vii. Skid Resistance: The surface of the marking shall provide a minimum skid resistance value of 50 BPN when tested in accordance with ASTM E 303.

viii. Removability: While in place for any time period from April 1st to November 1st, the preformed plastic pavement marking film shall be removable from bituminous concrete and Portland cement concrete in its entirety, either manually or by a mechanical roll-up device, at temperatures above 40 degrees Fahrenheit (ambient and road surface temperature), and without the use of heat, solvents, grinding, or blasting.

ix. Wet Reflective Performance: The visual performance of the marking in wet and dry conditions shall be nearly identical. For visual evaluation purposes, the marking material shall be considered to be in a “wet” condition when a layer of water completely covers the top surface of the material. The layer of water shall measure a minimum of ¼ inch from the highest profile point of the material to the top surface of the water layer.

x. Retroreflectivity: The markings shall be capable of maintaining a minimum average retroreflective performance level of 200/ mcd/m2/lx, while in place for any time period from April 1st to November 1st, in both dry and wet conditions when installed according to the manufacturer’s recommendations. Retroreflectance shall be measured in accordance with ASTM specifications E 2176 and/or E 2177 to determine the markings retroreflectivity in wet conditions. Average retroreflectance values shall be determined by following an adequate sampling plan to be determined by the Division. All retroreflectivity measurements will be taken with a LTL 2000 (dry condition), LTL-X (wet conditions), or other Traffic Engineering Division approved 30-meter geometry retroreflectometer.

xi. General: The pavement marking material as supplied shall be of good appearance, and free from cracks. Edges shall be true, straight, and unbroken.

xii. Approved Products Listing (APL): Approvals are based on results from AASHTO’s NTPEP testing program and/or WVDOH field evaluation tests. Approvals may also be granted or rescinded based on actual performance on WVDOH projects. A list of approved suppliers and their code numbers may be obtained by contacting:

West Virginia Division of Highways
Material Controls, Soil and Testing Division
190 Dry Branch Drive
Charleston, WV 25306

715.40.5-BLANK

715.40.6-Raised Pavement Markers (RPM’s): RPM’s include Type P-2 markers, Type R-4 markers, and Temporary markers.

715.40.6.1-Type P-2 Markers: This specification covers Type P-2 markers, a type of plowable, retroreflective, RPM for lane marking and delineation.

All references to ASTM specification D 4383 herein shall be taken as referencing the D 4383 – 05 version of this specification.
715.40.6.1.1-Casting Requirements: The metal castings of Type P-2 markers shall meet the following requirements:

a. When tested in accordance with the methods and procedures specified in ASTM D4383, the castings shall meet the Compressive Strength performance requirements of ASTM D4383.

b. When tested in accordance with the methods and procedures specified in ASTM D4383, the “ramps” of the castings shall meet the Hardness performance requirements of ASTM D4383.

c. The installed height of the casting shall not exceed 0.25 in. (6.4 mm) above the road surface.

d. The casting shall be manufactured of material specified in ASTM D4383, and shall be hardened to the level specified in ASTM D4383. The castings shall be capable of demonstrating that this hardness level has been achieved when tested in accordance with the methods and procedures specified in ASTM D4383.

e. The plow blade deflecting ramps of the casting shall be angled not more than six (6) degrees to the surface of the road.

f. The ramps of the castings shall be designed such that there shall be no vertical surfaces above the road level that can be contacted by the plow blade moving in the normal travel direction.

g. In new condition, the surfaces of the casting shall be free of scale, dirt, rust, oil, grease, or any other contaminant which may reduce its bond to the adhesive with which the casting is installed or with which the lens is mounted.

h. The casting shall be designed to be partially recessed below the pavement surface to withstand plow impact. It shall have means for indexing the pavement surface, such as tabs.

i. Castings with center rails shall not be allowed.

j. Castings shall have fully completed testing on the American Association of State and Highway Transportation Officials -National Transportation Product Evaluation Program (AASHTO-NTPEP) test deck in a location having a similar climate to West Virginia. Upon review, the performance of the castings on the test deck shall meet or exceed the historical performance of other industry standard castings approved by the WVDOH. This determination shall be made solely by the WVDOH.

k. Castings shall have been tested by an independent testing facility to the applicable ASTM D4383 specification requirements referenced herein. The castings shall have been sampled as specified in ASTM D4383 and shall meet the applicable specification requirements, as demonstrated by test results certified and made available by the testing facility. The applicable ASTM D4383 specification requirements referenced herein shall be considered to be parts a), b), and d) of this Section.
715.40.6.1.2-Lens Requirements: The retroreflective lenses of Type P-2 markers shall meet the following requirements:

a. The coefficient of luminous intensity (RI) of the lenses in new condition shall be not less than the values specified in ASTM D4383 when measured in accordance with the procedures and methods specified in ASTM D4383. Coefficient of luminous intensity shall be defined as the ratio of the luminous intensity (I) of the retroreflector in the direction of observation to the illuminance (E) at the retroreflector on a plane perpendicular to the direction of the incident light, expressed in candelas per lux (cd/lx).

b. After abrading the lenses in accordance with the procedures and methods specified in ASTM D4383, the coefficient of luminous intensity of the lenses at zero (0) degrees entrance angle shall be not less than the values specified in ASTM D4383 when measured in accordance with the procedures and methods specified in ASTM D4383. This requirement shall not apply to red faces of lenses.

c. When illuminated in accordance with ASTM D4383, the color of the lenses shall meet the color requirements of ASTM D4383 when measured in accordance with the procedures and methods specified in ASTM D4383.

d. When impacted in accordance with the methods and procedures specified in ASTM D4383, the lenses shall meet the Lens Impact Strength performance requirements of ASTM D4383.

e. When subjected to temperature cycling in accordance with the methods and procedures specified in ASTM D4383, the lenses shall meet the Temperature Cycling performance requirements of ASTM D4383.

f. The lens shall be comprised of materials with adequate chemical, water, and UV resistance for the intended use.

g. The lens width shall be approximately four (4) in. (102 mm).

h. The angle between the face of the lens and the base shall be no greater than forty-five (45) degrees.

i. The base of the marker shall be flat within 0.05 in. (1.3 mm). If the bottom of the marker is configured, the outermost faces of the configurations shall not deviate more than 0.05 in. (1.3 mm) from a flat surface.

j. The lens shell, or body, shall be a solid polymer with no fill material. The retroreflective face(s) of the lens shall not be required to be integral with the shell.

k. The retroreflective face(s) of the lens shall be subdivided into multiple “cells” which shall allow undamaged cells to continue to perform unaffect ed when one or more cells are damaged.

l. The retroreflective technologies incorporated into the retroreflective face(s) of the lens shall be designed such that the lens will provide retroreflectivity when wet.

m. Lenses shall have fully completed testing on the American Association of State and Highway Transportation Officials -National Transportation Product Evaluation Program (AASHTO-NTPEP) test deck in a location having a similar climate to West Virginia. Upon review, the performance of the lenses on the test deck shall meet or exceed the historical performance of other industry standard lenses approved by the WVDOH. This determination shall be made solely by the WVDOH.
n. Lenses shall have been tested by an independent testing facility to the applicable ASTM D4383 specification requirements referenced herein. The lenses shall have been sampled as specified in ASTM D4383 and shall meet the applicable specification requirements, as demonstrated by test results published and certified by the testing facility. The applicable ASTM D4383 specification requirements referenced herein shall be considered to be parts a), b), c), d), and e) of this Section.

715.40.6.1.3-Adhesive Requirements: Epoxy adhesive shall be used for applying Type P-2 markers to the pavement surface. The specific adhesive used shall be an adhesive recommended by the P-2 marker manufacturer and meeting the requirements of ASTM D4383.

The adhesive used for adhering the Type P-2 marker lenses in the castings shall be an adhesive recommended by the P-2 marker manufacturer.

715.40.6.1.4-Product Submission and Approval: Type P-2 marker castings and/or lenses to be considered for inclusion on the WVDOH Approved Products List (APL) shall be submitted to the Materials Division following the current procedures specified by the Materials Division. The manufacturer may contact the Traffic Engineering Division for verification. The manufacturer should include all relevant documentation and information with this form, including but not limited to Product Data Sheets, Product Flyers, Manufacturer Product Specifications, Product Bulletins, Engineering Drawings, AASHTO-NTPEP test results, and the independent testing facility test results described herein.

In addition to the above, the WVDOH may also require that the casting and/or lens product(s) submitted for evaluation be field tested in one or more locations in West Virginia in order to validate the acceptable performance of the product(s). This field testing shall typically be a minimum of six months to one year in duration including a full winter season. Specific details related to this testing, such as locations and quantities, shall be determined by the WVDOH.

All submitted information will be forwarded to the WVDOH Traffic Engineering Division, which will in turn contact and work directly with the manufacturer during the evaluation process. The Traffic Engineering Division will evaluate all submitted literature and documentation for compliance with the specified requirements as well as satisfactory performance on the AASHTO-NTPEP test deck. The Traffic Engineering Division may also arrange for the manufacturer to furnish test samples and arrange for the product to be installed for field testing as previously described. After the evaluation is complete, the Traffic Engineering Division will inform the Materials Division in writing of the outcome of its evaluation.
715.40.6.2-Type R-4 Markers: This specification covers Type R-4 markers, a type of nonplowable, retroreflective RPM for nighttime lane marking and delineation. Note, due to the fact that snow plowing operations are necessary throughout the state of West Virginia, Type R-4 markers are not placed such that they will be subjected to direct plowing; rather, the RPM’s are installed in limited locations in conjunction with surface mounted tubular markers in order to be shielded from plowing. All references to ASTM specification D 4280 herein shall be taken as referencing the D 4280 – 08 version of this specification.

Type R-4 markers shall meet the following requirements:

a. When tested in accordance with the methods and procedures specified in ASTM D4280, the markers shall meet the Flexural Strength performance requirements of ASTM D4280.

b. When tested in accordance with the methods and procedures specified in ASTM D4280, the markers shall meet the Compressive Strength performance requirements of ASTM D4280.

c. The markers shall be comprised of materials with adequate chemical, water, and UV resistance for the intended use.

d. The color of the marker shell shall match the color of the lens of the marker that is not red.

e. The marker height shall not exceed 0.80 in. (20.3 mm).

f. The marker width shall not exceed 5.1 in. (130 mm).

g. The base of the marker shall be substantially free from gloss or substances that may reduce its bond to adhesive.

h. The base of the marker shall be flat within 0.05 in. (1.3 mm). If the bottom of the marker is configured, the protruding faces of the configurations shall not deviate more than 0.05 in. (1.3 mm) from a plane.

i. The coefficient of luminous intensity (RI) of the marker lenses in new condition shall be not less than the values specified in ASTM D4280 when measured in accordance with the procedures and methods specified in ASTM D4280. Coefficient of luminous intensity shall be defined as the ratio of the luminous intensity (I) of the retroreflector in the direction of observation to the illuminance (E) at the retroreflector on a plane perpendicular to the direction of the incident light, expressed in candelas per lux (cd/lx).

j. After abrading the marker lenses in accordance with the procedures and methods specified in ASTM D4280, the coefficient of luminous intensity of the lenses at zero (0) degree entrance angle shall be not less than the values specified in ASTM D4280 when measured in accordance with the procedures and methods specified in ASTM D4280. This requirement shall not apply to red faces of lenses.

k. When illuminated in accordance with ASTM D4280, the color of the marker lenses shall meet the color requirements of ASTM D4280 when measured in accordance with the procedures and methods specified in ASTM D4280.

l. When impacted in accordance with the methods and procedures specified in ASTM D4280, the marker lenses shall meet the Lens Impact Strength performance requirements of ASTM D4280.
m. When subjected to temperature cycling in accordance with the methods and procedures specified in ASTM D4280, the marker lenses shall meet the Temperature Cycling performance requirements of ASTM D4280.

n. The retroreflective face(s) of the lens shall be subdivided into multiple “cells” which shall allow undamaged cells to continue to perform unaffected when one or more cells are damaged.

o. The retroreflective technologies incorporated into the retroreflective face(s) of the lens shall be designed such that the lens will provide retroreflectivity when wet.

p. The angle between the face of the marker lens and the base shall be no greater than forty-five (45) degrees.

q. The markers shall have fully completed testing on the American Association of State and Highway Transportation Officials -National Transportation Product Evaluation Program (AASHTO-NTPEP) test deck. Upon review, the performance of the markers on the test deck shall meet or exceed the historical performance of other industry standard Type R-4 markers approved by the WVDOH. This determination shall be made solely by the WVDOH.

r. The markers shall have been tested by an independent testing facility to the applicable ASTM D4280 specification requirements referenced herein. The markers shall have been sampled as specified in ASTM D4280 and shall meet the applicable specification requirements, as demonstrated by test results certified and made available by the testing facility. The applicable ASTM D4280 specification requirements referenced herein shall be considered to be parts a), b), i), j), k), l), and m) of this Section.

715.40.6.2.1-Adhesive Requirements: Standard set epoxy adhesive, rapid set epoxy adhesive, or bituminous adhesive may be used for applying Type R-4 markers to the pavement surface. The specific adhesive used shall be an adhesive recommended by the R-4 marker manufacturer and meeting the requirements of ASTM D4280 for one of the adhesive types described above.

715.40.6.2.2-Product Submission and Approval: Type R-4 markers to be considered for inclusion on the WVDOH Approved Products List (APL) shall be submitted to the Materials Division following the current procedures specified by the Materials Division. The manufacturer may contact the Traffic Engineering Division for verification. The manufacturer should include all relevant documentation and information with this form, including but not limited to Product Data Sheets, Product Flyers, Manufacturer Product Specifications, Product Bulletins, Engineering Drawings, AASHTO-NTPEP test results, and the independent testing facility test results described herein.

In addition to the above, the WVDOH may also require that the markers submitted for evaluation be field tested in one or more locations in West Virginia in order to validate the acceptable performance of the product(s). This field testing shall typically be a minimum of six months to one year in duration including a full winter season. Specific details related to this testing, such as locations and quantities, shall be determined by the WVDOH.

All submitted information will be forwarded to the WVDOH Traffic Engineering Division, which will in turn contact and work directly with the manufacturer during the evaluation process. The Traffic Engineering Division will evaluate all submitted literature
and documentation for compliance with the specified requirements as well as satisfactory performance on the AASHTO-NTPEP test deck. The Traffic Engineering Division may also arrange for the manufacturer to furnish test samples and arrange for the product to be installed for field testing as previously described. After the evaluation is complete, the Traffic Engineering Division will inform the Materials Division in writing of the outcome of its evaluation.

715.40.6.3-Temporary Markers: Temporary markers shall meet the same requirements as permanent Type R-4 markers, as described in Section 715.40.6.2, with the exception of requirements q) and r).

The adhesive used to apply the markers shall meet the requirements of Section 715.40.6.2.1 or, in lieu of adhesives of this type, the Contractor may utilize markers supplied by the manufacturer with a “peel and stick” pressure sensitive adhesive pad pre-applied to the marker, provided that the surface upon which the marker is to be placed is within the manufacturer’s recommendations for markers incorporating a pre-applied adhesive pad. Markers supplied for temporary application to newly placed asphalt final wearing course surfaces or newly placed concrete surfaces shall be placed using a pre-applied pressure sensitive adhesive pad.

Temporary markers are not required to be submitted for review, approval, and placement on an Approved Products List (APL). No APL shall be maintained for temporary markers. When requested, the Contractor shall submit to the project Engineer a letter of certification from the marker manufacturer certifying that the markers supplied meet the current WVDOH Standard Specifications.

715.41-TRAFFIC SAFETY DEVICES:


The Manufacturer of the Safety Device shall provide certified crash test data that indicates the product meets the requirements noted above.

The manufacturer shall submit to Traffic Engineering Division 8 copies of their design (installation) drawings for the specific device. This drawing will be reviewed, if approved, it will be stamped and one copy returned to the manufacturer. Multiple devices of the same design for the same project or purchase order will require one set of drawings, not one set for each device. In addition, one design and one installation manual shall be shipped with each safety device.

All safety devices shall be manufactured and fabricated using the same components as crash tested. Any changes in design or compound shall be requested in writing by the supplier. The Engineer's concurrence is required prior to any change.

715.41.1-Sand Barrel Impact Attenuating Device (Type V):

715.41.1.1-Description: The unit shall have cylindrical containers capable of holding various amounts of sand. The amount of sand capable of being held shall include at least 2, 4, 7, 14, or 21 cubic feet (0.056, 0.112, 0.196, 0.393 or 0.588 cubic meters).