

Construction Guidance for Pavement Marking Projects

(Revised July 14, 2014)

This document is applicable to stand-alone pavement marking projects as well as capital transportation projects with associated pavement marking work.

Equipment Certification Guidelines

All self-propelled pavement marking vehicles must complete the process described below to be certified by the department. Contractors must be on the MDOT prequalified contractors list for Pavement Marking (N3) prior to requesting certification.

All test requests are to be submitted to the Engineer of Construction Field Services. The test location will be coordinated between the contractor and the MDOT representative witnessing the test.

Pavement marking vehicles are required to meet subsection 811.03 of the 2012 Standard Specifications for Construction.

The vehicle must also be able to place 4, 6, and 12 inch (if applicable) lines to specifications or it will not be certified to work on MDOT roadways. If the vehicle is only successful in placing a 4 and/or 6 inch line, it will be certified to place material on non-freeway routes only.

STEP 1 - BEAD DROP TEST – Use for all drop-on bead systems with a 15 mil binder

Equipment Needed:

- Containers with 50 milliliter gradations, able to hold a maximum of 2,000 milliliters and capable of gathering all beads delivered out of one bead gun.
- Stop watch or watch with a second hand.

Process:

1. The operator determines the speed at which to attempt certification of the pavement marking vehicle.
2. The MDOT certification representative finds the appropriate application rate on the **15 mil Bead Calibration Chart** located below.
3. With the collection container placed under a bead gun, the operator delivers one five second sample of beads into the container.
4. If the bead volume collected in the container corresponds with the 15 mil Bead Calibration Chart, then the pavement marking vehicle can be certified at the respective speed, providing that STEP 2 is successful.

Example:

The operator decides to be tested for a speed of 10 mph. With a drop rate of 8 pounds per gallon (from contractor), the five second sample was measured at 550 milliliters. Comparing the rate with the chart, it is found that the equipment is capable of delivering the required amount of beads at 10 mph (540 ml required), but not at 11 mph (585 ml required). The vehicle can be certified at 10 mph provided STEP 2 is successful. If the operator intends to apply markings at a higher speed, the delivery of glass beads must be increased and measured again.

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STEP 2 - MATERIAL THICKNESS TEST – Use on 15 mil binder material applications

Equipment Needed:

- 6 inch x 12 inch Aluminum Plates (6 inch x 16 inch Aluminum Plates for 12 inch Lines)
- Mil Thickness Gauge
- Pocket Knife or Utility Knife
- Rag or Paper Towel
- Duct Tape
- Radar Gun

Process:

1. Place a thin aluminum plate on the ground, using duct tape to hold it in place. Place the plate so the entire width of the marking will be contained on the plate.
2. The operator will place a line of paint on the plate at the desired equipment certification speed as determined in STEP 1. The operator must shut the bead gun off prior to striping over the plate. The MDOT certification representative will measure vehicle speed with a radar gun.
3. Immediately after the plate has been striped, place the mil thickness gauge into the wet material. The plate may be removed from the ground prior to testing, but care must be taken to keep the plate from being tilted, which will cause material runs and sags. Insert the gauge at the center of the line and 6-10 millimeters (~ one quarter to one third of an inch) from both outside edges. All three locations must be tested. Do not slide the gauge as this will give a false reading. Wipe the gauge clean between each measurement. Do not allow paint material to build up on the edges of the gauge. If buildup does occur, carefully scrape the edges clean with a knife. Immediately replace any gauges that are damaged. When the gauge is placed and removed from the line, the paint material will touch an indented tab, but not touch the next. This area between the touch points is the mil thickness.
4. If the three gauge measurements are 15 mils (tolerance of + 1 mil) and the line is the appropriate width (tolerance of + 0.25 inch), the vehicle is certified for that speed, provided the vehicle is at the same speed as in STEP 1.

Example:

All three measured points should be very close in comparison to each other. If the measurements are too thick or thin in one area of the line, show these areas to the operator so that the pavement marking equipment can be adjusted. Once adjustments have been made, place another plate and repeat the procedure until the line is uniform in appearance.

The operator will be given three (3) opportunities for each line width. After three (3) unsuccessful attempts for any line width, the equipment will be denied certification and the MDOT certification representative will leave. The contractor will be responsible for making repairs/adjustments to the equipment and rescheduling an appointment no sooner than five (5) business days from the previous attempt.

If the operator was successful in STEP 1 and is successful in placing the four (4) inch line, but unsuccessful at the six (6) inch line width (after three attempts), the vehicle will be certified for

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non-MDOT routes only. The contractor will be responsible for making repairs/adjustments to the equipment and rescheduling an appointment no sooner than five (5) business days from the previous attempt if certification for MDOT routes is desired.

The contractor will be allowed three (3) appointments to accomplish STEP 1 and STEP 2. If a vehicle cannot be certified at the third appointment, the equipment will not be eligible for certification until the following pavement marking season.

When STEPS 1 and 2 have been successfully completed, a certification sticker will be placed in the door of the vehicle with the truck number, name of MDOT certification representative, date of certification, expiration date, material type, line widths certified and maximum vehicle speed for each line width. A hard copy of the certification is to be provided to the contractor and placed in the respective ProjectWise Pavement Marking directly.

The certified equipment may not place a line at a speed higher than noted on the certification sticker.

A vehicle may need to be re-certified if it changes the type of material that it is applying. The MDOT representative will determine if the change in material is of a nature that requires re-certification.

STEP 3

1. The operator shall stripe four (4) inch skip lines on no less than 1,250 feet of continuous roadway as agreed upon by the MDOT certification representative and the contractor.
2. The operator shall stripe no less than 1,250 feet of continuous six (6) inch edge line on a roadway as agreed upon by the MDOT certification representative and the contractor.

The operator may be required to place a new line or retrace an existing line. Line placement is to be done at the discretion of the MDOT certification representative.

The contractor shall supply all appropriate traffic control and convoy vehicles for STEP 3 necessary to complete the work as agreed upon with the MDOT certification representative.

When STEP 1, 2 and 3 are completed to the tolerances specified in the 2012 Standard Specifications for Construction and to the MDOT certification representative's satisfaction, the vehicle will be recertified.

Recertification after Revocation

A vehicle's certification may be revoked at any time during the striping season by a construction/project engineer for failure to place material within the tolerances noted in Subsection 811.03 of the 2012 Standard Specifications for Construction. Reason(s) for revocation will be documented by the engineer and provided to the contractor and the Construction Operations Engineer in Construction Field Services. If the certification sticker is removed from a vehicle, the certification is considered revoked and the vehicle is no longer approved to place pavement markings on MDOT roadways. Construction Field Services will maintain the list of certified vehicles and post all information in ProjectWise for statewide

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access. Revocation of certification notices will be provided to region construction engineers for construction distribution.

When certification is revoked, the recertification process will begin at STEP 1. The contractor must successfully complete STEPS 1 and 2, and also complete STEP 3 as described below. The recertification process shall take place no sooner than five (5) business days after the certification was revoked. The contractor may schedule no more than two (2) appointments to re-certify a vehicle (with a minimum of five (5) business days between appointments). If after the second attempt, the contractor fails to achieve recertification, the failed vehicle shall not be allowed to place pavement markings on MDOT routes for that pavement marking season.

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15 MIL Bead Calibration Chart

Bead volume in milliliters per five (5) seconds for a four (4) inch wide line

M P H ↓	L B S →	6	7	8	9	10	11	12	13	14	16	18	20	22	24
		24	960	1127	1295	1450	1605	1762	1920	2085	2250	2575	2880	3210	3510
23	920	1080	1240	1390	1540	1690	1840	2000	2160	2470	2760	3080	3320	3680	
22	880	1032	1185	1327	1470	1615	1760	1912	2065	2370	2640	2940	3220	3520	
21	840	982	1125	1262	1400	1540	1680	1822	1965	2250	2520	2800	3075	3360	
20	800	940	1080	1210	1340	1470	1600	1740	1880	2160	2400	2680	2930	3200	
19	760	890	1020	1145	1270	1395	1520	1650	1780	2040	2280	2540	2745	3040	
18	720	842	965	1085	1205	1322	1440	1565	1690	1930	2160	2410	2640	2880	
17	680	797	915	1027	1140	1250	1360	1475	1590	1830	2040	2280	2485	2710	
16	640	750	860	965	1070	1175	1280	1390	1500	1720	1920	2140	2345	2560	
15	600	702	805	902	1000	1100	1200	1302	1405	1610	1800	2000	2195	2400	
14	560	657	755	845	935	1027	1120	1215	1310	1500	1680	1870	2045	2240	
13	520	610	700	785	870	955	1040	1130	1220	1400	1560	1740	1905	2080	
12	480	562	645	722	800	880	960	1042	1125	1290	1440	1600	1755	1920	
11	440	512	585	657	730	805	880	952	1025	1170	1320	1460	1610	1760	
10	400	470	540	605	670	735	800	870	940	1080	1200	1340	1465	1600	
9	360	420	480	540	600	660	720	780	840	960	1080	1200	1280	1440	
8	320	372	425	480	535	587	640	695	750	850	960	1070	1175	1280	
7	280	327	375	422	470	515	560	605	650	750	840	940	1020	1110	
6	240	280	320	360	400	440	480	520	560	640	720	800	880	960	
5	200	232	265	297	330	365	400	432	465	530	600	660	730	800	
4	160	187	215	240	265	292	320	345	370	420	480	530	580	640	
3	120	140	160	180	200	220	240	260	280	320	360	400	440	480	
2	80	92	105	117	130	145	160	172	185	210	240	260	290	320	

DROP RATE IN POUNDS PER GALLON

Note:

To find the appropriate bead drop measurement for wider lines, multiply the volume of beads required for the four (4) inch line by 1.5 for the six (6) inch line, and by 3.0 for the 12 inch line.

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Pavement Marking Materials

Material Documentation

Prior to April 1 of a given year, Construction Field Services will send notice to all prequalified pavement marking contractors inquiring if they have any pavement marking material in their yard for use in the upcoming construction season.

The contractor must provide certification for liquid and solid applied pavement marking materials that have been stored per the manufacturer's requirements. The certification is defined as a letter from the contractor stating they certify that all liquid and solid applied pavement marking materials have been stored per the manufacturer's requirements. Materials not in compliance with this requirement should be rejected and/or removed. This is a requirement of the Special Provision for Pavement Marking Materials. The engineer may also inspect the contractor's storage facility/yard.

Form 1585, Pavement Marking Material Verification Checklist was developed to assist in documenting materials at the contractor yards and this form is required on every project with pavement markings. This form is to be completed at the beginning of each pavement marking contract season and a new form 1585 is to be completed when requested by the contractor if they have acquired new material or as deemed appropriate by the engineer. Contractors are to inform MDOT when they receive new materials.

The engineer or their designee charged with verifying the information will visit the respective storage yards that will be utilized by the contractor. Form 1585 is to be used during the yard visit to help with material documentation requirements. Completing part 2 of the form will identify the materials visible at the yard. Part 3 can be used to document the material documentation details. Photos of a label or the label itself can also be used for the material documentation requirements. An electronic or hard copy of the form is to be placed in the project files. Copies of completed forms are to be provided to the respective pavement marking contractor.

The pavement marking contractor provides form 501, Materials Source List, at the preconstruction meeting. This form will specify the materials along with product names that will be used and the approximate quantity for each item. The Materials Source List is not a substitute for other required material quality control and quality assurance documentation. The contractor must provide a complete and signed Materials Source List to the engineer in accordance with subsection 105.01 of the 2012 Standard Specifications for Construction. The materials source list may be submitted at or prior to the pre-construction meeting as well as any time material sources or quantities (only if tested material) change or become evident. In addition, the location of the materials (contractor's yard) is to be specified so the engineer can cross check that information with the information on form 1585. This information is then placed in the project files. If an inspector can read the label in the field from the paint drums on the equipment they should place this information on an IDR.

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Material and Field Testing

The following tests may be performed by the MDOT representative.

Moisture Test

Subsection 811.03.D of the Standard Specifications for Construction states in part the following:

Document moisture testing and provide results to the Engineer

The following procedure may be used to document moisture testing when weather conditions have resulted in potential moisture on the pavement.

An 18 inch by 18 inch sheet (4 mil) of transparent polyethylene shall be taped to the pavement. All edges will be sealed with tape (e.g. duct) that will stick to the pavement and not allow the infiltration of air. Leave the plastic sheet in place for 10 minutes to detect the presence of moisture. There must be no moisture visible on the polyethylene sheet after the 10 minute time has elapsed. If there is no indication of moisture, pavement marking may begin. Alternate methods to detect moisture may be submitted to the engineer for review and approval.

Bead Drop Test

Refer to STEP 1 in the Equipment Certification Guidelines section. This test can be run when requested or desired to assure a certified vehicle is operating as required.

Material Thickness Test

Refer to STEP 2 in the Equipment Certification Guidelines section. This test can be run at any time during production striping to assure a certified vehicle is operating as required.

Binder and Bead Plate Sample (see Plate Sampling for further information)

Equipment Needed:

- 6 inch x 12 inch Aluminum Plates (6 inch x 16 inch Aluminum Plates for 12 inch Lines)
- Marking Pen
- Watch
- Gloves
- Duct Tape
- Plastic Bags

Process:

1. Record the date, time, truck number, material, temperature, contractor and location of the sample on the back of an aluminum plate.
2. Place the aluminum plate on the ground, using duct tape to hold it in place. Place the plate so the entire width of the marking will be contained on the plate.
3. Allow the striper to pass over the plate. Note the time when the striper passes over the plate. Carefully remove the plate from the road, keeping it level until the material is dry. Once the plate is dry, turn it over and record the dry time. Dry is defined as the paint no longer runs (flows) and invalidates the test.
4. Place the dried plate into the plastic bag and seal the bag so that any loose beads are captured in the bag and will not be lost.

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5. Perform plate sampling as described within this document.

If there appears to be a problem, notify the operator and contractor immediately. The contractor must adjust the equipment so the pavement marking is placed to MDOT specifications. Refer to Sections 811, 812, 920, and 922 of the 2012 Standard Specifications for Construction.

Material and Application Verification Guidelines

Pavement marking materials are found on the Qualified Products List (QPL). The required documentation of a QPL product is found in Section F, Qualified Products Evaluation Procedures of the Materials Quality Assurance Procedures Manual:

Plate Sampling

The engineer is to randomly sample pavement marking placement for verification of application rates. Sampling is completed with the use of sampling plates placed in the direct path of the pavement marking application guns. The engineer must allow an appropriate distance at the start of the operation for the contractor's pavement marking vehicle to achieve an appropriate speed. The engineer is to check the plates for dry material thickness including beads, width of line, bead uniformity and line uniformity. Three locations on the plate are to be sampled and the average of the three locations recorded on an IDR, with additional information as noted below. Table 1 - Dry Mil Thickness of Liquid Applied Products as provided below shows the required dry mil thickness of liquid applied products. Refer to the contract documents for additional information and requirements.

The IDR should include the following information: date, location, material type, compliance with specifications, truck number, certification date, speed, type of line (edgeline, centerline, etc.) and mil thickness as well as any other pertinent information. If the plate sample meets specifications the process is complete and the passing plate sample must be noted on an IDR. If the plate sample does not meet MDOT specifications, the engineer should consult with Construction Field Services for appropriate action. The failing plate sample information must also be recorded on an IDR. All plate samples are to be retained until project completion and final acceptance.

Minimum Plate Sample Requirements

The following requirements are to be followed when performing pavement marking plate sampling.

Construction Projects - All Permanent Liquid Applied Materials

- Project length greater than two miles: 2 plate samples (minimum) per project
- Project length less than or equal to two miles: 1 plate sample (minimum) per project
- Projects less than 0.5 miles in length: Engineer may visually inspect pavement markings

The requirements above are total per project and are not per material, color, etc. These requirements also apply to Type NR Liquid Applied Materials if they will be in place over the winter season.

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Region / TSC Wide Pavement Marking Projects

- Waterborne: 2 plate samples (minimum) per week
- Sprayable Thermoplastic: 2 plate samples (minimum) per week

The requirements above are total per project per week and are not per material, color, etc.

Table 1 – Dry Mil Thickness of Liquid Applied Products

Material Name	Dry Mil Thickness (includes beads)
Waterborne	Min 20 mils
Spray Thermo	Min 40 mils
Polyurea	Min 45 mils
Modified Urethane or other plural component material	Min 45 mils

Field Inspection and Processing of Progress Payments

1. Pavement marking pay items are not to be paid solely based on contractor submittals.
2. Construction staff must visually verify that pavement marking work was completed per a field review. Visual inspection is required on all pavement marking applications to ensure that placement occurred for the contractor reported quantities. The visual inspection can occur either during placement or in a timely manner after work has been completed. Visual verification information is to be noted on an Inspector's Daily Report (IDR) and must occur prior to processing of payment for work completed. Visual inspection means field verification that material has been placed for all reported locations. Spot checking (checking a portion of completed work) is not allowed. It should be noted that visual inspection is not a re-measurement of quantities placed. Visual inspection verification can be provided by any MDOT staff (e.g. maintenance supervisors, design staff, etc.).
3. Upon completion of visual inspection verification, payment up to plan quantity is to occur based on contractor submittals and material documentation compliance. Contractor values may be accepted if the values are less than the distance noted in the contract documents (e.g., breakdown, segment, log, sequence, location, pay item, etc.) and the pay item quantity. However, if the contractor's numbers are greater than the contract amount, construction staff must field measure the discrepancy and pay to the field measured quantity. Field measurements of discrepancies are to be coordinated with the prime contractor and the pavement marking subcontractor as both parties must be present for all discrepancy field measurements. Payment is to be promptly processed for work satisfactorily completed and field verified.
4. Construction staff in coordination with design staff are asked to continually ensure that pavement marking log quantities are up to date, accurate, and provided to the Region/TSC design squad and the pavement marking program office.

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5. Plate sampling information must be recorded on an IDR. Information that must be included is; date of sample, location, time, weather, pay item sampled, thickness values, and any other pertinent plate sampling information.
6. Partial payment of quantities within log sequences, segments, or other pay item groupings is permitted. Visual confirmation of work completed must be documented and placed in the project files.
7. Pavement marking vehicle inspections are to take place before the start of a project and anytime thereafter during the life of the project.
8. The engineer may request samples of pavement marking materials from the contractor. Binder and bead plate samples should be taken during pavement marking operations to provide a sample of the actual quality of line being placed by the contractor (refer to Binder and Bead Plate Sample section in this document).
9. Approval of Value Engineering Change Proposals (VECP) submitted during construction for changing materials from tape to paint are discouraged when solely utilized for cost savings.
10. The contractor should provide advanced notice of their striping schedule to the engineer. Advanced notice is required to ensure adequate time to be able to place test plates according to the testing frequency noted in this document. This topic should be discussed at the preconstruction meeting and any requirements must be shown in the maintaining traffic special provision.

Field Inspection Checklist

- Material certification and/or inspection documents for the binder and glass beads.
- Appropriate measures have been taken to store binder materials per the manufacturer's recommendations.
- Striping vehicle certification is located on the inside of the driver's door. Certification is current.
- Required safety equipment (per specification and pavement marking typical) is on the vehicle, clearly visible and operating appropriately.
- Pavement surfaces are clean and dry (refer to Moisture Test in this guidance document).
- Air and surface temperatures are at or above recommended minimum values.
- Pavement marking material application rates are as specified in the contract documents.

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- ❑ Pavement marking lines are applied within tolerances. Verification information is placed on an IDR.
- ❑ Subsection 811.03.B of the 2012 Standard Specifications for Construction has been verified which states the following:
 - Apply sharp, well-defined markings, free of uneven edges, overspray, or other visible defects, as determined by the Engineer. Ensure pavement marking lines are straight, or of uniform curvature.
- ❑ When specified, all old pavement markings being removed are done so according to subsection 812.03.F of the 2012 Standard Specifications for Construction.