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## POLICY, PLANNING, & INTERMODAL DEVELOPMENT DIVISION

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### Research & Development Section



#### Attendees:

Jonathan Razinger, Research

Engineer

Chris Barker, R.E.

Logan Perron, Civil Engineer

L&D Safety Marking Corp.

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October 3, 2016

## FIELD REPORT

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### Berlin 2947(1) Pavement Marking Study – US 302 Bike Lane Installations

#### Product Information:

##### PreMark<sup>®</sup>

PreMark<sup>®</sup> preformed thermoplastic is manufactured by Ennis-Flint of Thomasville, North Carolina. The manufacturer claims the product is a heavy-duty, durable intersection grade pavement marking material. It is used primarily for regulatory markings on public streets, highways, and private properties. It is claimed to have a cost-effective service life that lasts 6 to 8 times longer than paint. There are no minimum ambient or road temperature requirements for application which can extend the marking season into colder months. Retroreflective glass beads are mixed throughout the material so that as the marking wears new beads become exposed. It provides a clean and crisp appearance because the product is pre-cut and ready for use. The nominal thickness is 90 mils for both white and green colors. [1]

##### CycleGrip<sup>®</sup> MMAX

CycleGrip<sup>®</sup> MMAX is a colored bike lane treatment, manufactured by Ennis-Flint of Thomasville, North Carolina. The manufacturer describes the products as a specialized system that combines state-of-the-art Methyl Methacrylate resins with hardwearing aggregate and premium pigments. The advanced technology provides long-lasting color retention, friction, and extreme durability. It is ideal for long lane areas with low to high vehicle traffic including cross-over points such as parking lot entries/exits along the corridor. The application thickness is 90 mils. [3]

##### Color-Safe<sup>®</sup>

Color-Safe<sup>®</sup> is an acrylic based resin system used for color pavement markings and anti-skid surfacing that is manufactured by Transpo Industries, Inc. of New Rochelle, New York. The manufacturer claims the product provides excellent color retention and durability. It is manufactured in a variety of colors and aggregate sizes and is typically used for demarcation of crosswalks, bicycle and pedestrian paths, bus lanes, and other specially designated areas. It can be used as a surface coat to enhance skid-resistance for high friction surfacing on hazardous turns and high accident areas. The typical application thickness is 60-100 mils. The target in place thickness for the product in this project will be as close as possible to 90 mils in

place. Both green and white will be used for this project. Green will be used for the green bike lane section as designated in the plans. White will be used for the Bicycle Detector Symbols located within the green bike lane as designated in the plans. [2]

**Work Plan:** WP 2013 R-4

**EA:** Experimental Features - SPR 352

**Date:** Friday & Saturday, August 26 - 27, 2016; Friday, September 2, 2016

**Time:** 11:00 AM Friday to 5:00 PM Saturday

**Weather:** 80°F, Partly Cloudy

Ennis-Flint PreMark Thermoplastic was installed in the bike lane between section markers 56+42 and 60+66. The bike lane from 56+62 to 58+60 is solid and skipped blocks from 58+60 to 60+66. The bike lane incorporates three Ennis-Flint PreMark bike lane symbols at: 56+58, 58+56 and 60+25. The bike lane was installed during a two-day period. The biker symbols at: 56+58, 58+56 and 60+25 within the bike lane were installed on 9/2/2016. There are no retroreflective beads in the bike lane PreMark Thermoplastic, which means that durability studies on the bike lanes will only involve visual inspections, photos and notes. The exact location where the bike lane and symbols are can be seen on the Construction Plans. [5]

**Notes:**

The white edge skips that were 3M 270 ES inlaid tape had to be pulled out because the spacing did not match the layout of the thermoplastic bike lane blocks. The missing white skips can be seen in Figures (3 – 5) and (10). Before the completion of the project L & D applied white Polyurea paint on the sides of the PreMark bike lane blocks from 58+56 -- 60+66. This can be seen in Figure (12). L & D was implementing the same installation process that was implemented earlier in the morning on the left arrows at 69+54 and 69+96. This included: brushing and blowing off the asphalt surface, applying an approved 2 part sealer to remove unwanted moisture from the asphalt surface, and heating the symbols into place. Jeremy Crow, the Ennis-Flint representative, was instructing the L & D crew how to properly install the PreMark thermoplastic material. This can be seen in Figure (1). When torch applying the material, he recommended slow and steady passes of the torch. The torch should be at a low to medium heat range, at approximately 4 to 8 inches above the material. If the torch is too hot or too close to the material surface, the material may burn like in Figure (8). The PreMark thermoplastic material reaches the proper installation temperature when the heat indicators disappear. The heat indicators are shown in Figure (9). A close-up of a properly installed PreMark block can be seen in Figure (6). Jeremy emphasized that the edges of the material when properly installed should be rounded. For further installation instructions read the PreMark Application Instructions [4].

During the install of the bike lane, 2 crew members from L & D applied the thermoplastic material. For both of the crew members it was their first time installing the product. A majority of the non-skid beads are distributed on the surface of the thermoplastic material. The beads on the surface of the material can be seen in Figure (2). As the thermoplastic matrix is heated, the beads sink lower into the matrix decreasing the skid resistance. The heated thermoplastic matrix increases the bond strength with the asphalt surface. Traffic and environmental wear will expose the beads and increase the skid resistance of the material. To

initially add skid resistance, it was suggested by Jeremy Crow to sprinkle Corundum (Aluminum oxide), which makes up Ennis-Flint anti-skid beads, on the surface of the recently heated PreMark thermoplastic material, as seen in Figure (5). Proper installation of the PreMark thermoplastic can be checked by conducting a Chisel Test. When Conducting a chisel test, a chisel is hammered into the thermoplastic material creating a V-shape and lifting the material. If particles of asphalt are visible on the backside of the lifted thermoplastic material, then the thermoplastic material is being applied properly. To repair the tested material, the lifted material is placed back into place and the area is reheated. I did not stay on site throughout the installation process, but I was told by Logan Perron that it took them approximately 4 hours to complete the skip section, without the biker symbol. The biker symbol was not installed because L & D did not have it in stock at the time. When installing the bike lane green solid section, the thermoplastic material was brought in 1 inch on either side to avoid burning the inlaid white 3M 270 ES Tape. This can be seen in Figures (7), (10) and (11).

**Photos:**



**Figure 1: Ennis-Flint Representative Jeremy Crow showing L & D Crew how to Operate the StreetHeat SR-28**



**Figure 2: Torch applying PreMark Bike Lane Green**



**Figure 3: Laying out PreMark Bike Lane Green Blocks**



**Figure 4: Installed PreMark Bike Lane Green Blocks**



Corundum applied  
on surface

**Figure 5: Installed PreMark Bike Lane Green with anti-skid Corundum**



**Figure 6: Close-up of Installed PreMark Bike Lane Green with anti-skid Corundum**



**Figure 7: Solid PreMark Bike Lane Green on Price Chopper Intersection**



**Figure 8: Installed PreMark Bike Lane Green Biker Symbol**



**Figure 9: Close-up of PreMark Bike Lane Green showing Heat Indicators**



**Figure 10: Completed PreMark Bike Lane at Price Chopper Intersection**



**Figure 11: PreMark Biker Symbol at Price Chopper Intersection**





**Figure 12: PreMark Bike Lane Blocks at Price Chopper Intersection with added Polyurea White Marks**

**Work Plan:** WP 2013 R-4

**EA:** Experimental Features - SPR 352

**Date:** Friday, September 30, 2016

**Time:** 8:00 AM to 3:30 PM

**Weather:** 60°F, Cloudy

Ennis-Flint CycleGrip MMAX Methyl Methacrylate (MMA) resin was installed in the bike lane between section markers 24+53 and 25+64. Ennis-flint CycleGrip MMAX was also installed for 12 bike lane blocks on the eastbound side from 29+00 – 29+88. The 13<sup>th</sup> bike lane block from 29+88 – 29+92 was installed with the Ennis-Flint PreMark Thermoplastic material. Ennis-Flint PreMark Thermoplastic was also installed on the westbound side bike lane blocks from 28+64 – 29+84.

CycleGrip MMAX was installed after the 30 day specification stipulating the placement of traffic marking paint. These sections of bike lane consisted only of blocks.

**Notes:**

Ennis-Flint Ride-A-Way epoxy-modified, waterborne coating was initially going to be placed in the bike lane between section markers 28+64 and 29+84 on the westbound side and between 29+00 and 29+92 on the eastbound side. Due to the low ambient temperature and high cure time, it was decided that Ride-A-Way would not be applied in the section. The decision was discussed and made on site by Chris Barker, Logan Perron, L & D personnel, Jeremy Crow and myself. Chris and I concluded that because the ideal application temperature is between 70 - 90°F and cure time is between 12 – 24 hours, that it would be unrealistic to install Ride-A-Way at that particular location. McDonalds has a lot of traffic and there was a chance of rain, which made it impractical to install the product at that this particular location and time of year. Jeremy Crow the Ennis-Flint representative said that he only recommends applying Ride-A-Way up until the first week of September in the northern sections of the U.S. and in very low traffic areas due to the high cure time. He also mentioned that CycleGrip MMAX might make Ride-A-Way obsolete in the future. Traffic control should be a major consideration when considering installing Ride-A-Way because of the long cure time.

Chris and I decided to install both CycleGrip MMAX and PreMark Thermoplastic at the McDonald's intersection, giving VTrans the ability of compare two different bike lane materials at the same intersection. Ennis-Flint CycleGrip MMAX was installed on the eastbound side from 29+00 to 29+88. This corresponds to the first 12 blocks, west too east. The 13<sup>th</sup> block between section markers 29+88 and 29+92 was installed as PreMark Thermoplastic. Ennis-Flint PreMark Thermoplastic was also installed on the westbound side from 28+64 to 29+84. There are no retroreflective beads in the bike lane PreMark Thermoplastic or CycleGrip MMAX, which means that durability studies on the bike lanes will only involve visual inspections, photos and notes. The exact location where the bike lane and symbols are can be seen on the Construction Plans. [5]

Prep work which included taping the inlaid pavement marking tape, marking out the bike lane blocks and mixing the Methyl Methacrylate (MMA) compound began at 9:00am on 9/30/16. The hour prior to the start of prepping was used to determine if applying Ride-A-Way at the McDonald's intersection was logistically

possible and if research would be effected from improperly installing the product. We determined that because the ambient temperature was below the application temperature of the Ride-A-Way material, that research would be affected by improperly installing the product. We realized that traffic control for 12 – 24 hours at this intersection, while the material was curing, would cause a number of logistical problems. L & D began applying CycleGrip MMAX at the Vermont Shopping Center Intersection between section markers 24+53 and 25+64 at around 9:45am. Five bike lane blocks were finished in 15 minutes and were fully cured by 10:45am. L & D purchased CycleGrip MMAX in 5 gallon kits, which cover approximately 50  $ft^2$ . A standard bike lane block is approximately 2 ft x 5 ft. The MMA resin can be seen in Figure (13). A catalyst was added and mixed into the kit. The recommended mixing ratios can be found on the “CycleGrip MMAX Application Instructions” [6]. The installation of the CycleGrip MMAX product can be seen in Figures (13 & 15). Ideal cure times for the CycleGrip MMAX product is between 20 – 60 minutes depending on the ambient temperature and moisture. The material cured at the Vermont Shopping Center intersection within 45 – 60 minutes, because it was cloudy, cool and the moisture was relatively high since it rained earlier in the morning.

Three kits were used to complete the 13 bike lane blocks at the Vermont Shopping Center Intersection. Prep for the second set of 5 blocks began at 10:45am and by 11:20am, L & D was able to start applying the CycleGrip MMAX. The 3 L & D crew members and Jeremy Crow were able to finish applying the material onto the 5 bike lane blocks in 25 minutes. The installation of the whole bike lane was finished at around 12:20pm. It should be noted that for the CycleGrip MMAX product it took L & D about 30 minutes to prep 5 bike lane blocks and 20 minutes to apply the CycleGrip MMAX material. This should be taken into account when establishing traffic control when this product is being applied in the future. The completed CycleGrip MMAX bike lane is shown in Figures (16 – 18).

At 12:45pm prep work at the McDonald’s intersection began to install CycleGrip MMAX on the eastbound side. At this point in the day, Jeremy Crow was confident that L & D had all the necessary skills needed to install the product. The bike lane at this section has 13 blocks. L & D tried to stretch the number of blocks they could cover with one kit. They managed to get 6 bike lane blocks per kit. This means that L & D was able to complete 12 blocks with 2 kits. Between prep and installation time it took L & D an hour and 20 minutes to complete 12 bike lane blocks, were installation took approximately 15 to 20 minutes per 6 blocks. Because L & D did not want to open up another kit, the 13<sup>th</sup> block was installed as PreMark Thermoplastic. The finished bike lane on the eastbound side of the McDonald’s intersection can be seen in Figures (19 & 20) and the thermoplastic block can be seen in Figures (25 & 26).

At 10:30am, when some of the L & D crew was applying CycleGrip MMAX at the Vermont Shopping Center Intersection, the most experienced PreMark thermoplastic applicator with an assistant was installing PreMark thermoplastic on the westbound side of the McDonald’s intersection. Unlike the bike lane near the Price Chopper intersection, the white inlaid tape skips that goes on the outer edges of the bike lane blocks were not removed. When applying the PreMark Thermoplastic at the McDonald’s intersection with a torch, the white Swarco Director 60 HPT inlaid tape got burnt. This can be seen in Figures (21 & 26). L & D should have tried to shield the tape in some way from the intense heat of the torch. Other than that the PreMark Thermoplastic was installed properly and took approximately 5 hours to fully install the bike lane blocks at that location. The installation of the PreMark product at this intersection can be seen in Figure (21) and the finished bike lane can be seen in Figures (23 & 24).

**Photos:**



**Figure 13: Installation of Ennis-Flint CycleGrip MMAX at the Vermont Shopping Center Intersection**



**Figure 14: Close-up of CycleGrip MMAX material kit**



**Figure 15: Application of Ennis-Flint CycleGrip MMAX at the Vermont Shopping Center Intersection**



**Figure 16: Curing CycleGrip MMAX from one kit at the Vermont Shopping Center Intersection**



**Figure 17: Close-up of curing CycleGrip MMAX**



**Figure 18: Finished CycleGrip MMAX section at the Vermont Shopping Center Intersection**



Figure 19: CycleGrip MMAX applied at McDonald's Intersection on the eastbound side. First 12 blocks.



Figure 20: Close-up of CycleGrip MMAX at McDonald's Intersection



Figure 21: PreMark Thermoplastic applied at McDonald's Intersection on the westbound side

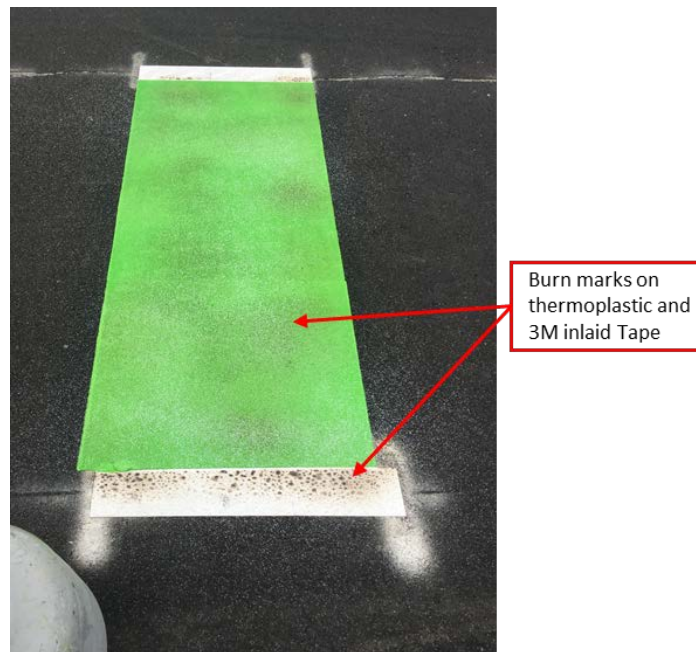


Figure 22: Burn marks on thermoplastic and 3M inlaid tape





Figure 23: Applied PreMark Thermoplastic at McDonald's Section



Figure 24: Completed Bike Lane Section at McDonald's Intersection



Figure 25: Eastbound side Bike Lane at McDonald's Intersection with both CycleGrip MMAX and PreMark Thermoplastic



Figure 26: Close-up of PreMark Thermoplastic on Eastbound side at McDonald's Intersection

**Work Plan:** WP 2013 R-4

**EA:** Experimental Features - SPR 352

**Date:** Wednesday, October 5, 2016

**Time:** 8:00 AM to 3:30 PM

**Weather:** 67°F, Partly Cloudy

Transpo Color-Safe acrylic based resin was installed in the bike lane between section markers 7+20 - 9+00 and 12+02 – 14+42. They are blocks between 7+20 – 9+00 and 13+00 – 14+42. A solid section of Color-Safe was installed between 12+02 – 13+00. A white Color-Safe biker symbol was installed at 12+10.

Transpo Color-Safe was installed after the 30 day specification stipulating the placement of traffic marking paint.

**Notes:**

Prep work which included taping the inlaid pavement marking tape, marking out the bike lane blocks and mixing the Methyl Methacrylate (MMA) compound began at 8:30am on 10/5/16. The MMA can be seen in Figure (27) and the taping of the inlaid tape is shown in Figure (30). The mixing of the MMA, catalyst and aggregate can be partially seen in Figure (28). David Crowell the Transpo representative was present at the installation of the Color-Safe bike lane material. David instructed the L & D crew to mix 2 gallons of MMA resin with 2 bags of catalyst and one bag of aggregate. He recommended this amount based on the ambient temperature. The amount of catalyst determines the cure time of the product and the aggregate acts as the anti-skid material. More precise mixing ratios for changing ambient temperature and other pertinent information regarding the Color-Safe bike lane material can be found on the Technical Data Sheet [2].

The prep work took longer than expected and the application of the Color-Safe bike lane material didn't begin until 10:45am. This was due to the inexperience of the L & D crew with the application of the Color-Safe product and the amount of taping necessary to cover the inlaid pavement marking tape with minimal L & D crew members. Once the application of the product began, the L & D crew and David Crowell established a rhythm and finished applying the Color-Safe material from 12+02 to 14+42 in 1.5 hours. The solid section was finished in 45 minutes and the following 18 blocks took the other 45 minutes. It took approximately 45 to 60 minutes for the Color-Safe product to cure in this location. This was due to the ambient temperature and the lack of direct sunlight. The application of the Color-Safe material can be seen in Figures (30 – 33). Images of the finished bike lane are shown in Figures (33 – 38). Figures (34, 35 and 37) show close-up views of the Color-Safe material and the texture giving the material its anti-skid property. The texture is given to the material when the applied material is back-rolled with a painting roller. Aggregate clumps arose on two of the bike lane blocks and can be seen in Figure (37). The clump was a product of the mixture curing before it was properly applied and from the sun coming out. The clumps were identified and chiseled off so that bike tires don't get caught on them and cause an accident.

From 12:20pm to 12:50pm the biker symbol was installed at section marker 12+10. The symbol was applied on top of the green bike lane material. L & D and Davis Crowell mixed a small batch of white Color-Safe without adding aggregate into the mix. This was a recommendation from David based on the

fact that the underlying green bike lane had substantial texture. L & D did not have a proper biker stencil so an extra thermoplastic biker symbol was taken apart and used as a stencil. The arrow was traced and then taped. The white Color-Safe paint was applied by dabbing a paint covered rag to the application surface. The stencil and the application process can be seen in Figure (39). The application method worked, but it resulted in the edges of the symbol not being as crisp and straight. The finished biker symbol at the CVS intersection can be seen in Figure (40).

Figures (41 – 43) depict the application, a close-up of the Color-Safe product texture, and the finished bike lane between section markers 7+20 to 9+00. L & D began work on that section at 1:15pm and finished at 2:30pm. The installation of the Color-Safe material went faster at this section because the crew was more experienced and comfortable installing the product. The cure time decreased at this section due to the fact that the material was installed when the sun was out, increasing the ambient temperature and having direct sun light hitting the material.

**Photos:**



**Figure 27: Transpo Color-Safe Methyl Methacrylate Compound**



**Figure 28: Pouring Methyl Methacrylate from Drum to make 2 Gallon Mixes**



**Figure 29: Bike Lane near CVS Before Transpo Color-Safe was Installed**



Painting Tape to create crisp lines and cover inlaid Pavement Marking Tape

Figure 30: Application of Transpo Color-Safe at CVS intersection



Figure 31: Close-up of the Solid Section of Transpo Color-Safe at CVS Intersection when Finished



**Figure 32: Application of Transpo Color-Safe at CVS intersection and Removing of Painters Tape**



**Figure 33: Finished Solid Section of Transpo Color-Safe at CVS intersection**



**Figure 34: Close-up of Transpo Color-Safe Texture**



**Figure 35: Finished Color-Safer Bike Lane Block**





**Figure 36: Finished Color-Safe Blocks Near CVS Intersection**



Clump of aggregate  
on Bike Lane Block.

**Figure 37: Close-up of Color-Safe Bike Lane Block with an Aggregate Clump**



**Figure 38: Finished Color-Safe Bike Lane Near CVS Intersection**



**Figure 39: Application of White Color-Safe Biker Symbol at CVS Intersection**



Figure 40: Finished White Color-Safe Biker Symbol at CVS Intersection



Figure 41: Transpo Color-Safe Bike Lane Blocks Near VW Dealership



**Figure 42: Close-up of a Transpo Color-Safe Bike Lane Block Near VW Dealership**



**Figure 43: Finished Transpo Color-Safe Bike Lane Blocks Near VW Dealership**

## **Concluding Installation Notes:**

Many things can be taken away from the installation of these different bike lane products, which included Ennis-Flint PreMark thermoplastic, Ennis-Flint CycleGrip MMAX, and Transpo Color-Safe. Both the CycleGrip MMAX and Color-Safe are very similar products that involve some more extensive prep time, but have quick application times. This becomes more evident with long solid sections where an application rhythm can be established and prep is minimal. That is why both the Ennis-Flint and Transpo representatives recommend their products for long sections in high traffic areas, where traffic control is an issue and quick material curing is ideal. Ennis-Flint specifically recommends installing; CycleGrip in long solid sections where traffic can be controlled until curing is complete, PreMark in short sections with high traffic where minimal cure is warranted, and Ride-A-Way on shoulders or very low traffic areas where traffic can be closed off for up to 24 hours.

Chris Barker, Logan Perron, Pike personnel and L & D personnel were really impressed by the; variable and quick cure times, the ease of installation, texture and initial durability of both the Ennis-Flint CycleGrip MMAX and Transpo Color-Safe products. For areas or projects where pavement marking tapes outline the bike lanes, Color-Safe and CycleGrip should be highly recommended due to the fact that the tapes can be covered and not at risk of being damaged. It creates a crisp edge and eliminates the risk of burning the pavement making tape, which is highly likely to occur if the tape is not properly shielded when applying a thermoplastic material with a torch. Where inlaid tape is not present, either white PreMark Thermoplastic skips or surface applied tape can be placed on the outer edges of the bike lane block.

It should be noted that for a large number of the bike lane blocks, the inlaid white tapes on the outer edges of the blocks were not aligning properly. They became misaligned when the taping crew was laying out the taping layout during the paving process. The taping crew must have measured from the wrong markers, an innocent mistake that occurs regularly during a fast pasted paving project. The misalignments can be seen in Figures (21 – 26). Between 58+56 – 60+66 white Polyurea paint was applied to the outer edges of the PreMark bike lane blocks. This was done because the white 3M 270 ES skips that were inlaid during the paving process did not align properly with the PreMark bike lane blocks. The inlaid skips were ripped out and the paint was applied in its place.

Approximately a month after the pavement marking tape was inlaid some very small sections of the tape are experiencing some issues. On 10/5/16 while installing the Transpo Color-Safe bike lane at 7+20 – 9+00, I noticed that a large section of white Brite-Line HDX tape (about 8in) had torn off. This was at around 9+50 on the westbound side. It is unclear why this 8 inch section failed, but it can be seen in Figure (44). During future field inspections this area and other areas of potential tape failures will be noted and investigated.

**Photos:**



**Figure 44: Brite-Line HDX Inlaid Tape Failure at 9+50 on Westbound Side**

**References:**

1. Ennis-Flint. “PreMark<sup>®</sup> Bike and Pedestrian Brochure.”  
[http://www.ennisflint.com/getmedia/39dded8b-3174-4269-8c8f-d99724402ec7/Brochure\\_PreMark-Bike-and-Ped?ext=.pdf](http://www.ennisflint.com/getmedia/39dded8b-3174-4269-8c8f-d99724402ec7/Brochure_PreMark-Bike-and-Ped?ext=.pdf).
2. Transpo Industries, Inc. “Color-Safe<sup>®</sup> Product Sheet.” <http://www.transpo.com/roads-highways/materials/pavement-marking-material/color-safe-bike-lanes>
3. Ennis-Flint. “CycleGrip<sup>®</sup> MMAX Brochure.”  
[http://www.ennisflint.com/getmedia/939b3c08-1bb2-4bfe-8a72-58592946ae8d/Brochure\\_CycleGripMMAX\\_041514\\_MKT00040?ext=.pdf](http://www.ennisflint.com/getmedia/939b3c08-1bb2-4bfe-8a72-58592946ae8d/Brochure_CycleGripMMAX_041514_MKT00040?ext=.pdf).
4. Ennis-Flint. “PreMark Application Instructions.”  
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<http://www.ennisflintamericas.com/by-brand/mmax/cyclegripmmax>
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