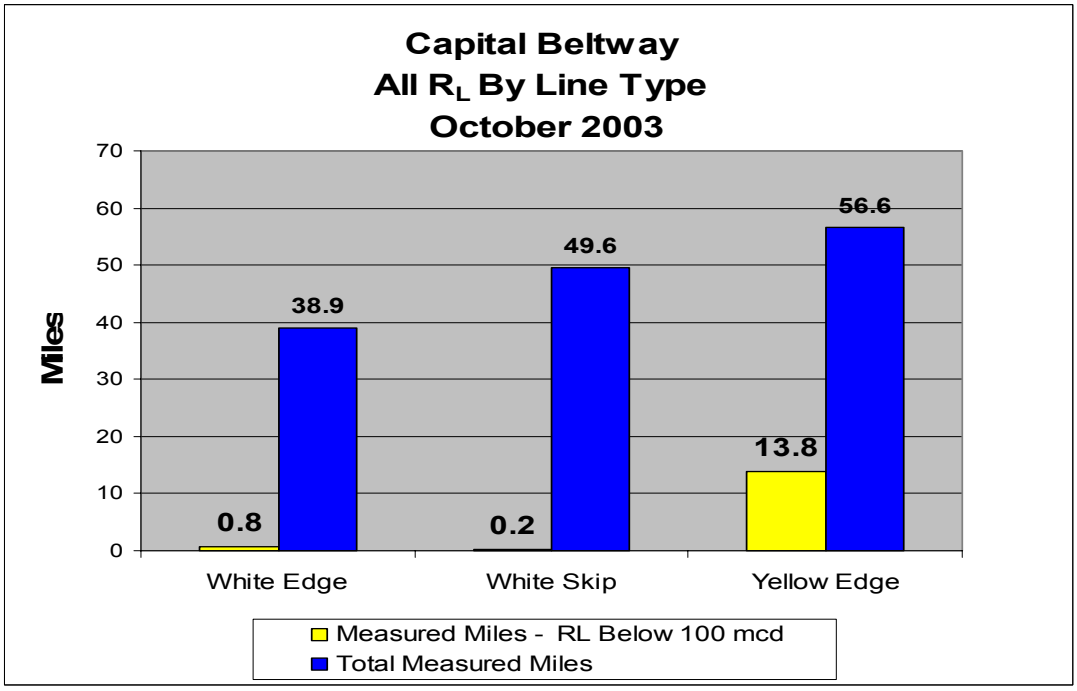





Baltimore Beltway
Loop R_L By Color
October 2003
Miles
180
160
140
120
100
80
60
40
20
0
153.2
89.6
2.4
4.8
5.3
3.5
White
Yellow
Inner Loop - RL Below 100 mcd
Outer Loop - RL Below 100 mcd
Total Measured Miles

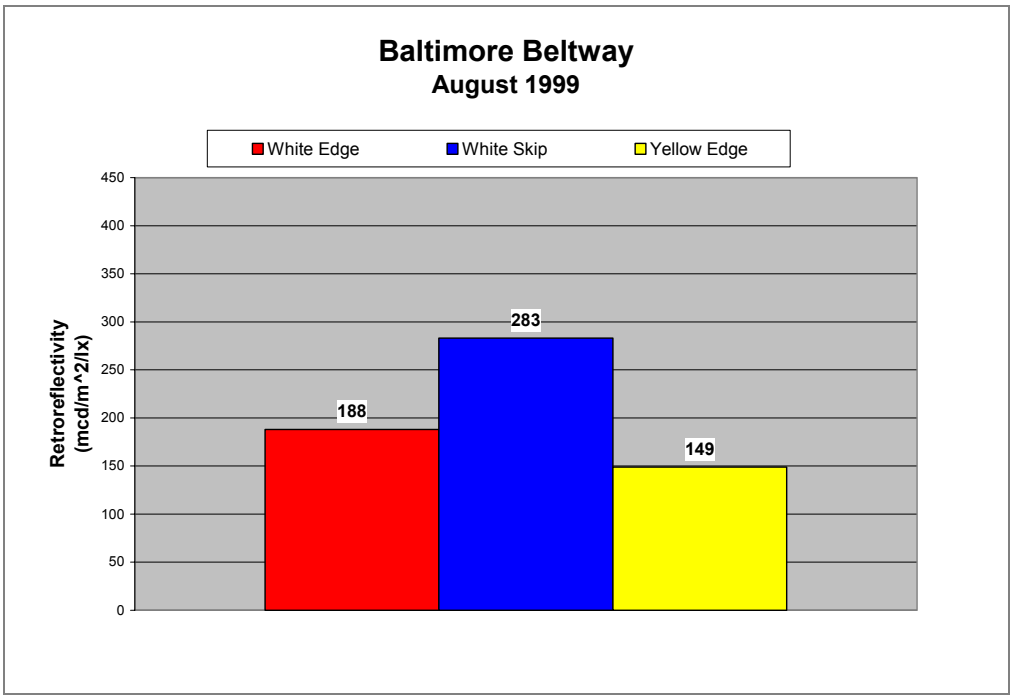

Capital Beltway
Loop R_L By Color
October 2003
Miles
100
90
80
70
60
50
40
30
20
10
0
88.5
56.6
11.8
0.3
0.7
2.0
White
Yellow
Inner Loop - RL Below 100 mcd
Outer Loop - RL Below 100 mcd
Total Measured Miles

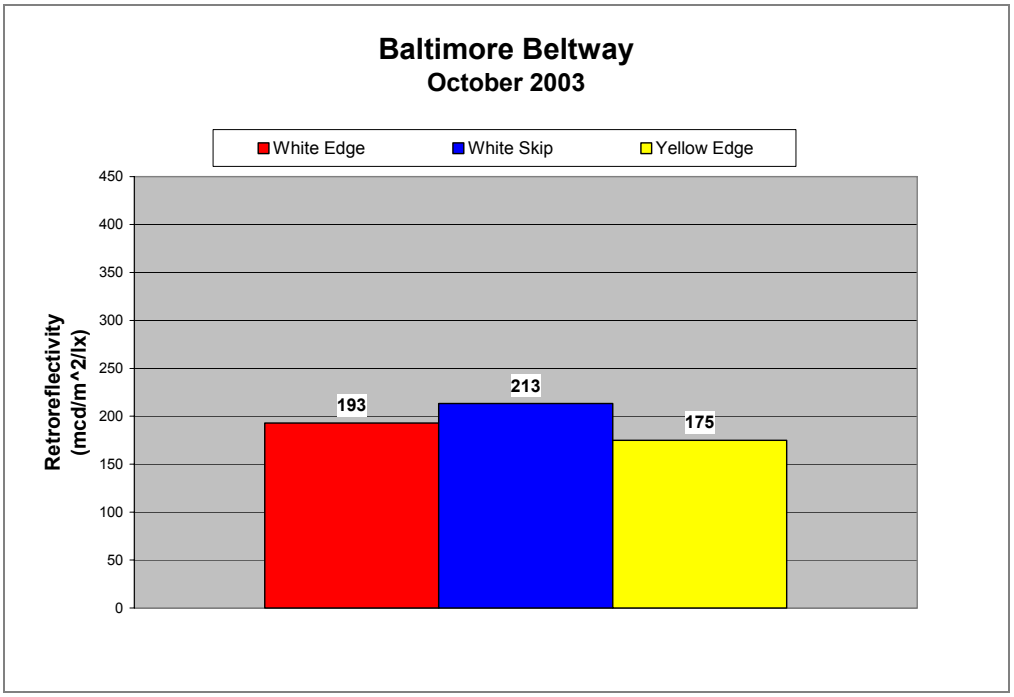


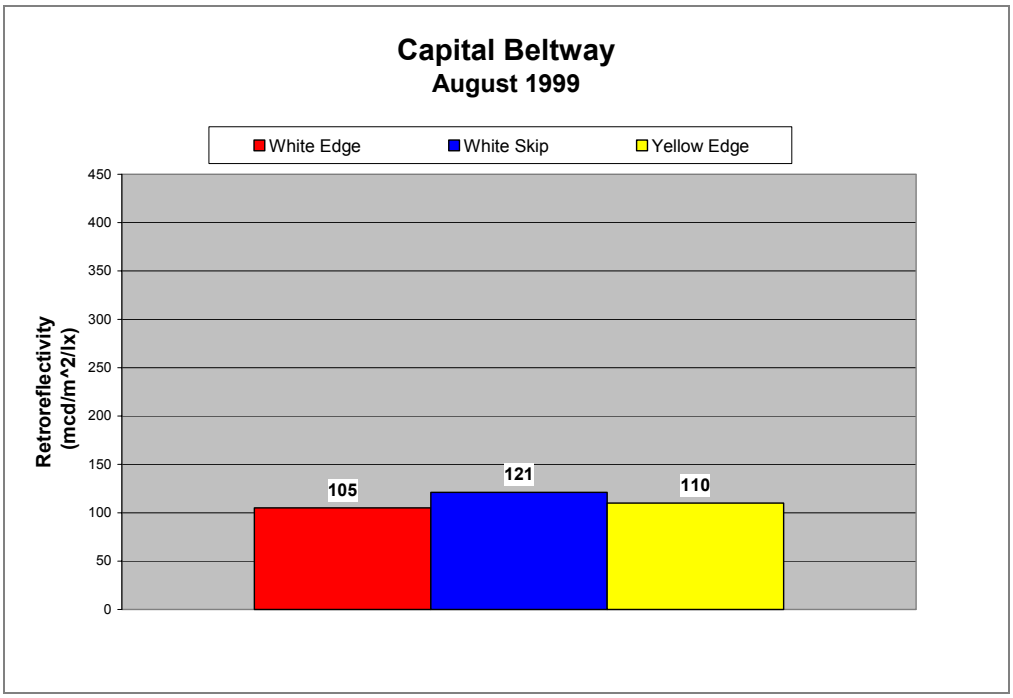


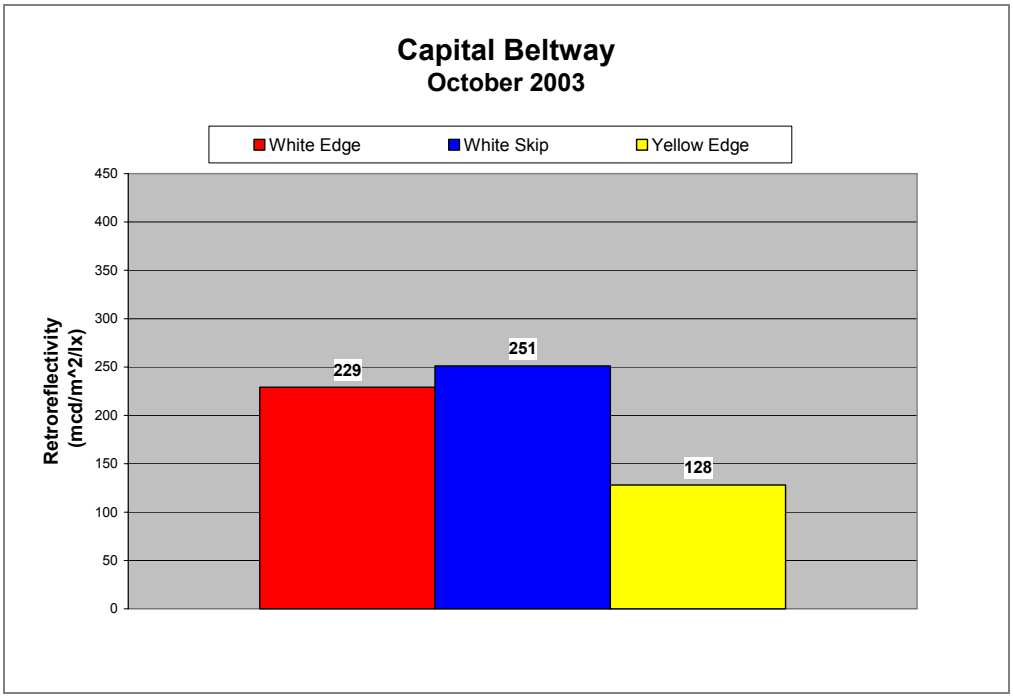
- For informational purposes only, please see graphs on the following pages showing the retroreflectivity of the pavement markings measured in October 2003 and August 1999 on the Baltimore and Capital Beltways. In both cases, the measurements were taken by Precision Scan, L.L.C. using the Laserlux. The

measurement stop and start points are not exactly the same in both cases. As the age and type of materials used and the distances measured are not the same in both cases, any conclusive comparison between the performances of the markings can not be made.









Please note that the purpose of this project was to establish a "benchmark" for the current pavement markings found on the Beltway(s), not to analyze the specific performance of any one product, contractor, etc...

Please find a series of tabs which contain the specific retroreflectivity data collected at each site measured in October 2003.

WHAT'S NEXT

Among other things, this report provides examples of how pavement marking retroreflectivity data collected using the Laserlux could provide guidance to MD SHA in the selection of pavement marking materials. The end result of compiling and analyzing retroreflectivity data should be to improve traffic safety at lower costs.

There are a variety of potential ways to use retroreflectivity data to improve traffic safety, including, but not limited to, performance contracts, warranty programs, life cycle cost evaluations, etc. As a starting point, MD SHA could identify the performance of pavement markings put down every day under the current MD SHA program. For instance, a percentage of the new construction programs implemented in 2004 could be measured. In addition to tracking retroreflectivity performance, other parameters could also be tracked, included but not limited to, cost, installer, bead type, adt, snow plows, etc... A web based database could be established and could provide a practical tool for MD SHA. This tool could be instrumental, in among other things:

- Material selection
- Planning/budgeting of new construction and/or maintenance

Precision Scan, L.L.C. is involved in such a program in North Carolina and it would be very interested in discussing that program or any other programs with MD SHA.

Thank you for the opportunity to work with you on this project. We are available to discuss this data in whatever format best suits your needs.

Yours Sincerely,

Laura Jensen