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### **HIGHWAY GUARDRAIL, GUARDRAIL END SECTION, BARRIER WALL, CABLE BARRIER, AND TEMPORARY RAISED PAVEMENT REFLECTORS**

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#### **Abstract**

A flexible substrate for adhering reflective film and attaching to highway guardrails, guardrail end sections, barrier walls, and cable barrier systems. The flexible material permits the reflector to flex and/or move on impact and thus can withstand impact without breaking or suffering significant damage. The reflectors of the present invention can also increase highway safety and reduce highway maintenance costs.

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## **Background/Summary**

CROSS-REFERENCE TO RELATED APPLICATION [0001] This application claims the benefit of priority of U.S. provisional application No. 63/553,200, filed Feb. 14, 2024, the contents of which are herein incorporated by reference.

### **BACKGROUND OF THE INVENTION**

[0002] The purpose of traffic safety reflectors is to increase visibility of roadside hazards like guardrails, concrete barrier walls, and cable barrier systems to name a few. They can also be used to temporarily mark lane lines on asphalt pavement resurface projects.

[0003] Conventional reflectors are typically comprised of polycarbonate, acrylic, or aluminum reflector substrates. However, the polycarbonate and acrylic substrates used in conventional reflector products often become brittle with time and at extreme cold temperatures and conventional reflectors used on highway guardrails, guardrail end sections and on barrier walls (by way of example) are often destroyed when impacted by vehicles and snow and ice removal operations and equipment. In addition, conventional devices are limited for installation in some areas and specific locations of guardrails and barriers.

[0004] The present invention is directed at improvements to the currently available products. In a preferred embodiment, the present invention is directed towards a flexible reflector that can be utilized in connection with highway guardrails, guardrail end sections, barrier walls, cable barrier systems, and asphalt pavement and can withstand impact without breaking or suffering significant damage.

### **SUMMARY OF THE INVENTION**

[0005] In one aspect of the present invention, there is disclosed a flexible substrate for adhering reflective film and attaching to highway guardrails, guardrail end sections, barrier walls, and cable barriers. The flexible material permits the reflector to flex/move on impact and thus can withstand impact without breaking or suffering significant damage. The reflectors of the present invention can also increase highway safety and reduce highway maintenance costs.

[0006] These and other features, aspects and advantages of the present invention will become better understood with reference to the following drawings, description and claims.

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## **Description**

### **BRIEF DESCRIPTION OF THE DRAWINGS**

[0007] FIG. 1 depicts a flexible bolt-mounted W-beam guardrail reflector constructed in accordance with a preferred embodiment of the present invention;

[0008] FIG. 2 depicts the 1 or 2-sided guardrail reflector of FIG. 1 installed on a guardrail in accordance with a preferred embodiment of the present invention;

[0009] FIG. 3 depicts a flexible 1 or 2-sided concrete barrier wall reflector constructed in accordance with a preferred embodiment of the present invention;

[0010] FIG. 4 depicts the reflector of FIG. 3 installed on a guardrail in accordance with a preferred embodiment of the present invention;

[0011] FIG. 5 depicts a flexible raised asphalt pavement reflector constructed in accordance with a

preferred embodiment of the present invention;  
[0012] FIG. 6 depicts the reflector of FIG. 5 installed in accordance with a preferred embodiment of the present invention;  
[0013] FIG. 7 depicts a flexible cable barrier reflector constructed in accordance with a preferred embodiment of the present invention;  
[0014] FIG. 8 depicts the reflector of FIG. 7 installed in accordance with a preferred embodiment of the present invention;  
[0015] FIG. 9 depicts the reflector of FIG. 7 being installed on a cable in accordance with a preferred embodiment of the present invention;  
[0016] FIG. 10 depicts a flexible cable barrier reflector with a locking tab constructed in accordance with a preferred embodiment of the present invention;  
[0017] FIG. 11 depicts a flexible bolt-mounted W-beam guardrail reflector constructed in accordance with a preferred embodiment of the present invention;  
[0018] FIG. 12 depicts the reflectors of FIG. 1 and FIG. 12 installed on a guardrail in accordance with a preferred embodiment of the present invention;  
[0019] FIG. 13 depicts the reflectors of FIG. 1 and FIG. 12 installed on a guardrail in accordance with a preferred embodiment of the present invention;  
[0020] FIG. 14 depicts a flexible 2-sided concrete barrier wall tent reflector constructed in accordance with a preferred embodiment of the present invention;  
[0021] FIG. 15 depicts the reflectors of FIG. 3 and FIG. 15 installed on a concrete barrier in accordance with a preferred embodiment of the present invention; and  
[0022] FIG. 16 depicts enlarged views of a cross-reinforced polypropylene substrate material for use in connection with the reflectors of the present invention.

#### DETAILED DESCRIPTION OF THE INVENTION

[0023] The following detailed description is of the best currently contemplated modes of carrying out exemplary embodiments of the invention. The description is not to be taken in a limiting sense, but is made merely for the purpose of illustrating the general principles of the invention, since the scope of the invention is best defined by the appended claims.

[0024] As stated above, conventional reflectors used on highway guardrails, guardrail end sections and on barrier walls are often destroyed when impacted, for example by vehicles and snow and ice removal operations and equipment. In addition, conventional devices are limited for installation in some areas and specific locations of guardrails and barriers and are also often made of metals and hard plastic materials which bend, break, and have potential to cause damage or injury on impact.

[0025] The present invention is directed at improvements to the currently available products. In a preferred embodiment, the present invention is directed towards a flexible substrate for adhering various reflective films and attaching to highway guardrails, guardrail end sections, barrier walls, and cable barriers. The flexible material permits the reflector to flex/move on impact and thus can withstand impact without breaking or suffering significant damage. The reflectors of the present invention can also increase highway safety and reduce highway maintenance costs.

[0026] The traffic safety reflector products of the present invention comprise several unique designs as well as unlimited size variations that utilize a flexible cross-reinforced and/or corrugated polypropylene substrate. Products that can be made in accordance with preferred embodiments of the present invention include, but are not limited to, Barrier Wall Reflectors, Guardrail Reflectors, Cable Barrier System Reflectors, and Temporary HMA (hot mix asphalt) raised pavement markers. These products can be installed similarly to conventional products with adhesive or mechanical fasteners. They are aligned to reflect back light from motorist headlights and warn them of various roadside hazards that the reflectors are mounted to.

[0027] The material used for the reflector substrate is not brittle and can survive impacts from snow and ice removal operations. Reflectors made in accordance with preferred embodiments of the present invention will remain functional when impacted by snow removal operations and have the

potential to save lives.

[0028] As described herein, and as seen in accompanying FIGS. **1-16**, the primary components of the present invention comprise a substrate comprising extruded and thermal formed flexible plastic sheet, a reflective top coating on the substrate, and one or more fastening devices.

[0029] FIG. **1** depicts a W-beam guardrail reflector **10** constructed in accordance with a preferred embodiment of the present invention. Reflector **10** comprises a main reflector body **12** and a first and second fastening members **14**. In a preferred embodiment, reflector body **12** is formed of a cross reinforced UV resistant polypropylene substrate, which is flexible enough to withstand impact without breaking. Retroreflective sheeting is applied to one or both sides of reflective body **12** polypropylene substrate. In a preferred embodiment, retroreflective sheeting meets various state department of transportation (DOT) specifications and includes Pressure Sensitive Adhesive for applying the sheeting to reflector body **12** and accommodates bending without breaking upon impact. In a preferred embodiment, the shape of reflector body **12** is die cut to nest inside the web of conventional W-beam guardrail and can be attached with self-taping screws **18** as depicted in FIG. **2**. Score lines **16** aid in bending and shaping the fastening members **14** for attachment to the guardrail **20**. In a preferred embodiment, the corners of reflective body **12** are rounded to help reduce sharp edges.

[0030] Installing reflector **10** comprises first folding fastener members **14** along score lines **16** towards the reverse side of the reflector **10**. Reflector **10** can then be positioned on guardrail **20** such that reflector **10** nests tightly in the appropriate section of guardrail **20** (see FIG. **2**, by way of example). Next, reflector **10** should be visually aligned so that it is vertical and perpendicular to traffic viewpoint. Reflector **10** can then be attached to guardrail **20** with self-taping screws **18**, with screws **18** tightened until firm contact is made between the screws and reflector **10** and guardrail **20**.

[0031] FIG. **3** depicts a flexible concrete barrier wall reflector **30** constructed in accordance with a preferred embodiment of the present invention. Reflector **30** is designed to install quickly and easily at any point along the length of a concrete, steel or wood barrier wall or railing. Reflector **30** comprises a cross-reinforced UV resistant polypropylene substrate that is flexible enough to withstand impact without breaking and includes retroreflective sheeting (per DOT specifications) on one or both sides of the reflector **30**. Such reflectors **30** can be installed on top of or on the sides of concrete barrier walls **34** on Interstates, highways, or country roads (see FIG. **4**, by way of example), or on concrete, steel or wood barrier walls and railing, and in a preferred embodiment, should be spaced per DOT specifications to enhance nighttime visibility.

[0032] In a preferred embodiment, reflector **30** comprises a score line **32** that allows reflector **30** to bend or flex when impacted. In an alternative embodiment, reflector **30** can be a flat sheet that can be attached to the side of guardrail post **111** (FIG. **13**).

[0033] Installing reflector **30** comprises first ensuring that dirt and dust have been removed from the concrete, steel or wood mounting surface. Next, an appropriate construction adhesive suitable for the barrier should be applied to the rear surface of reflector **30**, and reflector **30** should be positioned at the desired location along barrier wall **34**. Pressure should be applied, and reflector **30** moved side to side to ensure adequate adhesive contact is achieved. In addition, a mechanical fastener (not shown) may be used.

[0034] FIGS. **5** and **6** depict a temporary HMA raised pavement marker **40** constructed in accordance with a preferred embodiment of the present invention. Marker **40** allows for immediate marking of centerlines and lane lines on freshly laid HMA (Hot Mix Asphalt) and can be installed quickly and easily behind paving machines before the first pass of the roller machine.

[0035] In a preferred embodiment, marker **40** comprises a corrugated polypropylene substrate that is flexible enough to withstand impact without breaking and includes a retroreflective sheeting in accordance with DOT specifications on one or both sides of the reflector **40**. Reflector **40** comprises a score line **42** so that marker **40** will flex when roller machine and subsequent tires

from traffic roll over it (see FIG. 6). Marker **40** has a melting point exceeding the recommended installation temperature for HMA, is durable and will flex under traffic.

[0036] Reflector **40** can be installed after placement of HMA by the paving machine and before the first pass of the roller machine. Reflector **40** is designed to be installed into freshly laid pavement at an approximate installation angle of 45 degrees with the pointed end inserted down into the freshly laid pavement and opposite the direction of traffic (see FIG. 6, by way of example). For best results, marker **40** should be installed approximately 4 to 6 inches from the edge of the pavement joint to prevent damage from the paving machine when paving the adjacent lane. The roller should operate normally, rolling over marker **40** to firmly set it in place.

[0037] FIGS. 7-10 depict a universal cable barrier reflector **60** constructed in accordance with a preferred embodiment of the present invention. Reflector **60** is simple and unique, installs quickly and easily at any point along the length of a standard  $\frac{3}{4}$  inch cable barrier system **80**, and no tool or special hardware is required for installation. In a preferred embodiment, reflector **60** comprises a cross-reinforced UV resistant polypropylene substrate that is flexible enough to withstand impacts without breaking and includes retroreflective sheeting in accordance with DOT specifications (such as 3M Series 3930) on one or both sides of the reflector **60**. Reflector **60** comprises a cut line **62** that can be separated for easy installation over a cable barrier **80** (see FIG. 9, by way of example). In an alternative embodiment, cut line **62** can be replaced with a locking tab **64** (see FIG. 10).

[0038] Installing reflector **60** comprises selecting an installation location, opening reflector **60** along cut line **62** (or **64**) to create a gap to slip reflector **60** over cable **80**. Reflector **60** can then be positioned as desired along the length of the cable.

[0039] FIG. 11 depicts a flexible bolt-mounted W-beam guardrail reflector **100** constructed in accordance with a preferred embodiment of the present invention. Reflector **100** comprises a main reflector body **102** and a fastening member **104**. In a preferred embodiment, reflector body **102** is formed of a cross reinforced UV resistant polypropylene substrate, which is flexible enough to withstand impact without breaking. Retroreflective sheeting is applied to one or both sides of reflective body **102** polypropylene substrate. In a preferred embodiment, the retroreflective sheeting meets DOT specifications and includes Pressure Sensitive Adhesive for applying the sheeting to reflector body **102** and accommodates bending without breaking upon impact. In a preferred embodiment, the shape of reflector body **102** is die cut to nest inside the web of conventional W-beam guardrail and can be attached with a  $\frac{5}{8}$ -inch attachment bolt **110** as depicted in FIGS. 12 and 13. Score line **106** aids in bending and shaping the fastening member **104** for attachment to the guardrail **108**. In a preferred embodiment, the corners of reflective body **100** are rounded to help reduce sharp edges.

[0040] Installing reflector **100** comprises loosening bolt **110**, inserting fastener member **104** under loosened bolt **110**, visually aligning reflector **100** so that it is vertical and perpendicular to traffic, and then tightening bolt **110** until firm contact is made between fastener member **110** and guardrail **108**.

[0041] FIG. 14 depicts a flexible 2-sided concrete barrier wall tent reflector **200** constructed in accordance with a preferred embodiment of the present invention. Reflector **200** is designed to install quickly and easily at any point along the length of a concrete, steel or wood barrier wall or railing (see FIG. 15, by way of example). Reflector **200** comprises a cross-reinforced UV resistant polypropylene substrate that is flexible enough to withstand impact without breaking and includes retroreflective sheeting in accordance with DOT specifications on one or both sides of the reflector **200**. Such reflectors **200** can be installed on top of or on the sides of concrete barrier walls **220** on Interstates, highways, or country roads (see FIG. 15, by way of example), or on concrete, steel or wood barrier walls and railing, and in a preferred embodiment, should be spaced per DOT specifications to enhance nighttime visibility.

[0042] In a preferred embodiment, reflector **200** comprises two end score lines **210** and a center score line **208** that allows reflector **200** to bent and formed into a tent shape for installation (see

FIG. 15, by way of example).

[0043] FIG. 16 depicts an example of a cross-reinforced polypropylene substrate suitable for the reflectors described and depicted herein. In this embodiment, substrate **80** is a co-extruded board made of three layers sold under the name Prime Bubble-X by Primex Plastics.

[0044] While the primary use of the reflectors of the present invention is intended for highway safety warning, the devices may also be used in Industrial facilities for employee safety.

[0045] It should be understood, of course, that the foregoing relates to exemplary embodiments of the invention and that modifications may be made without departing from the spirit and scope of the invention as set forth in the following claims.

## Claims

1. A highway reflector that can withstand impact without breaking, the reflector formed of a flexible cross-reinforced UV resistant polypropylene substrate and comprising a retroreflective sheeting applied to one or both sides of the reflector.
  2. The reflector of claim 1, wherein the reflector is shaped to nest inside the web of conventional W-beam guardrail.
  3. The reflector of claim 1, further comprising first and second fastening members for fastening the reflector to a conventional W-beam guardrail.
  4. The reflector of claim 1, further comprising a first fastening member for fastening the reflector to a conventional concrete barrier wall.
  5. The reflector of claim 1, wherein the reflector is circular in shape and includes a cut line for separating/opening and attaching the reflector to a cable barrier.
  6. The reflector of claim 5, wherein cut line comprises a locking tab.
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