Montana Department of Transportation
Research Programs
May 2015

EXPERIMENTAL PROJECTS FINAL REPORT

URETHANE EPOXY PAVEMENT MARKINGS

Location:	I-15 (C000015), Jefferson County, Butte District. Milepost Reference Point Approximately 143-163
Project Name:	Elk Park
Project Number:	HWY-310386-RP
Experimental Project No.	MT-12-02
Type of Project:	Urethane Epoxy Pavement Markings
Principal Investigators:	Craig Abernathy, Experimental Project Manager (ExPM)
Date of Construction:	June 11-15, 2012 – **Site Inspection Period:** October 2012-May 2015
Contractors:	Swarco Colorado Paint Company Ennis Traffic Safety Solutions

Objective

Determine the effectiveness and long-term durability of the products Swarco MFUA-10 and Ennis HPS-4 urethane epoxy pavement markings as compared to our currently approved epoxies (Poly-Carb).

Experimental Design

The following is the control and test sections as constructed:

Control Section 1: RP 143 to RP 153 - **South Bound**

- Current Epoxy Spec/Poly-Carb
- Light Grind

Test Section 2: RP 153 to RP 163 - **South Bound**

- Ennis HPS-4
- Heavy Grind

Control Section 3: RP 143 to RP 153 - **North Bound**

- Current Epoxy Spec/Poly-Carb
- Heavy Grind

Test Section 4: RP 153 to RP 163 - **North Bound**

- Swarco MFUA-10
- Heavy Grind

Note: Project layout diagram located at end of this report.

Evaluation Procedures

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 general 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.

This report will document the installation for best practice and any constructions concerns germane to the performance of the product. At a minimum, semi-annual inspections will report on pavement markings durability, retroreflectivity, and any other measurable outcomes. Additional site inspections may supplement the semi-annual visits based on need. District Maintenance will be asked to report on condition of markings as required.

Construction and Post-Project Documentation: Will include information specific to detail prior and to the placement of the markings. Research will conduct semi-annual inspections (late fall, early spring) of pavement marking conditions for a duration of sixty (60) months if required.

Evaluation Schedule

Research will report on performance for a minimum period of five years annually. This is in accordance with the Department's "Experimental Project Procedures". Delivery of a construction/installation report, annual reports is required as well as a final project report (responsibility of Research). The web page dedicated to display all reporting from the project is located at: http://www.mdt.mt.gov/research/projects/urethane.shtml

Pavement Marking Retroreflectivity Index (RI)

Initial RI readings were taken for the entire project at intervals of one-tenth (1/10) per mile. Yellow markings averaged an RI of **240** rated as good (baseline of acceptable yellow RI at 205). White markings RI averaged **430** rated as good (baseline of acceptable RI white at 330). Future RI collection data activities will be asked to breakout the indices for the one control and two test sections to establish a trend of RI performance and will be added to this report as they become available.

The following project information (pages 5-17) detail the average condition of the pavement markings before and after the subsequent paint application of the control and test sections.

A separate section will detail the difference of the light and heavy grinds as seen on the project (pages 18-24). The April 2013 site inspection is located on pages 28-44.

Analysis April 2013

A site inspection was conducted mid-April 2013. In attendance was Justin Juelfs, Maintenance Division Projects Reviewer, Joe Nye, Materials Bureau Inspection Operations Supervisor, and Craig Abernathy, Experimental Projects Manager.

General consensus from all is that all control and test sections (light and heavy grind) are (in appearance) performing equally in the area of product durability since installation in June of 2012, specifically the amount of damage to the striping due to repetitive plow passes during the winter season. At this time it is difficult to determine a percentile breakout of representative sections of pavement marking conditions. Conversely there was equally good striping condition on all sections as well. Future inspections may determine if the current trend continues.

Analysis April 2014

A site inspection was conducted late April 2014.

After 3 separate drive-through of the project and spot inspections all control and test sections (light and heavy grind) are (in appearance) performing equally in the area of product durability since installation in June of 2012, specifically the amount of damage to the striping due to repetitive plow passes during the winter season. Visually, on average, it appears that all sections are identical in the amount of distress either by environmental factors or winter maintenance activities. If the District conducts retroreflectivity data it will be added to this report. The images beginning on page 44-52 attempts to characterize average conditions of the project sections.

Next inspection will be in spring of 2015.

Analysis May 2015 – Final Inspection

The intent of the project was to compare performance of the selected urethane epoxies to our current epoxy striping specification. In addition to ascertain if light to heavy grinding affected durability as well.

The selected stretch of Interstate 15 has an average elevation of 5800' (1768 meters), with an average AADT of 3000. Maintenance activity involving plowing during the winter months can be extensive due to the harsh environment of the project area.

Since installation in summer of 2012 and to May of 2015, Research visited the site each year in late fall and early spring to gather data for the annual update to the construction report. Based on consent with the principals in the Maintenance Division who sponsored the project, and information gathered to date on performance of the test sections; that the project documentation phase has sufficiently determined the comparison of product efficacy and to terminate any further evaluation.

The report focused on examples of stripe degradation included, raveling (or debonding), pop-outs, abrasion, etc. under the assumption the main attribute to distress would be snow plow activity and potential environmental and traffic factors. Also this analysis assumes that the surface preparation and application of the selected marking materials were placed adequately with no issues during installation which may have affected performance.

Conversely there were good sections of intact pavement marking as well, but as stated in previous inspections; all sections performed equally over time on both asphalt and PCCP surfaces in documented marking distress. Comparison of the light and heavy grind sections exhibited no noticeable difference on pavement marking performance.

One issue was the grinding phase and to what level of application is interpreted from the special provision as to what was done in the field.

Per the special provision:

▪*Light grinding is defined as continuous full-width surface abrasion to the existing pavement marking to establish a roughened surface free of loose paint chips, loose seal aggregate and surface impurities.*

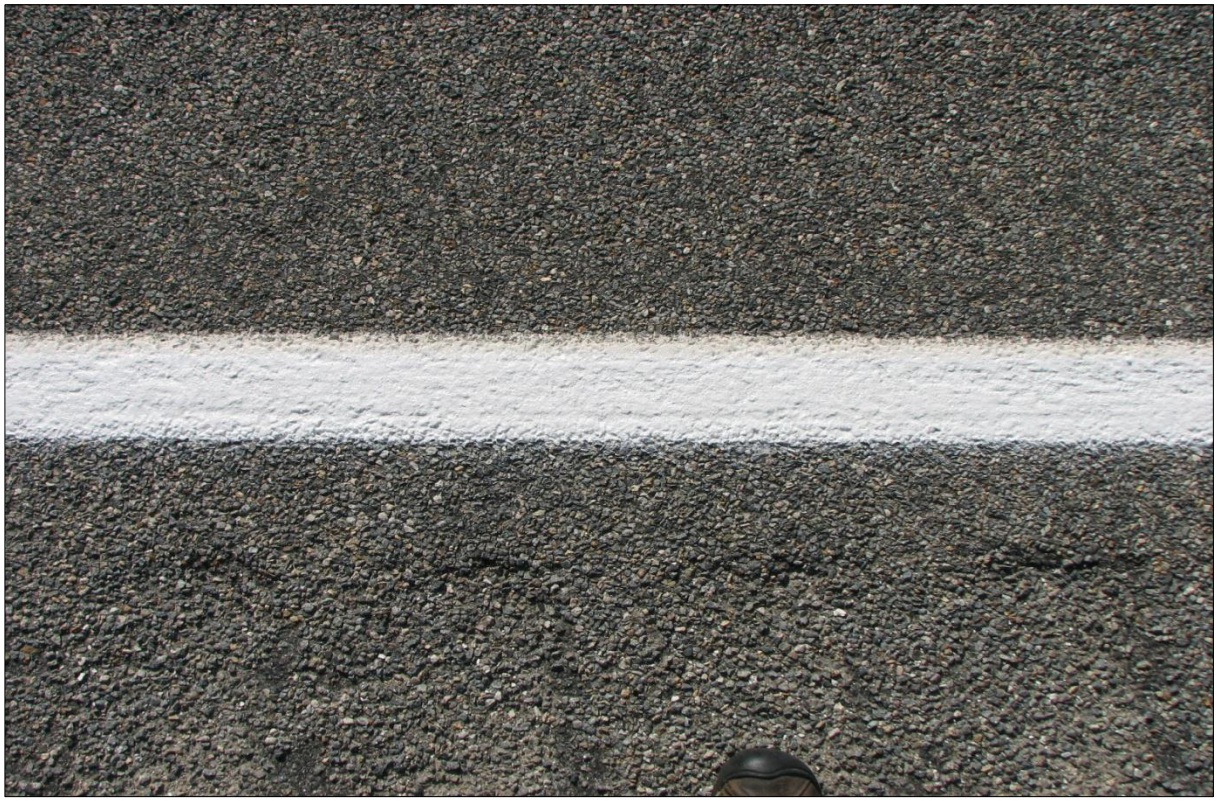
▪*Heavy grinding is defined as complete removal of pavement markings (entire pavement marking width) to the top of the pavement surface.*

Pages 18-24 in this report have general examples of the typical light and heavy grinds as documented. Specifically with the heavy grinding; may be interpreted as what could apply a light grind to be. The heavy grind on the project did not completely remove the pavement marking as stated in the special. When asking the contractor about the level of grind, it was stated they were instructed not to disturb the underling chip seal, and to attempt a complete removal of the stripe would most likely cut into the existing seal and cover. Their grinding equipment did not have the capability for that type of tolerance. This resulted in the way the heavy grind was applied on this project.

Pages 53-60 have representative images of the May 2015 site inspection.

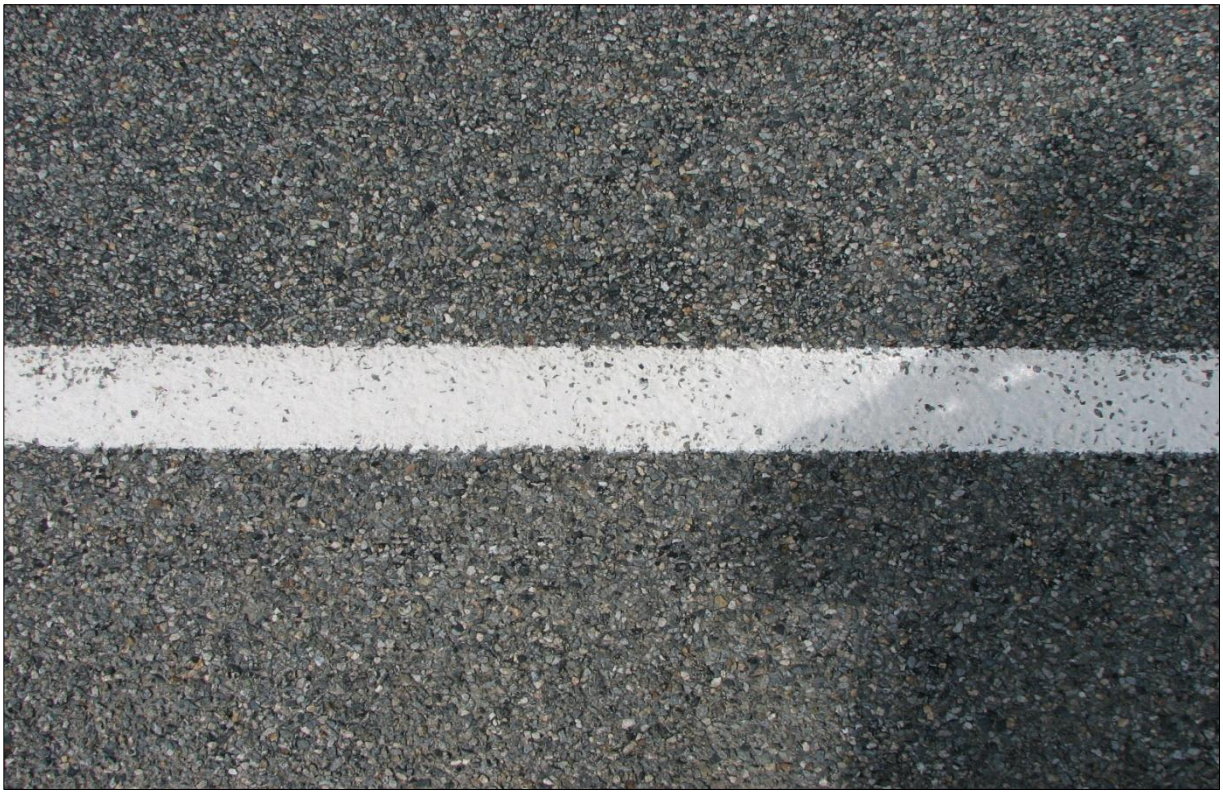
Control Section: Poly-Carb Epoxy – Light Grind South Bound (SB) Lanes MP143-153

🡅🡇 Representative images of the Poly-Carb SB control section prior to the new markings application.

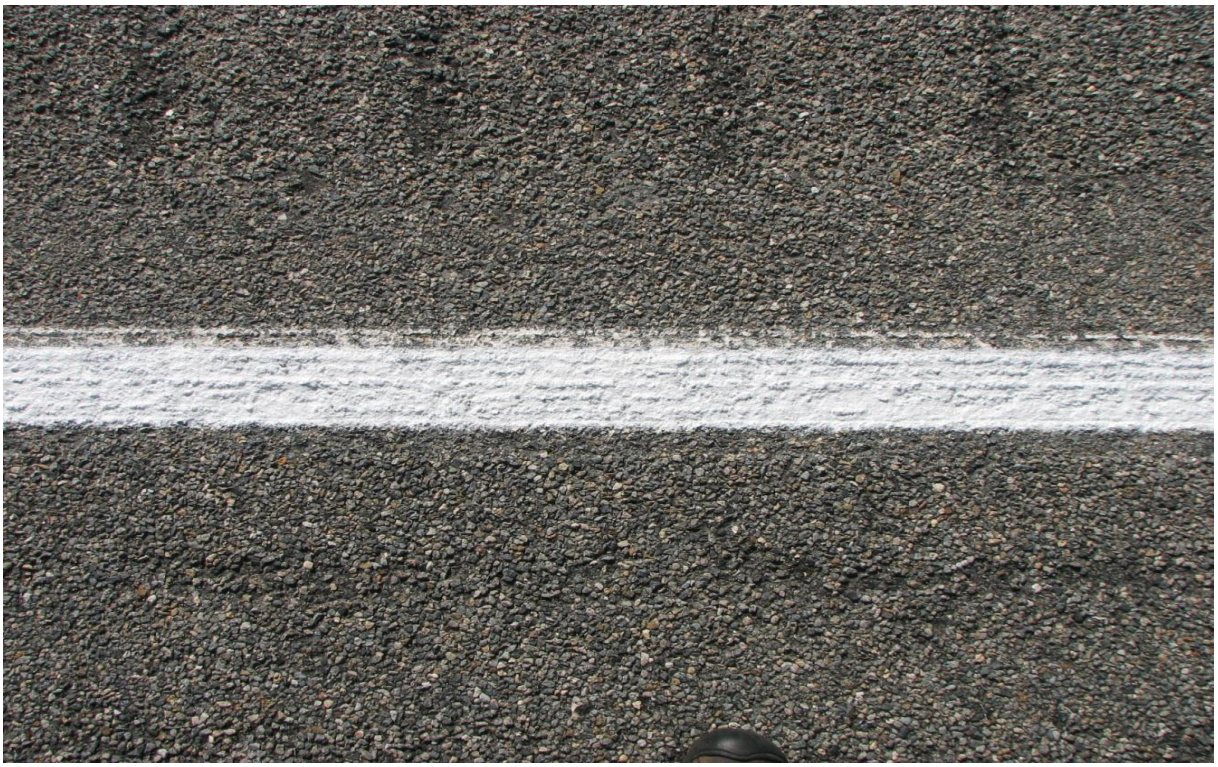


🡅🡇 Representative images of the Poly-Carb SB control section after the pavement marking application.

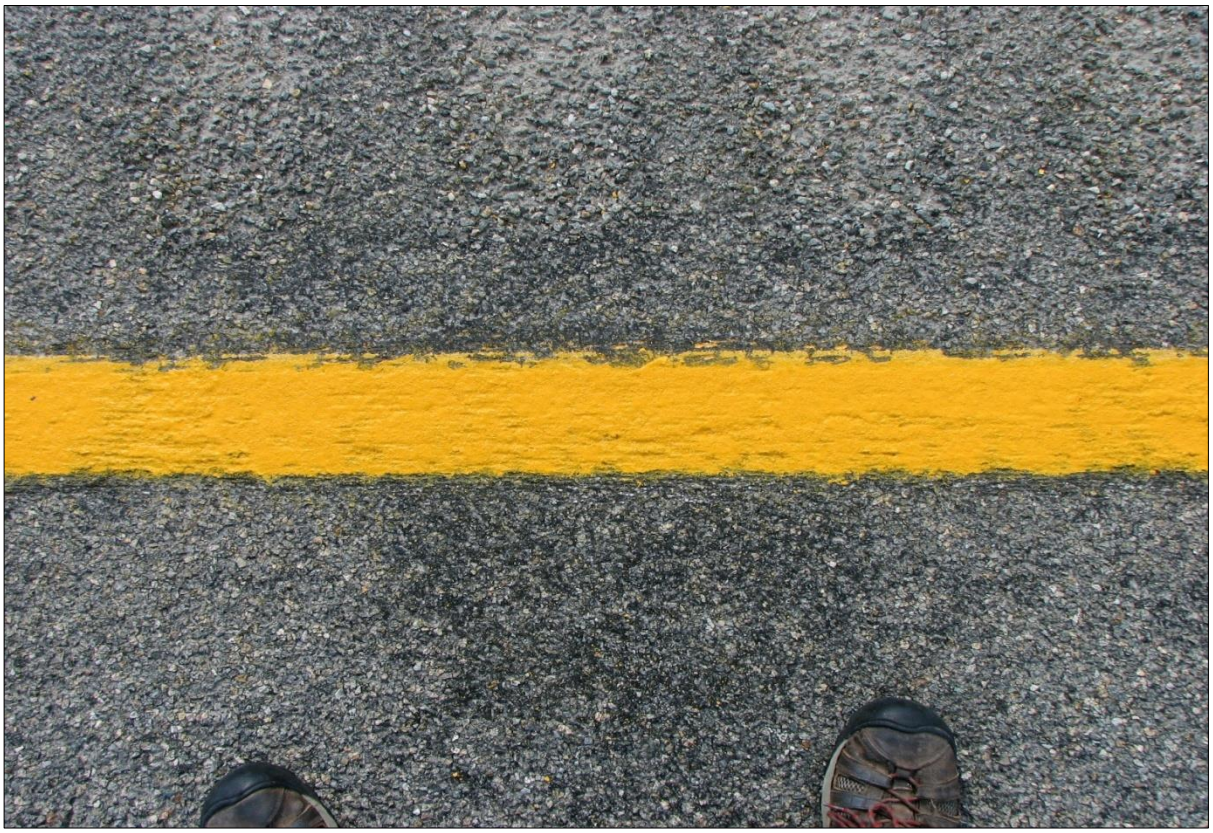
Control Section: Poly-Carb Epoxy – Heavy Grind North Bound (NB) Lanes MP143-153



🡅🡇 Representative images of the Poly-Carb NB control section prior to the new markings application.

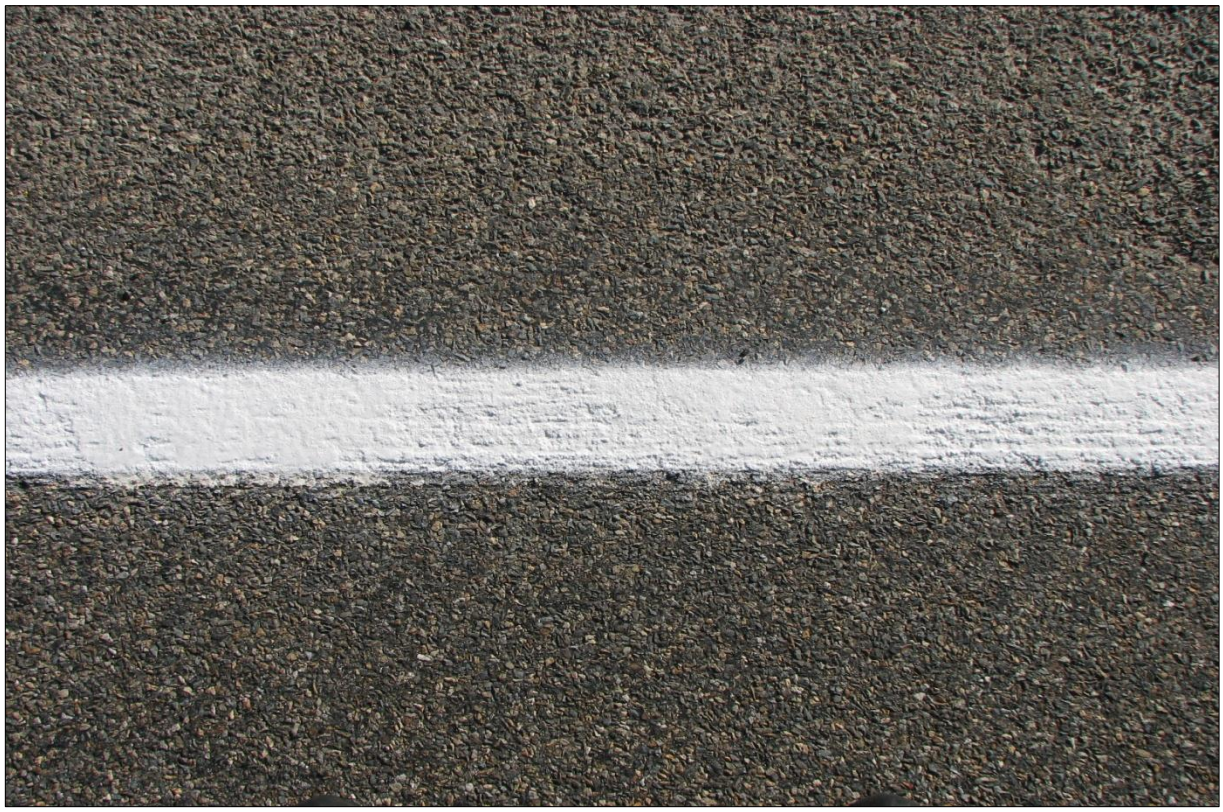


⬆⬇ Representative images of the Poly-Carb NB control section after the pavement marking application.



🡅🡇 Representative images of the yellow Poly-Carb NB control section after the pavement marking application.

Test Section: Ennis HPS-4 – Heavy Grind South Bound (SB) Lanes MP153-163



🡅🡇 Representative images of the white Ennis HPS-4 test section after the pavement marking application.

⬆⬇ Representative images of the yellow Ennis HPS-4 test section after the pavement marking application.

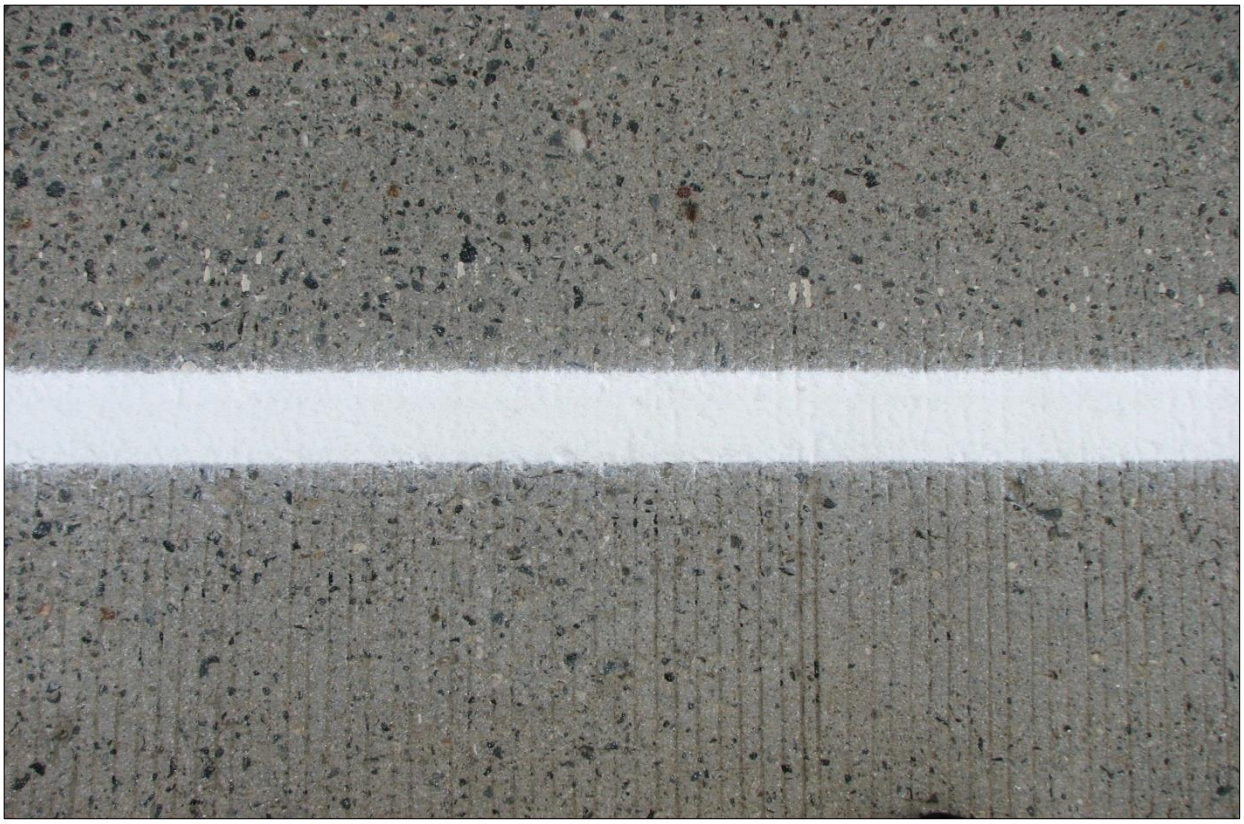
🡅🡇 Representative images of the white Ennis HPS-4 test section after the portland cement concrete pavement (PCCP) pavement marking application.

🡅🡇 Representative images of the yellow Ennis HPS-4 test section after the PCCP pavement marking application.

Test Section: Swarco MFUA-10 – Heavy Grind North Bound (NB) Lanes MP153-163

🡅🡇 Representative images of the white Swarco MFUA-10 test section after the pavement marking application.

🡅🡇 Representative images of the yellow Swarco MFUA-10 test section after the pavement marking application.



🡅🡇 Representative images of the white Swarco MFUA-10 test section after the PCCP pavement marking application.

🡅🡇 Representative images of the yellow Swarco MFUA-10 test section after the PCCP pavement marking application.

Documentation of Light and Heavy Grind of Control and Test Sections

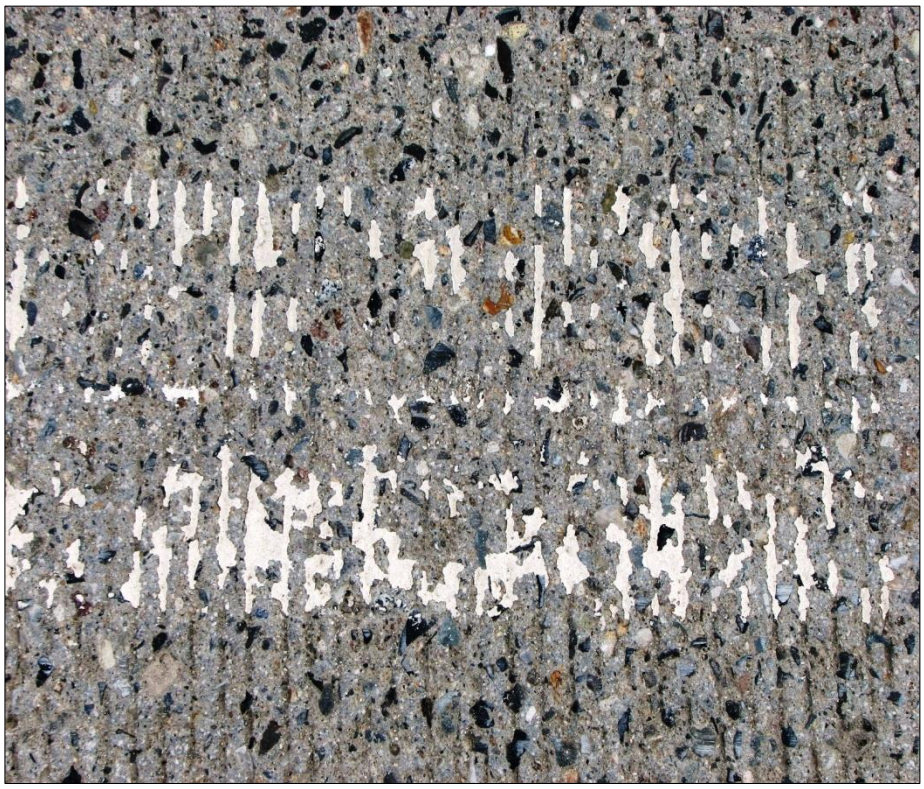
The following are representative images of the grinding phase of the pavement marking application. A light grind was only applied to the Poly-Carb SB test section (MP 143-153). A heavy grind was applied on all other sections of the project.

The effective level of grinding either on light or heavy applications can be dependent on many variables associated with pavement surface and existing marking. The contractor (as in a heavy grind) has to balance the intent of removing as much current material as possible without damaging the underling chip seal. In regards to a light grind the intent is to scuff the surface to provide a cleaner bond.

LIGHT GRIND: PolyCarb SB Only

HEAVY GRIND: Poly-Carb/Swarco NB – Ennis SB

Supplemental Information



🡸 Example of marking stripe on one of the areas PCCP bridges prior to new marking application.

🡸 Example of snow plows damage to pavement markings which was prevalent on all sections of the project.

🡐 Image shows how test and control sections are marked in the field.

🡐Sample image of binder and reflective bead application.

🡅 Representative image of completed striping (northbound Poly-Carb control section).

Site Inspection April 2013 – Poly-Carb Light-Grind MP 143-153 Southbound

🡅 Representative image of Southbound Poly-Carb control section; view south.

🡇 Representative image of Southbound Poly-Carb control section - PCCP deck; view south.

🡅 Representative image of Southbound Poly-Carb control section, white stripe application (fog line); view south.

🡅 Representative image of Southbound Poly-Carb control section, yellow stripe application; view south.

🡸🡻 PCCP deck: sample images of white and yellow striping; view south.

AC and PCCP striping applications; close-up of plow damage.

Site Inspection April 2013 – Poly-Carb Heavy-Grind MP 143-153 Northbound

🡅 Representative image of northbound Poly-Carb control section; view north.

🡇 Representative image of northbound Poly-Carb control section - PCCP deck; view north.

🡅 Representative image of northbound Poly-Carb control section, white stripe application; view north.

🡅 Representative image of northbound Poly-Carb control section, yellow stripe application; view north.

🡸🡻 PCCP deck: sample images of white and yellow striping; view north.

AC and PCCP striping applications; close-up of plow damage.

Site Inspection April 2013 – Swarco MFUA-10 Heavy-Grind MP 153-163 Northbound

🡅 Representative image of northbound MFUA-10 test section; view north.

🡇 Representative image of northbound MFUA-10 test section - PCCP deck; view north.

🡅 Representative image of northbound MFUA-10 test section, white stripe application; view north.

🡅🡇 PCCP deck: representative images of white and yellow striping.

Site Inspection April 2013 – Ennis HPS-4 Heavy-Grind MP 153-163 Southbound

🡅 Representative image of southbound Ennis HPS-4 test section; view south.

🡇 Representative image of southbound Ennis HPS-4 test section - PCCP deck; view south.

🡅 Representative image of southbound Ennis HPS-4 test section, white stripe application; view south.

🡅 Representative image of southbound Ennis HPS-4 test section, yellow stripe application; view south.

🡸🡻 PCCP deck: sample images of white and yellow striping; view south.

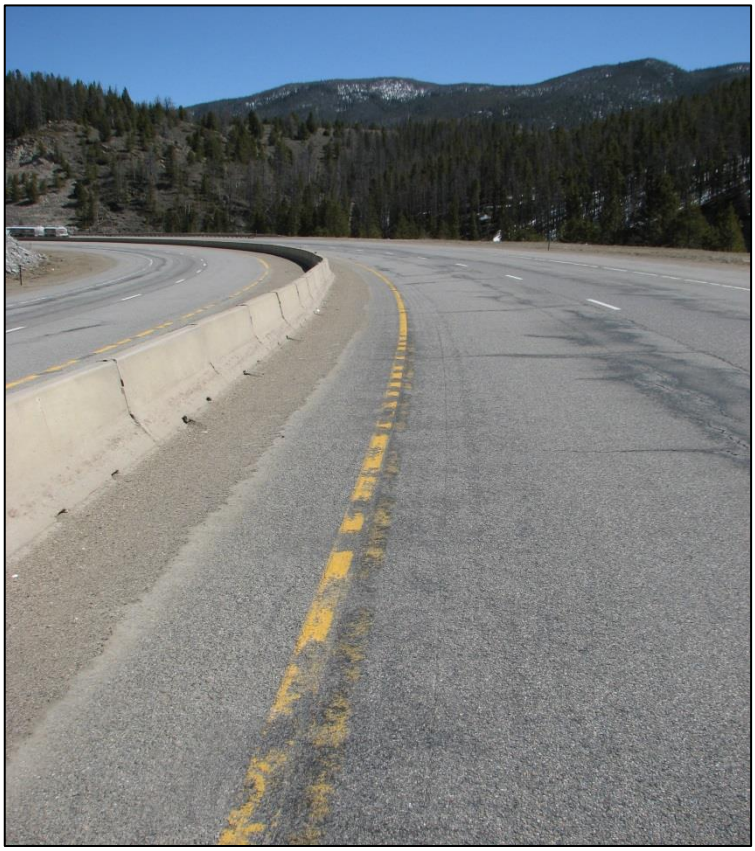
Site Inspection April 2014 – Poly-Carb Light-Grind MP 143-153 Southbound

🡸🡻 Representative images of the white and yellow striping on the project asphalt surface.

🡸🡻 Representative images of the white and yellow striping on the project concrete deck surface.

Site Inspection April 2014 – Poly-Carb Heavy-Grind MP 143-153 Northbound

🡸🡻 Representative images of the white and yellow striping on the project asphalt surface.



🡸🡻 Representative images of the white and yellow striping on the project concrete deck surface.

Site Inspection April 2014 – Swarco MFUA-10 Heavy-Grind MP 153-163 Northbound

🡸🡻 Representative images of the white and yellow striping on the project asphalt surface.

🡸🡻 Representative images of the white and yellow striping on the project concrete deck surface.

Site Inspection April 2014 – Ennis HPS- 4 Heavy-Grind MP 153-163 Southbound

🡸🡻 Representative images of the white and yellow striping on the project asphalt surface.

🡸🡻 Representative images of the white and yellow striping on the project concrete deck surface.

Site Inspection: May 2015 – Poly-Carb Light-Grind MP 143-153 Southbound

🡸🡻 Representative images of the white and yellow striping on the project asphalt surface (view south).

Site Inspection: May 2015 – Poly-Carb Light-Grind MP 143-153 Southbound/PCCP

🡸🡻 Representative images of the white and yellow striping on the project bridge deck surface (view south).

Site Inspection May 2015 – Poly-Carb Heavy-Grind MP 143-153 Northbound

🡸🡻 Representative images of the white and yellow striping on the project asphalt surface (view north).

Site Inspection May 2015 – Poly-Carb Heavy-Grind MP 143-153 Northbound/PCCP

🡸🡻 Representative images of the white and yellow striping on the project bridge deck surface (view north).

Site Inspection May 2015 – Swarco MFUA-10 Heavy-Grind MP 153-163 Northbound

🡸🡻 Representative images of the white and yellow striping on the project asphalt surface (view north).

Site Inspection May 2015 – Swarco MFUA-10 Heavy-Grind MP 153-163 Northbound

🡸🡻 Representative images of the white and yellow striping on the project (PCCP) bridge deck surface (view north).

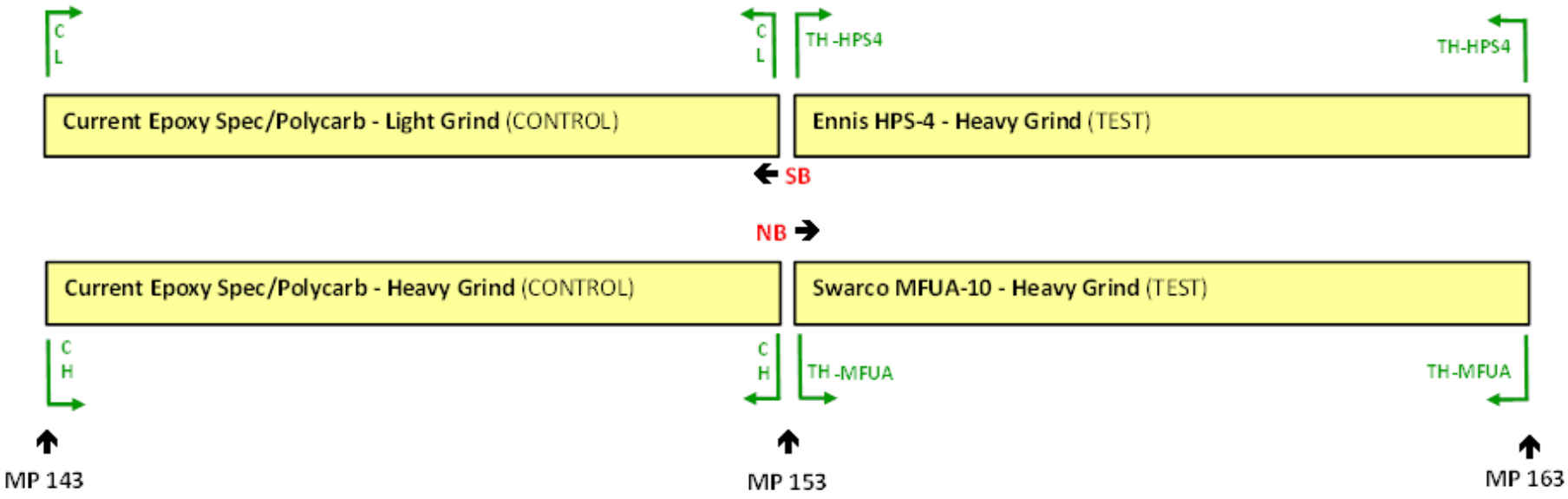
Site Inspection May 2015 – Ennis HPS-4 Heavy-Grind MP 153-163 Southbound

🡸🡻 Representative images of the white and yellow striping on the project asphalt surface (view south).

Site Inspection May 2015 – Ennis HPS-4 Heavy-Grind MP 153-163 Southbound/PCCP

🡸🡻 Representative images of the white and yellow striping on the project bridge deck surface (view south).

Interstate 15: MP 143-163 - Urethane Epoxy Pavement Markings Project Layout



Note: Green text and symbols denote how project control and test sections are marked in the field

Disclaimer

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