SPECIAL PROVISIONS

01.00 GENERAL
02.00 PREQUALIFICATION OF BIDDERS
03.00 PREVAILING WAGES
04.00 RESTRICTION OF OPERATIONS DURING HOLIDAY PERIODS
05.00 BIDDING
06.00 WORK AUTHORIZATION
07.00 MOBILIZATION
08.00 MAINTENANCE AND PROTECTION OF TRAFFIC
09.00 REAPPLICATION OF HIGHLY REFLECTORIZED EPOXY PAVEMENT MARKINGS
10.00 HIGHLY REFLECTORIZED POLYUREA PAVEMENT MARKINGS
11.00 REAPPLICATION OF HIGHLY REFLECTORIZED POLYUREA PAVEMENT MARKINGS
12.00 PERMANENT PREFORMED PATTERNED REFLECTIVE PAVEMENT MARKINGS
13.00 REAPPLICATION OF PERMANENT PREFORMED PATTERNED REFLECTIVE PAVEMENT MARKINGS
14.00 REAPPLICATION SURFACE PREPARATION
15.00 PUBLIC WORKS EMPLOYMENT VERIFICATION ACT
16.00 ACCESS TO JOB SITE
17.00 INDEMNITY
18.00 ENUMERATION OF DRAWINGS

ATTACHMENTS

PENNSYLVANIA TURNPIKE COMMISSION SPECIFICATIONS

Section 901 - Maintenance and Protection of Turnpike Traffic During Construction CS-901 04/03/15
Section 962 - Painting Traffic Lines and Markings CS-962 10/03/14
Section 963 - Pavement Marking Removal CS-963 04/01/11
Section 964 - Highly Reflectorized Epoxy Pavement Markings CS-964 04/04/14
Section 1103 - Traffic Signing and Marking CS-1103 04/05/13

HOLIDAY RESTRICTIONS
01.00 GENERAL

This proposal covers the requirements of the Commission for the contract period beginning on the date of Notice to Proceed and extending for a period of three years.

It is understood that the total maximum cost of this contract to the Commission may not exceed Two Million Five Hundred Thousand Dollars ($2,500,000.00) over the three-year period. No modification to this amount may be permitted unless approved in writing by the Commission.

This contract provides for the furnishing of all labor, material, equipment and work necessary to perform installing durable pavement markings as the need arises.

02.00 PREQUALIFICATION OF BIDDERS

Prequalification by the Pennsylvania Department of Transportation is a necessary prerequisite for bidding on this project.

03.00 PREVAILING WAGES

The Provisions of the Pennsylvania Prevailing Wage Act of August 15, 1961, P.L. 987 as amended, together with the rates and regulations promulgated by the Secretary of Labor and Industry, are a part of these contract documents.

04.00 RESTRICTION OF OPERATIONS DURING HOLIDAY PERIODS

Arrange schedule to provide maximum use of the roadway during holiday periods. Have all travel lanes, shoulders, interchange ramps and toll lanes available to traffic and at same elevation during the holiday periods. Applicable holiday periods are included as an attachment.

05.00 BIDDING

The contractor will bid a fixed price for each item listed. The bid total will not constitute the value of the contract, but the value of the unit costs for the items listed in the bid proposal.

On the list of items, the numbers in the parenthesis of the Item column are the quantity range for the item. The number in the Quantity column is the quantity to be used for bidding purposes. The bid quantity multiplied by the unit price will equal the bid for the item.
06.00 WORK AUTHORIZATION

The Commission will issue Work Authorizations. These authorizations constitute the contractor's authority to provide the service. All Work Authorizations received by the Contractor up to and including the expiration date of the contract are acceptable and must be honored in accordance with this contract.

Each Work Authorization will contain an estimated quantity for each item of work to be performed and a required completion date.

Items of work listed on a Work Authorization and not covered by this contract will be negotiated between the Commission and the Contractor. All prices for additional new items of work must be approved by the Commission prior to beginning work.

Some items listed may not be used in the course of the contract. The Contractor will be paid only for the quantity of each item used as listed in the work authorization or negotiated.

Each Work Authorization will be as mutually agreed.

When a Work Authorization is issued by the Commission for this contract, the Contractor will be paid for the work and material based on the quantity range unit price from the contract that the actual Work Authorization quantity falls into.

07.00 MOBILIZATION

The following provisions supersede those of Section 608:

Costs incurred to mobilize and demobilize will not be paid separately. Costs associated with these items are to be included in the unit price for each bid item.

08.00 MAINTENANCE AND PROTECTION OF TRAFFIC
(ITEMS: 4901-0001, 4901-0004 AND 4901-0005)

08.01 Description - This work is the furnishing, installing, maintaining, resetting, relocating, storing, and removal of all traffic control devices necessary for maintenance and protection of traffic during construction.

08.03 Construction -

Perform maintenance and protection of traffic according to Section 901, PTS (910, 960, 980), the contract drawings and the special provisions.

A single lane traffic pattern for a maximum length as specified on PTS-910, closing the right or left lane, will be permitted as follows:

1. MP 000.00 to MP 075.39 – 9 PM to 6 AM nightly, Sunday night through Friday morning
2. MP 075.39 to MP 179.44 – 10 PM to 7 AM nightly, Sunday night through Friday morning
3. MP 179.44 to MP 226.54 – 9 PM to 9 AM nightly, Sunday night through Friday morning
4. MP 226.54 to MP 241.87 – 7 PM to 6 AM nightly, Sunday night through Friday morning
5. MP 241.87 to MP 245.75 – 10 PM to 6 AM nightly, Sunday night through Friday morning
6. Toll I-376, Turnpike 66, Turnpike 43, Turnpike 576 – 9 AM to 3 PM daily, Monday through Thursday; 9 PM to 6 AM nightly, Sunday night through Friday morning
No work will be performed during holiday periods. Applicable holiday periods are included as an attachment.

Furnish, install and maintain all required lights, guides, sandbags and appurtenances as deemed necessary by the Representative for the proper maintenance and protection of traffic and to warn of any obstruction or hazard to traffic. Use Type A and Type B flasher units and Type C steady burn units on this project. Furnish, install and maintain all shadow vehicles. Shadow vehicles without a truck mounted attenuator must be a 33,000 lb GVW (Gross Vehicle Weight) or larger vehicle and loaded to weigh a minimum of 22,000 lbs. in addition to meeting the requirements of Publication 212.

Provide signs with PennDOT approved Type XI reflectorized material.

Utilize the following general procedures for maintenance and protection of traffic:

A. For Pre-Construction Signing: Erect these signs prior to the performance of any work that may affect or alter the normal traffic pattern on the Turnpike.

1. Erect MPT-33, CAUTION - NEW TRAFFIC PATTERNS - NEXT X MILES at the approaches to the work zone. If the work is in an interchange, toll plaza, or service plaza, then instead of “MPT-33, CAUTION - NEW TRAFFIC PATTERNS - NEXT X MILES”, erect the appropriate sign information for the project of “MPT-09, INTERCHANGE AREA CONSTRUCTION”, or “MPT-10, TOLL PLAZA AREA CONSTRUCTION”, or “MPT-11, SERVICE PLAZA AREA CONSTRUCTION”. In addition, erect R22-1 signs, WORK ZONE STATE LAW TURN ON HEADLIGHTS, as the first sign approaching the work zone. The R22-1 sign for traffic coming into this Commonwealth will be installed within this Commonwealth.

2. Erect Type W20-1 and other signs at the approach to the work limit for the first work zone as indicated on the plans. Except for the median signs on the approaches to the work zone, 55 MPH speed limit signs, MPT-33, MPT-09, MPT-10, MPT-11 and W8-11 signs, all other signs may be mounted on PennDOT approved portable supports, x-frame, with a minimum height of 1 foot from the pavement surface to the bottom of the signs. Except W8-11 signs, all other median signs may be mounted on approved temporary median barrier sign supports. Portable supports and signs must be removed from the roadway during non-working hours. In lieu of portable sign supports, post-mount signs at locations designated by the Representative in such manner as not to obstruct shoulders and to be clear of work areas. Relocate this approach signing as work progresses.

Erect W21-19 signs, ACTIVE WORK ZONE WHEN FLASHING INCREASED PENALTIES, when workers are present on the roadway, berm, or shoulder and not
protected by concrete barrier. Do not erect the sign within a transition or at a location where workers are put at risk when they may need to turn the light on and off. When there is more than one active work zone separated by a distance of more than 1 mile, erect signs for each active work zone. Attach a PennDOT approved white Type B high-intensity flashing light to the upper portion of each W21-19 sign. Activate the white Type B high-intensity flashing light only when workers are present on the roadway, berm, or shoulder and not protected by concrete barrier and turn off the white Type B high-intensity flashing light when workers are not present on the roadway, berm, or shoulder for 60 minutes or more or are protected by concrete barrier. Cover the W21-19 and W21-20 signs during non-working hours.

Erect W21-20 signs, END ACTIVE WORK ZONE, immediately at the end of each active work zone, except this sign is not necessary if the G20-2, END ROAD WORK, sign is installed at the end of the active work zone.

For Work Authorizations whose costs exceed $300,000, provide a PennDOT approved Speed Display Sign ½ to 1 mile in advance of the physical work zone to advise motorists of their vehicle’s speeds. Provide an additional PennDOT approved Speed Display Sign 500 to 900 feet in advance of the physical work zone to advise motorists of their vehicle’s speeds. The Contractor may furnish additional units. Trim trees and vegetation, and remove all obstructions at each placement site. The locations and times of operation are as approved by the Representative.

The R22-1, W21-19, and W21-20 signs, the white Type B high-intensity flashing light, and the Speed Display Sign have been created by PennDOT in response to the requirements of Act 229. These signs and devices, as well as the associated guidelines, can be found in 67 PA Code, Chapter 212, Official Traffic Control Devices. Review, familiarize, and apply these guidelines and all its supplements to this construction project as required by Act 229.

Use PTS-910, Sheet 2 or 3 of 8, Mobile Operation for 2 or 3 Lanes, respectively, to cover and uncover signs and install and remove traffic control devices. Provide an additional Shadow Vehicle with arrow panel to be used with PTS-910, Sheet 2 or 3 of 8, Mobile Operation for 2 or 3 Lanes, respectively, as needed. During nighttime hours, provide 1 Multi-Directional Lighting Device on Shadow Vehicle(s) with Truck Mounted Attenuator and each of the Work Vehicle(s).

B. Do not exceed a maximum work zone of 3 miles in length for operations not behind barrier. In the event a 3-mile work zone for operations not behind barrier is not required or the work zone is not used in an efficient manner, the Representative will direct the length of the work zone be shortened to that length sufficient for the Contractor's operation and efficiency. Maintain a minimum of 2 miles of unrestricted roadway between patterns on the same side of the road.

1. Furnish, operate, and maintain in the following manner, additional safety devices and controls for operation adjacent to traffic patterns:

   a. Furnish equipment working adjacent to traffic with a yellow flashing light attached to the equipment to indicate its outer limit, visible 360 degrees. Lights are to be according to Section 901.
b. Mount vertical panels with Type A lights at the approach end, facing traffic, of all shoulder inlets, guide rail ends, and bridge parapet ends whenever traffic is using the shoulder or part of the shoulder as a travel lane.

c. Place vertical panels at 25 foot intervals for 150 feet in advance of each Vehicle Attenuating Terminal End Treatment (VATET) during traffic control stages in which traffic will operate on shoulders adjacent to guide rail and VATETs.

2. Use PennDOT approved vertical panels with self-ballasting bases for channelizing devices. The entire face of the vertical panel visible to traffic is to be reflectorized with PennDOT approved Type XI reflectorized material. Remove channelizing devices from the roadway during non-working hours. Channelizing devices may be temporarily relocated to the minimum offset to allow for work to be performed, as directed by the Representative. The channelizing devices must remain between traffic and the work zone. Relocate channelizing devices to original position as work progresses.

3. Lane restrictions will not be permitted during non-working hours for any operation requiring either a mobile lane restriction or a stationary lane or shoulder restriction.

4. Maintain the entrances and exits to Interchanges, Service Plazas, Maintenance Sheds and Access Ramps at all times.

5. Where the traffic will operate on shoulders adjacent to guide rail, install reflectors at permanent spacing, 75 feet on tangent and 37.5 feet on curves, before shifting traffic to the affected areas.

6. When traffic will operate on median or shoulder, secure all inlet grates in the travel lane or within 2 feet of the travel lane. Provide a grate securing system for approval. Ensure all inlets are accessible when traffic no longer uses the median or shoulder.

7. It is the Contractor's responsibility to locate the existing concrete pavement edges for the proper placement of the final pavement markings.

8. Do not set up a traffic pattern for work on the mainline within 2 miles of an Interchange or Service Plaza while working on an Interchange or Service Plaza.

9. The Representative is to coordinate the work in any Interchange or Service Plaza area with Fare Collection or Service Plaza personnel. Notify the Representative a minimum of fourteen (14) days in advance of the scheduled work any Interchange or Service Plaza area.

10. Maintain access for emergency and authorized vehicles to any Interchange or Service Plaza building(s) at all times.

11. Queuing of traffic onto the Turnpike mainline and/or onto a state or local road must be avoided. If queuing occurs, remove all work zone lane restrictions immediately to alleviate the queue. Resume work after approval from the Representative.

12. When working where the single lane traffic pattern will begin on a structure, maintain the single-lane pattern across the bridge using PennDOT approved vertical panels spaced at 100-foot intervals.
13. When working within 1,000 feet of a Tunnel Cross-over Scissors, establish a single-lane traffic control pattern by closing the appropriate lane as shown on PTS-910 on far side of the Tunnel. The lane closure must be a minimum of 1,320 feet prior to the approach portal of the Tunnel. Maintain single lane traffic through the Tunnel without a tunnel cross-over pattern. Set PennDOT approved vertical panels 6 feet into the closed lane at 50-foot intervals through the Tunnel. Coordinate with the Representative for the placement of the vertical panels through the Tunnel. Blue Mountain Tunnel and Kittatinny Tunnel is to be addressed as one tunnel and any lane closure is to be set through both the Blue Mountain Tunnel and the Kittatinny Tunnel.

14. Maintain access for emergency and authorized vehicles to the Access Ramps and the entrances and exits to the Tunnel Portal Buildings at all times.

15. All equipment, materials, and debris are to be removed prior to opening the Tunnel to traffic.

16. Be aware and familiar with the location and weather conditions around and on the approaches to the Tunnel. Traffic or inclement weather, including the forecasting of inclement weather, may require the opening of all travel lanes or the cancellation of work at the time. If work is in progress at the time of notification from the Representative, or the Turnpike detail of the Pennsylvania State Police, be able to remove all personnel, equipment, and materials from the Tunnel within one (1) hour. All areas disturbed by operations must be cleaned prior to leaving the Tunnel so that no obstructions, debris, or materials remain in the tunnel.

17. Notify the Representative a minimum of fourteen (14) days prior to the initial closing of a tube of the Tunnel. The Representative will notify the Turnpike detail of the Pennsylvania State Police and the Commission’s Maintenance Personnel of the tube closed to traffic and the time and expected duration of each closing.

C. Utilize the following sequences to perform all work located along the mainline.

1. During allowable working hours, close the appropriate lane(s) by placing channelizing devices 2-feet into the appropriate lane(s) as shown on PTS-910.

2. Perform surface preparation, removal of existing pavement markings, and/or installation of durable pavement markings.

D. Utilize the following sequences to perform all work on State and Local roads.

1. Install work zone traffic control on the state or local road according to Publication 212.

2. Perform surface preparation, removal of existing pavement markings, and/or installation of durable pavement markings.

E. Utilize the following sequences to perform all work located within an Interchange or Service Plaza area.
Perform work on ramps to minimize impedance of traffic. Use advance signing, flaggers and warning and traffic control devices to the extent necessary to provide for the maintenance and protection of traffic. As directed by the Representative and at a minimum, provide W21-101, RAMP WORK AHEAD, W3-4, BE PREPARED TO STOP, W20-7, Flagger Symbol, W21-10, Stop and Slow Paddle, and channelizing devices before and through the work area while performing the work. Locate channelizers with Type "A" flasher lights as necessary to aid in the delineation of the pattern established. Remove all channelizers from the travel lanes during all non-working hours.

During all working operations that require flaggers, flaggers will be utilized in advance of, as shown on the contract drawings, and within the work zone. Flaggers must be in radio communication for ramp operations and are to be equipped with PennDOT approved stop and slow paddles.

Additional signs, devices and flaggers may be required for construction and protection of traffic within the interconnecting ramps. Secure signs and devices for such conditions, if available, from those of the project. If signs and devices can not be secured from those on the project, provide these at no additional cost to the Commission. Consider erection, relocation, and maintenance of such signs and devices incidental to the work of the project.

Complete all ramp work according to the plans and as directed by the Representative.

08.04 Measurement and Payment –

(a) Maintenance and Protection of Traffic, Single Lane Pattern – PTS-910 – Each. Includes furnishing, installation and removal of signs, channelizing devices, cover and uncover of applicable signs, one arrow board, one portable changeable message sign, one shadow vehicle with truck mounted attenuators and MDLDs.

(b) Maintenance and Protection of Traffic, Right and Center Lanes – PTS-910 – Each. Includes furnishing, installation and removal of signs, channelizing devices, cover and uncover of applicable signs, two arrow boards, two portable changeable message signs, two shadow vehicles with truck mounted attenuators and MDLDs.

Single lane pattern will include right or left lane.

Payment is for the standard lane closure pattern(s) shown on PTS-910. Any additional MPT requirements beyond standard lane closure pattern will be extra work and will be addressed in specific work authorization(s).

09.00 REAPPLICATION OF HIGHLY REFLECTORIZED EPOXY PAVEMENT MARKINGS


09.01 Description - This work consists of furnishing and installing highly reflectorized epoxy pavement markings of the color indicated, at the existing locations of the highly reflectorized epoxy pavement markings.
09.02 Material -

(a) General. Provide materials from a source listed in Bulletin 15. Certify materials as specified in Section 106.03(b)3.

(b) Epoxy Resin. Provide only those epoxy materials listed in Bulletin 15. Do not use polluting solvents or fillers.

1. Color. Furnish white and yellow pavement markings that satisfy the following chromaticity coordinates:

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>x</td>
<td>y</td>
<td>x</td>
<td>y</td>
<td>x</td>
</tr>
<tr>
<td>White</td>
<td>0.330</td>
<td>0.370</td>
<td>0.355</td>
<td>0.345</td>
</tr>
<tr>
<td>Yellow</td>
<td>0.515</td>
<td>0.465</td>
<td>0.505</td>
<td>0.430</td>
</tr>
</tbody>
</table>

Furnish black epoxy that satisfies color chip 37038 of Federal Standard 595B and is equal to the quality of the white epoxy being used.

2. No Track Time. Dry to a no-track condition in 10 minutes or less when tested according to ASTM D 711 at a temperature of 75°F ± 2°F at a thickness of 20 mils ±1 mil with glass beads applied at a rate of 20 pounds per gallon of epoxy.

(c) Optics. Apply a combination of the following to the epoxy resin:

- Standard Glass Beads - Section 1103.14
- Potters Visibead Plus II Highway Safety Marking Spheres or approved equal
- 3M AW 70/71 E Series elements containing microcrystalline ceramic beads. For white markings, use 3M Series AW 70E Series elements or approved equal. For yellow markings, use 3M Series AW 71E Series elements or approved equal.

(d) Black Aggregate. Furnish with the following gradations:

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>Retained (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. 20</td>
<td>17-37</td>
</tr>
<tr>
<td>No. 30</td>
<td>45-65</td>
</tr>
<tr>
<td>No. 40</td>
<td>14-25</td>
</tr>
</tbody>
</table>

09.03 Construction -

(a) General. Hot apply the epoxy marking material by spray method onto clean and dry roughened epoxy pavement marking surface at the thickness and width specified. Apply the retroreflective optics to the hot epoxy paint using either a double or triple drop system.

Line marking configurations are according to PTS-980. All lines are to be positioned 4 inches from the respective pavement joint in the existing groove.

Highly reflectorized epoxy pavement markings are to be recessed in the pavement and resistant to damage and deformation by traffic and damage from snow removal equipment.
Coordinate a pre-paint meeting at least thirty (30) days prior to starting the installation of any pavement markings. At the pre-paint meeting, provide the Representative with the following:

- The source of supply for the epoxy material and the epoxy manufacturer’s written instructions for use. These instructions are to include, but not be limited to, material mixing ratios and application temperatures (for the epoxy material and the pavement surface).
- Provide test plates of the exact pavement markings to be installed. Provide 3 test plates of each color. Include a minimum 6-inch wide by 24-inch long sample of the marking on a flat and rigid substrate for each test plate. Provide the dry and wet retroreflectivity levels of each sample in accordance with (e).
- Procedures for cutting the grooves with diamond saw blades.
- Procedures for installing the highly retroreflectorized epoxy pavement marking in the existing groove.
- The source of supply for all retroreflective optics.

Apply pavement markings in the direction of traffic.

Provide protection to allow adequate time for the pavement markings to dry and be track-free from vehicular traffic. This operation must be done during allowable working hours listed in Special Provision 08.00. Remove, to the satisfaction of the Representative, all tracking marks, spilled epoxy, and epoxy markings applied in unauthorized areas.

Establish marking line points at 40-foot intervals throughout the length of the pavement as directed by the Representative.

(b) Equipment. Equip the grinding equipment with a free-floating cutting or grinding head to provide a consistent groove depth over irregular pavement surfaces. Equip the grinding or cutting head with diamond saw blades. The grinding equipment must be capable of producing a final pavement surface that is flat and free of ridges.

Provide a mobile applicator that is a truck mounted, self-contained pavement marking machine, specifically designed to apply epoxy resin materials and retroreflective optics in continuous and skip line patterns. The application equipment shall be maneuverable to the extent that straight lines can be followed and normal curves can be made in true arc.

At any time throughout the duration of the project, provide free access to the epoxy application equipment for the inspection by the Representative.

Provide application equipment capable of installing a minimum of 100,000 feet of highly reflectorized epoxy pavement markings in an eight hour day and includes the following features:

- Individual tanks for the storage of Part A and Part B of the epoxy resin and for the storage of reflective glass spheres.
- Heating equipment of sufficient capacity to maintain the individual epoxy resin components at the manufacturer’s recommended temperature for spray application.
- Equipment capable of mixing Part A with Part B of the epoxy resin material to manufacturer’s recommendations.
• Retroreflective optic dispensing equipment and the capacity of applying the optics as specified.
• Metering devices or pressure gauges on the proportioning pumps, positioned to be readily visible to the Representative.
• All necessary spray equipment, mixers, compressors, and other appurtenances for the placement of highly reflectorized epoxy pavement markings in a simultaneous sequence of operations.

(c) Surface Preparation. Refer to Special Provision 14.00.

(d) Installation. Recess the epoxy pavement markings into the existing recessed groove.

Apply black epoxy markings on cement concrete roadways. Recess the black markings, flooded with black aggregate, immediately after all white skip line patterns. Cut the recessed area 25 feet in length with a maximum tolerance of +6 inches on either end. The line dimensions are 15’ for white and 10’ for black.

The use of temporary shadow lines within the recessed area is prohibited.

Do not begin marking operations until surface preparation work is completed and approved by the Representative. Install epoxy on dry pavement only if the road surface and ambient temperatures are 40°F or higher unless otherwise approved by the Representative and acceptable to the manufacturer.

Apply pavement markings by the following simultaneous operation:

1. The existing grooved pavement surface is air-blasted with dry air to remove dirt and residues

2. The epoxy resin, mixed and heated in accordance with the manufacturer’s recommendations, is uniformly hot-sprayed into the groove at a wet thickness of 20 to 25 mils.

3. Retroreflective optics are dropped onto the liquid epoxy marking so that they are uniformly distributed. Drop the retroreflective optics according to the following requirements for the option chosen:

   OPTION A – Triple Drop
   • First Drop - All-weather (AW) elements at a rate of 5 to 7 pounds per gallon
   • Second Drop - Visibead Plus II Highway Safety Marking Spheres or approved equal at a rate of 5 to 7 pounds per gallon
   • Third Drop - Standard glass beads at a rate of 5 to 7 pounds per gallon
   or

   OPTION B – Double Drop
   • First Drop - All-weather (AW) elements at a rate of 5 to 7 pounds per gallon
   • Second Drop - Visibead Plus II Highway Safety Marking Spheres or approved equal at a rate of 10 to 12 pounds per gallon

10
(e) Retroreflectance. Test dry and wet retroreflectivity in the direction of traffic on each line (left edge, skip(s), right edge) at every whole milepost. Refer to ASTM E1710 for retroreflective measurements under dry conditions and ASTM E2832 for retroreflective measurements under continuous wet conditions.

Dry retroreflectivity measurements are to be taken within a 400-foot evaluation section at every whole milepost. Average a minimum of 20 retroreflectivity readings per line within the 400-foot evaluation section. Each average for each line will be used to determine a grand average for each line for the length of the project. The grand average of each line will be used to determine compliance. Directional data will be treated independently. See Figure 1 in ASTM D7585 for an example of how to space individual readings. For dry measurements, mobile equipment can be used as a substitute for handheld equipment.

Take at least one wet retroreflectivity reading on each line at every whole milepost. The grand average for each line will be determined from the respective wet readings. The grand average of each line will be used to determine compliance. Directional data will be treated independently. Take wet readings within the same 400-foot evaluation section used to obtain dry retroreflectivity readings.

Provide reports with all dry and wet retroreflectivity readings and their averages to the Representative within 5 days after the measurements are taken.

(f) Adhesion. Test the adhesion of the highly retroreflectorized epoxy pavement markings on each line (left edge, skip(s), right edge) at every whole milepost using the test method described in ASTM D6677. The rating system described in Table 1 of ASTM D6677 shall be used to rate the adhesion. The average of these tests will be used to determine compliance. Directional data will be treated independently. Take geocoded digital photographs of each test result.

Provide reports with all adhesion tests, their averages, and geocoded digital photographs to the Representative within 5 days after the measurements are taken.

(g) Observation Period. Be responsible for any defects in materials and workmanship of the highly reflectorized epoxy pavement markings for a period of 90 days from the date the markings are applied and under traffic.

Before the end of the observation period, but at least 30 days after the pavement markings are installed, inspect the pavement marking for adhesion, color and retroreflectivity; and inform the Representative in writing of all pavement markings that have failed and require replacement. The adhesion and retroreflectivity testing are to be performed by an agreed upon third party. Provide testing results to the Representative within 5 days after the measurements are taken. The pavement marking will be considered failed for any of the following conditions:

- Insufficient thickness or line width, uneven cross-section.
- Inadequate adhesion as determined by the adhesion testing results. Averaged scores less than 6 using Table 1 rating system shown in ASTM D6677 will be considered unacceptable.
- Insufficient depth of the groove.
• Retroreflected luminance \((R_L)\) levels are below those shown in Table 1.
• Marking is discolored based on a visual inspection. Color chips provided by the manufacturer will be used to assess discoloring. The initial color of the white and yellow pavement markings shall meet the criteria established in 23 CFR 655.601 (required color criteria are included in the appendix to subpart F).

### Table 1. Minimum Required Retroreflectivity Levels

<table>
<thead>
<tr>
<th></th>
<th>WHITE</th>
<th>DRY</th>
<th>CONTINUOUS WET</th>
</tr>
</thead>
<tbody>
<tr>
<td>Entrance Angle</td>
<td>88.76°</td>
<td>88.76°</td>
<td></td>
</tr>
<tr>
<td>Observation Angle</td>
<td>1.05°</td>
<td>1.05°</td>
<td></td>
</tr>
<tr>
<td>Retroreflected Luminance (R_L) (mcd/m²/lx)</td>
<td>500</td>
<td>250</td>
<td></td>
</tr>
<tr>
<td></td>
<td>YELLOW</td>
<td>DRY</td>
<td>WET</td>
</tr>
<tr>
<td>Entrance Angle</td>
<td>88.76°</td>
<td>88.76°</td>
<td></td>
</tr>
<tr>
<td>Observation Angle</td>
<td>1.05°</td>
<td>1.05°</td>
<td></td>
</tr>
<tr>
<td>Retroreflected Luminance (R_L) (mcd/m²/lx)</td>
<td>300</td>
<td>200</td>
<td></td>
</tr>
</tbody>
</table>

Note: The test instrument shall use an Entrance Angle of 88.76° and Observation Angle of 1.05° which represent a simulated driver viewing geometry at a 30 meter distance.

(h) Defective Markings. Remove and replace highly reflectorized epoxy pavement markings, which after application and curing are determined by the Representative to be defective and not in conformance with this specification, within 30 days of receiving written notification from the Representative at no additional cost to the Commission. Work shall be in conformance with the manufacturer’s recommendations and as approved by the Representative before the project is accepted. The replacement markings shall conform to the same requirements as the original markings. Repair defective markings to the satisfaction of the Representative as follows:

• Insufficient film thickness and line width; insufficient glass bead coverage or inadequate glass bead retention; insufficient groove depth; uneven cross-section; retroreflected luminance \((R_L)\) levels below those shown in Table 1.

Repair Method: Prepare the surface of the defective highly reflectorized epoxy pavement markings by grinding or blast cleaning. No other cleaning methods are permitted. Prepare the surface so that a substantial amount of the reflective glass spheres are removed and a roughened epoxy marking surface remains. Immediately after surface preparation, remove loose particles and foreign debris by vacuuming and air blasting with compressed dry air. Re-stripe over the cleaned surface in accordance with the requirements of this specification and at full thickness.

• Uncured or discolored epoxy*; inadequate adhesion (to pavement surface or existing durable marking).

Repair Method: Completely remove the defective epoxy to the underlying pavement surface in accordance with the requirements of this specification. Remove the defective area plus any adjacent highly reflectorized epoxy pavement marking
material extending a minimum of three feet in any direction. After surface preparation work is complete, re-apply new epoxy over the cleaned pavement surface in accordance with the requirements of this specification.

*Uncured epoxy is defined as applied material that fails to cure (dry) within a reasonable time period under actual field conditions, as defined by the Representative. Discoloration is defined as localized areas or patches of brown, grayish or black colored epoxy marking material. These areas often occur in a cyclic pattern and often are not visible until several days or weeks after markings are applied.

Repair or replace other defects not noted above, but determined by the Representative to need repair, as directed by and to the satisfaction of the Representative.

(i) Emergency Repair. If the Commission determines that emergency repairs are necessary, perform the repairs within 24 hours of notification. If the Contractor fails to respond within the 24 hour period, the Commission reserves the right to perform the repairs and will charge the Contractor for all costs. The Commission’s determination of costs incurred is final and conclusive.

09.04 Measurement and Payment - Linear Foot, for the type indicated.

10.00 HIGHLY REFLECTORIZED POLYUREA PAVEMENT MARKINGS
(ITEMS: 4000-0001, 4000-0002, 4000-0003, 4000-0004, 4000-0005, 4000-0006, 4000-0007, 4000-0008, 4000-0009, 4000-0010, 4000-0011, 4000-0012, 4000-0013, 4000-0014, 4000-0015 AND 4000-0016)

10.01 Description - This work consists of furnishing and installing highly reflectorized polyurea pavement markings of the color indicated, at the locations indicated.

10.02 Material -

(a) General. Provide materials from a source listed in Bulletin 15. Certify materials as specified in Section 106.03(b)3.

(b) Polyurea Resin. Provide only those polyurea materials listed in Bulletin 15. Do not use volatile or polluting solvents and fillers.

1. Color. Furnish white and yellow pavement markings that satisfy the following chromaticity coordinates:

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th></th>
<th>2</th>
<th></th>
<th>3</th>
<th></th>
<th>4</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>x</td>
<td>0.330</td>
<td>y</td>
<td>0.370</td>
<td>x</td>
<td>0.355</td>
<td>y</td>
<td>0.345</td>
<td>x</td>
</tr>
<tr>
<td>White</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yellow</td>
<td>0.515</td>
<td>0.465</td>
<td>0.505</td>
<td>0.430</td>
<td>0.440</td>
<td>0.415</td>
<td>0.420</td>
<td>0.443</td>
</tr>
</tbody>
</table>

Furnish black polyurea that satisfies color chip 37038 of Federal Standard 595B and is equal to the quality of the white polyurea being used.

White Cap Y without beads shall measure > 90 following ASTM E1349 45/0 (0/45) with CIE D65 Illuminant and CIE 2 degree standard observer
2. No Track Time. Dry to a no-track condition in 10 minutes or less when tested according to ASTM D 711 at a temperature of 75°F ± 2°F at a thickness of 20 mils ±1 mil with glass beads applied at a rate of 20 pounds per gallon of polyurea.

(c) Optics. Apply a combination of the following to the polyurea:

- Standard Glass Beads - Section 1103.14
- Potters Visibead Plus II Highway Safety Marking Spheres or approved equal
- 3M AW 70/71 P Series elements containing microcrystalline ceramic beads. For white markings, use 3M Series AW 70P Series elements or approved equal. For yellow markings, use 3M Series AW 71P Series elements or approved equal.

(d) Black Aggregate. Furnish with the following gradations:

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>Retained (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. 20</td>
<td>17-37</td>
</tr>
<tr>
<td>No. 30</td>
<td>45-65</td>
</tr>
<tr>
<td>No. 40</td>
<td>14-25</td>
</tr>
</tbody>
</table>

10.03 Construction

(a) General. Hot apply the polyurea marking material by spray method onto clean and dry pavement surfaces at the thickness and width specified. Apply the retroreflective optics to the hot polyurea paint using either a double or triple drop system.

Line marking configurations are according to PTS-980. All lines are to be positioned 4 inches from the respective pavement joint or as otherwise indicated.

Highly reflectorized polyurea pavement markings are to be recessed in the pavement and resistant to damage and deformation by traffic and damage from snow removal equipment.

Coordinate a pre-paint meeting at least thirty (30) days prior to starting the installation of any pavement markings. At the pre-paint meeting, provide the Representative with the following:

- The source of supply for the polyurea material and the polyurea manufacturer’s written instructions for use. These instructions are to include, but not be limited to, material mixing ratios and application temperatures (for the polyurea material and the pavement surface).
- Provide test plates of the exact pavement markings to be installed. Provide 3 test plates of each color. Include a minimum 6-inch wide by 24-inch long sample of the marking on a flat and rigid substrate for each test plate. Provide the dry and wet retroreflectivity levels of each sample in accordance with (e). Provide at least one test plate of each color without beads or reflective optics.
- Procedures for cutting the grooves with diamond saw blades.
• Procedures for installing the highly retroreflectorized polyurea pavement marking in the diamond cut saw groove.
• The source of supply for all retroreflective optics.

Apply pavement markings in the direction of traffic.

Provide protection to allow adequate time for the pavement markings to dry and be track-free from vehicular traffic. This operation must be done during allowable working hours listed in Special Provision 08.00. Remove, to the satisfaction of the Representative, all tracking marks, spilled polyurea, and polyurea markings applied in unauthorized areas.

Establish marking line points at 40-foot intervals throughout the length of the pavement as directed by the Representative.

(b) Equipment. Equip the grinding equipment with a free-floating cutting or grinding head to provide a consistent groove depth over irregular pavement surfaces. Equip the grinding or cutting head with diamond saw blades. The grinding equipment must be capable of producing a final pavement surface that is flat and free of ridges.

Provide a mobile applicator that is a truck mounted, self-contained pavement marking machine, specifically designed to apply polyurea resin materials and retroreflective optics in continuous and skip line patterns. The application equipment shall be maneuverable to the extent that straight lines can be followed and normal curves can be made in true arc.

At any time throughout the duration of the project, provide free access to the polyurea application equipment for the inspection by the Representative.

Provide application equipment capable of installing a minimum of 100,000 feet of highly reflectorized polyurea pavement markings in an eight hour day and includes the following features:

• Individual tanks for the storage of Part A and Part B of the polyurea resin and for the storage of reflective glass spheres.
• Heating equipment of sufficient capacity to maintain the individual polyurea resin components at the manufacturer’s recommended temperature for spray application.
• Equipment capable of mixing Part A with Part B of the polyurea resin material to manufacturer’s recommendations.
• Retroreflective optic dispensing equipment and the capacity of applying the optics as specified.
• Metering devices or pressure gauges on the proportioning pumps, positioned to be readily visible to the Representative.
• All necessary spray equipment, mixers, compressors, and other appurtenances for the placement of highly reflectorized polyurea pavement markings in a simultaneous sequence of operations.

(c) Surface Preparation. Clean the roadway surface where the highly reflectorized polyurea pavement markings will be applied. Remove all surface treatment, laitance, curing compound, or any other contaminants that would hinder adhesion. Clear any loose dirt and other debris from the area where the highly reflectorized polyurea pavement markings will be applied with compressed dry air. Surface preparation is incidental to the application of
the highly reflectorized polyurea pavement markings. Use material and equipment that will not damage the final pavement surface and that will show the final lines on which the pavement markings will be placed. Place guide markings for all permanent pavement markings. Identify the location of the pavement markings by applying spots on the pavement at 40-foot intervals. The Representative will approve the locations.

(d) Installation. Recess the polyurea pavement markings into the existing pavement surface. This includes asphalt, concrete pavement, concrete bridge decks and interchange ramps. Diamond cut the recessed area to a depth of 80 to 100 mils and 1 inch wider than the width of the pavement marking. For skip lines, cut the recessed area 15 feet in length with a maximum tolerance of +6 inches on either end.

For dry saw blade operation, clean and remove debris and dust from the entire roadway surface by self-contained vacuuming immediately after grinding.

Wet saw blade operation is only permitted for use on concrete surfaces. When water is used, flush the groove with clean high-pressure water immediately following the cut to avoid build-up and hardening of the slurry in the groove. The concrete surface must be clean and dry before the application of the highly reflectorized polyurea pavement markings.

Properly dispose of the waste resulting from the grinding operations. Dumping of any milling or grinding waste within the Turnpike right-of-way is strictly prohibited.

Apply black polyurea markings on cement concrete roadways. Recess the black markings, flooded with black aggregate, immediately after all white skip line patterns. Cut the recessed area 25 feet in length with a maximum tolerance of +6 inches on either end. The line dimensions are 15’ for white and 10’ for black.

The use of temporary shadow lines within the recessed area is prohibited.

Do not begin marking operations until surface preparation work is completed and approved by the Representative. Install polyurea on dry pavement only if the road surface and ambient temperatures are 32°F or higher unless otherwise approved by the Representative and acceptable to the manufacturer.

Apply pavement markings by the following simultaneous operation:

1. The grooved pavement surface is air-blasted with dry air to remove dirt and residues

2. The polyurea resin, mixed and heated in accordance with the manufacturer’s recommendations, is uniformly hot-sprayed into the groove at a wet thickness of 20 to 25 mils.

3. Retroreflective optics are dropped onto the liquid polyurea marking so that they are uniformly distributed. Drop the retroreflective optics according to the following requirements for the option chosen:

   OPTION A – Triple Drop

   • First Drop - All-weather (AW) elements at a rate of 5 to 7 pounds per gallon
• Second Drop - Visibead Plus II Highway Safety Marking Spheres or approved equal at a rate of 5 to 7 pounds per gallon
• Third Drop - Standard glass beads at a rate of 5 to 7 pounds per gallon

or

OPTION B – Double Drop

• First Drop - All-weather (AW) elements at a rate of 5 to 7 pounds per gallon
• Second Drop - Visibead Plus II Highway Safety Marking Spheres or approved equal at a rate of 10 to 12 pounds per gallon

(c) Retroreflectance. Test dry and wet retroreflectivity in the direction of traffic on each line (left edge, skip(s), right edge) at every whole milepost. Refer to ASTM E1710 for retroreflective measurements under dry conditions and ASTM E2832 for retroreflective measurements under continuous wet conditions.

Dry retroreflectivity measurements are to be taken within a 400-foot evaluation section at every whole milepost. Average a minimum of 20 retroreflectivity readings per line within the 400-foot evaluation section. Each average for each line will be used to determine a grand average for each line for the length of the project. The grand average of each line will be used to determine compliance. Directional data will be treated independently. See Figure 1 in ASTM D7585 for an example of how to space individual readings. For dry measurements, mobile equipment can be used as a substitute for handheld equipment.

Take at least one wet retroreflectivity reading on each line at every whole milepost. The grand average for each line will be determined from the respective wet readings. The grand average of each line will be used to determine compliance. Directional data will be treated independently. Take wet readings within the same 400-foot evaluation section used to obtain dry retroreflectivity readings.

Provide reports with all dry and wet retroreflectivity readings and their averages to the Representative within 5 days after the measurements are taken.

(f) Adhesion. Test the adhesion of the highly retroreflectorized polyurea pavement markings on each line (left edge, skip(s), right edge) at every whole milepost using the test method described in ASTM D6677. The rating system described in Table 1 of ASTM D6677 shall be used to rate the adhesion. The average of these tests will be used to determine compliance. Directional data will be treated independently. Take geocoded digital photographs of each test result.

Provide reports with all adhesion tests, their averages, and geocoded digital photographs to the Representative within 5 days after the measurements are taken.

(g) Observation Period. Be responsible for any defects in materials and workmanship of the highly reflectorized polyurea pavement markings for a period of 90 days from the date the markings are applied and under traffic.

Before the end of the observation period, but at least 30 days after the pavement markings
are installed, inspect the pavement marking for adhesion, color and retroreflectivity; and inform the Representative in writing of all pavement markings that have failed and require replacement. The adhesion and retroreflectivity testing are to be performed by an agreed upon third party. Provide testing results to the Representative within 5 days after the measurements are taken. The pavement marking will be considered failed for any of the following conditions:

- Insufficient thickness or line width, uneven cross-section.
- Inadequate adhesion as determined by the adhesion testing results. Averaged scores less than 6 using Table 1 rating system shown in ASTM D6677 will be considered unacceptable.
- Insufficient depth of the groove.
- Retroreflected luminance (RL) levels are below those shown in Table 1.
- Marking is discolored based on a visual inspection. Color chips provided by the manufacturer will be used to assess discoloring. The initial color of the white and yellow pavement markings shall meet the criteria established in 23 CFR 655.601 (required color criteria are included in the appendix to subpart F).

### Table 1. Minimum Required Retroreflectivity Levels

<table>
<thead>
<tr>
<th></th>
<th>WHITE DRY</th>
<th>CONTINUOUS WET</th>
</tr>
</thead>
<tbody>
<tr>
<td>Entrance Angle</td>
<td>88.76°</td>
<td>88.76°</td>
</tr>
<tr>
<td>Observation Angle</td>
<td>1.05°</td>
<td>1.05°</td>
</tr>
<tr>
<td>Retroreflected Luminance</td>
<td>500</td>
<td>250</td>
</tr>
<tr>
<td>Yellow DRY</td>
<td>WET</td>
<td></td>
</tr>
<tr>
<td>Entrance Angle</td>
<td>88.76°</td>
<td>88.76°</td>
</tr>
<tr>
<td>Observation Angle</td>
<td>1.05°</td>
<td>1.05°</td>
</tr>
<tr>
<td>Retroreflected Luminance</td>
<td>300</td>
<td>200</td>
</tr>
</tbody>
</table>

Note: The test instrument shall use an Entrance Angle of 88.76° and Observation Angle of 1.05° which represent a simulated driver viewing geometry at a 30 meter distance.

(h) Defective Markings. Remove and replace highly reflectorized polyurea pavement markings, which after application and curing are determined by the Representative to be defective and not in conformance with this specification, within 30 days of receiving written notification from the Representative at no additional cost to the Commission. Work shall be in conformance with the manufacturer’s recommendations and as approved by the Representative before the project is accepted. The replacement markings shall conform to the same requirements as the original markings. Repair defective markings to the satisfaction of the Representative as follows:

- Insufficient film thickness and line width; insufficient glass bead coverage or inadequate glass bead retention; insufficient groove depth; uneven cross-section; retroreflected luminance (RL) levels below those shown in Table 1.

**Repair Method:** Prepare the surface of the defective highly reflectorized polyurea pavement markings by grinding or blast cleaning. No other cleaning methods are
permitted. Prepare the surface so that a substantial amount of the reflective glass spheres are removed and a roughened polyurea marking surface remains. Immediately after surface preparation, remove loose particles and foreign debris by vacuuming and air blasting with compressed dry air. Re-stripe over the cleaned surface in accordance with the requirements of this specification and at full thickness.

- Uncured or discolored polyurea*; inadequate adhesion (to pavement surface or existing durable marking).

Repair Method: Completely remove the defective polyurea to the underlying pavement surface in accordance with the requirements of this specification. Remove the defective area plus any adjacent highly reflectorized polyurea pavement marking material extending a minimum of three feet in any direction. After surface preparation work is complete, re-apply new polyurea over the cleaned pavement surface in accordance with the requirements of this specification.

*Uncured polyurea is defined as applied material that fails to cure (dry) within a reasonable time period under actual field conditions, as defined by the Representative. Discoloration is defined as localized areas or patches of brown, grayish or black colored polyurea marking material. These areas often occur in a cyclic pattern and often are not visible until several days or weeks after markings are applied.

Repair or replace other defects not noted above, but determined by the Representative to need repair, as directed by and to the satisfaction of the Representative.

(i) Emergency Repair. If the Commission determines that emergency repairs are necessary, perform the repairs within 24 hours of notification. If the Contractor fails to respond within the 24 hour period, the Commission reserves the right to perform the repairs and will charge the Contractor for all costs. The Commission’s determination of costs incurred is final and conclusive.

10.04 Measurement and Payment - Linear Foot, for the type indicated.

11.00 REAPPLICATION OF HIGHLY REFLECTORIZED POLYUREA PAVEMENT MARKINGS

(ITEMS: 4000-0017, 4000-0018, 4000-0019, 4000-0020, 4000-0021, 4000-0022, 4000-0023, 4000-0024, 4000-0025, 4000-0026, 4000-0027, 4000-0028, 4000-0029, 4000-0030, 4000-0031 AND 4000-0032)

11.01 Description - This work consists of furnishing and installing highly reflectorized polyurea pavement markings of the color indicated, at the existing locations of the highly reflectorized polyurea pavement markings.

11.02 Material -

(a) General. Provide materials from a source listed in Bulletin 15. Certify materials as specified in Section 106.03(b)3.

(b) Polyurea Resin. Provide only those polyurea materials listed in Bulletin 15. Do not use volatile or polluting solvents and fillers.
1. Color. Furnish white and yellow pavement markings that satisfy the following chromaticity coordinates:

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>White</td>
<td>0.330</td>
<td>0.370</td>
<td>0.355</td>
<td>0.345</td>
</tr>
<tr>
<td>Yellow</td>
<td>0.515</td>
<td>0.465</td>
<td>0.505</td>
<td>0.430</td>
</tr>
</tbody>
</table>

Furnish black polyurea that satisfies color chip 37038 of Federal Standard 595B and is equal to the quality of the white polyurea being used.

White Cap Y without beads shall measure > 90 following ASTM E1349 45/0 (0/45) with CIE D65 Illuminant and CIE 2 degree standard observer.

Yellow Cap Y without beads shall measure between 52 and 60 following ASTM E1349 45/0 (0/45) with CIE D65 Illuminant and CIE 2 degree standard observer.

2. No Track Time. Dry to a no-track condition in 10 minutes or less when tested according to ASTM D 711 at a temperature of 75°F ± 2°F at a thickness of 20 mils ±1 mil with glass beads applied at a rate of 20 pounds per gallon of polyurea.

(c) Optics. Apply a combination of the following to the polyurea:

- Standard Glass Beads - Section 1103.14
- Potters Visibead Plus II Highway Safety Marking Spheres or approved equal
- 3M AW 70/71 P Series elements containing microcrystalline ceramic beads. For white markings, use 3M Series AW 70P Series elements or approved equal. For yellow markings, use 3M Series AW 71P Series elements or approved equal.

(d) Black Aggregate. Furnish with the following gradations:

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>Retained (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. 20</td>
<td>17-37</td>
</tr>
<tr>
<td>No. 30</td>
<td>45-65</td>
</tr>
<tr>
<td>No. 40</td>
<td>14-25</td>
</tr>
</tbody>
</table>

11.03 Construction -

(a) General. Hot apply the polyurea marking material by spray method onto clean and dry roughened polyurea pavement marking surface at the thickness and width specified. Apply the retroreflective optics to the hot polyurea paint using either a double or triple drop system.

Line marking configurations are according to PTS-980. All lines are to be positioned 4 inches from the respective pavement joint in the existing groove.

Highly reflectorized polyurea pavement markings are to be recessed in the pavement and resistant to damage and deformation by traffic and damage from snow removal equipment.
Coordinate a pre-paint meeting at least thirty (30) days prior to starting the installation of any pavement markings. At the pre-paint meeting, provide the Representative with the following:

- The source of supply for the polyurea material and the polyurea manufacturer’s written instructions for use. These instructions are to include, but not be limited to, material mixing ratios and application temperatures (for the polyurea material and the pavement surface).
- Provide test plates of the exact pavement markings to be installed. Provide 3 test plates of each color. Include a minimum 6-inch wide by 24-inch long sample of the marking on a flat and rigid substrate for each test plate. Provide the dry and wet retroreflectivity levels of each sample in accordance with (e). Provide at least one test plate of each color without beads or reflective optics.
- Procedures for installing the highly retroreflectorized polyurea pavement marking in the existing groove.
- The source of supply for all retroreflective optics.

Apply pavement markings in the direction of traffic.

Provide protection to allow adequate time for the pavement markings to dry and be track-free from vehicular traffic. This operation must be done during allowable working hours listed in Special Provision 08.00. Remove, to the satisfaction of the Representative, all tracking marks, spilled polyurea, and polyurea markings applied in unauthorized areas.

Establish marking line points at 40-foot intervals throughout the length of the pavement as directed by the Representative.

(b) Equipment. Provide a mobile applicator that is a truck mounted, self-contained pavement marking machine, specifically designed to apply polyurea resin materials and retroreflective optics in continuous and skip line patterns. The application equipment shall be maneuverable to the extent that straight lines can be followed and normal curves can be made in true arc.

At any time throughout the duration of the project, provide free access to the polyurea application equipment for the inspection by the Representative.

Provide application equipment capable of installing a minimum of 100,000 feet of highly reflectorized polyurea pavement markings in an eight hour day and includes the following features:

- Individual tanks for the storage of Part A and Part B of the polyurea resin and for the storage of reflective glass spheres.
- Heating equipment of sufficient capacity to maintain the individual polyurea resin components at the manufacturer’s recommended temperature for spray application.
- Equipment capable of mixing Part A with Part B of the polyurea resin material to manufacturer’s recommendations.
- Retroreflective optic dispensing equipment and the capacity of applying the optics as specified.
- Metering devices or pressure gauges on the proportioning pumps, positioned to be
readily visible to the Representative.

- All necessary spray equipment, mixers, compressors, and other appurtenances for the placement of highly reflectorized polyurea pavement markings in a simultaneous sequence of operations.

(c) Surface Preparation. Refer to Special Provision 14.00.

(d) Installation. Recess the polyurea pavement markings into the existing recessed groove.

Apply black polyurea markings on cement concrete roadways. Recess the black markings, flooded with black aggregate, immediately after all white skip line patterns. Cut the recessed area 25 feet in length with a maximum tolerance of +6 inches on either end. The line dimensions are 15’ for white and 10’ for black.

The use of temporary shadow lines within the recessed area is prohibited.

Do not begin marking operations until surface preparation work is completed and approved by the Representative. Install polyurea on dry pavement only if the road surface and ambient temperatures are 32°F or higher unless otherwise approved by the Representative and acceptable to the manufacturer.

Apply pavement markings by the following simultaneous operation:

1. The existing grooved pavement surface is air-blasted with dry air to remove dirt and residues

2. The polyurea resin, mixed and heated in accordance with the manufacturer’s recommendations, is uniformly hot-sprayed into the groove at a wet thickness of 20 to 25 mils.

3. Retroreflective optics are dropped onto the liquid polyurea marking so that they are uniformly distributed. Drop the retroreflective optics according to the following requirements for the option chosen:

   OPTION A – Triple Drop

   - First Drop - All-weather (AW) elements at a rate of 5 to 7 pounds per gallon
   - Second Drop - Visibead Plus II Highway Safety Marking Spheres or approved equal at a rate of 5 to 7 pounds per gallon
   - Third Drop - Standard glass beads at a rate of 5 to 7 pounds per gallon

   or

   OPTION B – Double Drop

   - First Drop - All-weather (AW) elements at a rate of 5 to 7 pounds per gallon
   - Second Drop - Visibead Plus II Highway Safety Marking Spheres or approved equal at a rate of 10 to 12 pounds per gallon

(e) Retroreflectance. Test dry and wet retroreflectivity in the direction of traffic on each line
(left edge, skip(s), right edge) at every whole milepost. Refer to ASTM E1710 for retroreflective measurements under dry conditions and ASTM E2832 for retroreflective measurements under continuous wet conditions.

Dry retroreflectivity measurements are to be taken within a 400-foot evaluation section at every whole milepost. Average a minimum of 20 retroreflectivity readings per line within the 400-foot evaluation section. Each average for each line will be used to determine a grand average for each line for the length of the project. The grand average of each line will be used to determine compliance. Directional data will be treated independently. See Figure 1 in ASTM D7585 for an example of how to space individual readings. For dry measurements, mobile equipment can be used as a substitute for handheld equipment.

Take at least one wet retroreflectivity reading on each line at every whole milepost. The grand average for each line will be determined from the respective wet readings. The grand average of each line will be used to determine compliance. Directional data will be treated independently. Take wet readings within the same 400-foot evaluation section used to obtain dry retroreflectivity readings.

Provide reports with all dry and wet retroreflectivity readings and their averages to the Representative within 5 days after the measurements are taken.

(f) Adhesion. Test the adhesion of the highly retroreflectorized polyurea pavement markings on each line (left edge, skip(s), right edge) at every whole milepost using the test method described in ASTM D6677. The rating system described in Table 1 of ASTM D6677 shall be used to rate the adhesion. The average of these tests will be used to determine compliance. Directional data will be treated independently. Take geocoded digital photographs of each test result.

Provide reports with all adhesion tests, their averages, and geocoded digital photographs to the Representative within 5 days after the measurements are taken.

(g) Observation Period. Be responsible for any defects in materials and workmanship of the highly reflectorized polyurea pavement markings for a period of 90 days from the date the markings are applied and under traffic.

Before the end of the observation period, but at least 30 days after the pavement markings are installed, inspect the pavement marking for adhesion, color and retroreflectivity; and inform the Representative in writing of all pavement markings that have failed and require replacement. The adhesion and retroreflectivity testing are to be performed by an agreed upon third party. Provide testing results to the Representative within 5 days after the measurements are taken. The pavement marking will be considered failed for any of the following conditions:

- Insufficient thickness or line width, uneven cross-section.
- Inadequate adhesion as determined by the adhesion testing results. Averaged scores less than 6 using Table 1 rating system shown in ASTM D6677 will be considered unacceptable.
- Retroreflected luminance ($R_L$) levels are below those shown in Table 1.
- Marking is discolored based on a visual inspection. Color chips provided by the
manufacturer will be used to assess discoloring. The initial color of the white and yellow pavement markings shall meet the criteria established in 23 CFR 655.601 (required color criteria are included in the appendix to subpart F).

Table 1. Minimum Required Retroreflectivity Levels

<table>
<thead>
<tr>
<th></th>
<th>WHITE</th>
<th>DRY</th>
<th>CONTINUOUS WET</th>
</tr>
</thead>
<tbody>
<tr>
<td>Entrance Angle</td>
<td>88.76°</td>
<td>88.76°</td>
<td></td>
</tr>
<tr>
<td>Observation Angle</td>
<td>1.05°</td>
<td>1.05°</td>
<td></td>
</tr>
<tr>
<td>Retroreflected Luminance R_l (mcd/m²/lx)</td>
<td>500</td>
<td>250</td>
<td></td>
</tr>
</tbody>
</table>

Note: The test instrument shall use an Entrance Angle of 88.76° and Observation Angle of 1.05° which represent a simulated driver viewing geometry at a 30 meter distance.

(h) Defective Markings. Remove and replace highly reflectorized polyurea pavement markings, which after application and curing are determined by the Representative to be defective and not in conformance with this specification, within 30 days of receiving written notification from the Representative at no additional cost to the Commission. Work shall be in conformance with the manufacturer’s recommendations and as approved by the Representative before the project is accepted. The replacement markings shall conform to the same requirements as the original markings. Repair defective markings to the satisfaction of the Representative as follows:

- Insufficient film thickness and line width; insufficient glass bead coverage or inadequate glass bead retention; uneven cross-section; retroreflected luminance (R_l) levels below those shown in Table 1.

  Repair Method: Prepare the surface of the defective highly reflectorized polyurea pavement markings by grinding or blast cleaning. No other cleaning methods are permitted. Prepare the surface so that a substantial amount of the reflective glass spheres are removed and a roughened polyurea marking surface remains. Immediately after surface preparation, remove loose particles and foreign debris by vacuuming and air blasting with compressed dry air. Re-stripe over the cleaned surface in accordance with the requirements of this specification and at full thickness.

- Uncured or discolored polyurea*; inadequate adhesion (to pavement surface or existing durable marking).

  Repair Method: Completely remove the defective polyurea to the underlying pavement surface in accordance with the requirements of this specification. Remove the defective area plus any adjacent highly reflectorized polyurea pavement marking material extending a minimum of three feet in any direction. After surface preparation work is complete, re-apply new polyurea over the cleaned pavement.
surface in accordance with the requirements of this specification.

*Uncured polyurea is defined as applied material that fails to cure (dry) within a reasonable time period under actual field conditions, as defined by the Representative. Discoloration is defined as localized areas or patches of brown, grayish or black colored polyurea marking material. These areas often occur in a cyclic pattern and often are not visible until several days or weeks after markings are applied.

Repair or replace other defects not noted above, but determined by the Representative to need repair, as directed by and to the satisfaction of the Representative.

(i) Emergency Repair. If the Commission determines that emergency repairs are necessary, perform the repairs within 24 hours of notification. If the Contractor fails to respond within the 24 hour period, the Commission reserves the right to perform the repairs and will charge the Contractor for all costs. The Commission’s determination of costs incurred is final and conclusive.

11.04 Measurement and Payment - Linear Foot, for the type indicated.

12.00 PERMANENT PREFORMED PATTERNED REFLECTIVE PAVEMENT MARKINGS (ITEMS: 4000-0033, 4000-0034, 4000-0035, 4000-0036, 4000-0037, 4000-0038, 4000-0039, 4000-0040, 4000-0041, 4000-0042, 4000-0043 AND 4000-0044)

12.01 Description - This work consists of furnishing, installing and warranting permanent preformed patterned reflective pavement (PPRP) markings as specified in the Contract Documents and as directed by the Representative. These markings shall be warranted in writing by the manufacturer for a period of five years from the date of the end of the observation period.

12.02 Material –

(a) Permanent Preformed Patterned Reflective Pavement Marking. 3M™ Stamark™ High Performance All Weather Tape Series 380AW & 381AW distributed by:

3M Traffic Control Materials Division
3M Center, Building 582-1-15
St. Paul MN 55144-0100
(800) 553-1380

or an approved equal.

12.03 Construction – Apply the PPRP markings according to the manufacturer’s installation instructions and as directed by the Representative. Line marking configurations are according to PTS-980. All lines are to be positioned 4 inches from the respective pavement joint or as otherwise indicated.

(a) Equipment: Equip the grinding equipment with a free-floating cutting or grinding head to provide a consistent groove depth over irregular pavement surfaces. Equip the grinding or cutting head with diamond saw blades. The grinding equipment must be capable of producing a final pavement surface that is flat and free of ridges. For dry saw blade operation, clean and remove debris and dust from the entire roadway
surface by self-contained vacuuming immediately after grinding.

Wet saw blade operation is only permitted for use on concrete surfaces. When water is used, flush the groove with clean high-pressure water immediately following the cut to avoid build-up and hardening of the slurry in the groove. The concrete surface must be clean and dry before the installation of the PPPRP markings.

Properly dispose of the waste resulting from the grinding operations. Dumping of any milling or grinding waste within the Turnpike right-of-way is strictly prohibited.

At any time throughout the duration of the project, provide free access to the PPPRP application equipment for the inspection by the Representative.

(b) Manufacturer’s Recommendations. Provide a copy of the manufacturer’s recommendations to the Representative at least thirty (30) days prior to starting the installation of any pavement markings.

(c) Manufacturer’s Certification. Provide a notarized copy of the manufacturer’s certification including the material’s date of manufacture and National Transportation Product Evaluation Program (NTPEP) code number.

(d) Surface Preparation: Clean the roadway surface where the PPPRP markings will be applied. Remove all surface treatment, laitance, curing compound, or any other contaminants that would hinder adhesion. Clear any loose dirt and other debris from the area where the PPPRP markings will be applied with compressed dry air. Surface preparation is incidental to the application of the PPPRP markings. Use material and equipment that will not damage the final pavement surface and that will show the final lines on which the pavement markings will be placed. Place guide markings for all permanent pavement markings. Identify the location of the pavement markings by applying guide markings on the pavement at 40-foot intervals. The Representative will approve the locations.

(e) Installation: Recess the PPPRP markings into the existing pavement surface. This includes asphalt, concrete pavement, concrete bridge decks and interchange ramps. Diamond cut the recessed area to a depth of 120 mils and 1 inch wider than the width of the pavement marking. For skip lines, cut the recessed area 15 feet in length with a maximum tolerance of +6 inches on either end.

Marking operations shall not begin until applicable surface preparation work is completed and approved by the Representative, and the atmospheric conditions and pavement surface temperature is within the tolerances set by the manufacturer and is acceptable to the Representative.

PPPRP markings are to be recessed in the pavement and be resistant to deformation by traffic and damage from snow removal equipment.

Apply PPPRP markings in the direction of traffic.

Establish marking line points at 40 foot intervals throughout the length of the pavement as directed by the Representative.
Apply PPPRP markings by the following simultaneous operation:

1. The grooved pavement surface is air-blasted with dry air to remove dirt and residues.

2. Apply PPPRP markings in the groove following the manufacturer’s detailed recommendations.

3. Tamp the PPPRP markings thoroughly with a minimum of six (6) passes (three passes forward and three passes back) over the surface of the new PPPRP markings in the groove.

(f) Tamping: Tamp the PPPRP markings thoroughly with a minimum of six (6) passes (three passes forward and three passes back) over the surface of the new PPPRP markings in the groove. Use a tamper cart with a minimum 200-pound load or a vehicle tire as recommended by the manufacturer.

PPPRP marking application in the groove will require tamping with a tamper cart roller cut to fit in the groove. Tamping the edges of the PPPRP markings is very important. Use a modified tamper cart roller if necessary. Use of a vehicle tire to tamp a long line application of PPPRP marking is acceptable provided the vehicle is recommended by the manufacturer and acceptable to the Representative. When using the tamper cart do not twist or turn the tamper cart on the PPPRP markings and make sure all edges are firmly adhered.

(g) Retroreflectance. Test dry and wet retroreflectivity in the direction of traffic on each line (left edge, skip(s), right edge) at every whole milepost. Refer to ASTM E1710 for retroreflective measurements under dry conditions and ASTM E2832 for retroreflective measurements under continuous wet conditions.

Dry retroreflectivity measurements are to be taken within a 400-foot evaluation section at every whole milepost. Average a minimum of 20 retroreflectivity readings per line within the 400-foot evaluation section. Each average for each line will be used to determine a grand average for each line for the length of the project. The grand average of each line will be used to determine compliance. Directional data will be treated independently. See Figure 1 in ASTM D7585 for an example of how to space individual readings. For dry measurements, mobile equipment can be used as a substitute for handheld equipment.

Take at least one wet retroreflectivity reading on each line at every whole milepost. The grand average for each line will be determined from the respective wet readings. The grand average of each line will be used to determine compliance. Directional data will be treated independently. Take wet readings within the same 400-foot evaluation section used to obtain dry retroreflectivity readings.

Provide reports with all dry and wet retroreflectivity readings and their averages to the Representative within 5 days after the measurements are taken.

(h) Adherence. Test the adhesion of the PPPRP markings on each line (left edge, skip(s), right edge) at every whole milepost using a paint scraper or other approved tool, held parallel with the highway surface. The edge of the material shall be scraped lightly and there shall be no dislodging of the PPPRP markings. Notify the Representative to witness
this procedure. Directional data will be treated independently.

(i) Observation Period. Be responsible for any defects in materials and workmanship of the PPPRP markings for a period of 90 days from the date the markings are applied and under traffic.

Before the end of the observation period, but at least 30 days after the pavement markings are installed, inspect the pavement markings for adhesion, color and retroreflectivity; and inform the Representative in writing of all pavement markings that have failed and require replacement. The adhesion and retroreflectivity testing are to be performed by an agreed upon third party. Provide testing results to the Representative within 5 days after the measurements are taken. The pavement marking will be considered failed for any of the following conditions:

- The substrate is exposed in any section of longitudinal pavement marking line.
- Inadequate adhesion or delamination as determined by the adhesion testing results.
- Insufficient depth of the groove.
- Retroreflected luminance (R<sub>L</sub>) levels are below those shown in Table 1.
- Marking is discolored based on a visual inspection. Color chips provided by the manufacturer will be used to assess discoloring.

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<td>Retroreflected Luminance R&lt;sub&gt;L&lt;/sub&gt; (mcd/m&lt;sup&gt;2&lt;/sup&gt;/lx)</td>
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</table>

| **YELLOW** | **DRY** | **WET** |
| Entrance Angle | 88.76° | 88.76° |
| Observation Angle | 1.05° | 1.05° |
| Retroreflected Luminance R<sub>L</sub> (mcd/m<sup>2</sup>/lx) | 300 | 200 |

Note: The test instrument shall use an Entrance Angle of 88.76° and Observation Angle of 1.05° which represent a simulated driver viewing geometry at a 30 meter distance.

(j) Defective Markings. Remove and replace PPPRP markings, which after installation are determined by the Representative to be defective and not in conformance with this specification, within 30 days of receiving written notification from the Representative at no additional cost to the Commission. Work shall be in conformance with the manufacturer’s recommendations and as approved by the Representative before the project is accepted. The replacement markings shall conform to the same requirements as the original markings. Repair defective markings to the satisfaction of the Representative as follows:

- Insufficient line width or exposed substrate; poor adhesion or delamination; insufficient groove depth; retroreflected luminance (R<sub>L</sub>) levels below those shown in Table 1; discoloration.
Repair Method: Prepare the surface of the defective PPPRP markings by grinding or blast cleaning. No other cleaning methods are permitted. Prepare the surface so that all of the defective PPPRP markings are removed and a clean surface remains. Immediately after surface preparation, remove loose particles and foreign debris by vacuuming and air blasting with compressed dry air. Re-install PPPRP markings on the cleaned surface in accordance with the requirements of this specification.

Repair or replace other defects not noted above, but determined by the Representative to need repair, as directed by and to the satisfaction of the Representative.

(k) Warranty. Provide the Commission with a written five year warranty for the PPPRP markings. The written warranty is to include but is not limited to agreement to the conditions in (i). The five year period begins at the conclusion of the observation period. The warranty shall cover the pavement marking materials, the work to replace the markings when necessary, and the cost to provide maintenance and protection of traffic during the reinstallation.

The manufacturer is to warrant PPPRP markings used will remain effective for its intended use and will meet the minimum retained coefficient of dry retroreflection value of 100 mcd/m²/lx (in accordance with ASTM D4061).

If the pavement markings are applied in accordance with the manufacturer’s application recommendations and fail by any one of the following during the warranty period:

1. Retroreflectance values drop below the minimum retained coefficient of dry retroreflection value of 100 mcd/m²/lx.
2. Failure to completely adhere to the roadway.
3. Failure due to complete wear-through.

The manufacturer will provide and install the replacement materials that will restore the pavement marking retroreflectivity values to warranty levels or greater for failure areas.

The manufacturer will provide the Commission with full reimbursement for contract cost of initial installation of the PPPRP markings and reimbursement of line painting of 2 applications per year for the remainder of the warranty period for failure areas.

(l) Emergency Repair. If the Commission determines that emergency repairs are necessary, the manufacturer shall perform the repairs within 24 hours of notification. If the manufacturer fails to respond within the 24 hour period, the Commission reserves the right to perform the repairs and will charge the manufacturer for all costs. The Commission’s determination of costs incurred is final and conclusive.

(m) Warranty Retroreflectance Measurement Procedures.

1. The manufacturer is to provide a yearly inspection measuring retroreflectance values under dry conditions in accordance with the testing procedures of ASTM D4061. Provide the measurement results to the Commission within 1 week of the inspection.
2. Routine visual inspections will be performed by Commission personnel to monitor
the quality of the markings. Areas that appear to be below the minimum retained retroreflectance value will be identified for further investigation.

3. Areas that appear to be below the minimum retained retroreflectance value will be jointly reviewed by the manufacturer and the Commission visually at night within 30 days notification.

4. When retroreflectivity measurements become necessary to confirm failures, readings will be taken by the manufacturer in conformance with ASTM D4061. When retroreflectivity is below accepted values, the manufacturer shall replace the markings.

5. Manufacturer is to provide a contact person to the Commission. The contact person for the Commission is the Manager of Traffic Engineering. Provide a minimum of 2 weeks advance notice prior to performing any retroreflectance measurements.

12.04 **Measurement and Payment** – Linear Foot.

13.00 **REAPPLICATION OF PERMANENT PREFORMED PATTERNED REFLECTIVE PAVEMENT MARKING**

(ITEMS: 4000-0045, 4000-0046, 4000-0047, 4000-0048, 4000-0049, 4000-0050, 4000-0051, 4000-0052, 4000-0053, 4000-0054, 4000-0055 AND 4000-0056)

13.01 **Description** - This work consists of furnishing, installing and warranting permanent preformed patterned reflective pavement (PPPRP) markings at the existing locations of the permanent preformed patterned reflective pavement markings. These markings shall be warranted in writing by the manufacturer for a period of five years from the date of the end of the observation period.

13.02 **Material** –

(a) Permanent Preformed Patterned Reflective Pavement Marking. 3M™ Stamark™ High Performance All Weather Tape Series 380AW & 381AW distributed by:

3M Traffic Control Materials Division
3M Center, Building 582-1-15
St. Paul MN 55144-0100
(800) 553-1380

or an approved equal.

13.03 **Construction** – Apply the PPPRP markings according to the manufacturer’s installation instructions and as directed by the Representative. Line marking configurations are according to PTS-980. All lines are to be positioned 4 inches from the respective pavement joint in the existing groove.

(a) Equipment: At any time throughout the duration of the project, provide free access to the PPPRP application equipment for the inspection by the Representative.

(b) Manufacturer’s Recommendations. Provide a copy of the manufacturer’s recommendations to the Representative at least thirty (30) days prior to starting the installation of any pavement markings.
(c) Manufacturer’s Certification. Provide a notarized copy of the manufacturer’s certification including the material’s date of manufacture and National Transportation Product Evaluation Program (NTPEP) code number.

(d) Surface Preparation: Refer to Special Provision 14.00.

(e) Installation: Recess the PPPRP markings into the existing recessed groove.

Marking operations shall not begin until applicable surface preparation work is completed and approved by the Representative, and the atmospheric conditions and pavement surface temperature is within the tolerances set by the manufacturer and is acceptable to the Representative.

PPPRP markings are to be recessed in the pavement and be resistant to deformation by traffic and damage from snow removal equipment.

Apply PPPRP markings in the direction of traffic.

Establish marking line points at 40 foot intervals throughout the length of the pavement as directed by the Representative.

Apply PPPRP markings by the following simultaneous operation:

1. The existing grooved pavement surface is air-blasted with dry air to remove dirt and residues.

2. Apply PPPRP markings in the existing groove following the manufacturer’s detailed recommendations.

3. Tamp the PPPRP markings thoroughly with a minimum of six (6) passes (three passes forward and three passes back) over the surface of the new PPPRP markings in the groove.

(f) Tamping: Tamp the PPPRP markings thoroughly with a minimum of six (6) passes (three passes forward and three passes back) over the surface of the new PPPRP markings in the groove. Use a tamper cart with a minimum 200-pound load or a vehicle tire as recommended by the manufacturer.

PPPRP marking application in the groove will require tamping with a tamper cart roller cut to fit in the groove. Tamping the edges of the PPPRP markings is very important. Use a modified tamper cart roller if necessary. Use of a vehicle tire to tamp a long line application of PPPRP marking is acceptable provided the vehicle is recommended by the manufacturer and acceptable to the Representative. When using the tamper cart do not twist or turn the tamper cart on the PPPRP markings and make sure all edges are firmly adhered.

(g) Retroreflectance. Test dry and wet retroreflectivity in the direction of traffic on each line (left edge, skip(s), right edge) at every whole milepost. Refer to ASTM E1710 for retroreflective measurements under dry conditions and ASTM E2832 for retroreflective measurements under continuous wet conditions.

Dry retroreflectivity measurements are to be taken within a 400-foot evaluation section at
every whole milepost. Average a minimum of 20 retroreflectivity readings per line within the 400-foot evaluation section. Each average for each line will be used to determine a grand average for each line for the length of the project. The grand average of each line will be used to determine compliance. Directional data will be treated independently. See Figure 1 in ASTM D7585 for an example of how to space individual readings. For dry measurements, mobile equipment can be used as a substitute for handheld equipment.

Take at least one wet retroreflectivity reading on each line at every whole milepost. The grand average for each line will be determined from the respective wet readings. The grand average of each line will be used to determine compliance. Directional data will be treated independently. Take wet readings within the same 400-foot evaluation section used to obtain dry retroreflectivity readings.

Provide reports with all dry and wet retroreflectivity readings and their averages to the Representative within 5 days after the measurements are taken.

(h) Adherence. Test the adhesion of the PPPRP markings on each line (left edge, skip(s), right edge) at every whole milepost using a paint scraper or other approved tool, held parallel with the highway surface. The edge of the material shall be scraped lightly and there shall be no dislodging of the PPPRP markings. Notify the Representative to witness this procedure. Directional data will be treated independently.

(i) Observation Period. Be responsible for any defects in materials and workmanship of the PPPRP markings for a period of 90 days from the date the markings are applied and under traffic.

Before the end of the observation period, but at least 30 days after the pavement markings are installed, inspect the pavement markings for adhesion, color and retroreflectivity; and inform the Representative in writing of all pavement markings that have failed and require replacement. The adhesion and retroreflectivity testing are to be performed by an agreed upon third party. Provide testing results to the Representative within 5 days after the measurements are taken. The pavement marking will be considered failed for any of the following conditions:

- The substrate is exposed in any section of longitudinal pavement marking line.
- Inadequate adhesion or delamination as determined by the adhesion testing results.
- Insufficient depth of the groove.
- Retroreflected luminance ($R_L$) levels are below those shown in Table 1.
- Marking is discolored based on a visual inspection. Color chips provided by the manufacturer will be used to assess discoloring.

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Note: The test instrument shall use an Entrance Angle of 88.76° and Observation Angle of 1.05° which represent a simulated driver viewing geometry at a 30 meter distance.

(j) Defective Markings. Remove and replace PPPRP markings, which after installation are determined by the Representative to be defective and not in conformance with this specification, within 30 days of receiving written notification from the Representative at no additional cost to the Commission. Work shall be in conformance with the manufacturer’s recommendations and as approved by the Representative before the project is accepted. The replacement markings shall conform to the same requirements as the original markings. Repair defective markings to the satisfaction of the Representative as follows:

- Insufficient line width or exposed substrate; poor adhesion or delamination; insufficient groove depth; retroreflected luminance ($R_L$) levels below those shown in Table 1; discoloration.

Repair Method: Prepare the surface of the defective PPPRP markings by grinding or blast cleaning. No other cleaning methods are permitted. Prepare the surface so that all of the defective PPPRP markings are removed and a clean surface remains. Immediately after surface preparation, remove loose particles and foreign debris by vacuuming and air blasting with compressed dry air. Re-install PPPRP markings on the cleaned surface in accordance with the requirements of this specification.

Repair or replace other defects not noted above, but determined by the Representative to need repair, as directed by and to the satisfaction of the Representative.

(k) Warranty. Provide the Commission with a written five year warranty for the PPPRP markings. The written warranty is to include but is not limited to agreement to the conditions in (i). The five year period begins at the conclusion of the observation period. The warranty shall cover the pavement marking materials, the work to replace the markings when necessary, and the cost to provide maintenance and protection of traffic during the reinstallation.

The manufacturer is to warrant PPPRP markings used will remain effective for its intended use and will meet the minimum retained coefficient of dry retroreflection value of 100 mcd/m²/lx (in accordance with ASTM D4061).

If the pavement markings are applied in accordance with the manufacturer’s application recommendations and fail by any one of the following during the warranty period:

1. Retroreflectance values drop below the minimum retained coefficient of dry retroreflection value of 100 mcd/m²/lx.

2. Failure to completely adhere to the roadway.
3. Failure due to complete wear-through.

The manufacturer will provide and install the replacement materials that will restore the pavement marking retroreflectivity values to warranty levels or greater for failure areas.

The manufacturer will provide the Commission with full reimbursement for contract cost of initial installation of the PPPRP markings and reimbursement of line painting of 2 applications per year for the remainder of the warranty period for failure areas.

(l) Emergency Repair. If the Commission determines that emergency repairs are necessary, the manufacturer shall perform the repairs within 24 hours of notification. If the manufacturer fails to respond within the 24 hour period, the Commission reserves the right to perform the repairs and will charge the manufacturer for all costs. The Commission’s determination of costs incurred is final and conclusive.

(m) Warranty Retroreflectance Measurement Procedures.

1. The manufacturer is to provide a yearly inspection measuring retroreflectance values under dry conditions in accordance with the testing procedures of ASTM D4061. Provide the measurement results to the Commission within 1 week of the inspection.

2. Routine visual inspections will be performed by Commission personnel to monitor the quality of the markings. Areas that appear to be below the minimum retained retroreflectance value will be identified for further investigation.

3. Areas that appear to be below the minimum retained retroreflectance value will be jointly reviewed by the manufacturer and the Commission visually at night within 30 days notification.

4. When retroreflectivity measurements become necessary to confirm failures, readings will be taken by the manufacturer in conformance with ASTM D4061. When retroreflectivity is below accepted values, the manufacturer shall replace the markings.

5. Manufacturer is to provide a contact person to the Commission. The contact person for the Commission is the Manager of Traffic Engineering. Provide a minimum of 2 weeks advance notice prior to performing any retroreflectance measurements.

13.04 Measurement and Payment – Linear Foot.

14.00 REAPPLICATION SURFACE PREPARATION
(ITEMS: 4000-0057, 4000-0058, 4000-0059 AND 4000-0060)

14.01 Description - This work is the surface preparation of existing durable pavement markings in an existing groove for reapplication of new durable pavement markings.

14.03 Construction - Prepare the surface of the existing highly reflectorized epoxy, highly reflectorized polyurea, or PPPRP markings by grinding or blast cleaning. No other cleaning methods are permitted. Remove all surface treatment, laitance, curing compound, or any other contaminants that would hinder adhesion. Clear any loose dirt and other debris from the area where the highly reflectorized epoxy, highly reflectorized polyurea, or PPPRP markings will be applied with compressed dry air. Prepare the highly reflectorized epoxy or
polyurea pavement marking surface so that a substantial amount of the reflective glass spheres are removed and a roughened epoxy or polyurea pavement marking surface remains. Prepare the PPPRP marking surface so that all of the PPPRP markings are removed and a clean surface remains. Immediately after surface preparation, remove loose particles and foreign debris by vacuuming and air blasting with compressed dry air. Use material and equipment that will not damage the final pavement surface and that will show the final lines on which the pavement markings will be placed.

14.04 Measurement and Payment - Linear Foot

F15.00 PUBLIC WORKS EMPLOYMENT VERIFICATION ACT

**General.** In accordance with Act 127 of 2012, known as the Public Works Employment Verification Act (“the Act”), effective January 1, 2013, 43 P.S. §§167.1-167.11, use the Federal Government’s E-Verify system to ensure that all employees performing work on the project, including subcontractor’s employees, are authorized to work in the United States.

**Verification Form.** Verify the employment eligibility of each new employee hired after January 1, 2013 and submit the Commonwealth Public Works Employment Verification Form (“Form”) to the Commission.

**Contractor.** Submit the Form, signed by an authorized representative of the Contractor, possessing sufficient knowledge to make the representations and certifications on the Form, prior to performing any work. Failure to provide a completed Form may subject the Contractor to the enforcement activities, sanctions and civil penalties specified in the Act.

**Subcontractor.** Obtain a form signed by an authorized representative of the subcontractor performing work on the project, possessing sufficient knowledge to make the representations and certifications on the Form. Submit it to the Representative prior to the Subcontractor performing any work on the project. Failure or refusal to provide the Form will be considered a refusal to comply with contract requirements and may subject the subcontractor to the enforcement activities, sanctions and civil penalties specified in the Act.

Include information about the requirements of the Act in all subcontracts.

**Department of General Services.** The Department of General Services is the Commonwealth agency responsible for enforcement and administration of the Act. Please direct questions about the Act to:

Department of General Services Public Works  
Employment Verification Compliance Office  
Room 105 Tent Building  
18th and Herr Streets  
Harrisburg, PA 17125  
Fax: 717-214-3669

16.00 ACCESS TO JOB SITE

To the extent necessary, Contractor's materials, supplies, on-site supervisory personnel and equipment will be granted toll-free access to the job site.

Equipment necessary for the performance of the work under contract will be granted non-revenue passage. All equipment delivering materials necessary for the proper execution of the work under contract will be granted non-revenue privileges except common or contract carriers.

The Contractor's on-site supervisory personnel and vehicles for group transportation of personnel
assigned to the performance of the work under contract will be provided non-revenue passage to and from the work area.

Provide group transportation for all non-supervisory personnel. Non-revenue privileges are not extended to individual employees other than on-site supervisory personnel.

All vehicles entering the Turnpike System must obtain a toll ticket. If exiting at an interchange, the ticket and the Non-Revenue Card must be presented to the Toll Collector. If valid, the Card will be returned to the driver. If a driver exits at a location other than an interchange, the ticket(s) must be turned into their supervisor, on a daily basis. The supervisor will have the ticket(s) forwarded to the Commission's Fare Audit Department in Central Office. All drivers attempting to exit the system without a card must pay the appropriate toll with cash. Vehicles entering at locations other than an interchange may use the card when exiting at an interchange. Each vehicle entering or exiting the Turnpike system must have a valid non-revenue card specific to the project.

Overweight and oversized vehicles must obtain a permit number from the Commission's Safety Department prior to making the trip to and from the work site. Permit numbers can be obtained from the Safety Department by phone between 8:30 A.M. and 4:30 P.M., Monday through Friday.

Report all stolen cards immediately to the Card Control Center or the Communications Center located in the Turnpike's Administration Building, (717) 939-9551.

The Non-Revenue Cards will expire one month after the completion date of the contract.

Non-revenue passage is governed by State Police and Turnpike safety regulations.

Violation of any regulation governing the use of a Non-Revenue Card as well as any safety regulation could result in revocation of all non-revenue privileges.

To obtain Non-Revenue Cards, PTC Form 33-97, Contractor's Non-Revenue Card Application, must be completed and forwarded to the Representative at least 14 calendar days prior to the starting date of the work with the appropriate monies attached. A $50.00 deposit is required for each card. The deposit will be refunded when the card is returned to the Commission's Card Control Center. The deposit will not be refundable if the cards are returned to the Commission six months after the contract completion date. Additional cards may be obtained throughout the duration of the contract on an as-needed basis.

All interchange access requests are subject to the approval of the Representative.

The Commission reserves the right to limit the number of cards and/or revoke cards at any time during the course of the project.

It is the Contractor's responsibility to keep an accurate accounting of all passes issued to him for use on the project. All requests for non-revenue passes must be made through the General Contractor.

Final payment is subject to the return of all non-revenue cards.

17.00 INDEMNITY

The Contractor will assume the entire responsibility and liability for any damage or injury of any kind or nature whatever (including death resulting therefrom) to all persons, whether employees of the Contractor or otherwise, and to all property caused by, resulting from, arising out of, or occurring in connection with the execution of the work of the Contractor, and if any claims for such damage or injury, (including death resulting therefrom) be made or asserted, whether or not such claims are based upon the alleged active or passive negligence or participation in the wrong of the Commission, its Commissioners, and/or employees (herein collectively the "Commission") or upon any alleged breach of any statutory duty or obligation on the part of the Commission; the Contractor agrees to indemnify and hold harmless the Commission, from and against any and all such claims, loss, costs, expense, liability, damage or injury, including legal fees, interest, penalties, and disbursements that the Commission may directly or indirectly sustain, suffer or incur as a result thereof and the Contractor will assume, on behalf of the Commission, the defense of any action at law or in equity which may be brought against the Commission arising by reason of such claims and will further pay on behalf of the Commission upon demand, the amount of any judgment that may be entered against the Commission, individually, jointly, or severally in any such action.
In the event that any such claim, loss, cost, expense, liability, damage or injury arises or is made, asserted, or threatened against the Commission, its Commissioners, officers, or employees, the Commission only will have the right to withhold from any payments due or to become due to the Contractor an amount sufficient in the Commission's judgment to protect and indemnify it, its Commissioners, officers, and employees from and against any and all such claims, loss, cost, expense, liability, damage or injury, including legal fees and disbursements, or the Commission only in its discretion, may require the Contractor to furnish a surety bond satisfactory to the Commission guaranteeing such protection, which bond will be furnished by the Contractor within five (5) days after written demand has been made therefor. In the event performance of the terms of this paragraph by the Contractor requires the retention of legal counsel on behalf of the Commission, the selection of such legal counsel by the Contractor will be subject to the approval of the Commission, such approval not to be unreasonably withheld by the Commission. In the event the Commission is required to take legal action to enforce the terms of this Paragraph, Contractor will be responsible for the Commission's cost of collection including attorney's fees.

18.00 ENUMERATION OF STANDARD DRAWINGS

<table>
<thead>
<tr>
<th>STANDARD DRAWING NO.</th>
<th>DESCRIPTION</th>
<th>APPlicable DATE</th>
</tr>
</thead>
<tbody>
<tr>
<td>PTS-910</td>
<td>Maintenance and Protection of Traffic-Construction, Sheets 1 to 8 of 8</td>
<td>February 2015</td>
</tr>
<tr>
<td>PTS-960</td>
<td>Maintenance and Protection of Traffic-Construction, Sign Fabrication, Sheets 1 to 5 of 5</td>
<td>February 2015</td>
</tr>
<tr>
<td>PTS-980</td>
<td>Maintenance and Protection of Traffic-Construction Miscellaneous Details, Sheets 1 to 17 of 17</td>
<td>February 2015</td>
</tr>
<tr>
<td>Section</td>
<td>Description</td>
<td>Code</td>
</tr>
<tr>
<td>----------</td>
<td>-----------------------------------------------------------</td>
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</tr>
<tr>
<td>901</td>
<td>Maintenance and Protection of Turnpike Traffic During</td>
<td>CS-901</td>
</tr>
<tr>
<td></td>
<td>Construction</td>
<td></td>
</tr>
<tr>
<td>962</td>
<td>Painting Traffic Lines and Markings</td>
<td>CS-962</td>
</tr>
<tr>
<td>963</td>
<td>Pavement Marking Removal</td>
<td>CS-963</td>
</tr>
<tr>
<td>964</td>
<td>Highly Reflectorized Epoxy Pavement Markings</td>
<td>CS-964</td>
</tr>
<tr>
<td>1103</td>
<td>Traffic Signing and Marking</td>
<td>CS-1103</td>
</tr>
</tbody>
</table>
SECTION 901 - MAINTENANCE AND PROTECTION OF TURNPIKE TRAFFIC DURING CONSTRUCTION

901.1 DESCRIPTION - This work is the furnishing, installing, maintaining, and relocating of traffic control devices of Turnpike traffic adjacent to and within the construction area. Perform all work as specified in these Specifications, the Publication 212, the Special Provisions, Standard Drawings, the Maintenance and Protection of Traffic/Traffic Control Plans (TCP), and as directed.

901.2 MATERIAL - Furnish material and traffic control devices necessary for maintenance and protection of traffic, and conforming to the TCP, Publication 212, and as follows:

- Temporary Concrete Barrier - Section 627.2
- Temporary Impact Attenuating Devices - Section 696.2
- Reset Temporary Concrete Barrier - Section 628.2
- Reset Temporary Impact Attenuating Devices - Section 697.2
- Painting Traffic Lines and Markings - Section 962.2
- Temporary Pavement Markers - As manufactured by Ennis Paint, Inc.
  - Non-Plowable Raised Pavement Markers - Model No. 911 or approved equal
  - Recessed Reflective Pavement Markers - Model No. 948 or approved equal
- Bituminous Tack Coat - Section 460.2
- Superpave Bituminous Wearing Course - Section 409.2
- Bituminous Wearing Course FJ-1 - Section 422.2
- Flat Sheet Signs (for Post Mounted Signs, Type B, C and F and Distance Marker(s)) – Section 1103.04

When traffic line paint and glass beads are provided according to the requirements of Section 901.3(k), furnish certification, as specified in Section 106.03(b)3, that these materials meet specifications.

All temporary traffic control devices must be listed in Bulletin 15 as NCHRP-350 compliant. Temporary Type III barricades must comply with Standard Drawing TC-8716 or be listed in Bulletin 15 as NCHRP-350 compliant.

901.3 CONSTRUCTION -

(a) General. Comply with Publication 212.

At least 2 weeks before any maintenance and protection of traffic signs are set up, submit a QC Plan describing the installation, maintenance, and relocation operations for traffic control devices, protection of Turnpike traffic adjacent to and within the construction area, and methods necessary to achieve the requirements of this section, Publication 212, special provisions, Standard Drawings and the Maintenance and Protection of Traffic/Traffic Control Plans (TCP) and hold a pre-operations meeting to review the quality control plan for field control and evaluation of the maintenance and protection of traffic operations. Approval of the QC plan does not change or alter any specification requirements.
Furnish, install, maintain, and remove traffic control devices as indicated on the TCP and the Standard Drawings. To accommodate active operations, furnish and maintain all necessary signs and devices. If construction operations, equipment and resultant conditions, including winter shutdown periods and unforeseen conditions, necessitate the use of additional signs, devices and flaggers, furnish and maintain such as are required and to the satisfaction of the Representative. The Representative may revise the TCP in writing during construction. If revisions are made to the TCP by the Representative, install and maintain any additional warning lights and traffic control signs and devices on necessary mounting devices according to Publication 212, and at locations designated in writing by the Representative. Use PennDOT approved channelizing devices only. Reflectorize channelizing devices with PennDOT approved Type XI reflectorized material. Provide safety for the general public and the work crew. Ensure that all equipment approaches, enters, and departs from working zones in the direction of and with the normal adjacent traffic flow. Schedule construction operations to allow movement of traffic through various phases of construction with minimum interference. If traffic interruptions become too frequent, cease operations in the area concerned, as directed. Take remedial action to correct the situation before continuing operations. Remove or cover existing traffic control devices that conflict with the TCP. When the conflict no longer exists, erect or uncover them. The Chief Executive Officer may impose restrictions on the Contractor's operations, including complete suspension, as is necessary to eliminate adverse traffic conditions on the Turnpike without liability for delay.

The Contractor is cautioned that other Commission Contractor(s) and/or Commission Maintenance Personnel may be working adjacent to the work zone(s) during portions of this contract period. The Representative will specify the working sequence of the contracts in order to facilitate coordinated traffic control operations.

If it is necessary to stop traffic, the Pennsylvania State Police Troop T will conduct all traffic stoppages. These stoppages will not exceed fifteen minutes in length. To halt traffic, schedule the stoppage during non-peak hours during the time period indicated in the Special Provisions. For consecutive stoppages, Troop T may stop traffic following the preceding stoppage and after traffic has returned to its normal flow. According to current traffic conditions, Troop T will determine the time duration between stoppages. Troop T may stop traffic only when the weather conditions are satisfactory.

A minimum of 14 days in advance of the scheduled work that will require a traffic stoppage, notify the Representative. The Representative will notify the Pennsylvania State Police Troop T. In addition, provide sufficient flaggers to assist Troop T. These flaggers are subject to the direction and control of Troop T.

Maintain full access to all interchanges, maintenance areas, service plazas, rest areas and access gates. When operations prevent full access to these areas, schedule, arrange, and conduct work in such manner as will provide the least interference to traffic, utilizing the provided access, and to the satisfaction of the Representative. Maintain open traffic lanes in a satisfactory manner. Immediately remove all dirt, spillage or other foreign material deposited on the roadway. Be responsible for any damage caused to passing vehicles or persons. Provide suitable shields or other means to prevent such damage. The Representative’s approval of such measures does not relieve the Contractor of the responsibility for damage caused.

Cover all speed limit signs as well as all other existing warning and informational signs and retain the covers when such messages are inappropriate for the traffic control pattern used. When work is not being performed and all normal lanes and shoulders are available and at the same elevation for the effected direction(s), cover all work area signs and turn off all Type A, Type B, and Type C lights associated with these signs. When all normal lanes and shoulders are not available or are not at the same elevation for the effected direction(s), cover all appropriate work area signs and turn off all Type A, Type B and Type C lights associated with these signs. Uncover signs and turn on all Type A, Type B and Type C lights associated with these signs prior to the resumption of work.

Install and maintain reduced regulatory speed limit signs in work areas, as indicated on the TCP, the Standard Drawings, or as directed. Establish work zone speed limit of 55 MPH in all construction zones except when using tunnel cross-over traffic pattern establish work zone speed limit of 40 MPH. Establish work zone speed limit by installing 55 MPH speed limit signs in median and shoulder ½ mile in advance.
of construction area access openings as shown in Standard Drawings. Existing R2-1/G20-5AP signs may be overlaid for 55 MPH in lieu of covering/uncovering signs.

Temporarily remove or cover reduced regulatory speed limit signs when workers are not present, except as otherwise indicated on the TCP, the Standard Drawings, or as directed. Cover or remove work zone speed limit signs when all normal lanes and all normal median and shoulders are available and are at the same elevation for the affected direction(s). Cover or remove work zone speed limit signs when temporary concrete barrier closes the median or shoulder.

Open any substantially completed section of roadway for the use and convenience of traffic, as directed, and as specified in Section 107.15. When work is completed, immediately remove temporary traffic control devices.

Construct and erect all devices in an efficient manner. Maintain, clean, and properly operate the devices during the entire time they are in use. Traffic control devices must meet the acceptable or marginal standards of the Pennsylvania Quality Guidelines for Temporary Traffic Control Devices. Remove all devices when no longer required or not used for a period of two weeks. Where operations are performed in stages, maintain and operate only the necessary devices that apply to the present stage of construction. Store devices off the Turnpike right-of-way until required on the project.

Do not allow weeds, brush, trees, construction equipment, materials, and the like to obscure any traffic control device.

Secure all approved access gates to prevent the unauthorized entry of persons, vehicles and animals. When required, station watchmen at the access gates to provide security. Secure approved access gates with locks when watchmen are not used. Provide locks that will not interfere with the Commission's locking system.

At the completion of the project, remove all signs and devices from the Turnpike right-of-way.

(b) Maintenance of Roadway and/or Structures. Treat existing earth roads or improved roads that have been graded, with calcium chloride or by other approved dust control palliatives, as specified in the proposal or as directed.

For the duration of the project, be responsible for repairs, on a 24 hour a day basis, necessary to maintain smooth traffic flow in all available traffic lanes within the limits of the traffic control patterns. These limits start where any traffic control devices begin encroaching on the roadway and end where traffic is returned to its normal lanes. If operations cease during the holiday period or if the Commission suspends construction, the Commission's Maintenance Department will be responsible for maintaining open traffic lanes. Payment for repairs directed by the Representative will be according to Section 110.03.

The Commission reserves the right to enter upon a project and, at its own expense, maintain the existing roadway and/or structures. This maintenance will be during the life of the project, but will not include those items that are the Contractor's responsibility as specified in Section 105.13 for the contract items of work and Section 901.3(e) for the accommodation of local traffic. The Commission does not assume responsibility in any way for maintenance of traffic as a consequence of performing this roadway and/or structure maintenance. If the Commission does not exercise its right to enter upon a project, then the Contractor is to perform routine maintenance of the existing roadway and/or structures that are open to traffic at not additional cost to the Commission.

(c) Snow Removal and Anti-Skid Material. The Commission reserves the right to enter upon a project and, at its own expense, remove snow and/or place anti-skid material, considered necessary for continued traffic flow. The Commission does not assume responsibility in any way for maintenance of traffic as a consequence of removing snow or placing anti-skid material.

Remove the anti-skid material, when necessary.

(d) Employee Parking and Safety. Turnpike traffic regulations prohibit parking of vehicles on or adjacent to the travel lanes. Employees will not be permitted to park their cars within the Turnpike right-of-way, including interchange areas. Provide off-site parking areas for employee's cars and transport
employees between the parking areas and the project in buses or other approved vehicles. In no case will employees be permitted to ride on the outside of any vehicle. Do not discharge passengers from any vehicle within ten feet of any travel lane. Workers are not permitted to cross live traffic lanes except in the interchanges and service plazas.

Turnpike regulations also prohibit U-turns and crossing of travel lanes with vehicles and equipment. Exceptions to these regulations may be granted by the Safety Manager upon receipt of proper written request. The Commission will not permit U-turns at interchanges.

Require all persons to wear high-visibility safety apparel meeting the Performance Class 2 or 3 requirements of the current ANSI/ISEA 107 publication when working within the Commission’s right-of-way or while in work zones adjacent to traffic.

(e) Local Traffic Maintenance and Safety. Proceed with the work to ensure safety and the least inconvenience to local traffic. Maintain local traffic ingress and egress by use of existing or new roadways.

Provide and maintain local access to and from the nearest intersecting public road or street, unless otherwise directed. As directed, provide temporary approaches for local vehicular and pedestrian access to and from commuter service, residential, business, industrial, and other public and private facilities.

Also, provide and maintain adequate bridging over base and surface courses, trenches, or other construction, when directed.

(f) Equipment and Material Storage. At the end of the workday and whenever practical during the workday, store equipment, vehicles and material a minimum of 40 feet from the edge of the nearest open travel lane or store behind existing guide rail and/or concrete barrier using the clearances in RC 54M.

(g) Tubular Markers. When indicated, furnish and install tubular markers according to Publication 212.

When directed or as required, replace the complete tubular marker or the tubular marker post only, as the case may be.

When directed or as required, replace the reflective band on the tubular marker.

Remove all tubular markers when no longer necessary for traffic control or as directed.

(h) Existing Commission Signs. Remove and temporarily relocate to appropriate locations existing warning, regulatory, guide, and directional signs as required to accommodate construction operations. Do not remove Stop or Yield signs unless an alternate type of traffic control is provided, such as flaggers, temporary traffic signals, etc. Continue the alternate traffic control until the Stop or Yield signs are replaced. Stake or mark sign locations or locate signs on construction drawings before removing any signs. Mark signs with the milepost or station of its existing location along with the offset in feet from the existing centerline. With the exception of Stop or Yield signs as herein noted, permanently reinstall existing warning, regulatory, guide and directional signs at appropriate locations as soon as operations that interfere with the signs are complete. The Contractor is responsible for signs or supports damaged or lost.

(i) Barricades. When indicated, furnish and install barricades according to Publication 212.

(j) Entrances and Exits to Turnpike. In addition to the existing entrances and exits to the Turnpike, establish all temporary entrances and exits that are deemed necessary and approved in writing by the Representative. In order to meet the rules and regulations of the Commission, the Representative will establish controls for construction, safety, and traffic. Deviations from such rules will not be tolerated and will be sufficient grounds for the withdrawal of the Representative’s approval. Upon completion of the Contract, restore the affected areas and appurtenances to their original condition.

(k) Work Zone Pavement Markings. The type and location of temporary pavement markings will be indicated on the TCP. Do not open any section of roadway to traffic without proper temporary or
permanent pavement markings. Remove conflicting pavement markings prior to changing traffic patterns. Correct any irregular or inaccurate pavement markings as directed by the Representative.

   The Contractor is responsible for all temporary pavement markings.

   Place standard pavement markings in the same location as covered or destroyed pavement markings, unless otherwise indicated on the TCP or directed.

   Be responsible for the maintenance of all work zone pavement markings. Reapply work zone pavement markings prior to winter shutdown, prior to beginning construction in the spring, and every 3 months for each stage of construction.

   Be responsible for the removal of all work zone pavement markings as specified in Section 963.3. Remove the temporary painted markings by water blasting or sandblasting. Use only high-pressure water blasting to remove lines on permanent, Superpave surfaces. Temporary painted markings must be entirely removed.

   Remove any pavement markings improperly placed and install in the correct location at no additional cost to the Commission.

   Do NOT, under any circumstances, apply painted markings to permanent barrier used on the project or on mainline bridge decks with latex concrete surfacing.

1. Painted Pavement Markings. Section 962 and as follows:

   Paint any temporary markings at half the normal millage used when painting permanent markings, except when reapplying temporary pavement markings prior to winter shutdown use normal millage. Paint the temporary skip line 4 inches wide by 10 feet long with a 30-foot space between each temporary skip line. Apply glass beads at the normal rate. Use traffic line paint and glass beads for pavement markings meeting requirements in Publication 212.

2. Temporary Pavement Markers. Install markers according to the manufacturer's specifications. Unless otherwise specified below, space markers at 20 foot centers in transition areas and at 40 foot centers elsewhere. Install markers adjacent to solid lines and in between skip lines. Markers are to be the same color as adjacent pavement markings. Remove pavement markers that are no longer required or that conflict with traffic patterns being used.

   Install markers as shown on the plans and according to the following requirements:

   • Mainline bridges. Use temporary non-plowable raised pavement markers for all temporary pavement markings required on the bridge decks.

   • Roadway Pavement. Install temporary non-plowable raised pavement markers in addition to pavement markings along the centerline of narrowed or shifted travel lanes and along the right edgeline of shifted travel lanes. Temporary non-plowable raised pavement markers along the right edgeline of shifted travel lanes are not required when the right edgeline is directly adjacent to temporary barrier.

   • Median Reconstruction. On final roadway pavement surface, install temporary yellow non-plowable raised pavement markers on the pavement adjacent to the permanent concrete median barrier in temporary position at the midpoint of each permanent concrete median barrier section.

   • Markings required between March 1 and November 30 - Install non-plowable raised pavement markers.

   • Markings required between December 1 and February 29 – Install non-plowable raised pavement markers on final surfaces only. Install recessed reflective pavement markers on non-final surfaces only. Install as shown on the Standard Drawings, as recommended by the manufacturer, as directed by the Representative and as follows:
Perform a test section prior to performing any work and at any time as directed by the Representative. Select a location for the test in an area agreed to by the Representative. Perform the test section to ensure that the machine is capable of cutting RRPM slots as shown on the Standard Drawings.

Install the recessed pavement markers by cutting a slot in the pavement as shown on the Standard Drawings. Ensure that the slot is wide enough for the marker to fit freely into the slot and deep enough to allow for epoxy adhesive. Ensure that the top of the installed marker is flush with the pavement surface or no more than 1/16 inch below the pavement surface.

Bond the marker in the slot with an acceptable epoxy adhesive in such a manner as specified and recommended by the manufacturer and as approved by the Representative.

Prior to opening the lane to traffic, remove and dispose of all milled debris as required.

- Remove temporary non-plowable raised pavement markers prior to November 30 and replace, if required, with temporary recessed reflective pavement markers. If a stage change occurs between October 1 and March 1, temporary recessed reflective pavement markers may be installed on non-final surfaces only in lieu of the temporary non-plowable raised pavement markers for the duration of the stage at no additional cost to the Commission, as approved by the Representative.

3. Temporary Concrete Barrier Delineation. Install delineators of an approved type listed in Bulletin 15. Delineators are to be the same color as adjacent pavement markings.

   (l) Portable Road Light and Power Unit. Use portable road light and power units to illuminate all crossovers at night and to illuminate work zones during nighttime work hours. Do not locate lighting fixtures to produce distracting or blinding glare for the driver. Provide units meeting the following minimum requirements:

   1. Illumination.

      - Lamp - 250 watt, high-pressure sodium.
      - Distribution - IES Type V.
      - Mounting Height - 25 feet.
      - Design and construct refractor from unbreakable material and to reduce specified light distribution without causing glare to motorists.

   2. Power Unit. Self-contained power generation unit satisfactory to the Representative.

   3. Assembly. Mount lamps on telescoping pole or tower with T-bar support for three lamps capable of being operated separately or together by individual control. Mount lamps on T-bar assembly to enable positioning lamps at any location within 180 degrees of horizontal. Mount entire power-pole unit on trailer capable of being towed. Secure unit to trailer by mechanical attachment affixed to trailer so that unit cannot be raised inadvertently while being towed. Equip trailer unit with rubber tires and automotive wheels. Equip trailer with standard attachment tow-bar assembly with safety chain and Pennsylvania approved taillights and directional signals. Stabilize for wind conditions in excess of 65 MPH. Provide electric wiring, cable, connection, etc., according to type approved for automotive use and meeting the requirements of the latest National Electric Code and the Commonwealth of Pennsylvania.

   4. Alternate Power Supply. Make provisions for quiet zone operation from alternate power supply or commercial service.
5. **Acceptance.** Obtain the Representative’s approval of each unit prior to use on the project.

Alternate construction lighting may be used to illuminate work zones during nighttime work hours. The Commission has pre-approved an alternate that meets the following requirements:

- Multi-Directional Lighting Device (MDLD) units which can self-inflate and are capable of illuminating approximately 15,000 ft².
- MDLD units 3.5 ft. horizontal diameter and capable of withstanding 60 mph winds.
- MDLD units with halogen bulbs recommended by the manufacturer.

Furnish, maintain, and operate sufficient number of units to properly illuminate work zones and/or provide proper lighting of all crossovers. Repair or replace damaged lighting units and bulbs within 24 hours.

**(m) Construction Vehicles and Equipment.** Identify all vehicles, cars and trucks used on the project and which travel the open lanes of traffic with a magnetically attached sign, or approved equal sign, prominently positioned on the rear of the vehicle. Attach signs to vehicles whenever traveling open traffic lanes. Provide signs of sufficient size to display the legend in letter size and arrangement that is easily read at a distance of 200 feet in normal daylight. Provide black legend on orange Type XI reflectorized material arranged as follows:

CONSTRUCTION VEHICLE
KEEP ALERT FOR
SUDDEN STOPS AND TURNS

Obtain the Representative’s approval prior to using the signs on the project. Keep signs clean and in good repair at all times to the satisfaction of the Representative. Ensure that all equipment approaches, enters, and departs from working zones in the direction of the adjacent traffic flow. Furnish all equipment and vehicles with a yellow flashing light attached to the equipment adjacent to and facing the traffic and which is visible 360 degrees. Provide lights meeting the following requirements:

1. **Description.** Operate light from a nominal 12 volt DC power source. Provide amber lens and lamps that rotate 360 degrees. Furnish housing to provide rigid support to the lamp, motor and drive train.

2. **Minimum Dimensions.** Height 7.25 in; Diameter 8.5 in.

3. **Lamps.** Consisting of two Par 36 Sealed Beam Incandescent Lamps to provide 3500 beam candlepower. Provide sealed beam lamps that produce approximately 80 flashes per minute when rotating.

4. **Construction.** Provide reinforced thermoplastic lamp holder. Use spring clips to hold lamp in holder and make electrical connection to the lamp when properly placed in holder. Screw terminals or spade connections to the lamp are unacceptable.

5. **Motor.** Provide a permanently lubricated, high torque, permanent magnet type operating from nominal 12 volt DC, filtered to reduce radio frequency interference.

6. **Drive Train.** Utilize a gear assembly with the worm-gear being part of the motor armature. Incorporate in the drive chain a slip clutch arrangement to prevent motor damage. RUBBER BANDS OR FRICTION DRIVE UNITS ARE UNACCEPTABLE.
7. **Lens Retainer.** Fabricated from stainless steel with a nut and bolt fastener. Luggage clamp type fasteners are acceptable.

8. **Mounting.** Provide unit capable of being surface mounted or on a self-leveling mount. Provide all mounting hardware including 14-gauge wire, 24 feet in length with an in-line fuse, switch-rocker type (lighted), and roof mounting bolts. Provide a rubber or neoprene gasket or mounting pad to form a weatherproof seal between housing and vehicle roof.

9. **Reference.** Arrow Model 530, Modified (99005); Federal Model 14, Modified; Dietz Model 7-40004; or approved equal. Strobe type lights that meet the dimension, candlepower, flash, lens and retainer and mounting requirements will be acceptable.

(n) **Sign Identification and Covers.** Provide contract number, Contractor name, owner of traffic control sign and Contractor’s telephone number for 24-hour contact on the back of each traffic control sign. This information is to be available to Turnpike personnel for emergency purposes. Furnish a sticker indicating the manufacturer of each traffic control sign.

Cover existing signs and traffic control signs that conflict with the TCP or that do not apply to existing conditions. Cover with rubber roofing material (EPDM) having a thickness of 0.045 inch or any other approved material, to cover the entire sign. Burlap or similar open mesh materials are unacceptable. Stabilize and fasten this material to the sign with either plastic or wood to prevent any movement. Do not apply tape to the face of the sign. Do not deface or damage the sign face using this procedure. Maintain sign cover retainers in good condition. Remove signs not required or not used for a period of two weeks. Store signs off the Turnpike right-of-way until required on the project.

(o) **Tenth and Whole Mile Markers.** Mark sign locations or locate signs on construction drawings before removing whole mile marker signs in the median. At all times, ensure that the customers can see the whole and tenth mile markers. Permanently reinstall the whole mile marker signs in the median and the tenth mile marker signs on the shoulder as soon as operations that interfere with the signs are complete. The Contractor is responsible for signs or supports damaged or lost.

(p) **Inspections and Patrols.** Perform routine inspection of traffic control elements during each work shift. Assign responsibility for safety and traffic control to a representative(s) trained in the principles of safe traffic control during each work shift. This individual(s) will ensure that all traffic control measures implemented on the project are necessary, conform to the TCP, and are effective in providing safe conditions for motorists and workers. If modifications to traffic control or working conditions are required to satisfy these requirements, this representative(s) will have the authority to modify conditions or stop the work until a safe condition is provided. Submit the name and qualifications of this individual(s) for acceptance by the Commission.

Assign personnel with vehicles to patrol the project, its approaches and other affected roadways. Provide patrol personnel with vehicles equipped with a 360-degree emergency warning light as specified in Section 901.3(m). Equip vehicles with four-way flashing warning lights, visible from front and rear to be used when the vehicle is stopped. Assign sufficient patrol personnel to provide for all necessary maintenance, repair or replacement of signs and devices. The patrol personnel are responsible to insure all access gates are locked or secured and to report accidents involving damaged traffic control devices to the Commission’s Operations Center.

Report any adverse traffic conditions to the Operations Center who will notify the Pennsylvania State Police Troop T. Remain at the scene until Troop T arrives. Take all reasonable steps to abate the adverse traffic conditions and take necessary precautions to warn other customers of the condition. Upon arrival of Troop T, cooperate with Troop T to control traffic. At no time is the Contractor relieved of the responsibility for the maintenance and protection of traffic.
Patrol personnel are to report to the Operations Center traffic accidents involving customers and construction employees, equipment or vehicles. The Operations Center will notify Troop T. Report to the designated safety officer industrial-type accidents involving construction personnel. Notify the Representative of all accidents occurring within the project, its approaches or on other affected roadways.

Provide 24 hour patrols during continuous single lanes and when less than two 11 foot lanes, three 11 foot lanes in 3-lane sections, in either direction are available during non-working hours. Provide 24 hour patrols when normal ramp lanes and ramp widths are unavailable during non-working hours.

(q) **Temporary Concrete Barrier.** Except for temporary pavement markings, temporary concrete barrier is not to be painted.

Provide, install and maintain top-mounted and side-mounted delineators on temporary concrete barriers, glare screen and bridge barrier as indicated on the TCP.

Clean or replace all delineators as directed. Clean in an approved method.

(r) **Flaggers.** Provide flaggers at all sites where construction equipment and vehicles cross or have access to the travel lanes. The flaggers are responsible to regulate the entry and departure of the construction equipment and vehicles.

(s) **Lifting of Construction Materials.** Stop traffic during the placement or removal of any construction materials that are above open lanes to traffic, such as, but not limited to, lifting equipment, bridge components, signs, and overhead sign structure components as directed.

(t) **Non-Compliance of Maintenance and Protection of Traffic.** Liquidated damages will be assessed in the event of non-compliance with Maintenance and Protection of Traffic requirements. Liquidated damages will be assessed following notification by the Inspector-in-Charge.

If the Contractor remains in violation of the Maintenance and Protection of Traffic provisions, the Assistant Chief Engineer – Construction may direct Commission Maintenance Personnel to correct the deficiencies. In such cases, the Contractor will be charged for labor, equipment, and material costs incurred by the Commission.

(u) **Arrow Panels.** Provide units from an approved source with panels a minimum of 48-inch high and 96-inch wide with non-reflective, flat black finish. Use a 12-volt battery pack to supply electrical power to the sign panel for a minimum of 72 continuous hours. Solar powered arrow panels listed in Bulletin 15 are acceptable. Operation from alternate electric power supply or commercial electric service may be used with the approval of the Representative.

The number of units required will be indicated in the bid proposal for the project. The Contractor may furnish additional units at no additional cost to the Commission.

(v) **Shadow Vehicle with Truck Mounted Attenuator (TMA).** Provide a shadow vehicle with TMA that meets the requirements of Publication 212. Provide documentation to the Representative that the requirements for the shadow vehicle with TMA are met. To the rear of the shadow vehicle, attach a Truck Mounted Attenuator (TMA) provided from a PennDOT approved source and tested and approved for NCHRP 350 Test Level 3 Criteria. In the bed of the shadow vehicle, insert a Skid-Mounted Arrow Panel (from a PennDOT approved source) that measures a minimum of 48 inches high by 96 inches wide. In conjunction with the use of the Shadow Vehicle with TMA, provide and use a PennDOT approved Traffic Alert Radio that is capable of being carried by the Shadow Vehicle with TMA.

To provide advance information to approaching drivers and to separate the workers and work vehicles from approaching drivers, position the shadow vehicle with TMA in advance of work locations which are not separated from approaching drivers by concrete barrier. Assign operator(s) to each Shadow Vehicle with TMA. Provide a means for the operator(s) to verbally communicate with the operation for which the Shadow Vehicle with TMA is being used. The operator(s) must be available at all times to position...
and/or relocate the shadow vehicle with TMA. During periods of multiple work locations, prioritize the use of the shadow vehicle with TMA based on the priority chart provided.

1. **Stationary Operation.** When separating a stationary operation (i.e.: stopped for more than fifteen minutes) from approaching drivers, the shadow vehicle with TMA is to be unoccupied.

2. **Slow-Moving or Moving Operation.** When separating approaching drivers from an operation that will be moving continuously or intermittently where the vehicle will not be stopped at any single location for more than fifteen minutes, the operator is to be the only occupant of the vehicle.

3. **Position.** Position all shadow vehicles with TMA so they are visible to approaching vehicles from a distance calculated as follows:

   Speed Limit (mph) x 10 = Sight Distance (feet)

   If this sight distance cannot be obtained, use the maximum sight distance which the local geometry of the road allows. Orient all shadow vehicles with TMA so that the rear of the vehicle (and the TMA) is perpendicular to and facing oncoming traffic.

4. **Priorities for the Application of Shadow Vehicles with TMA.**

<table>
<thead>
<tr>
<th>Closure / Exposure Condition</th>
<th>Priority</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Formal Lane Closure</td>
<td></td>
</tr>
<tr>
<td>a) Shadow Vehicle with TMA for Operation Involving Exposed Personnel</td>
<td>1a</td>
</tr>
<tr>
<td>b) Shadow Vehicle with TMA for Operation Not Involving Exposed Personnel</td>
<td>1b</td>
</tr>
<tr>
<td>No Formal Shoulder Closure</td>
<td></td>
</tr>
<tr>
<td>a) Shadow Vehicle with TMA for Operation Involving Exposed Personnel</td>
<td>2a</td>
</tr>
<tr>
<td>b) Shadow Vehicle with TMA for Operation Not Involving Exposed Personnel</td>
<td>2b</td>
</tr>
<tr>
<td>Formal Lane Closure</td>
<td></td>
</tr>
<tr>
<td>a) Shadow Vehicle with TMA for Operation Involving Exposed Personnel</td>
<td>3a</td>
</tr>
<tr>
<td>b) Shadow Vehicle with TMA for Operation Not Involving Exposed Personnel</td>
<td>3b</td>
</tr>
<tr>
<td>Formal Shoulder Closure</td>
<td></td>
</tr>
<tr>
<td>a) Shadow Vehicle with TMA for Operation Involving Exposed Personnel</td>
<td>4a</td>
</tr>
<tr>
<td>b) Shadow Vehicle with TMA for Operation Not Involving Exposed Personnel</td>
<td>4b</td>
</tr>
</tbody>
</table>
The number of units required for the payment type indicated will be shown in the bid proposal for the project. The Contractor may furnish additional units for the payment type indicated at no additional cost to the Commission. In addition, the Contractor may furnish additional shadow vehicles with TMA regardless of the payment type indicated at no additional cost to the Commission.

(w) **Portable Changeable Message Signs.** From a PennDOT approved source, provide units that can display a three-line message. Install portable changeable message signs a minimum of one week prior to lane closures, stoppages, or traffic paces to inform customers of upcoming construction work.

Place portable changeable message signs off the paved shoulder and behind guiderail or concrete barrier, if practical. Where guiderail or concrete barrier is not available, place off the paved shoulder and outside the clear zone. If a portable changeable message sign has to be placed on the paved shoulder or within the clear zone, delineate it with PennDOT approved channelizing devices with PennDOT approved Type XI reflectorized material. The Representative will determine the sign locations and approve messages. Based on traffic conditions and as directed by the Representative, relocate the signs at no additional cost.

Within 24 hours of being notified that a sign is damaged or inoperative, repair or replace the sign to the satisfaction of the Representative. If the sign remains unrepaired beyond the 24-hour limit, the Contractor will be assessed $500.00 per day in liquidated damages.

The number of units required will be indicated in the bid proposal for the project. The Contractor may furnish additional units at no additional cost to the Commission.

(x) **Emergency Contact.** Designate a responsible individual(s) to be in charge of all safety including the maintenance and protection of traffic. Designate an individual(s) that can be contacted at all times (day or night) and who is authorized to make necessary decisions. Furnish the name(s), address and telephone number of the designated individual(s) for 24-hour availability.

### 901.4 MEASUREMENT AND PAYMENT -

(a) **Maintenance and Protection of Turnpike Traffic During Construction.** Lump Sum

The Commission will measure and pay for this item in a proportionate manner, one designated by the Commission, on the basis of current estimates.

With the exception of the separate pay items specified in Section 901.4(b), if an item or device is required for maintenance and protection of traffic, the cost of the item or device is incidental to Item 2901-0001.

(b) **Separate Pay Items.** The Commission will separately measure and pay for the following items or devices, when indicated or required or as directed by the Representative for maintenance and protection of traffic during construction:

- Arrow Panel - Each
- Calcium Chloride - Ton
- Other Dust Control Palliatives - Gallon or Ton
- Tubular Markers - Each
- Replace Tubular Markers - Each
- Replace Tubular Markers, Post Only - Each
• Replace Reflective Band on Tubular Marker - Each
• Remove Tubular Markers - Each
• Changeable Message Sign - Each
• Temporary Concrete Barrier - Section 627.4
• Reset Temporary Concrete Barrier - Section 628.4
• Pavement Marking Removal - Section 963.4
• Painting Traffic Lines and Markings - Section 962.4
• Temporary Non-Plowable Raised Pavement Markers, Yellow - Each
• Temporary Non-Plowable Raised Pavement Markers, White - Each
• Temporary Recessed Reflective Pavement Markers, Yellow - Each
• Temporary Recessed Reflective Pavement Markers, White - Each
• Temporary Bituminous Rumble Strips - Square Yard
• Temporary Impact Attenuating Devices - Section 696.4
• Reset Temporary Impact Attenuating Devices - Section 697.4
• Standard Pavement Markings, Paint & Beads, for the type indicated - Linear Foot. Payment will be made for the initial application of temporary markings for each stage of construction. Maintenance of temporary markings, including the required reapplications prior to winter shutdown, prior to beginning construction in the spring, and every 3 months for each stage of construction are incidental to the initial application.

• Shadow Vehicle with Truck Mounted Attenuator (TMA) - One of the following:
  a) Each.
  b) Day. A day is defined as approved usage of any duration within a 24-hour calendar day period.
  c) Hour. Measured beginning when the Shadow Vehicle with TMA is properly positioned in advance of the work location to the time when the Shadow Vehicle with TMA is removed from in advance of the work location rounded to the nearest whole hour.
SECTION 962 - PAINTING TRAFFIC LINES AND MARKINGS

962.1 DESCRIPTION - This work is the furnishing and application of waterborne pavement marking, of the type and color indicated.

962.2 MATERIAL -

(a) **General.** Provide materials from a source listed in Bulletin 15. Certify materials as specified in Section 106.03(b)3.

(b) **Paint.** Provide waterborne traffic paints listed in Bulletin 15.

(c) **Glass Beads.** Section 1103.14, furnish Type A glass beads unless otherwise specified.

962.3 CONSTRUCTION -

(a) **General.** At least 5 days before beginning work, provide the Representative with a schedule of operations. In addition, provide the Representative with the manufacturer’s instruction for the installation of the materials, application temperatures, proper mixing techniques, and any other data to ensure the material is being properly installed. Provide 2 applications of final markings on final pavement.

(b) **Equipment.**

1. **Line Application.** Use a machine that is:

   • Capable of heating the paint to 130° F ± 5° F;

   • Capable of simultaneously applying two parallel lines of the width indicated in solid or broken patterns or various combinations thereof;

   • Capable of automatically dispensing glass beads onto the painted surface, at the required application rate, by the pressurized glass-gun method; and

   • Equipped with a measuring device, which automatically and continuously measures the length of each line placed, to the nearest foot.

2. **Legend Application.** Includes crosswalks, symbols, legends, stop lines, and other miscellaneous items. Do not apply with hand brushes or rollers. Glass beads may be hand-applied.

(c) **Application Rates.**

1. **Paint.** Dispense in a wet-film thickness of 15 mils ± 1 mil, except edge markings are 12 mils ± 1 mil.

2. **Glass Beads.** Apply at a rate of 7 pounds per gallon of paint.

3. **Calibration.** Use a machine calibrated as follows:

   • **Line Measuring Device.** Calibrate automatic line length gauges to maintain a tolerance of ± 25 feet per mile.
• **Cycle Length/Line Timer.** Calibrate cycle length in a tolerance of ± 6 inches per 40 feet; calibrate length to maintain a tolerance of ± 3 inches per 15 feet.

• **Bead Guns.** Calibrate to dispense glass beads at the specified rate. Check by dispensing glass beads into a gallon container for a predetermined fixed period of time. Verify the weight of glass beads.

• **Paint Guns.** Calibrate to simultaneously apply the paint at the uniform rates specified with an allowable tolerance of ± 1 mil and with an allowable width tolerance of ± 1/4 inch.

(d) **Surface Preparation.** Clean the surface where the waterborne pavement markings will be applied. Remove all surface treatment, laitance, curing compound, or any contaminants that would hinder adhesion. Clear any loose dirt and other debris from the area to be painted with compressed air. Surface preparation is incidental to the application of waterborne pavement markings, except for the removal of pavement markings which is performed and paid for under Section 963. Use material and equipment that will not damage the pavement surface and that will show the final lines on which the pavement markings will be placed. Place guide markings for all temporary and permanent pavement markings. Identify the location of the pavement markings by applying spots on the pavement at 40-foot intervals. The Representative will approve the locations.

(e) **Temperature Restriction.** Apply on a dry pavement with minimum ambient and pavement temperatures of 50° F and a maximum relative humidity of 80%. Confirm the proper atmospheric and pavement surface conditions with the Representative.

(f) **Protection of Painted Surfaces.** Provide protection to allow adequate time for the markings to dry and be track-free from vehicular traffic. Paint applied at 130° F ± 5° F may be protected by the use of additional vehicles in the painting operation or by the use of satisfactorily spaced channelizing devices. Channelizing devices are to be used only during allowable working hours. Repaint marked or damaged areas, as directed.

(g) **Centerline Application.** Locate and place as indicated and as follows:

- Apply markings at 130° F ± 5° F.
- Avoid placing markings on longitudinal pavement joints and seams. Where existing centerlines are visible and properly located, apply directly over the existing pattern.
- Where centerlines do not exist or existing centerlines are improperly located, apply at the correct location, as determined by the Representative. Remove the improperly located existing markings, as specified in Section 963.3.
- Divide the roadway on two-lane roadways. However, if a portion of the roadway on either or both sides is to be used for parking, then divide the traveled way.
- Provide permanent centerline markings in 15 ft lengths with 25 ft of unmarked pavement between markings.

(h) **Edgeline Application.** Apply markings at 130° F ± 5° F. Do not place markings on joints or seams between the traveled way and shoulder.

(i) **Retroreflectivity.** Provide markings with an average minimum initial retroreflectivity of 250 mcd/m²/lux for white and 165 mcd/m²/lux for yellow for one 400 ft section of marking for projects less than 6 miles long and one 400 ft section of marking for each 3 mile section for projects greater than 6 miles long.

- Repaint the markings that fail the average minimum initial retroreflectivity with one new application
and retest the retroreflectivity of the markings as described above. Continue to repaint the markings that fail the average minimum initial retroreflectivity until such time as the markings pass the minimum initial retroreflectivity requirements.

Measure with a Department approved 30-meter geometry retroreflectometer conforming to ASTM E-1710 within 21 days after installation according to PTM No. 431.

(j) **Defective Work.** Remove and replace any markings placed incorrectly. Repair those markings, which after application and drying, the Representative determines to be defective. Complete this work at no additional cost to the Commission. Major types of defective work areas and method of repair include the following:

- Insufficient thickness or line width, uneven cross-section – Grind or blast clean defective material to remove a substantial amount of beads and to roughen the marking surface. Remove loose particles and debris with compressed air. Restripe the cleaned surface as specified in this specification.

- Inadequate retroreflectivity, glass bead coverage or retention. Restripe over defective marking.

- Poor Adhesion, Delaminating – Remove defective markings as specified in Section 963.3 and clean pavement surface, including 1 foot beyond each end of the affected area. Remove loose particles and debris with compressed air. Restripe the marking on the cleaned surface as specified in this specification.

(k) **Guarantee.** Guarantee pavement marking material against failure due to premature wear and poor adhesion resulting from defective materials or method of application according to Section 107.16(b) for a period of 90 days from the date of acceptance.

### 962.4 MEASUREMENT AND PAYMENT—

(a) **Line.**

1. Linear Foot
2. Lump Sum

(b) **Legend.** Each

No additional payment will be provided for the second application of final markings on final pavement.

Payment will be made for the initial application of temporary markings for each stage of construction. Maintenance of temporary markings, including the required reaplications prior to winter shutdown, prior to beginning construction in the spring, and every 3 months for each stage of construction are incidental to the initial application.
SECTION 963—PAVEMENT MARKING REMOVAL

963.1 DESCRIPTION—This work is the removal of pavement markings and legends.

963.3 CONSTRUCTION—Remove existing pavement markings, as indicated, immediately before any change in traffic patterns or before the application of final markings. Remove markings that conflict with revised traffic patterns and may confuse motorists. Do not paint over existing lines with black paint. Remove by methods that will cause the least damage to pavement structure or pavement surface.

Pavement markings and legends must be entirely removed. Remove waterborne pavement markings by water blasting, grit blasting or sandblasting. Grinding is acceptable only for the removal of thermoplastic, cold plastic, or epoxy marking materials. Obtain approval of the proposed removal method before beginning work.

Vacuum or collect residue, including sand, dust, and marking material, concurrently with the removal operation unless alternate procedure is submitted and accepted. Clean the area of dust with compressed air. Perform this work only in the area where the markings are to be applied. Do not allow sand, dust, or other residual material, which may interfere with drainage or constitute a traffic hazard, to accumulate. Dispose of all residue in an acceptable manner.

Repair any pavement or surface damage caused during the removal process. If pavement or surface damage becomes excessive, use another acceptable method of removal.

Prevent damage to transverse and longitudinal joint sealers, and repair any damage as specified in Section 513.

963.4 MEASUREMENT AND PAYMENT—Meter (Linear Foot).

(a) Lines.

1. Meter (Linear Feet)

2. Square Meter (Square Foot)

(b) Legends.

1. Each

2. Square Meter (Square Foot)
SECTION 964 - HIGHLY REFLECTORIZED EPOXY PAVEMENT MARKINGS

964.1 DESCRIPTION - This work consists of furnishing and installing highly reflectorized epoxy pavement markings of the color indicated, at the locations indicated.

964.2 MATERIAL -

(a) General. Provide materials from a source listed in Bulletin 15. Certify materials as specified in Section 106.03(b)3.

(b) Epoxy Resin. Provide only those epoxy materials listed in Bulletin 15. Do not use polluting solvents or fillers.

1. Color. Furnish white and yellow pavement markings that satisfy the following chromaticity coordinates:

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>White</td>
<td>x</td>
<td>y</td>
<td>x</td>
<td>y</td>
</tr>
<tr>
<td></td>
<td>0.330</td>
<td>0.370</td>
<td>0.355</td>
<td>0.345</td>
</tr>
<tr>
<td>Yellow</td>
<td>x</td>
<td>y</td>
<td>x</td>
<td>y</td>
</tr>
<tr>
<td></td>
<td>0.515</td>
<td>0.465</td>
<td>0.505</td>
<td>0.430</td>
</tr>
</tbody>
</table>

Furnish black epoxy that satisfies color chip 37038 of Federal Standard 595B and is equal to the quality of the white epoxy being used.

2. No Track Time. Dry to a no-track condition in 10 minutes or less when tested according to ASTM D 711 at a temperature of 75°F ± 2°F at a thickness of 20 mils ±1 mil with glass beads applied at a rate of 20 pounds per gallon of epoxy.

(c) Optics. Apply a combination of the following to the epoxy resin:

- Standard Glass Beads - Section 1103.14
- Potters Visibead Plus II Highway Safety Marking Spheres or approved equal
- 3M AW 70/71 E Series elements containing microcrystalline ceramic beads. For white markings, use 3M Series AW 70E Series elements or approved equal. For yellow markings, use 3M Series AW 71E Series elements or approved equal.

(d) Black Aggregate. Furnish with the following gradations:

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>Retained (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. 20</td>
<td>17-37</td>
</tr>
<tr>
<td>No. 30</td>
<td>45-65</td>
</tr>
<tr>
<td>No. 40</td>
<td>14-25</td>
</tr>
</tbody>
</table>

964.3 CONSTRUCTION -

(a) General. Hot apply the epoxy marking material by spray method onto clean and dry pavement surfaces at the thickness and width specified. Apply the retroreflective optics to the hot epoxy paint using either a double or triple drop system.

Line marking configurations are according to PTS-980. All lines are to be positioned 4 inches from the respective pavement joint or as otherwise indicated.
Highly reflectorized epoxy pavement markings are to be recessed in the pavement and resistant to damage and deformation by traffic and damage from snow removal equipment.

Coordinate a pre-paint meeting at least thirty (30) days prior to starting the installation of any pavement markings. At the pre-paint meeting, provide the Representative with the following:

- The source of supply for the epoxy material and the epoxy manufacturer’s written instructions for use. These instructions are to include, but not be limited to, material mixing ratios and application temperatures (for the epoxy material and the pavement surface).
- Provide test plates of the exact pavement markings to be installed. Provide 3 test plates of each color. Include a minimum 6-inch wide by 24-inch long sample of the marking on a flat and rigid substrate for each test plate. Provide the dry and wet retroreflectivity levels of each sample in accordance with Section 964.3(e).
- Procedures for cutting the grooves with diamond saw blades.
- Procedures for installing the highly retroreflectorized epoxy pavement marking in the diamond cut saw groove.
- The source of supply for all retroreflective optics.

Apply pavement markings in the direction of traffic.

Provide protection to allow adequate time for the pavement markings to dry and be track-free from vehicular traffic. Remove, to the satisfaction of the Representative, all tracking marks, spilled epoxy, and epoxy markings applied in unauthorized areas.

Establish marking line points at 40-foot intervals throughout the length of the pavement as directed by the Representative.

(b) Equipment. Equip the grinding equipment with a free-floating cutting or grinding head to provide a consistent groove depth over irregular pavement surfaces. Equip the grinding or cutting head with diamond saw blades. The grinding equipment must be capable of producing a final pavement surface that is flat and free of ridges.

Provide a mobile applicator that is a truck mounted, self-contained pavement marking machine, specifically designed to apply epoxy resin materials and retroreflective optics in continuous and skip line patterns. The application equipment shall be maneuverable to the extent that straight lines can be followed and normal curves can be made in true arc.

At any time throughout the duration of the project, provide free access to the epoxy application equipment for the inspection by the Representative.

Provide application equipment capable of installing a minimum of 100,000 feet of highly reflectorized epoxy pavement markings in an eight hour day and includes the following features:

- Individual tanks for the storage of Part A and Part B of the epoxy resin and for the storage of reflective glass spheres.
- Heating equipment of sufficient capacity to maintain the individual epoxy resin components at the manufacturer’s recommended temperature for spray application.
- Equipment capable of mixing Part A with Part B of the epoxy resin material to manufacturer’s recommendations.
- Retroreflective optic dispensing equipment and the capacity of applying the optics as specified.
- Metering devices or pressure gauges on the proportioning pumps, positioned to be readily visible to the Representative.
- All necessary spray equipment, mixers, compressors, and other appurtenances for the placement of highly reflectorized epoxy pavement markings in a simultaneous sequence of operations.
(c) **Surface Preparation.** Clean the roadway surface where the highly reflectorized epoxy pavement markings will be applied. Remove all surface treatment, laitance, curing compound, or any other contaminants that would hinder adhesion. Clear any loose dirt and other debris from the area where the highly reflectorized epoxy pavement markings will be applied with compressed dry air. Surface preparation is incidental to the application of the highly reflectorized epoxy pavement markings. Use material and equipment that will not damage the final pavement surface and that will show the final lines on which the pavement markings will be placed. Place guide markings for all permanent pavement markings. Identify the location of the pavement markings by applying spots on the pavement at 40-foot intervals. The Representative will approve the locations.

(d) **Installation.** Recess the epoxy pavement markings into the final pavement surface. This includes newly paved asphalt after the final rolling of the surface, concrete pavement, concrete bridge decks and interchange ramps. Diamond cut the recessed area to a depth of 80 to 100 mils and 1 inch wider than the width of the pavement marking. For skip lines, cut the recessed area 15 feet in length with a maximum tolerance of +6 inches on either end.

   For dry saw blade operation, clean and remove debris and dust from the entire roadway surface by self-contained vacuuming immediately after grinding.

   Wet saw blade operation is only permitted for use on concrete surfaces. When water is used, flush the groove with clean high-pressure water immediately following the cut to avoid build-up and hardening of the slurry in the groove. The concrete surface must be clean and dry before the application of the highly reflectorized epoxy pavement markings.

   Properly dispose of the waste resulting from the grinding operations. Dumping of any milling or grinding waste within the Turnpike right-of-way is strictly prohibited.

   Apply black epoxy markings on cement concrete roadways. Recess the black markings, flooded with black aggregate, immediately after all white skip line patterns. Cut the recessed area 25 feet in length with a maximum tolerance of +6 inches on either end. The line dimensions are 15’ for white and 10’ for black.

   The use of temporary shadow lines within the recessed area is prohibited.

   Do not begin marking operations until surface preparation work is completed and approved by the Representative. Install epoxy on dry pavement only if the road surface and ambient temperatures are 40°F or higher unless otherwise approved by the Representative and acceptable to the manufacturer.

   Apply pavement markings by the following simultaneous operation:

   1. The grooved pavement surface is air-blasted with dry air to remove dirt and residues

   2. The epoxy resin, mixed and heated in accordance with the manufacturer’s recommendations, is uniformly hot-sprayed into the groove at a wet thickness of 20 to 25 mils.

   3. Retroreflective optics are dropped onto the liquid epoxy marking so that they are uniformly distributed. Drop the retroreflective optics according to the following requirements for the option chosen:

   **OPTION A – Triple Drop**

   - First Drop - All-weather (AW) elements at a rate of 5 to 7 pounds per gallon
   - Second Drop - Visibead Plus II Highway Safety Marking Spheres or approved equal at a rate of 5 to 7 pounds per gallon
   - Third Drop - Standard glass beads at a rate of 5 to 7 pounds per gallon

   or
OPTION B – Double Drop

- First Drop - All-weather (AW) elements at a rate of 5 to 7 pounds per gallon
- Second Drop - Visibead Plus II Highway Safety Marking Spheres or approved equal at a rate of 10 to 12 pounds per gallon

(e) Retroreflectance. Test dry and wet retroreflectivity in the direction of traffic on each line (left edge, skip(s), right edge) at every whole milepost. Refer to ASTM E1710 for retroreflective measurements under dry conditions and ASTM E2832 for retroreflective measurements under continuous wet conditions.

Dry retroreflectivity measurements are to be taken within a 400-foot evaluation section at every whole milepost. Average a minimum of 20 retroreflectivity readings per line within the 400-foot evaluation section. Each average for each line will be used to determine a grand average for each line for the length of the project. The grand average of each line will be used to determine compliance. Directional data will be treated independently. See Figure 1 in ASTM D7585 for an example of how to space individual readings. For dry measurements, mobile equipment can be used as a substitute for handheld equipment.

Take at least one wet retroreflectivity reading on each line at every whole milepost. The grand average for each line will be determined from the respective wet readings. The grand average of each line will be used to determine compliance. Directional data will be treated independently. Take wet readings within the same 400-foot evaluation section used to obtain dry retroreflectivity readings.

Provide reports with all dry and wet retroreflectivity readings and their averages to the Representative within 5 days after the measurements are taken.

(f) Adhesion. Test the adhesion of the highly retroreflectorized epoxy pavement markings on each line (left edge, skip(s), right edge) at every whole milepost using the test method described in ASTM D6677. The rating system described in Table 1 of ASTM D6677 shall be used to rate the adhesion. The average of these tests will be used to determine compliance. Directional data will be treated independently. Take geocoded digital photographs of each test result.

Provide reports with all adhesion tests, their averages, and geocoded digital photographs to the Representative within 5 days after the measurements are taken.

(g) Observation Period. Be responsible for any defects in materials and workmanship of the highly reflectorized epoxy pavement markings for a period of 90 days from the date the markings are applied and under traffic.

Before the end of the observation period, but at least 30 days after the pavement markings are installed, inspect the pavement marking for adhesion, color and retroreflectivity; and inform the Representative in writing of all pavement markings that have failed and require replacement. The adhesion and retroreflectivity testing are to be performed by an agreed upon third party. Provide testing results to the Representative within 5 days after the measurements are taken. The pavement marking will be considered failed for any of the following conditions:

- Insufficient thickness or line width, uneven cross-section.
- Inadequate adhesion as determined by the adhesion testing results. Averaged scores less than 6 using Table 1 rating system shown in ASTM D6677 will be considered unacceptable.
- Insufficient depth of the groove.
- Retroreflected luminance (R₁) levels are below those shown in Table 1.
- Marking is discolored based on a visual inspection. Color chips provided by the manufacturer will be used to assess discoloring. The initial color of the white and yellow pavement markings shall meet the criteria established in 23 CFR 655.601 (required color criteria are included in the appendix to subpart F).
Table 1. Minimum Required Retroreflectivity Levels

<table>
<thead>
<tr>
<th></th>
<th>WHITE</th>
<th>DRY</th>
<th>CONTINUOUS WET</th>
</tr>
</thead>
<tbody>
<tr>
<td>Entrance Angle</td>
<td>88.76°</td>
<td>88.76°</td>
<td></td>
</tr>
<tr>
<td>Observation Angle</td>
<td>1.05°</td>
<td>1.05°</td>
<td></td>
</tr>
<tr>
<td>Retroreflected Luminance $R_L$ (mcd/m²/lx)</td>
<td>500</td>
<td>250</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>YELLOW</th>
<th>DRY</th>
<th>WET</th>
</tr>
</thead>
<tbody>
<tr>
<td>Entrance Angle</td>
<td>88.76°</td>
<td></td>
<td>88.76°</td>
</tr>
<tr>
<td>Observation Angle</td>
<td>1.05°</td>
<td></td>
<td>1.05°</td>
</tr>
<tr>
<td>Retroreflected Luminance $R_L$ (mcd/m²/lx)</td>
<td>300</td>
<td>200</td>
<td></td>
</tr>
</tbody>
</table>

Note: The test instrument shall use an Entrance Angle of 88.76° and Observation Angle of 1.05° which represent a simulated driver viewing geometry at a 30 meter distance.

(h) Defective Markings. Remove and replace highly reflectorized epoxy pavement markings, which after application and curing are determined by the Representative to be defective and not in conformance with this specification, within 30 days of receiving written notification from the Representative at no additional cost to the Commission. Work shall be in conformance with the manufacturer’s recommendations and as approved by the Representative before the project is accepted. The replacement markings shall conform to the same requirements as the original markings. Repair defective markings to the satisfaction of the Representative as follows:

- Insufficient film thickness and line width; insufficient glass bead coverage or inadequate glass bead retention; insufficient groove depth; uneven cross-section; retroreflected luminance ($R_L$) levels below those shown in Table 1.

  Repair Method: Prepare the surface of the defective highly reflectorized epoxy pavement markings by grinding or blast cleaning. No other cleaning methods are permitted. Prepare the surface so that a substantial amount of the reflective glass spheres are removed and a roughened epoxy marking surface remains. Immediately after surface preparation, remove loose particles and foreign debris by vacuuming and air blasting with compressed dry air. Re-stripe over the cleaned surface in accordance with the requirements of this specification and at full thickness.

- Uncured or discolored epoxy*; inadequate adhesion (to pavement surface or existing durable marking).

  Repair Method: Completely remove the defective epoxy to the underlying pavement surface in accordance with the requirements of this specification. Remove the defective area plus any adjacent highly reflectorized epoxy pavement marking material extending a minimum of three feet in any direction. After surface preparation work is complete, re-apply new epoxy over the cleaned pavement surface in accordance with the requirements of this specification.

*Uncured epoxy is defined as applied material that fails to cure (dry) within a reasonable time period under actual field conditions, as defined by the Representative. Discoloration is defined as localized areas or patches of brown, grayish or black colored epoxy marking.
material. These areas often occur in a cyclic pattern and often are not visible until several days or weeks after markings are applied.

Repair or replace other defects not noted above, but determined by the Representative to need repair, as directed by and to the satisfaction of the Representative.

(i) **Emergency Repair.** If the Commission determines that emergency repairs are necessary, perform the repairs within 24 hours of notification. If the Contractor fails to respond within the 24 hour period, the Commission reserves the right to perform the repairs and will charge the Contractor for all costs. The Commission’s determination of costs incurred is final and conclusive.

964.4 **MEASUREMENT AND PAYMENT** - Linear Foot, for the type indicated.
SECTION 1103 - TRAFFIC SIGNING AND MARKING

1103.01 GENERAL REQUIREMENTS - Certify material, as specified in Section 106.03(b)3.

1103.02 EXTRUDED ALUMINUM CHANNEL SIGNS (FOR POST MOUNTED SIGNS, TYPES A AND E AND STRUCTURE MOUNTED) -

(a) Extruded Aluminum Channels. As shown on the Standard Drawings.
Use channels conforming to ASTM B 221/B 221M, Alloy 6063-T6, from a manufacturer listed in Bulletin 15.
Use continuous-channel sections equal to the sign width. The channel section is nominal. The Contractor may use an alternate extruded channel section of equal or greater section moduli with dimensions suitable to utilize the mounting hardware with written permission.

(b) Coating Treatment. Use a chemical conversion coating, such as Alodine No. 1200, Alodine No. 1200S, or Bonderite No. 781.
Apply the coating to the channel surfaces to ensure a good bond between the reflective sheeting material and the surface. Coat according to Military Specification, MIL-C-5541E, “Chemical Conversion Coatings on Aluminum and Aluminum Alloys.” Do not handle with bare hands between the chemical conversion coating process and the application of the reflective sheeting. Handle by special devices or by hand wearing clean PVC gloves.

(c) Reflective Sheeting. Use precolored Type XI sheeting, conforming to the Department's specification for Retroreflective Sheeting Materials and Process Inks for Traffic Control, from a manufacturer listed in Bulletin 15.
Apply the sheeting to the face and a 3/8-inch width along both edges of the channel sections, using a procedure specified by the sheeting material manufacturer. Apply free of bubbles or wrinkles greater than 3 inches in length and with total sheeting shrinkage of not more than 1/8 inch. A maximum of one splice may be made in the sheeting for any channel section. Make the splice perpendicular to the longitudinal centerline of the channel, with the edges of adjacent pieces butted together throughout the entire seam length, without any overlap or separation. If covered sections are stacked before sign fabrication, then use microfoam between sign faces and store sections in a vertical position.

(d) Legend and Border. Use direct-applied cutout Type XI reflective sheeting material for letters, numerals, accessories, borders, and symbols.

(e) Sign Fabrication. Apply the reflective sheeting, then firmly bolt channels together with the webs in the same plane, to form a smooth and uniform surface. Adjust channel ends for correct position so the edges are free from projections.
Securely fasten assembled sign panels to a rigid framework, before application of legend and before shipment. Lay out the legend and border on the sign face as indicated on the sign fabrication drawings.
Apply cutout Type XI legend and border to sign face according to manufacturer's instructions.
Fabricate signs in a single unit. If necessary, ship large signs sectionalized in panels. When shipping sectionalized signs, slit any legend and border, which overlaps the panels.

(f) Sign Identification. Fabricate the plaques of aluminum, plastic, or fiberglass of sufficient thickness to provide the necessary stiffness and to resist vandalism, or stencil directly on the sign panel with weather-resistant paint. Indicate sign number and the month and year of erection in 1-inch high characters of a contrasting color to the background, and affix to the rear of the sign in the lower righthand corner when viewed from the back. If rivets are used to attach plaques, use 1/8-inch aluminum rivets inserted from the sign face.
1103.03 FLAT SHEET ALUMINUM SIGNS WITH STIFFENERS (FOR POST MOUNTED SIGNS, TYPES A, D, AND E; AND STRUCTURE MOUNTED SIGNS) -

(a) Flat Sheet Aluminum. Use aluminum as specified in Section 1103.04(a) with a minimum thickness of 0.080 inch.

Fabricate panels from a single aluminum sheet or from a number of pieces, making every effort to minimize the total length of joints. Locate joints so the legend does not straddle two or more aluminum sheets, whenever possible. Use sheets with a minimum width of 48 inches, wherever possible. Use continuous sheets for the full width of signs less than 12 feet wide or for the full height of signs less than 12 feet high. Use sheets free of buckles, warps, or dents. Remove burrs.

(b) Coating Treatment and Reflective Sheeting. Sections 1103.02(b) and (c), except as follows:

Apply the sheeting only to the face of the sign. A maximum of one splice in the reflective sheeting will be allowed on an aluminum sheet.

(c) Legend and Border. Section 1103.02(d)

(d) Extruded Aluminum Stiffeners, and Splice Bars. As shown on the Standard Drawings and as follows:

Manufacture channels from aluminum, conforming to ASTM B 209/B 209M, Alloy 6061-T6.

Use large stiffener sections in 16-foot lengths and medium stiffener sections in 12-foot lengths. An alternate cross section of equal or greater section modulus than that indicated may be used with written permission.

(e) Sign Fabrication. Stiffener sections may end at a maximum of 3 inches from each sign edge. If the sign is more than 6 inches wider than the length of a full-length stiffener section, then splice two sections together, using 3/16-inch rivets, as shown on the Standard Drawings, to form a longer composite section. Position the splice so it is not on or within 15 inches of a sign post or within the center half of the span between sign posts. Stagger splices on adjacent sign stiffeners as much as possible. The aluminum sheeting may extend above the top stiffener or below the bottom stiffener for a maximum distance equal to one-third of the spacing between the stiffeners. If using an exit panel, use a stiffener on both the primary sign top and on the exit panel bottom.

Use 3/16-inch aluminum rivets at a maximum spacing of 6 inches and end rivets within 1 inch of the end of the stiffener. Hold the aluminum sheet firmly against the stiffener section while holes are drilled and rivets are expanded.

If the aluminum sheets are placed with the long dimension vertical or if a single large section stiffener or a single flanged medium section stiffener is used to join two panels together, then it may be necessary to have the flat sheet aluminum clamped to the stiffener section while the holes are drilled. Then, disassemble the sign for shipping. If disassembled, then remove burrs around the drilled holes to facilitate handling and to ensure a tight connection.

If exit panels cannot be supported by two sign posts, brace the panel with one or more auxiliary supports. Bolt the supports to a minimum of three stiffeners on the primary sign by use of clips.

If a single stiffener section is not used to join two adjacent panels together use butting plates, as shown on the Standard Drawings. Place butting plates at the left and right edges of the sign and at intervals not greater than 36 inches throughout the length of horizontal joints between the posts. Use either twist-in bolts or standard-connection bolts and plastic inserts to fasten the butting plates.

For joints between aluminum sheets, without a stiffener on the joint, fasten lightweight aluminum sheets with 1/8-inch aluminum rivets to the sign back.

Use twist-in toggle and buckle straps, or post clips, on stiffener sections at each post.

Lay out the legend and border on the sign face according to the sign fabrication drawings.

Apply cutout Type XI legend and border to sign face according to manufacturer's instructions.
Fabricate signs in a single unit. If necessary, ship large signs sectionalized in panels. Slit any legend and border, which overlaps the panel, when shipping sectionalized signs.

(f) **Sign Identification.** Section 1103.02(f)

(g) **Internally Illuminated Signs.** Provide from a Bulletin 15 manufacturer, as shown on the approved plans, and as follows:

- Mount to traffic signal support using a minimum of two bracket connections. Secure each bracket to the mast arm using double stainless steel banding. Connect wiring from Internally Illuminated Sign to a circuit breaker in the electrical service disconnect box. Provide maintenance demonstration to municipal official responsible for maintaining the sign.
- Construct sign using a weatherproof housing with drain holes in the bottom of the sign and corrosion resistant stainless steel for all fasteners and hardware.
- Sign must be UL listed and approved.
- Use Bulletin 15 approved transparent reflective sheeting capable of being internally illuminated and retroreflective when not energized. Use Clearview W2 font or as specified on the plan. Display the designated message clearly and legibly during both daylight and during hours of darkness. Internally illuminate with Light Emitting Diodes (LEDs).
- For Street Name Signs show approved street name on both faces (double-sided), unless otherwise approved by the Representative in writing.
- Supply a weather-tight wire entrance junction box with the sign assembly. Mount the box on the exterior or interior of the sign. Use an appropriately sized 3-conductor (minimum 14 AWG) cable between the sign and the controller assembly.
- For Street Name Signs provide brackets that allow the sign to swing freely. Use a two-point support assembly to mount the Internally Illuminated Street Name Sign to a mast arm that is perpendicular to the street, or use a single-point support assembly if the Internally Illuminated Sign is attached to a mast arm that is diagonal to the street.
- Mount a photocell on the top of each sign.
- Provide all warranty documentation to the Representative at final acceptance.

(h) **School Zone Speed Limit Flashing Warning Sign.** Provide a School Zone Speed Limit Sign Assembly in accordance with Section 1104, as shown on the approved plans, and as follows:

- Utilize approved yellow Light Emitting Diode (LED) indications as indicated in Section 955.
- For Type II and Type III sign, use LED-illuminated “15” speed limit message.
- Include all hardware to provide a functional assembly. Assembly includes specified structural support with foundation, mounting hardware, an approved solid state flasher - dual circuit controller assembly, an approved solid state time clock and wiring for the indications.
- Provide and label an on/off switch in the controller assembly to operate the flashing yellow LED lenses and the steady red "15" speed limit message while retaining power to the time clock.
- Provide sign assembly capable of obtaining power from solar or electric source.
- Provide all warranty documentation to the Representative at final acceptance.

(i) **Flashing Warning Sign.** Provide a Flashing Warning Sign in accordance with Section 1104, as shown on the approved plans, and as follows:

- Utilize approved yellow Light Emitting Diodes (LED) indications as indicated in Section 955.
- Include all hardware to provide a functional assembly. Assembly includes specified structural support with foundation, mounting hardware, an approved solid state flasher - dual circuit controller assembly, an approved solid state time clock and wiring for the indications.
- Provide and label an on/off switch in the controller assembly to operate the flashing yellow LED lenses while retaining power to the time clock.
- Provide sign assembly capable of obtaining power from solar or electric source.
(j) **Light Emitting Diode (LED) Blank-Out Signs.** Provide LED Blank-Out sign from a manufacturer listed in Bulletin 15, in accordance with Section 936, conforming to all regulations, and as shown on the approved plans. Provide verification from independent laboratory test results. Provide all warranty documentation to the Representative at final acceptance.

1103.04 **FLAT SHEET SIGNS (FOR POST MOUNTED SIGNS, TYPES B, C, AND F; AND DISTANCE MARKER(S) -**

(a) **Blanks.** Use aluminum blanks. For signs furnished under Section 901, use plywood, aluminum, acrylonitrile butadiene styrene (ABS), aluminum/plastic laminate, corrugated polypropylene, or polyethylene blanks. Physical and chemical properties of plywood and aluminum blanks are to conform to Publication 306M.

(b) **Coating Treatment.** Prepare sign faces with appropriate coating conforming to Publication 306M.

(c) **Reflective Sheeting.** Use sheeting from a manufacturer listed in Bulletin 15.

1. **General.** Apply the sheeting to the sign face using a procedure according to the sheeting manufacturer, free of bubbles or wrinkles greater than 3 inches in length, and with total sheeting shrinkage of not more than 1/8 inch.
   - On signs larger than 48 inches on the shorter side, sheeting may be spliced with the edges of adjacent pieces butted together throughout the entire seam length without any overlap or separation.
   - Use Type III or Type IV sheeting for all signs.

(d) **Ink.** As recommended by the manufacturer of the reflective sheeting.

(e) **Electronic Cuttable (EC) Film.** Use film from a sheeting manufacturer listed in Bulletin 15. Apply the sheeting to the sign face using a procedure according to the sheeting manufacturer, free of bubbles or wrinkles greater than 1 inch in length.

(f) **Legend and Border.** Apply legend and border of the color, size, and dimensions shown in Publication 212, Publication 213, and the MUTCD or as indicated. Use silk screens with a mesh of 12XX or finer for reverse screening. Use stencils with sharp clear-cut edges, uniform curvature, and straight lines. Silk screen in a manner resulting in uniform color and tone, with sharply-defined edges and without blemishes on the sign background. Air dry or bake signs after silk screening to achieve a smooth hard finish. Blisters appearing during the drying process will be cause for rejection. If direct-applied legend is indicated for any directional or destination sign, use Type III or Type IV reflective sheeting. Slip-sheet and pack signs to ensure delivery in an undamaged condition.

1103.05 **DELINEATION DEVICES -** Not used.

1103.07 **STEEL S OR W BEAM POSTS AND BREAKAWAY SYSTEM (FOR POST MOUNTED SIGNS, TYPE A) -**

(a) **Steel S or W Beam Posts.** As shown on the Standard Drawings.

(b) **Breakaway System.** As shown on the Standard Drawings and as follows:

1. **Couplings.** Alloy steel AMS 6378D with:
Minimum tensile yield stress of 130,000 psi.
Ultimate tensile strength of 150,000 psi.
Minimum Rockwell C hardness of 32.
Capable of withstanding a tensile breaking load of 41,000 pounds.

2. **Hinge Plates.** Alloy steel AISI 4130, 4340, or an equivalent material with a minimum tensile yield stress of 70,000 pounds per square inch, an ultimate tensile stress range of 90,000 pounds per square inch to 108,000 pounds per square inch, and a tensile breaking load, in pounds, as follows:

<table>
<thead>
<tr>
<th>Model</th>
<th>Minimum Load</th>
</tr>
</thead>
<tbody>
<tr>
<td>SBHB1B</td>
<td>51 min. (11,450 min.)</td>
</tr>
<tr>
<td>SBHB2B</td>
<td>73 min. (16,400 min.)</td>
</tr>
</tbody>
</table>

3. **Brackets.** Aluminum alloy ASTM B 221/B 221M, Alloy 6061-T6 or equal, with a load-concentrating boss of stainless steel, ASTM A 582/A 582M, Type 416, or equal.

4. **Bolts, Nuts, and Washers.**
   4.a **Hinge Plates.** AISI 4130 Steel. Galvanized as specified in Section 1105.02(s), ASTM A 153.
   4.b **Brackets.** ASTM B 209; Alloy 6061-T6.

5. **Anchor.** Type 304 stainless steel ferrule with 1053 steel rod and coil.

6. **Coupling Bolts.** AMS 6378D, galvanized as specified in Section 1105.02(s), ASTM A 153/A 153M.

   (c) **Fabrication.** Cut, drill or punch holes in parts or members, before galvanizing. Furnish a statement, before the beginning of galvanizing, showing the carbon content of the steel to be galvanized. Hot-dip galvanize posts and hardware after fabrication, as specified in Section 1105.02(s). Bolts, nuts, and washers to be galvanized according to ASTM B 695 and B 696 (AASHTO M 298 and M 299) and conforming to the coating thickness, adherence, and quality requirements of ASTM A 153/A 153M (AASHTO M 232).

**1103.08 BREAKAWAY STEEL POSTS (FOR POST MOUNTED SIGNS, TYPE B AND DISTANCE MARKERS) -**

   (a) **Steel Channel Bar Posts.** As shown on the Standard Drawings and as follows:

   Roll posts from standard carbon steel rails, ASTM A 499, with a minimum tensile strength of 90,000 pounds per square inch and a minimum yield strength of 60,000 pounds per square inch or new billet steel equivalent with a minimum tensile strength of 90,000 pounds per square inch and a minimum yield strength of 60,000 pounds per square inch. Cast heat analysis of new billet as follows:

<table>
<thead>
<tr>
<th>Element</th>
<th>Composition (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbon</td>
<td>0.67 to 0.82</td>
</tr>
<tr>
<td>Manganese</td>
<td>0.70 to 1.10</td>
</tr>
<tr>
<td>Phosphorus, max.</td>
<td>0.04</td>
</tr>
<tr>
<td>Sulphur, max.</td>
<td>0.05</td>
</tr>
<tr>
<td>Silicon</td>
<td>0.10 to 0.25</td>
</tr>
</tbody>
</table>
Roll bars to the required shape, dimensions, and weight.
Drill or punch holes for mounting. Additional holes on 1-inch centers available for punching are allowed. After fabrication, paint green according to ASTM G 154 using Federal Color No. 595.14062; electrostatically coat with a green polyester coating as specified in Section 1103.08(c); or hot-dip galvanize as specified in Section 1105.02(s) (ASTM A 123/A 123M).

(b) Steel Square Posts. As shown on the Standard Drawings and as follows:

1. Material. Roll formed and conforming to one of the following:
   - Cold rolled steel in 10 gage (0.135-inch) or 12 gage (0.105-inch) with a minimum yield strength of 33,000 pounds per square inch and a minimum tensile strength of 45,000 pounds per square inch, conforming to the chemical and mechanical requirements of ASTM A 653/A 653M and ASTM A 924/A 924M, Grade 230 (Grade A).
   - Hot rolled carbon sheet steel in 12 gage (0.105 inch) or 14 gage (0.083-inch) with a minimum yield strength of 60,000 pounds per square inch and a minimum tensile strength of 75,000 pounds per square inch, conforming to the chemical requirements of ASTM A 1011/A 1011M, Grade 55.
   - Cold rolled steel in 14 gage (0.075-inch) with a minimum yield strength of 60,000 pounds per square inch and a minimum tensile strength of 70,000 pounds per square inch, conforming to the chemical requirements of ASTM A 1008/A 1008M.

2. Fabrication.
   - Corner weld and scarf as necessary to allow sections to telescope within each other.
   - Space 7/16-inch diameter cut holes or knockout holes on 1-inch centers, on the centerline of all four sides, in true alignment, and opposite to each other.

3. Protective Coating. Apply after fabrication using one of the following methods:

3.a Method 1. Galvanize or coat the inside and outside as specified in Section 1105.02(s) (AASHTO M 111). Either of two alternate coating systems may be used as follows:
   - Outside. Apply a hot-dipped coating of zinc, according to ASTM B 6, at a minimum rate of 1.0 ounce per square foot ± 0.1 ounce per square foot of actual surface area; a chromate conversion coating at a rate 30 micrograms per square inch ± 15 micrograms per square inch of actual surface area; and a thermoplastic, electrostatically applied acrylic or polymer coating, 0.5 mil ± 0.2 mil in thickness, and
   - Inside. Apply a zinc based coating, 0.5 ± 0.2 mil in thickness, at a rate of 0.3 ounce per square foot ± 0.05 ounce per square foot with a minimum of 80% zinc powder by weight.

3.b Method 2. Apply a triple coating of zinc, conforming to AASHTO M 120, having a weight of 0.60 ounce per square foot ± 0.15 ounce per square foot, to the outside of posts after fabrication. Apply a chromate conversion coating of 15 micrograms per square inch ± 5 micrograms per square inch and a clear organic exterior coating of 0.2 mil ± 0.1 mil following the zinc application. Provide a double, in-line application of a full zinc-based organic coating of 1.2 mils ± 0.6 mils for the inside surface, tested according to ASTM B 117.

(c) Polyester Post Coating.

1. Powder Composition. As follows, or of sufficiently similar composition to meet the specified testing requirements:

- Polyester Resin (molecular weight equivalent 2,000-5,000) 40%-75%
- Blocked-Isocyanate Curing Agent (molecular weight equivalent 1,000-3,000) 10%-25%
- Flow Control Agent (acrylo-terpolymers) 0.1%-2.0%
- Exterior-Durable Grade Pigment and Extender 25%-50%
- Organic Volatile Content 3% Max.

2. Pretreatment. Blast clean steel posts to near white with blast profile not greater than 2 mils. Apply coating immediately after cleaning, as an electrostatically charged dry powder sprayed onto the grounded post, using an electrostatic spray gun.

3. Color. Green, unless otherwise specified.

4. Physical Tests. Test coating as follows:

- Impact Test. According to ASTM D 2794, showing no cracks or breaks when an impact of 100 inch-pounds is applied.
- Salt Spray. No rust, blisters, or undercutting of uncoated or scribed areas apparent, when tested for 500 hours, according to ASTM B 117.
- Film Thickness. Thickness measured on a flat surface of the post, according to ASTM D 1186, 0.002 inch minimum.
- Weatherometer. No more than 15% gloss loss, when tested for 1,000 hours in a carbon arc weatherometer, according to ASTM G 152, Type EH.
- Humidity. No blistering of the coating nor gloss loss greater than 5%, when tested according to ASTM D 2247.

1103.09 TREATED WOOD AND COMPOSITE POSTS (FOR POST MOUNTED SIGNS, TYPES C AND E) –

(a) Treated Wood Posts (for Post Mounted Signs, Types C and E).

1. Posts. S4S No. 1 Dense or No. 1 Dense SR Southern Yellow Pine or No. 1 Douglas Fir-Larch, seasoned to a maximum of 19% moisture.
Grade and grade mark each post, before treatment, with an official grade stamp or inspection agency mark, certified by the Board of Review, American Lumber Standards Committee. Cut and drill before preservative treatment.

2. **Treatment.** Treat with Ammoniacal Copper Arsenite (ACA) or Chromated Copper Arsenate (CCA) Type A, B, or C meeting AWPA Standard P5. Use a minimum preservative retention of 0.40 pound per cubic foot by assay (oxide basis). Treat and quality mark according to AWPA C2. Inspect according to AWPA Standards M1 and M2.

Include a treatment certificate with each shipment.

(b) **Composite Posts (for Post Mounted Signs, Type E).**

1. **Posts.** Unsaturated polyester resin reinforced with E-glass and lightweight aggregate concrete not greater than 110 pounds per cubic foot to form a rigid structural support member. Tensile modulus of tube to be not less than 2,500 kips per square inch. Posts to be equal to or greater in strength to Schedule 40 steel of the same diameter (ASTM A 53/A 53M).

2. **Weathering.** Post shall have less than 10% loss of strength after 3,600 hours of accelerated weathering exposure to moisture and lamps required in ASTM G 152, G 155, and G 154.

3. **Color.** Specified post color will be permanent throughout the FRP tube with not less than 1.5 mil dry film thickness. After 3,600 hours exposure according to ASTM G 152, G 155, and G 154, posts will exhibit 90% adhesion, ASTM D 4541 and a maximum color change of 25, Delta -E.

1103.10 **DELINEATOR POSTS** - Not used.

1103.11 **MISCELLANEOUS MATERIALS** -

(a) **Hex Head Bolts, Nuts, and Washers for Extruded Panel Sign Post-Clips.** Galvanized steel as specified in Section 1105.02(s):

1. **Hex Head Bolts.** ASTM A 307, Grade A or B.

2. **Nut.** ASTM A 563 DH or ASTM A 194 Grade 1 or 2.

3. **Washer.** Carbon steel helical coil or ASTM F 436 or ASTM F 844 (Note 1)

**Note 1:** If either ASTM F 436 or ASTM F 844 flat washers are used, bolt must be fastened either using two nuts or a single nut with the threads galled adjacent to the nut to prevent loosening.

(b) **Post-Clips.** For extruded panel signs, aluminum, conforming to ASTM B 108, Alloy 356-T6. For flat sheet aluminum signs with stiffeners, stainless steel, Type 304, 14 gage.

(c) **Auxiliary Supports for Exit Panels.** Aluminum conforming to ASTM B 211/B 211M, Alloy 6061-T6. 3 inches by 3 inches by 3/16-inch angle, 6 1/2 feet long or long enough to attach to three stiffeners on the main sign.

(d) **Lag Screws.** 5/16-inch round head, galvanized steel as specified in Section 1105.02(s); ASTM A 307.

(e) **Rivets.** Aluminum, self-plugging or hollow-core, as follows:
- 3/16-inch for mounting reflective units and distance plaques—Alloy 5056 with 7178 mandrels.

- 3/16-inch for mounting flat aluminum sheets to stiffeners sections—Alloy 5056 with carbon steel mandrels.

Rivet size specified is the minimum shank diameter. Use rivets with sufficient grip range to attach to background sign material, stiffeners, or posts. Use a No. 10 drill for 3/16-inch rivets for attachment of stiffeners and splice bars.

(f) **Bolts, Nuts, and Washers for Flat Sheet Aluminum Signs with Stiffeners.** Stainless steel, Type 304 bolts. Use 5/16-inch by 1 inch long for butting plates and 5/16-inch by 2 inches long for post-clips. Use standard connection bolts or twist-in bolts.

(g) **Twist-in Toggle and Buckle Straps.** Stainless steel, Type 201, and 0.75 inch wide and 0.03 inch thick, with rounded edges. Spot welded, twist-in type toggle on end of strap. Spot welded, antirotational buckle on other end of strap. Toggles and buckles shall be stainless steel, Type 304, and 1/16 inch thick.

(h) **Butting Plates.** Fabricate from stainless steel, Type 304.

(i) **Anchors.** Section 1105.02(c)2. From a manufacturer listed in Bulletin 15.

(j) **Anti-Theft Sign Hardware.**

1. **System A.**

   - **Bolts.** Section 1105.02(c)1 and as follows:
     Provide 5/16 inch by 2 1/2-inch steel carriage bolts with minimum 11/16-inch diameter round head, square neck, and threads to within 1 inch of head.
     Furnish bolts having a mechanically deposited cadmium coating, ASTM B 696, or zinc, Type I coating as specified in Section 1105.02(s).

   - **Nuts.** Square, pyramidal-shaped nuts with all four sides sloping at an angle of 41 degrees; 5/16-18 UNC threads; C-1010 cold-rolled steel, case hardened to Rockwell hardness of 55 to 60.
     Furnish nuts having a 0.002 inch to 0.005 inch thick, mechanically deposited, zinc, Type II yellow chromate coating as specified in Section 1105.02(s) (ASTM B 695), tested according to ASTM B 201.

2. **System B.**

   - **Bolts.** Section 1103.11(m) and as follows:
     Provide 5/16-inch by 2 1/2-inch and 5/16-inch by 3-inch bolts with minimum 9/16-inch diameter one-way heads and threads to within 1 inch of head.

   - **Nuts.** Section 1103.11(n) and as follows:
• **Washers.** Nylon 1/8 inch thick by 1-inch minimum outside diameter with 480 inch-pounds maximum allowable applied torque.

(k) **Banding.** Stainless steel, Type 201, 0.750 inch wide by 0.030 inch thick, with rounded edges for handling ease and safety. Buckles and other necessary hardware shall be of stainless steel, Type 304.

(m) **Aluminum Bolts.** ASTM B 211/B 211M. Alloy 2024-T4, thread fit, ANSI Class 6g, and threads shall be within two threads of the head or a minimum of 1 3/4 inches.

(n) **Aluminum Nuts.** ASTM B 211/B 211M. Alloy 2024-T6, thread fit, ANSI Class 6H (ANSI Class 2B, 18 UNC threads).

### 1103.12 SIGN AND DISTANCE MARKER SUPPORTS -

(a) **General.** Hot-dip galvanize steel, except stainless steel, after fabrication, as specified in Section 1105.02(s). Drill or punch holes and cut before galvanizing.

(b) **Brackets for Post Mounted Signs, Types C, D, and F.** ASTM A 283.

(c) **Bars for Post Mounted Signs, Types C, D, and E.** AASHTO M 270/M 270M (ASTM A 709/A 709M) Grade 250 (Grade 36).

(d) **Shims for Post Mounted Sign, Types C and E.** AASHTO M 270/M 270M (ASTM A 709/A 709M) Grade 250 (Grade 36).

(e) **Steel Pipe Supports for Post Mounted Signs, Types D and E.** ASTM A 53/A 53M.

(f) **Shapes and Plates for Post Mounted Signs, Type D.** AASHTO M 270/M 270M (ASTM A 709/A 709M) Grade 250 (Grade 36).

(g) **Angles (Aluminum) for Post Mounted Signs, Type E, and Structure Mounted Signs.** ASTM B 308/B 308M, Alloy 6061-T6.

(h) **Shim Bars and Plates for Post Mounted Signs, Type E.** AASHTO M 270/M 270M (ASTM A 709/A 709M) Grade 250 (Grade 36).

(i) **Brackets, Bars, Clamps, Strips, and Gussett Plates (for Erecting Distance Markers on Bridge Railing).** Stainless Steel, ASTM A 167.

### 1103.13 DELINEATOR BRACKETS - Not used.

### 1103.14 REFLECTIVE GLASS BEADS -

(a) **General.** Furnish reflective glass beads conforming to AASHTO M 247, except as follows:

1. **Gradation.** Satisfies the following gradation for type indicated:
<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>Type A</th>
<th>Type B</th>
<th>Type C</th>
<th>Type D</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.0 mm (10)</td>
<td>-</td>
<td>100</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>1.7 mm (12)</td>
<td>-</td>
<td>95 to 100</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>1.4 mm (14)</td>
<td>-</td>
<td>80 to 95</td>
<td>95 to 100</td>
<td>-</td>
</tr>
<tr>
<td>1.18 mm (16)</td>
<td>100</td>
<td>10 to 40</td>
<td>80 to 95</td>
<td>100</td>
</tr>
<tr>
<td>1.0 mm (18)</td>
<td>-</td>
<td>0 to 5</td>
<td>10 to 40</td>
<td>-</td>
</tr>
<tr>
<td>850 µm (20)</td>
<td>-</td>
<td>0 to 2</td>
<td>0 to 5</td>
<td>95 to 100</td>
</tr>
<tr>
<td>710 µm (25)</td>
<td>-</td>
<td>-</td>
<td>0 to 2</td>
<td>65 to 90</td>
</tr>
<tr>
<td>600 µm (30)</td>
<td>75 to 95</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>500 µm (35)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>10 to 45</td>
</tr>
<tr>
<td>300 µm (50)</td>
<td>15 to 35</td>
<td>-</td>
<td>-</td>
<td>0 to 10</td>
</tr>
</tbody>
</table>

2. **Rounds.** Provide glass beads with a minimum of 75% true spheres overall, a minimum of 70% true spheres per sieve, and not more than 3% angulars overall.

3. **Coating.** Supply Types A, B, and D glass beads with coatings to enhance moisture resistance, embedment, and adherence with the binder. Supply Type C with coatings to enhance embedment and adherence.
HOLIDAY RESTRICTIONS

2015 HOLIDAYS

FALL CARLISLE AUTO SHOW ....................... From 5:00 A.M., local time, Friday, October 2 to 11:00 P.M., local time, Sunday, October 4, 2015.

HERSHEY REGION FALL MEET ..................... From 5:00 A.M., local time, Friday, October 9 to 11:00 P.M., local time, Sunday, October 11, 2015.

FORT LIGONIER DAYS ............................... From 5:00 A.M., local time, Friday, October 9 to 11:00 P.M., local time, Sunday, October 11, 2015.

THANKSGIVING DAY .................................. From 5:00 A.M., local time, Tuesday, November 24 to 11:00 P.M., local time, Sunday, November 29, 2015.

CHRISTMAS AND NEW YEARS ........................ From 5:00 A.M., local time, Friday, December 18, 2015 to 11:00 P.M., local time, Sunday, January 3, 2016.

2016 HOLIDAYS

PRESIDENTS DAY ...................................... From 5:00 A.M., local time, Friday, February 12 to 11:00 P.M., local time, Monday, February 15, 2016.

EASTER ..................................................... From 5:00 A.M., local time, Friday, March 25 to 11:00 P.M., local time, Monday, March 28, 2016.

SPRING CARLISLE AUTO SHOW .................. From 5:00 A.M., local time, Thursday, April 21 to 11:00 P.M., local time, Sunday, April 24, 2016.

MEMORIAL DAY ......................................... From 5:00 A.M., local time, Friday, May 27 to 11:00 P.M., local time, Tuesday, May 31, 2016.

U.S. MEN’S OPEN ....................................... From 5:00 A.M., local time, Friday, June 10 to 11:00 P.M., local time, Monday, June 20, 2016.

INDEPENDENCE DAY ................................. From 5:00 A.M., local time, Friday, July 1 to 11:00 P.M., local time, Monday, July 11, 2016.

CORVETTES AT CARLISLE AUTO SHOW ... From 5:00 A.M., local time, Friday, August 26 to 11:00 P.M., local time, Sunday, August 28, 2016.

LABOR DAY .............................................. From 5:00 A.M., local time, Friday, September 2 to 11:00 P.M., local time, Tuesday, September 6, 2016.

FALL CARLISLE AUTO SHOW .................... From 5:00 A.M., local time, Friday, September 30 to 11:00 P.M., local time, Sunday, October 2, 2016.

HERSHEY REGION FALL MEET .................... From 5:00 A.M., local time, Friday, October 7 to 11:00 P.M., local time, Sunday, October 9, 2016.
FORT LIGONIER DAYS .................................... From 5:00 A.M., local time, Friday, October 14 to 11:00 P.M., local time, Sunday, October 16, 2016.

THANKSGIVING DAY ..................................... From 5:00 A.M., local time, Tuesday, November 22 to 11:00 P.M., local time, Sunday, November 27, 2016.

CHRISTMAS AND NEW YEARS ...................... From 5:00 A.M., local time, Friday, December 23, 2016, to 11:00 P.M., local time, Monday, January 2, 2017.

2017 HOLIDAYS

PRESIDENTS DAY ............................................ From 5:00 A.M., local time, Friday, February 17 to 11:00 P.M., local time, Monday, February 20, 2017.

EASTER .............................................................. From 5:00 A.M., local time, Friday, April 14 to 11:00 P.M., local time, Monday, April 17, 2017.

SPRING CARLISLE AUTO SHOW ............... From 5:00 A.M., local time, Thursday, Prior to Spring Carlisle Auto Show to 11:00 P.M., local time, Sunday, After Spring Carlisle Auto Show, 2017.

MEMORIAL DAY .............................................. From 5:00 A.M., local time, Friday, May 26 to 11:00 P.M., local time, Tuesday, May 30, 2017.

INDEPENDENCE DAY ..................................... From 5:00 A.M., local time, Friday, June 30 to 11:00 P.M., local time, Monday, July 10, 2017.

CORVETTES AT CARLISLE AUTO SHOW ... From 5:00 A.M., local time, Friday, Prior to Corvettes at Carlisle Auto Show to 11:00 P.M., local time, Sunday, After Corvettes at Carlisle Auto Show, 2017.

LABOR DAY ...................................................... From 5:00 A.M., local time, Friday, September 1 to 11:00 P.M., local time, Tuesday, September 5, 2017.

FALL CARLISLE AUTO SHOW............... From 5:00 A.M., local time, Friday, Prior to Fall Carlisle Auto Show to 11:00 P.M., local time, Sunday, After Fall Carlisle Auto Show, 2017.

HERSHEY REGION FALL MEET .................... From 5:00 A.M., local time, Friday, October 6 to 11:00 P.M., local time, Sunday, October 8, 2017.

FORT LIGONIER DAYS............................... From 5:00 A.M., local time, Friday, October 13 to 11:00 P.M., local time, Sunday, October 15, 2017.

THANKSGIVING DAY ..................................... From 5:00 A.M., local time, Tuesday, November 21 to 11:00 P.M., local time, Sunday, November 26, 2017.

CHRISTMAS AND NEW YEARS .................... From 5:00 A.M., local time, Friday, December 22, 2017, to 11:00 P.M., local time, Monday, January 1, 2018.
2018 HOLIDAYS

PRESIDENTS DAY ............................................ From 5:00 A.M., local time, Friday, February 16 to 11:00 P.M., local time, Monday, February 19, 2018.

EASTER .............................................................. From 5:00 A.M., local time, Friday, March 30 to 11:00 P.M., local time, Monday, April 2, 2018.

SPRING CARLISLE AUTO SHOW ............. From 5:00 A.M., local time, Thursday, Prior to Spring Carlisle Auto Show to 11:00 P.M., local time, Sunday, After Spring Carlisle Auto Show, 2018.

MEMORIAL DAY .............................................. From 5:00 A.M., local time, Friday, May 25 to 11:00 P.M., local time, Tuesday, May 29, 2018.

INDEPENDENCE DAY ....................................... From 5:00 A.M., local time, Friday, June 29 to 11:00 P.M., local time, Monday, July 9, 2018.

CORVETTES AT CARLISLE AUTO SHOW ... From 5:00 A.M., local time, Friday, Prior to Corvettes at Carlisle Auto Show to 11:00 P.M., local time, Sunday, After Corvettes at Carlisle Auto Show, 2018.

LABOR DAY ...................................................... From 5:00 A.M., local time, Friday, August 31 to 11:00 P.M., local time, Tuesday, September 4, 2018.

FALL CARLISLE AUTO SHOW ............... From 5:00 A.M., local time, Friday, Prior to Fall Carlisle Auto Show to 11:00 P.M., local time, Sunday, After Fall Carlisle Auto Show, 2018.

HERSHEY REGION FALL MEET .................... From 5:00 A.M., local time, Friday, October 5 to 11:00 P.M., local time, Sunday, October 7, 2018.

FORT LIGONIER DAYS................................. From 5:00 A.M., local time, Friday, Prior to Fort Ligonier Days to 11:00 P.M., local time, Sunday, After Fort Ligonier Days, 2018.

THANKSGIVING DAY .............................. From 5:00 A.M., local time, Tuesday, November 20 to 11:00 P.M., local time, Sunday, November 25, 2018.

CHRISTMAS AND NEW YEARS ............... From 5:00 A.M., local time, Friday, December 21, 2018, to 11:00 P.M., local time, Tuesday, January 1, 2019.