



Florida Department of Transportation

CHARLIE CRIST
GOVERNOR

605 Suwannee Street
Tallahassee, FL 32399-0450

STEPHANIE KOPELOUSOS
SECRETARY

July 20, 2007

Dr. Leslie McCarthy, PhD, P.E.
Program Operations Engineer
Federal Highway Administration
545 John Knox Road, Suite 200
Tallahassee, Florida 32303

Re: Office of Design, Specifications
Section 993
Proposed Specification: 9930000.D01 Object Markers and Delineators

Dear Dr. McCarthy:

We are submitting, for your approval, two copies of a proposed Supplemental Specification for Object Markers and Delineators.

This change was proposed by Chester Henson of the State Design Office to address differences between object markers and delineators and to eliminate inconsistencies between the current specifications and the Manual on Uniform Traffic Control Devices.

Please review and transmit your comments, if any, within two weeks. Comments should be sent via Email to SP965DB or duane.brautigam@dot.state.fl.us.

If you have any questions relating to this specification change, please call Duane F. Brautigam, State Specifications Engineer at 414-4110.

Sincerely,

Signature on File

Duane F. Brautigam, P.E.
State Specifications Engineer

DFB/ft

Attachment

cc: General Counsel
Florida Transportation Builders' Assoc.
State Construction Engineer

OBJECT MARKERS AND DELINEATORS.(REV ~~5-14-07~~**7-18-07**)

SECTION 993 (Pages 909 - 912) is deleted and the following substituted:

SECTION 993**OBJECT MARKERS AND ~~HIGHWAY~~-DELINEATORS
(INCLUDING ~~POSTS AND ATTACHMENTS~~)****993-1 Object Markers.**

993-1.1 General: *Object markers shall meet the general requirements outlined in the Manual of Uniform Traffic Control Devices (MUTCD). For uniformity all Type 1 markers shall be either OM1-1 or OM1-3 style markers, all Type 2 markers shall be either OM2-1V or OM2-2V style markers and all end of road markers shall be either OM4-1 or OM4-3 style markers.*

993-1 Type A Delineators~~Retroreflectors~~

993-1.21 Reflectors~~Retroreflectors~~: The reflectors ~~for these alternate delineators~~ shall be of acrylic plastic and shall be a minimum of 3 inches in diameter. They shall be mounted in a heavy-duty housing with a back plate.

The reflector shall consist of a clear and transparent plastic lens, which shall be ~~red~~~~colorless~~ or amber as specified, and a plastic back of the same material, fused to the lens under heat and pressure around the entire perimeter, in such manner as to form a homogeneous unit, permanently sealed against dust, water, and water vapor.

The lens shall consist of a smooth front surface, free from projections or indentations (other than for identification or orientation) and a rear surface bearing a prismatic configuration such that it will effect total internal reflection of light.

The acrylic plastic shall be of a type meeting the requirements of Federal Specification L-P-380, Type I, Class 3, and, in order that the Department can readily check the suitability of the raw material used, the manufacturer shall stipulate the raw material and the particular molding compound to be furnished.

~~The reflector element shall meet the test requirements specified below.~~

993-1.2.1 Durability Tests For ~~Type A~~ ~~Retro~~Reflectors:

~~(a) Seal Test: The following test will be used to determine if a reflector is adequately sealed against dust and water.~~

~~Submerge 50-20 samples in water bath at room temperature. Subject the submerged samples to a vacuum of 5-10 inches gauge for five minutes. Restore atmospheric pressure and leave samples submerged for five minutes, then remove and examine the samples for water intake. Failure of more than two of the 50-20 samples tested shall be cause for tentative rejection of the LOT.~~

~~In the event of such tentative failure of more than two of the 50 samples tested, a re-sample of the 100 reflector shall be checked tested. If not more than four of these 100 samples fail then the LOT will be considered as acceptable.~~

~~(b) Corrosion Test: The reflector assembly shall withstand the combined corrosion test set forth in ASTM B 117.~~

993-1.2.23 Optical Requirements:

~~993-1.3.1 Definitions: The term, "Entrance Angle", designates the angle at the reflector between the direction of light incident on it and the direction of the reflector axis.~~

~~The term, "Observation Angle", designates the angle at the reflector between the observer's line of sight and the direction of light incident on the reflector.~~

~~The term, "Specific Intensity", designates the candle power returned by a reflector at the specific observation angle, for each foot-candle of illuminance at the reflector.~~

~~993-1.3.2 Specific Intensity: The *initial* specific intensity of every reflex reflector intended for use in the delineators *object markers* shall be at least equal to the minimum values shown below. Failure to meet the required specific intensity shall constitute failure of the reflector being tested. Failure of more than two reflectors out of 50 subjected to test shall constitute failure of the entire LOT.~~

| Observation Angle | Entrance Angle | Specific Intensity candle power <i>candelas</i> /foot-candle | | |
|-------------------|----------------|--|--------|------------|
| | | Crystal | Yellow | <i>Red</i> |
| 0.1 degree | 0 degree | 40 | 24 | <i>10</i> |
| 0.1 degree | 20 degree | 16 | 10 | <i>4</i> |

~~993-1.3.3 Optical Testing Procedure: The reflex reflector to be tested shall be spun so as to have an average orientation effect, and shall be placed at a distance of 100 feet from a single light source having an effective diameter of 2 inches. The light source shall be operated at approximately normal efficiency. The return light from the reflector shall be measured by means of a photo-electric photometer having a minimum sensitivity of 1 by 10^{-7} foot-candles per mm scale division. The photometer shall have a receiving aperture of 1/2 inch diameter, shielded to prevent the entry of stray light. The distance from light source center to aperture center shall be 2.1 inches for the 0.1 degree observation angle.~~

If a test distance other than the stipulated 100 feet is used, the source and the aperture dimensions, and the distance between source and aperture shall be modified directly as the test distance.

~~993-1.2.34 Delineator-Reflector Retroreflective-Housing Element: The delineator retroreflective element shall consist of a reflector *shall be* element mounted in a housing fabricated of aluminum alloy No. 3003-H 14 (or other alloy approved as equal for the purpose), ~~or of heavy thickness, cold-rolled, hot-dip, galvanized steel,~~ and having a thickness of 0.064 inch.~~

~~After all fabrication has been completed, the aluminum housing shall be treated with Alodine 1200, Iridite 14-2, Bonderite 721, or equal product, in accordance with the recommendations of the manufacturer of the particular treatment used.~~

~~993-1.5 Assembly: The attachment of the delineator retroreflector to the housing and of the housing to the post shall be by such method that no mounting hole is required in the *object marker or delineator*; also, that the *object marker or delineator* can be easily~~

~~removed from the post with proper tools but that such removal is not possible without the use of such tools.~~

~~_____The mounting holes shall be sized to receive 1/4 inch carriage bolts, or other 1/4 inch bolts, and shall be spaced to fit holes on the posts spaced at 1 inch centers.~~

993-1.32 Type C Delineators *Retroreflective Sheeting.*

~~_____~~ **993-1.32.1 *Retro* Reflective Sheeting:** The *retro* reflective sheeting for *object markers* ~~these alternate delineators~~ shall meet the requirements of Section 994, sheeting Types III, IV, ~~V~~ *or* VII. The *retro* ~~delineators~~ *reflective area* shall be *in accordance with the MUTCD* ~~4 by 4 inch or 4 by 8 inch.~~ *The retro* ~~with the~~ reflective sheeting *shall be* permanently adhered to 0.040 inch sheet aluminum *for Type 2 markers and 0.080 inch sheet aluminum for Type 1, 3 and 4 end of the road markers.* Aluminum *shall be* of 6061-T6 (ASTM B 209) prepared in accordance with recommendations of the sheeting manufacturer.

~~_____~~ **993-1.32.2 Assembly:** ~~The attachment of the delineator~~ *Type 2 and 3 markers shall be reflective sheeting and sheet aluminum mounted* directly to the post ~~shall be~~ by two holes on the face of the *marker* ~~delineator.~~

~~_____~~ The mounting holes shall be 1/4 inch square holes to receive 1/4 inch carriage bolts, or other 1/4 inch bolts and shall be spaced to fit holes on the post spaced at 1 inch centers.

~~_____~~ *For flexible, plastic posts, the reflective sheeting is installed onto the flat surface of the top end of the post.*

993-1.43 Delineator Posts and Accessories.

The *marker* ~~delineator~~ posts shall be of steel ~~, or or~~ aluminum, ~~plastic or recycled plastic~~ as shown in the *Design Standards or plans.* *Steel posts shall be 2.5[#]/Ft. flanged U-Channel meeting the requirements of 700-2.3. Round aluminum posts shall meet the requirements of Index 11860.* ~~and of the alloys called for.~~ They shall have the necessary ~~holes for attachment of the delineator housing.~~

The assembly shall be furnished with the necessary bolts, nuts and washers for ~~attaching to the posts.~~

993-2 Delineators.

993-2.1 General: *Delineators shall be classified into ~~three~~ four types: recycled flexible post delineators, nonflexible post delineators, high visibility median separator delineators, and high performance delineators.*

993-2.2 Recycled Flexible Post Delineators: *Meet the requirements of Section 972.*

993-2.3 Nonflexible Post Delineators:

993-2.3.1 Posts: *The post shall be 2.5[#] 1.1[#]/Ft. steel flanged U-Channel posts ~~and have a minimum height of 48 inches above the pavement surface~~ meeting the requirements of 700-2.3.*

993-2.3.2 Retroreflective Sheeting: *The retroreflective sheeting shall be Type I III, IV, V or VII sheeting and meet the requirements of Section 994. The reflective sheeting shall have a minimum width of 4 inches and have a minimum area of 32 square inches². The retroreflective sheeting shall be permanently adhered to 0.040 inch sheet aluminum.*

993-2.4 High Visibility Median Separator Delineators:

993-2.4.1 Dimensions: ~~The post~~delineator shall have a minimum height of 42 inches above the surface of the separator.

993-2.4.2 Post Base: ~~The base shall have a replacement feature which allows for~~be manufactured to accommodate the replacement of the post. The base shall be ~~permanently~~mechanically anchored to the separator and be capable of withstanding ~~one hundred~~ten vehicle impacts without damage.

993-2.4.3 Color: The plastic post shall be opaque white. The yellowness index shall not exceed 12 when tested in accordance with ASTM D 1925 or ASTM E 313. The daylight 45 degree, 0 degree luminous directional reflectance shall be a minimum of 70 when tested in accordance with ASTM E 1347.

993-2.4.4 Retroreflective Sheeting: The reflective sheeting shall be Types III, IV, V or VII and meet the requirements of Section 994. The reflective sheeting shall have a minimum width of 8 inches and have a minimum area of 230 square inches² facing the approach to the separator.

993-2.4.5 Impact Performance: The post, installed according to manufacturer's recommendations, shall be capable of returning to a vertical position ± 5 degrees when tested according to National Testing Product Evaluation Program (NTPEP). NTPEP data or independent test lab data shall be submitted for product approval. ~~and remain serviceable after receiving twenty five vehicle impacts at 55 mph at a 20 degree angle. The ambient temperature must be no less than 40°F.~~

993-2.5 High Performance Delineators:

993-2.5.1 Dimensions: ~~The post~~delineator shall have a minimum height of 48 inches above the pavement surface. ~~The post shall~~ and have a minimum diameter or width of ~~3~~2.7 inches.

993-2.5.2 Post Base: ~~The base shall have a replacement feature which allows for~~be manufactured to accommodate the replacement of the post. The base shall be ~~permanently~~mechanically anchored to the ~~roadway~~separator and be capable of withstanding ~~one hundred~~fifty vehicle impacts without damage.

993-2.5.3 Color: The plastic post shall be opaque white. The yellowness index shall not exceed 12 when tested in accordance with ASTM D 1925 or ASTM E 313. The daylight 45 degree, 0 degree luminous directional reflectance shall be a minimum of 70 when tested in accordance with ASTM E 1347.

993-2.5.4 Retroreflective Sheeting: The reflective sheeting shall be Type IV abrasion resistant sheeting and meet the requirements of Section 994. The reflective sheeting shall have a minimum width of 3 inches and have a minimum omni directional area of 30 square inches².

993-2.5.5 Marking: The top of the post on the side away from traffic shall be date stamped showing the month and year of fabrication. The numerals shall be at least 1/2 inch in height and shall be either die stamped or legibly stamped with permanent ink.

993-2.5.6 Impact Performance: The post, installed according to manufacturer's recommendations, shall be capable of returning to a vertical position ± 5 degrees with no delaminating after receiving fifty vehicle impacts when tested according to National testing Product Evaluation Program (NTPEP). The NTPEP requirement of one-half of the hits at 32 F is waived. All hits shall be at 85 F. NTPEP

data or independent test lab data shall be submitted for product approval and remain serviceable after receiving one hundred vehicle impacts at 55 mph at a 20 degree angle. The ambient temperature must be no less than 40°F.

993-4 Insulating Materials.

Neoprene, for the separating of aluminum parts and steel parts, shall contain at least 60%, by volume, of pure neoprene. Other approved material may be used, subject to the requirement that the material shall meet the approval of the Engineer as to pliability and ability to withstand wear caused by stretching or distortion.

If other material or method is proposed for use as insulation, it shall be indicated along with any details necessary.

Additional materials specifications are shown in the plans.

993-35 RetrorReflector Units for Guardrail and Concrete Barrier Wall.

993-53.1 General: *Retror*Reflector units for use on guardrail and concrete barrier wall installations shall consist of a ~~hermetically sealed acrylic plastic prismatic reflex reflector or~~ retroreflective sheeting permanently adhered to 0.090040 inch *minimum* thick sheet aluminum of 6061 T6 (ASTM B 209)-*body. The body shall have a flexible hinge which allows the reflector to fold down and spring back to an upright position after impact prepared in accordance with recommendations of the sheeting manufacturer. Guardrail reflectors shall be designed for mounting to the web of steel posts or designed for mounting to wood posts. Barrier wall reflectors shall be designed for mounting to the top of the barrier wall.*

993-53.2 Retroreflective SheetingReflector Element: *The sheeting for these reflector units shall be Type IV, V, or VII meeting the requirements of Section 994. The sheeting shall be yellow or white, depending on the locations of use for each. The dimensions of the reflective sheeting shall be 3 wide by 4 inches high. The sheeting shall be installed by the reflector manufacturer.*

~~**993-5.2.1 Acrylic Plastic:** These reflectors shall be of acrylic plastic meeting the requirements of Federal Specification L-P-380, Type I, Class 3. The manufacturer shall stipulate the raw material used in the compound in order that the Department may readily check the suitability of the raw material.~~

~~The reflector shall consist of a clear transparent, or translucent amber plastic face, herein referred to as the lens, with a heat sealable plastic coated metallic foil back fused to the lens under heat and pressure around the entire perimeters of the lens to form a unit permanently sealed against dust, water and water vapor.~~

~~The reflector lens shall consist of a smooth front surface, free from projections or indentations and the necessary identification markings, and a rear surface having a prismatic configuration such that it will affect total internal reflection of light.~~

~~When the reflectors are tested as specified in 993-1.3 for Type A Delineators, the specific intensity of the colorless reflectors shall not be less than 119 at 0 degree entrance angle and not less than 47 at 20 degree entrance angle, and the specific intensity of the amber reflectors shall be not less than 71 at 0 degree entrance angle and not less than 28 at 20 degree entrance angle.~~

~~**993-5.2.2 Retroreflective Sheeting:** Retroreflective sheeting for these reflector units shall be Type III, IV, V, or VII meeting the requirements of Section 994. The sheeting shall be yellow or white, depending on the locations of use for each. The~~

~~minimum reflective surface area of the marker shall be 9 inch². The adhesive backing for these markers shall be Class I.~~

~~————~~**993-53.3 Installation:** ~~Markers shall be installed at locations identified in the plans and in accordance with the Design Standards, Index Nos. 400 and 410.~~*The reflector units shall be capable of being installed on the top of guardrail posts or the top of the barrier wall.*

993-46 Product Acceptance on the Project.

Acceptance will be made in accordance with the requirements of Section 705. Manufacturers seeking evaluation of their product must submit an application in accordance with Section 6.

OBJECT MARKERS AND DELINEATORS.**(REV 7-17-07)**

SECTION 993 (Pages 909 - 912) is deleted and the following substituted:

**SECTION 993
OBJECT MARKERS AND DELINEATORS**

993-1 Object Markers.

993-1.1 General: Object markers shall meet the general requirements outlined in the Manual of Uniform Traffic Control Devices (MUTCD). For uniformity all Type 1 markers shall be either OM1-1 or OM1-3 style markers, all Type 2 markers shall be either OM2-1V or OM2-2V style markers and all end of road markers shall be either OM4-1 or OM4-3 style markers.

993-1.2 Retroreflectors: The reflectors shall be of acrylic plastic and shall be a minimum of 3 inches in diameter. They shall be mounted in a heavy-duty housing with a back plate.

The reflector shall consist of a clear and transparent plastic lens, which shall be red or amber as specified, and a plastic back of the same material, fused to the lens under heat and pressure around the entire perimeter, in such manner as to form a homogeneous unit, permanently sealed against dust, water, and water vapor.

The lens shall consist of a smooth front surface, free from projections or indentations (other than for identification or orientation) and a rear surface bearing a prismatic configuration such that it will effect total internal reflection of light.

The acrylic plastic shall be of a type meeting the requirements of Federal Specification L-P-380, Type I, Class 3, and, in order that the Department can readily check the suitability of the raw material used, the manufacturer shall stipulate the raw material and the particular molding compound to be furnished.

993-1.2.1 Durability Tests For Retroreflectors: Seal Test: The following test will be used to determine if a reflector is adequately sealed against dust and water.

Submerge 20 samples in water bath at room temperature. Subject the submerged samples to a vacuum of 10 inches gauge for five minutes. Restore atmospheric pressure and leave samples submerged for five minutes, then remove and examine the samples for water intake. Failure of more than two of the 20 samples tested shall be cause for rejection of the LOT.

993-1.2.2 Optical Requirements: The initial specific intensity of every object markers shall be at least equal to the minimum values shown below. Failure to meet the required specific intensity shall constitute failure of the reflector being tested.

| Observation Angle | Entrance Angle | Specific Intensity candelas/foot-candle | | |
|-------------------|----------------|--|--------|-----|
| | | Crystal | Yellow | Red |
| 0.1 degree | 0 degree | 40 | 24 | 10 |
| 0.1 degree | 20 degree | 16 | 10 | 4 |

The reflector to be tested shall be spun so as to have an average orientation effect, and shall be placed at a distance of 100 feet from a single light source having an effective diameter of 2 inches. The light source shall be operated at approximately normal efficiency. The return light from the reflector shall be measured by means of a photo-electric photometer having a minimum sensitivity of 1 by 10⁷ foot-candles per mm scale division. The photometer shall have a receiving aperture of 1/2 inch diameter, shielded to prevent the entry of stray light. The distance from light source center to aperture center shall be 2.1 inches for the 0.1 degree observation angle.

If a test distance other than the stipulated 100 feet is used, the source and the aperture dimensions, and the distance between source and aperture shall be modified directly as the test distance.

993-1.2.3 Reflector Housing: The reflector shall be mounted in a housing fabricated of aluminum alloy No. 3003-H 14 (or other alloy approved as equal for the purpose), and having a thickness of 0.064 inch.

993-1.3 Retroreflective Sheeting.

993-1.3.1 Retroreflective Sheeting: The retroreflective sheeting for object markers shall meet the requirements of Section 994, sheeting Types III, IV, or VII. The retroreflective area shall be in accordance with the MUTCD. The retroreflective sheeting shall be permanently adhered to 0.040 inch sheet aluminum for Type 2 markers and 0.080 inch sheet aluminum for Type 1, 3 and end-of-road markers. Aluminum shall be of 6061-T6 (ASTM B 209) prepared in accordance with recommendations of the sheeting manufacturer.

993-1.3.2 Assembly: Type 2 and 3 markers shall be mounted directly to the post by two holes on the face of the marker. The mounting holes shall be 1/4 inch square holes to receive 1/4 inch carriage bolts, or other 1/4 inch bolts and shall be spaced to fit holes on the post spaced at 1 inch centers.

993-1.4 Posts: The marker posts shall be of steel or aluminum as shown in the Design Standards or plans. Steel posts shall be 2.5#/Ft. flanged U-channel meeting the requirements of Section 700-2.3. Round aluminum posts shall meet the requirements of Index 11860.

993-2 Delineators.

993-2.1 General: Delineators shall be classified into four types: recycled flexible post delineators, nonflexible post delineators, high visibility median separator delineators, and high performance delineators.

993-2.2 Recycled Flexible Post Delineators: Meet the requirements of Section 972.

993-2.3 Nonflexible Post Delineators:

993-2.3.1 Posts: The post shall be 1.1 #/Ft. steel U-channel posts meeting the requirements of Section 700-2.3.

993-2.3.2 Retroreflective Sheeting: The retroreflective sheeting shall be Type III, IV, V or VII sheeting and meet the requirements of Section 994. The reflective sheeting shall have a minimum width of 4 inches and have a minimum area of 32 square inches. The retroreflective sheeting shall be permanently adhered to 0.040 inch sheet aluminum.

993-2.4 High Visibility Median Separator Delineators:

993-2.4.1 Dimensions: The delineator shall have a minimum height of 42 inches above the surface of the separator.

993-2.4.2 Post Base: The base shall be manufactured to accommodate the replacement of the post. The base shall be mechanically anchored to the separator and be capable of withstanding ten vehicle impacts without detaching.

993-2.4.3 Color: The plastic post shall be opaque white. The yellowness index shall not exceed 12 when tested in accordance with ASTM D 1925 or ASTM E 313. The daylight 45 degree, 0 degree luminous directional reflectance shall be a minimum of 70 when tested in accordance with ASTM E 1347.

993-2.4.4 Retroreflective Sheeting: The reflective sheeting shall be Types III, IV, V or VII and meet the requirements of Section 994. The reflective sheeting shall have a minimum width of 8 inches and have a minimum area of 230 square inches facing the approach to the separator.

993-2.4.5 Impact Performance: The post, installed according to manufacturer's recommendations, shall be capable of returning to a vertical position ± 5 degrees when tested according to National Testing Product Evaluation Program (NTPEP). NTPEP data or independent test lab data shall be submitted for product approval.

993-2.5 High Performance Delineators:

993-2.5.1 Dimensions: The delineator shall have a minimum height of 48 inches above the pavement surface and have a minimum diameter or width of 2.7 inches.

993-2.5.2 Post Base: The base shall be manufactured to accommodate the replacement of the post. The base shall be mechanically anchored to the separator and be capable of withstanding fifty vehicle impacts without damage.

993-2.5.3 Color: The plastic post shall be opaque white. The yellowness index shall not exceed 12 when tested in accordance with ASTM D 1925 or ASTM E 313. The daylight 45 degree, 0 degree luminous directional reflectance shall be a minimum of 70 when tested in accordance with ASTM E 1347.

993-2.5.4 Retroreflective Sheeting: The reflective sheeting shall be Type IV abrasion resistant sheeting and meet the requirements of Section 994. The reflective sheeting shall have a minimum width of 3 inches and have a minimum omnidirectional area of 30 square inches.

993-2.5.5 Impact Performance: The post, installed according to manufacturer's recommendations, shall be capable of returning to a vertical position ± 5 degrees with no delaminating after receiving fifty vehicle impacts when tested according to National Testing Product Evaluation Program (NTPEP). The NTPEP requirement of one-half of the hits at 32 F is waived. All hits shall be at 85 F. NTPEP data or independent test lab data shall be submitted for product approval.

993-3 Retroreflector Units for Guardrail and Concrete Barrier Wall.

993-3.1 General: Retroreflector units for use on guardrail and concrete barrier wall installations shall consist of retroreflective sheeting permanently adhered to 0.090 inch minimum thick body. The body shall have a flexible hinge which allows the reflector to fold down and spring back to an upright position after impact. Guardrail reflectors shall be designed for mounting to the web of steel posts or designed for

mounting to wood posts. Barrier wall reflectors shall be designed for mounting to the top of the barrier wall.

993-3.2 Retroreflective Sheeting: The sheeting for these reflector units shall be Type IV, V, or VII meeting the requirements of Section 994. The sheeting shall be yellow or white, depending on the locations of use for each. The dimensions of the reflective sheeting shall be 3 inches wide by 4 inches high. The sheeting shall be installed by the reflector manufacturer.

993-3.3 Installation: The reflector units shall be capable of being installed on the top of guardrail posts or the top of the barrier wall.

993-4 Product Acceptance on the Project.

Acceptance will be made in accordance with the requirements of Section 705. Manufacturers seeking evaluation of their product must submit an application in accordance with Section 6.