

Section 646 Pavement Marking

646.1 Description

- (1) This section describes providing and removing pavement marking.

646.2 Materials

646.2.1 General

- (1) Furnish pavement marking products from the department's APL. Submit certificates of compliance certifying that the products supplied under the contract conform to these specifications.

646.2.2 Glass Beads

- (1) Furnish dual coated glass beads treated for both moisture resistance and adherence conforming to AASHTO M247, Type I, except with a minimum of 80 percent true spheres. For each batch of beads actually furnished for the work, submit a certificate of compliance certifying that beads supplied under the contract conform to these specifications.
- (2) Furnish beads in containers or bags labeled with the bead type, net weight, lot or batch number, blend date, and manufacturer's name and address.

646.3 Construction

646.3.1 General

646.3.1.1 General Marking

Revise 646.3.1.1(1) to reinstate language that prohibited removing polymer overlay material to receive pavement marking. This change was implemented in ASP 6 effective with the December 2017 letting.

- (1) Prepare the surface and apply marking as the manufacturer specifies. Provide manufacturer specifications as the engineer requests. Do not mark over a marking product with less adherence or over chipped or peeled marking. **Do not remove polymer overlay materials in areas receiving pavement marking. Use only epoxy pavement marking where the contract requires marking placed on polymer overlays.**
- (2) For moving marking operations conform to the marking plan details.
- (3) On highways open to 2-way traffic, in addition to the marking vehicle, provide a leading vehicle and at least one trailing vehicle. Do not use flashing arrow panels to direct traffic to pass. Equip each leading and trailing vehicle with the following:
 1. A slow-moving vehicle emblem.
 2. One or more flashing or revolving yellow lights showing to the front and rear.
 3. Signs to advise traffic of the wet line and number of vehicles in the marking train.
- (4) On one-way roadways, operate marking train vehicles in the direction of traffic. Provide the same marking train as specified for 2-way traffic in [646.3.1.1\(3\)](#) except as follows:
 - A leading vehicle is not required, but use 2 trailing vehicles.
 - The contractor may use flashing arrow panels to direct traffic to pass.

Revise 646.3.1.1(5) to require masking over pavement marking when resealing bridge decks. This change was implemented in ASP 6 effective with the December 2017 letting.

- (5) After the marking can sustain exposure to traffic, re-apply clear protective surface treatment conforming to [502.2.11](#) where removed from structures during marking surface preparation. **Seal exposed concrete including grooves for tape. Cover marking during resealing with a system that will not degrade the marking's retroreflectivity when removed. Uncover marking before opening to traffic.**

646.3.1.2 Liquid Marking

- (1) Apply marking to the width and color the bid item indicates. Provide a sharp cutoff for both sides and ends of the marking with a uniform cross-section. Do not damage existing marking that will remain in place.
- (2) If the engineer requests, provide calculations demonstrating that the application rate is consistent with the specified dimensions and that the bead application rate is consistent with the specified rate. If on any 0.5-mile section or individual special marking have a calculated application rate less than 90 percent of that specified, remove and remark this section or special marking.
- (3) If the roadway is open to traffic use temporary raised pavement markers or apply temporary same day marking. Apply permanent marking within 7 days of completing mainline paving. If the roadway is closed during construction, apply permanent marking before opening to traffic.

- (4) Protect freshly applied marking until the line is dry or cured enough to prevent pickup under traffic. Place traffic cones on wet lines immediately behind the marking train or use a convoy of moving vehicles to keep traffic from crossing the wet line. Remove cones promptly after the line dries or cures.
- (5) Apply liquid marking and glass beads across the line at or exceeding the following:

LIQUID MARKING	PAVEMENT TYPE	THICKNESS (mils)	BEAD APPLICATION (pounds per gallon)
Paint	all	16	8-10
Epoxy	SMA, seal coats, and polymer overlays	25	25
Epoxy	all other	20	22.5

646.3.1.3 Cold Weather Marking

Revise 646.3.1.3 to include tape; epoxy width, thickness, and bead rate; and proving period for cold weather marking.

- (1) Do not place permanent paint or **permanent tape** marking if the ambient or pavement temperature is below 50 F. Choose an epoxy marking compatible with field conditions when placed. Do not place permanent epoxy marking if the ambient or pavement temperature is below 35 F unless the engineer allows in writing.
- (2) If the engineer allows or **requires** marking below **the specified minimum temperatures**, apply epoxy from the department's [APL](#) in the exact location **and width** where permanent marking would be installed. **Place epoxy at the mil thickness and the glass bead application rate specified for permanent epoxy.** Maintain until weather permits permanent placement.
- (3) Using the failure criteria specified in [646.3.1.5](#), perform corrective maintenance whenever the failure rate exceeds 25 percent of any section of marking. Completely remove and replace cold weather marking with permanent marking when weather permits. **The proving period for the final marking begins after replacement.**

646.3.1.4 Removing Marking

- (1) Completely remove marking from locations the plan show or as the engineer directs. Unless the bid item designates water blasting, the contractor may use one or a combination of air blasting, water blasting, and grinding. Provide a dust control system and remove accumulated sand or other materials. Collect, haul, and dispose of dust or residue from removals.
- (2) Perform air blasting conforming to the following:
 - If air blasting within 10 feet of a lane open to traffic, remove all dust and other residue continuously while blast cleaning.
 - If removing existing marking before applying new marking, expose at least 90 percent of the marking surface.
 - If removing yellow centerline for no passing zone changes, ensure that the cycling mechanism on line removal equipment produces a uniform cycle or alternatively remove by hand.
- (3) Perform water blasting only if the ambient temperature is at least 36F and rising. Use a truck mounted ultra-high pressure pump and water tank capable of delivering a minimum of 30,000 psi and up to 40,000 psi to water jet nozzles. Provide a vacuum recovery system that contains waste water and debris to provide a clean, damp-dry surface, without a secondary cleanup operation.
- (4) Grind using a truck-mounted or hand system capable of complete removal of the marking. Provide a vacuum system to completely collect dust and debris.

646.3.1.5 Proving Period

- (1) The department will accept the work based on an inspection conducted when the contractor completes the work. The engineer will, however, conduct post acceptance inspections periodically during a proving period to evaluate the performance of the marking. The proving period begins on the last day of the month, for all marking placed within each calendar month. For paint, the proving period is 180 days. For other marking, the proving period extends through April 15 of the next calendar year or 180 days, whichever is longer. If weather or road surface conditions prevent the engineer from fully evaluating the marking at the end of the proving period, the engineer may extend the proving period.
- (2) The engineer will determine the percent failing during the proving period. The engineer will exclude failures due to abrasion loss at private entrances and within intersections, except for roundabouts. The department defines failure as discoloration, chipping, substrate exposure, or inadequate reflectivity. Color readings need to meet [ASTM D6628](#). The department measures reflectivity in the direction of travel. Failing reflectivity, in millicandelas/lux/m², is defined as:

MATERIAL	COLOR	180 DAY DRY RETROREFLECTIVITY
Paint	White	< 235
	Yellow	< 140
Epoxy	White	< 250
	Yellow	< 160
Permanent Tape	White	< 525
	Yellow	< 380

- (3) The engineer will conduct an initial inspection of each marking section defined as follows:
1. Each edge line, lane line, or centerline, measured through any 0.5 mile section.
 2. Gore marking or turning lane marking at a single interchange or intersection.
 3. Each roundabout.
- (4) Replace all marking in sections with more than 10 percent failing and repair or replace marking that the engineer deems improperly constructed. If post-acceptance inspections uncover evidence of defective material or improper construction, the department may revoke acceptance under [105.11.2.3](#).

646.3.2 Long Line Marking

646.3.2.1 General

- (1) Long lines are centerlines, lane lines, edge lines, channelizing lines, and dotted extension lines.
- (2) On contracts without the Locating No-Passing Zones bid item where pavement resurfacing covers the marking, mark the beginning and end of all existing centerlines. After completing the resurfacing, accurately re-mark the centerlines.

646.3.2.2 Liquid Marking Equipment

- (1) Use equipment that can spray both yellow and white material to produce uniform lines of the specified dimension. Ensure the equipment can do the following:
 - Applies lines both on the left and right sides, not necessarily simultaneously.
 - Applies 2 lines simultaneously, with either line in a solid or intermittent pattern, in yellow or white.
 - Reports a daily-accumulated installed length for each gun.
 - Reports a volume of paint used each day.
- (2) Use automatic, mechanical devices to apply glass beads and report the volume used.

646.3.2.3 Grooving

646.3.2.3.1 General

- (1) Provide a groove depth as follows:

PRODUCT	GROOVED DEPTH
Grooved Wet Reflective Epoxy	80 +/- 10 mils
Grooved Tape	120 +/- 10 mils

- (2) Groove a maximum of 4 inches from both ends and 1 inch wider than the width of the marking segment. Achieve straight alignment with the grooving equipment, not to exceed a 3/8 inch variation in any 40-foot section of travelled way. Use a high-pressure air blower to clean the groove.
- (3) For grooving concrete, if water is used in the grooving process, allow the groove to dry a minimum of 24 hours before cleaning. Before applying the marking, ensure that the groove surface is clean and dry.
- (4) For grooving asphalt, wait 5 or more days after paving. Notify the engineer immediately if the structural integrity of the asphalt pavement is inadequate to support grooving operations.

646.3.2.3.2 Wet Reflective Epoxy

- (1) Apply wet reflective epoxy in a grooved slot with an epoxy binder that is 20 mils thick. Provide a double drop system of 5.3 pounds per gallon of wet reflective elements with 18-22 pounds per gallon of the following gradation:

US MESH	PERCENT PASSING
18	65 - 80
30	30 - 50
50	0 - 5

646.3.2.4 Contrast Marking

Revise 646.3.2.4(1) to no longer require the application of black aggregate on black epoxy.

- (1) Apply 1 1/2 inches of black epoxy **with a matte finish** on either side of the white marking; black marking is not required on the ends. Apply epoxy at a wet mil thickness of 20. Do not apply glass beads to black epoxy.

646.3.2.5 Permanent Same Day Marking

- (1) Under the Marking Same Day bid item, apply centerlines and no-passing barrier lines on the same day the final surface is placed or on the same day existing marking is removed. If weather or pavement conditions prohibit same-day applications, delineate the travel lanes and provide no-passing signing as the engineer directs. Apply centerlines as soon as conditions allow. The engineer may restrict operations until this marking is completed.
- (2) As an option, the contractor may use temporary marking to conform to these same-day requirements. Remove temporary marking before placing same day permanent marking.

646.3.3 Special Marking

- (1) Under the Marking Railroad Crossings bid items, apply the RXR symbol and 3 transverse lines as the plans show. Also apply edge lines, lane lines, and centerlines adjacent to the railroad crossing.
- (2) Under the Marking Curb bid items, mark the vertical face and the top of the curb.
- (3) Under the Marking Aerial Enforcement Bars bid items, the department will locate the marking. Notify the engineer at least one week before marking so the State Patrol can provide exact locations.

646.4 Measurement

- (1) The department will measure the EACH bid items under this section as each individual unit acceptably completed and as follows:
 - The department will measure the Marking Yield Line bid items as each individual triangle in the yield line.
- (2) The department will measure the LF bid items under this section by the linear foot of line acceptably completed.
- (3) The department will measure the Marking Corrugated Median bid items by the square foot acceptably completed.
- (4) The department will measure the Marking Removal bid items under this section as follows:
 - Marking Removal Lines bid items by the linear foot of line acceptably completed.
 - Marking Removal Special Marking bid items as each individual arrow, symbol, or word acceptably removed. The department will count removing an RXR symbol as 3 individual symbol removals.

Revise 646.4(5) specify measurement of the cold weather bid items previously in STSP 646-010.

- (5) **The department will measure the Cold Weather Marking Epoxy bid items by the LF of initial marking acceptably placed, maintained, and removed. The department will not measure work under these bid items as follows:**
 - **If the contractor fails to maintain and remove the initial marking as required in 646.3.1.3(2).**
 - **If initial marking is placed on days when the department is assessing liquidated damages.**

646.5 Payment

Revise 646.5 to add payment for Cold Weather Marking Epoxy 4-Inch and 8-Inch bid items previously in STSP 646-01.

646.5.1 General

- (1) The department will pay for measured quantities at the contract unit price under the following bid items.

ITEM NUMBER	DESCRIPTION	UNIT
646.1000 - 1020	Marking Line (material) 4-Inch	LF
646.1021 - 1999	Marking Line Grooved (material/type) 4-Inch	LF
646.3000 - 3020	Marking Line (material) 8-Inch	LF
646.3021 - 3999	Marking Line Grooved (material/type) 8-Inch	LF
646.4500 - 4699	Marking Line Same Day (material) (width)	LF
646.5000 - 5099	Marking Arrow (material)	EACH
646.5100 - 5199	Marking Word (material)	EACH
646.5200 - 5299	Marking Symbol (material)	EACH
646.5300 - 5399	Marking Railroad Crossing (material)	EACH
646.5400 - 5499	Marking Aerial Enforcement Bar (material)	EACH

646.5500 - 5599	Marking Outfall (material)	EACH
646.6000 - 6199	Marking Stop Line (material) (width)	LF
646.6200 - 6299	Marking Yield Line (material) 18-Inch	EACH
646.6300 - 6399	Marking Dotted Extension (material) 18-inch	LF
646.6400 - 6499	Cold Weather Marking Epoxy (width)	LF
646.7000 - 7199	Marking Diagonal (material) (width)	LF
646.7200 - 7399	Marking Chevron (material) 24-inch	LF
646.7400 - 7599	Marking Crosswalk (material/type) (width)	LF
646.8000 - 8099	Marking Corrugated Median (material)	SF
646.8100 - 8199	Marking Curb (material)	LF
646.8200 - 8299	Marking Island Nose (material)	EACH
646.8300 - 8399	Marking Parking Stall (material)	LF
646.9000 - 9299	Marking Removal Line (method) (width)	LF
646.9300 - 9399	Marking Removal Special Marking (method)	EACH
646.9400 - 9499	Marking Removal Plowable Raised Pavement Marker	EACH

- (2) Payment for the Marking bid items under this section is full compensation for providing the marking; and for resealing areas of clear protective surface treatments on structures.
- (3) Payment for liquid markings includes remarking as required under [646.3.1.2\(2\)](#).
- (4) Payment for the Marking bid items under this section also includes installing and removing all temporary marking installed under the contractor option of same-day marking.
- (5) Payment for the Marking Removal bid items is full compensation for removing the marking and for resealing areas of clear protective surface treatments on structures.

646.5.2 Cold Weather Marking

- (1) Payment for the Cold Weather Marking Epoxy bid items is full compensation for providing the initial marking including maintenance and removal. If the associated Cold Weather Marking bid item is not in the contract, the department will pay for the initial marking, maintenance, and removal as extra work.
- (2) The department will pay separately for the final marking under the associated Marking bid items.