

Montana Department of Transportation
Research Programs
March 2015

EXPERIMENTAL PROJECTS CONSTRUCTION REPORT AND ANNUAL EVALUATION

3M WET REFLECTIVE CERAMIC ELEMENTS AND POTTERS VISIMAX PLUS: NEW BEAD TECHNOLOGY FOR ADDED RETROREFLECTIVITY IN PAVEMENT MARKINGS

Location: US 310/US 212 (N4) Approximate Reference Point 43-53, Counties Carbon and Yellowstone Counties

Project Name: Rockvale - Laurel

Project Number: HSIP 4-1(63)43

Experimental Project No. MT-12-12

Type of Project: Pavement Markings Retroreflectivity

Principal Investigator: Craig Abernathy: Experimental Project Manager (ExPM)

Date of Installation: September 2013

Date of Inspection: March 2015

Description

Evaluate the effectiveness of 3M Ceramic Elements and Potters VISIMAX Plus when blended with conventional MDT Type II glass beads in highway pavement markings.

These elements are claimed to provide increased retro-reflectivity during wet conditions allowing states to recess a 20 mil thick striping in a 60 mil deep grind resulting in an increased durability during plowing seasons. The increased retro-reflectivity during wet conditions is also being evaluated to determine their effectiveness as safety treatments.

1. 3M Elements wet-reflective dualoptic beads (1.9 and 2.4 reflective-index bead blend) are microcrystalline ceramic beads embedded on a center core to provide added reflectivity for pavement markings under wet and rainy conditions. The 3M system combines standard glass beads with the ceramic elements blend to maintain optimal visibility as described by the manufacturer.
2. The Potters VISIMAX Plus incorporates three to four times the diameters of conventional beads with high-clarity glass to allow for maximum retroreflectivity in wet conditions. Thousands of high-index beads form the outer VISIMAX shell as described by the manufacturer.

Additional technical information on the products being tested may be found at:

Potters VISIMAX:

<http://www.pottersbeads.com/hs/NorthAmerica/Products/VISIMAXVISIMAXPLUSHywSafetyMarkingSpheres.aspx>

3M Elements:

<http://multimedia.3m.com/mws/mediawebserver?mwsId=66666UgxGCuNyXTtoxMVlxTEVtQEcuZgVs6E666666--&fn=Elements%20flyer.pdf>

Experimental Design

Beads used on the project was a blend consisting of 3M wet reflective elements and MDT Type 2 glass beads, a blend consisting of VISIMAX Plus and MDT Type 2 glass beads, and a control segment of 2 miles using MDT's standard application rate of Type 2 glass beads. The beads will be applied to 20 mil thick epoxy striping placed in a 60 mil +/- 5 mill groove.

The blend ratio of retro-reflective elements to MDT Type 2 glass beads was established based on supplier recommendations. The project will entail line striping of the centerline (non-grooved); which will have rumble strips, fog line and passing line.

The blend incorporating the 3M reflective elements will be placed from reference point (RP) 42.9 to 46.9, MDT Type 2 glass beads will be placed from RP 46.9 to 48.9 and serve as a control section, and the blend incorporating the VISIMAX Plus will be placed from RP 48.9 to 52.9 on N-4 (US 310/US 212).

The following is a detailed breakout of the test and control sections:

RP 42.9 to RP 46.9 (4 miles/6.4km)	6 lbs. per gallon 3M Wet Reflective Elements
	20 lbs. per gallon Type 2 Glass Beads in accordance with Section 620
RP 46.9 to RP 48.9 (2 miles/3.2km)	Control Section: 25 lbs. per gallon Type 2 Glass Beads in accordance with Section 620
RP 48.9 to RP 52.9 (4 miles/6.4km)	10 lbs. per gallon VISIMAX Plus
	10 lbs. per gallon Type 2 Glass Beads in accordance with Section 620

Evaluation Procedures

Research will document the installation for best practice and any constructions concerns germane to the performance of the striping placement. Initial retroreflectivity readings will establish a baseline for ongoing comparisons. Semi-annual inspections will report on markings integrity and any other measurable outcomes.

Additional site inspections may supplement the semi-annual visits based on need. Monitor and report on long-term performance. Documentation of actual nighttime wet-rainy/dry conditions will supplement the reporting. Before and after safety data will be added to the report as that becomes available.

Construction Documentation: Will include information specific to the installation events of the pavement markings.

Post Documentation: Will entail semi-annual inspections of the marking durability as well as documented retro-readings of the project sections.

The purpose of an experimental features report is to document the phases and events of any given project to gain the reader an understanding of the overall activities required to install or incorporate the research element into an active construction or maintenance project. This report also establishes a baseline for defining performance for any given feature under actual service conditions to determine its relative merits.

Evaluation Schedule

Research will monitor performance for a minimum period of five years annually, with every year up to ten years (informally). This is in accordance with the Department's "Experimental Project Procedures". Delivery of a construction/installation report, interim, annual or semi-annual reports is required as well as a final project report (responsibility of Research).

2013:	Installation/Construction Report
2014-2017:	Semi-Annual Inspections/ Annual Evaluation Reports
2018:	Final Evaluation/Final Report

Initial Remarks

This report attempts to capture the pertinent elements of the installation events to give the reader an understanding on how these new pavement marking components function. This report also establishes a baseline of documentation for use in determining future performance of the striping project. As noted earlier semi-annual site evaluations will be added annually to the construction report. This report and other information may be found at: http://www.mdt.mt.gov/research/projects/bead_technology.shtml

District staff connected with the project reported no concerns or issues regarding the applications of all three sections which may affect future performance. The grinding phase as well as the markings placement was competently installed.

Although subjective, District personnel as well as Research staff, on site inspections during nighttime dry and wet conditions; noticed increased retroreflectivity with the two test sections as compared to the control. Current consensus (directly after installation of the striping project) categorized the 3M and Visamax products as comparable in added illumination and acceptable contrast with the adjacent pavement.

Note on page nine (9) only the 3M test section is portrayed in this report during nighttime wet conditions. Due to increase traffic and safety concerns the VISIMAX section was reviewed while active driving but was not digitally captured. An attempt will be made to add that information in future site inspections.

The retroreflective measurement readings were taken after the striping was completed during wet pavement conditions. In early November additional retro-readings were taken during dry pavement conditions; it was reported due to a recent weather event deicer was present on the surface and may affect these readings. See page eleven (11) for those results. See page twelve (12) for project layout location diagram.

Research would like to thank Billings District staff: Jeff Dyekman, Tom Tilzey, and Dave Larson for their help and direction with this project.

Site Visit March 2015: Project Update

All project test and control sections white lines placed in the 60 mil groove are in good shape with no appreciable visible distress due to environmental factors or from snow plow activities. As predicted the yellow center lines have received distress from snow plows as seen in images contained in this report. Retro readings were conducted in October 2014.

The following are representative images and descriptions of the applied treatments taken in September and October of 2013, April of 2014, and in March 2015:

Pre and Post Installation Images



← Representative image taken in July of 2013 prior to new pavement markings application. View north.



← Representative image taken in September of 2013 after pavement markings application, showing added centerline and shoulder rumble strips. View north.

September 2013 – Project images taken during wet conditions



← Beginning of VISIMAX PLUS pavement markings at reference point 53 looking south.



← Beginning of Control (Type 2) pavement markings at reference point 49 looking south.



← Beginning of 3M Wet Reflective Element pavement markings at reference point 47 looking south.



← Close-up of the VISIMAX PLUS white pigmented pavement markings.



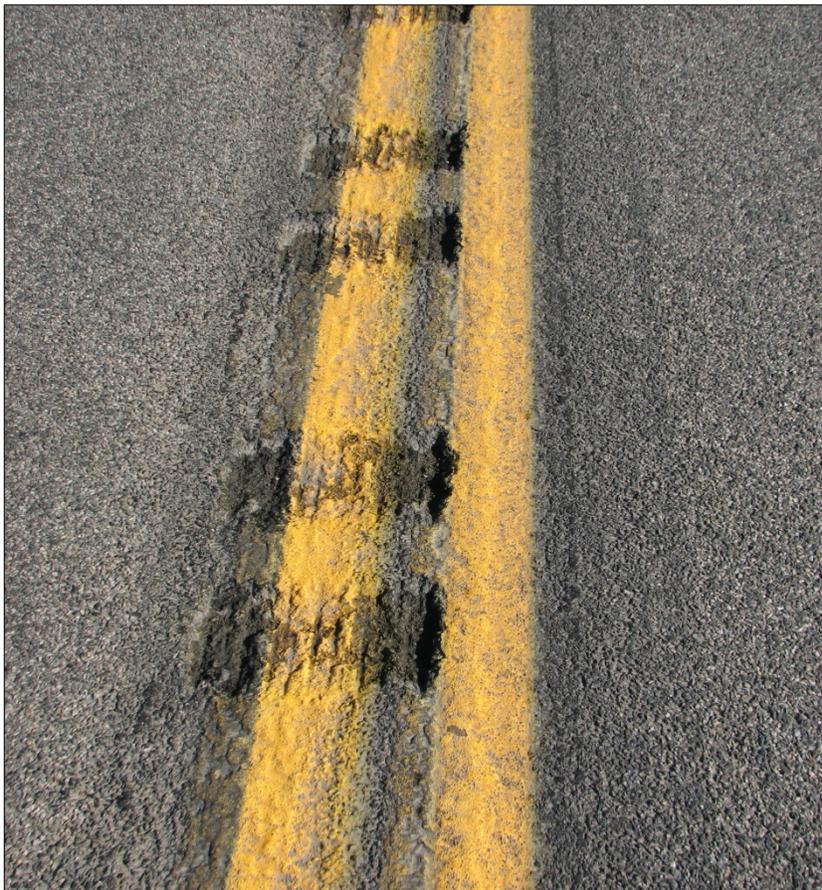
← Close-up of the Control (Type 2) white pigmented pavement markings.



← Close-up of the 3M Wet Reflective Elements white pigmented pavement markings.



← Representative image of no-passing stripes placed over center-line rumble strips (wet condition).



← Representative image (taken in mid-October 2013) of no-passing lane stripes placed over center-line rumble strips (dry condition).

Note that centerline striping did not receive a 60 mil groove treatment.

October 2013 – Project images taken during dry conditions



← Close-up of the VISIMAX PLUS white pigmented pavement markings.

Note that (for the most part) the pavement stripe falls well within the parameters of the 60 mil groove; which should aid in the durability of the stripe. This is indicative of all three (3) sections on the project.



← Close-up of the Control (Type 2) white pigmented pavement markings.



← Close-up of the 3M Wet Reflective Elements white pigmented pavement markings.

September 2013: Documentation during wet and nighttime conditions



↑ This is the transition of the 3M striping and control section at approximately RP 47 (yellow arrow). It was actively raining at the time. ↓ The image below is the transition of the conventional striping and 3M striping at approximately RP 43.

Although difficult to see in these images; during actual field observation, the difference in luminosity and contrast between the two test sections was apparent as compared to the control in nighttime driving under wet conditions.



Retroreflectivity Readings Collected during Dry and Wet Conditions - 2013

Milepost	SB September-Wet	SB November-Dry	NB September-Wet	NB November-Dry
	Shoulder	Shoulder	Shoulder	Shoulder
52-Visamax	392	178	382	175
50-Visamax	454	242	535	293
48-Control	221	235	359	241
47-Control	394	290	334	238
46-3M	325	223	614	231
44-3M	752	305	713	308

Milepost	September-Wet	November-Dry
	Center	Center
52-Visamax	397	192
50-Visamax	349	203
48-Control	336	225
47-Control	319	221
46-3M	357	258
44-3M	563	306

Retroreflectivity Readings Collected during Dry Conditions - 2014

Milepost	SB October	Center	NB October
	Shoulder		Shoulder
52-Visamax	Under Construction		
50-Visamax	225	135	166
48-Control	230	167	232
47-Control	290	120	228
46-3M	290	206	290
44-3M	328	221	254

Note: The District used a handheld retro gun; Potters model MX 30. Retro-readings were taken approximately at two locations per section.



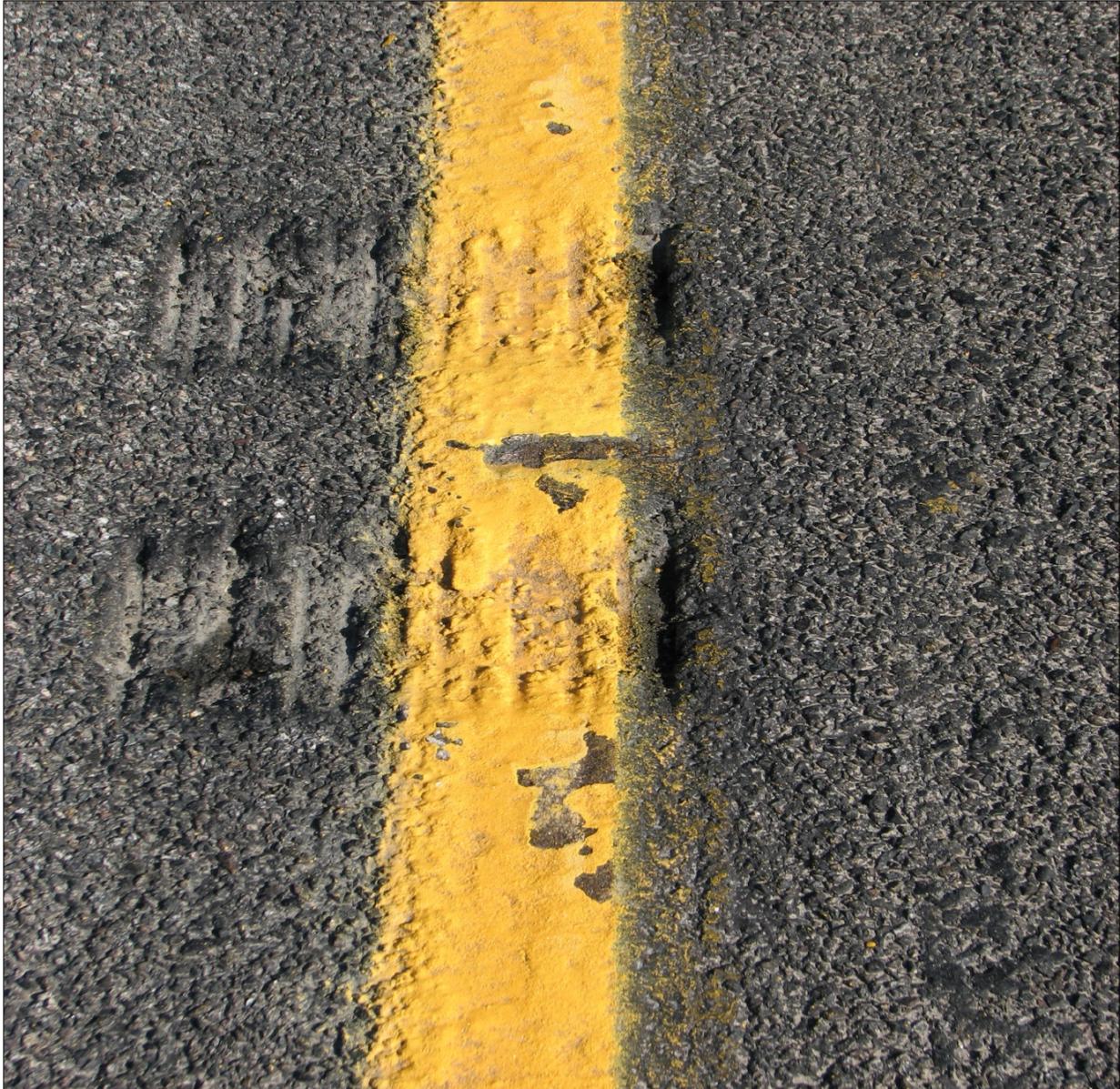
Project Sections Layout

- Section 1: 3M Wet Reflective Elements – Mile Point 42.9-46.9
- Section 2: Control: Type 2 Glass Beads – Mile Point 46.9-48.9
- Section 3: VISIMAX Plus – Mile Point 48.9- 52.9

Sections are delineated in the field by yellow paint markings.

All values are approximate.

Supplemental



↑ This image taken on October 15, 2013 of the centerline markings is showing distress of debonding of the striping binder to the pavement surface commonly associated with snow plow damage or some other type of metal to binder contact.

District Maintenance staff reported in November they are noticing more of this kind of distress and since it is not in a milled groove is expected to increase over time.

Site Visit April 2014 – 3M Elements Section



← Beginning of the 3M section at reference point 43; view east.



← Close-up of 3M Elements marking.

This image is representative of the overall condition of the stripe on the project.

Potters VISIMAX PLUS Section



← Beginning of the Visamax section at reference point 49; view east.



← Close-up of Visamax marking.

This image is representative of the overall condition of the stripe on the project.

Type II Control Section



← Beginning of the Type II control section at reference point 47; view east.



← Close-up of Type II marking.

This image is representative of the overall condition of the stripe on the project.

Yellow Centerline Documentation – April 2014



↙↘ Images representative of the general condition of the stripe over rumble strip on the project.

Loss of binder to pavement due to assumed snow plow passes.



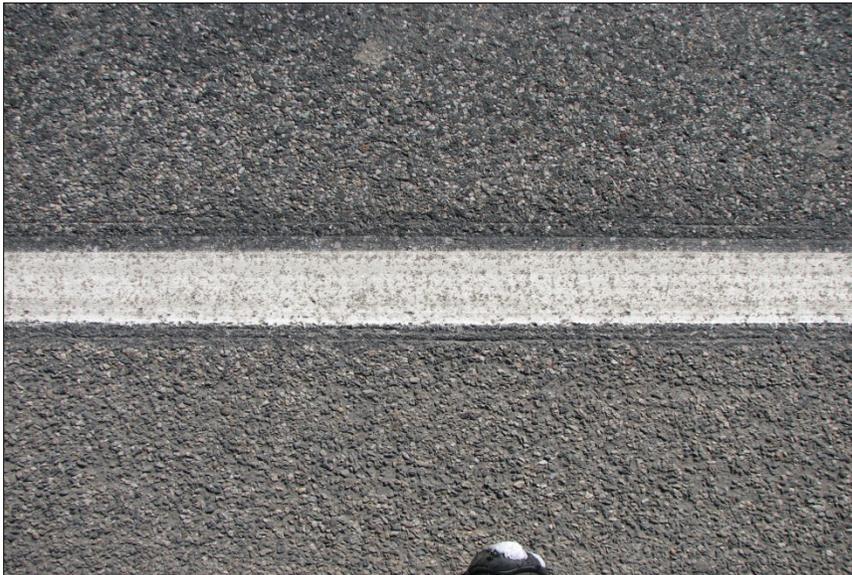


← There was a small linear section of no-passing zone that received a 60 mil grind within the 3M Element section. As seen the stripe is in good condition.

Site Visit March 2015 – 3M Elements Section



← Overview of 3M Elements section; view west near mile point 47.



← Close-up of 3M Elements marking.

This image is representative of the overall condition of the stripe on the project.

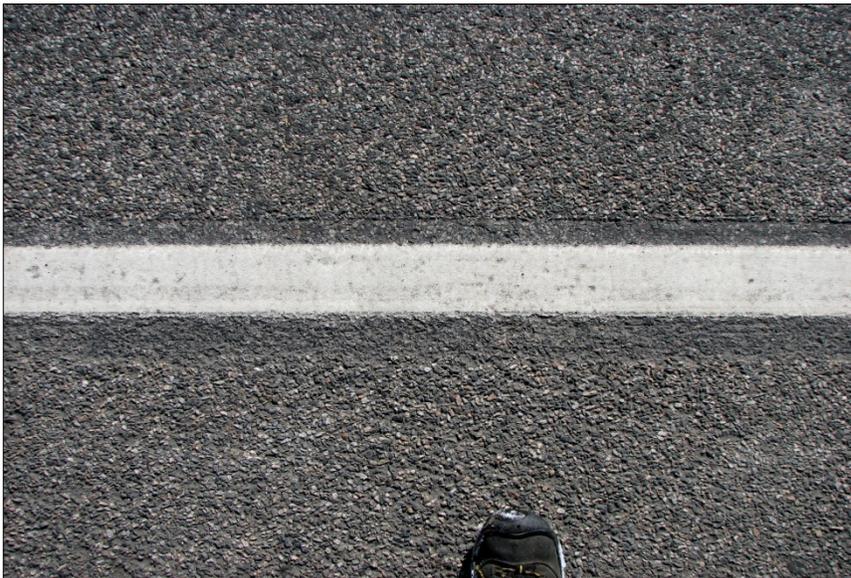


← Additional close-up of 3M Elements marking.

Type II Control Section



← Overview of Type II Control section; view west near mile point 49.



← Close-up of Type II marking.

This image is representative of the overall condition of the stripe on the project.



← Additional close-up of Type II marking.

VISIMAX PLUS Section



← Overview of VISIMAX PLUS section; view west near mile point 50.



← Close-up of VISIMAX PLUS marking.

This image is representative of the overall condition of the stripe on the project.



← Additional close-up of VISIMAX PLUS marking.

Yellow Centerline Documentation – March 2015



↙↓ Images representative of the general condition of the stripe over rumble strip on the project.



Disclaimer

The use of a product and/or procedure in the course of an evaluation does not constitute an endorsement by the Department nor does it imply a commitment to purchase, recommend, or specify the product in the future.

Data resulting from the project is public information and will not be considered privileged. The MDT may, at its discretion, release all information developed during and after the evaluation.