



PURPOSE

This subject was developed to provide guidance to improvement project inspectors as well as Department and County field and maintenance crews for the installation, service and maintenance of all types of highway signs and pavement markings on the State Highway network. The goal for this manual is to install signs and pavement markings to provide a safe, understandable and efficient system of guidance to the motoring public.

These guidelines are intended to provide a framework of policies and practices for the systematic reporting and handling of pavement marking installation and replacement or sign repair activities done by others under the direction of the Wisconsin Department of Transportation through its Regions. It is inherent these guidelines that the basic thrust be to promote safety of the motorist, safety for the improvement and maintenance crews and standardization of practices toward uniform application and appearance statewide.

Improvement project crews and maintenance crews will perform their operations in accordance with the Wisconsin Manual on Uniform Traffic Control Devices, Traffic Guidelines Manual and other Department policies as referenced within.

The Department recognizes these guidelines *may* require adjustments and revision as they are implemented.

INSTALLING MARKINGS

Pavement marking **shall** be in accordance with the WMUTCD, Facilities Development Manual and the Wisconsin Standard Specification Manual.

Types of Roadway Markings

Skip line is a broken or dashed line. The standard is a 12.5' line with a 37.5' gap.

Dash is a painted portion of a skip line. Typically a 3' line with 9' gap.

Cat track is a painted line for guidance. Typically a 2' line with a 6' gap.

Channelizing line is double the thickness of a standard line. Typically 8".

County Maintenance

Counties will be given segments of roadways that need to be painted. The scheduling of pavement marking operations will be left to the county. Counties will then be able to schedule their crews to what fits their needs, but the work **shall** be completed in a timely manner. WisDOT is requiring all marking to be placed at or above manufacture specifications. Each stripping crew is responsible for completing the Pavement Marking Daily Report. These reports **shall** be sent to the Regional Pavement Marking Coordinator or representative at the end of every week. State actual time spent not painting at the bottom of the report (drive time, weather delay, maintenance, etc.)

Improvement/Refurbishment Projects

Install per Spec 646, 647, and 649.

FIELD OPERATIONS

Paint and Beads **shall** be purchased off of the Statewide Bid for all State work. It **shall** be the responsibility of the County to order all paint and beads, unless other arrangements have been made with the Region. Return all empty paint totes to the provider. For application standards see the appropriate section below.

No Passing Zones

- No Passing Zone "T" is a mark on the roadway, which indicates the beginning and ending points of a barrier line.
- No Passing Zone "X" on the end of a line indicates that it needs to be extended or removed.
- No Passing Zone Dot indications the center of the roadway.

Figure 1. New Marking

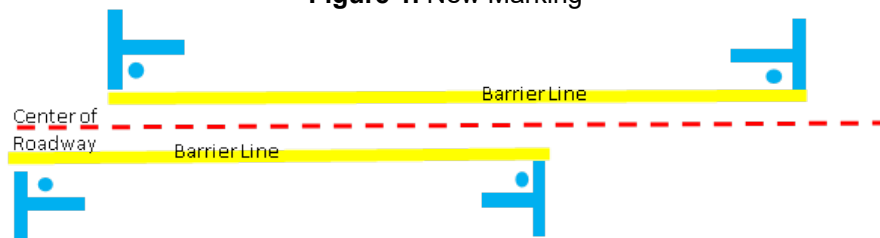


Figure 2. Existing Marking Extension



Figure 3. Existing Marking Removal



Waterborne Paint

General

Store waterborne paint in a dry area that will not freeze. Do not store paint for more than 12 months. Keep in mind the weather will drastically change the dry time of this product. Humidity and cooler weather are the biggest factors. Please let the Marking Coordinators know of any and all issues with the paint.

Types of Spraying

There are 2 ways to spray paint:

- Conventional: Air jets with a pressure (60 psi to 140 psi) at the tip of the paint gun that breaks up the paint. The tip defines the size of the line.
- Airless: The pressure created by the pump forces paint out through an orifice in the tip of the gun. The angle and size of tip affect the size of the line.

Temperature

Refer to manufacture specifications for the temperature the paint *should* be applied at. Typically the ambient temperature *should* be above 50°F.

Beads

Wisconsin is currently using the AASTHO Type I bead gradation with 80% rounds. These can also be purchased off of the State Contract.

Application

Product	Mil thickness	Gallons per Mile	Feet per Gallon	Lbs Beads per Gallon	Lbs per Mile
Paint	16	26.4	200	10	264

Epoxy

General

Epoxy is a two part system. Epoxy has a longer life expectancy and can be applied at lower temperatures; however, it takes longer to dry than waterborne paint. Epoxy has a life expectancy of 3-5 years. Humidity and cooler weather are the biggest factors. Please let the Marking Coordinators know of any issues.

Mixing

Since epoxy is a two part system the resin has to be mixed with a hardener. Typically it is 2 parts resin to 1 part hardener.

Temperature

Refer to manufacture specification for the temperature the epoxy *should* be applied at. Typically the ambient

temperature *should* be above 35°F

Beads

Wisconsin is currently using the AASTHO Type I bead gradation with 80% rounds. See table above for how many pounds of beads per gallon are required.

Application

Product	Pavement Type	Mil Thickness	Gallons per Mile	Feet per Gallon	Beads per Gallon	Pounds Per Mile
Epoxy	SMA/ Seal Coat/ Epoxy Overlays	25	41.1	129	25	661
Epoxy	All Others not stated above	20	32.8	161	22.5	595

Reflective Glass Beads

General

Beads are added to lines to increase the visibility of the lines at night. The beads help reflect light from a vehicle back to the driver as shown in the picture to the right.

Figure 1: No Beads

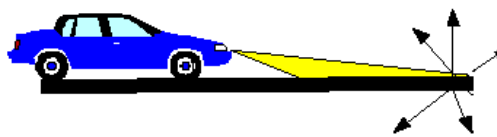


Figure 2: Beads added



Optimum embedment of beads is 50-60%. Anything less than that *may* cause the beads to pop out and any more than that affects how much light the bead can reflect back to the driver.

Bead Calibration

Bead calibration is very important since to many beads is expensive and doesn't adhere to the paint, and not enough beads can result in low retros. Hold a container under the bead gun for 10 seconds. Measure beads in milliliters. Use the table below to measure the volume of beads in milliliters per 10 seconds for a 6" wide line drop rate.

Regular Bead Calibration Chart (TX Type 1 through TX Type 4)
Lbs. / 100 ft² BEAD CALIBRATION CHART
BEAD VOLUME IN MILLILETERS PER 10 SECONDS FOR A 6" (15.24 CM) WIDE LINE
DROP RATE

Speed	6 Lbs / 100 ft ²	8 Lbs / 100 ft ²	10 Lbs / 100 ft ²	12 Lbs / 100 ft ²	14 Lbs / 100 ft ²	16 Lbs / 100 ft ²	18 Lbs / 100 ft ²	20 Lbs / 100 ft ²	22 Lbs / 100 ft ²	24 Lbs / 100 ft ²
10 mph or 16 kph	1200	1620	2010	2400	2820	3240	3600	4020	4395	4800
9 mph or 14.5 kph	1080	1440	1800	2160	2520	2880	3240	3600	3840	4320
8 mph or 12.9 kph	960	1275	1605	1920	2250	2550	2880	3210	3525	3840
7 mph or 11.3 kph	840	1125	1410	1680	1950	2250	2520	2820	3060	3330
6 mph or 9.7 kph	720	960	1200	1440	1680	1920	2160	2400	2640	2880
5 mph or 8 kph	600	795	990	1200	1395	1590	1800	1980	2190	2400
4 mph or 6.4 kph	480	645	795	960	1110	1260	1440	1590	1740	1920
3 mph or 4.8 kph	360	480	600	720	840	960	1080	1200	1320	1440
2 mph or 3.2 kph	240	315	390	480	555	630	720	780	870	960

Source: Potters

Troubleshooting Tips

Below are the common problems that occur during painting.

Table 1: Conventional Paint Application Troubleshooting

PROBLEM	CAUSE	REMEDY
Excessive Thickness (overall)	<ul style="list-style-type: none"> Paint tank or pump pressure too high Paint gun volume control open to wide (if present) Applicator speed too low 	<ul style="list-style-type: none"> Reduce tank or pump pressure Adjust paint gun volume control Increase speed
Excessive Thickness (middle of line)	<ul style="list-style-type: none"> Paint tank or pump pressure too high Paint gun volume control open too wide (if present) Atomizing air pressure off or too low Material buildup in paint gun tip and/or shroud 	<ul style="list-style-type: none"> Reduce tank or pump pressure Adjust paint gun volume control Increase atomizing air pressure Clean tip and/or shroud

Excessive Thickness (along one side)	<ul style="list-style-type: none"> Material buildup in paint gun tip and/or shroud Clogged hole(s) in paint gun atomizing tip 	<ul style="list-style-type: none"> Clean paint tip and/or shroud Clear clogged hole(s) in paint gun atomizing tip
Insufficient Thickness	<ul style="list-style-type: none"> Paint tank or pump pressure too low Paint gun volume control not open enough (if present) Vehicle speed too high Atomizing pressure too low. Material buildup in paint gun tip and/or shroud Material buildup in paint filter(s) and/or plumbing 	<ul style="list-style-type: none"> Increase tank or pump pressure Adjust paint gun volume control Increase applicator speed. Increase atomizing air pressure Clean paint gun tip and/or shroud Clean paint filter(s) and/or plumbing
Wide Paint Line	<ul style="list-style-type: none"> Paint gun set too high Worn or damaged paint gun tip and/or shroud 	<ul style="list-style-type: none"> Lower gun Repair or replace tip and/or shroud
Narrow Paint Line	<ul style="list-style-type: none"> Paint gun too low Paint gun tip slot not at 90° angle to paint line Clogged paint gun tip and/or shroud Low air pressure in paint machine tire. 	<ul style="list-style-type: none"> Raise paint gun Reposition paint gun tip Clean paint gun tip and/or shroud Inflate tire
Uneven Paint Line (spotty)	<ul style="list-style-type: none"> Atomizing air pressure too low Paint tank pressure too low Old paint (viscosity too high) Loose paint gun tip and/or shroud Not enough heat for paint to flow evenly No shroud 	<ul style="list-style-type: none"> Increase atomizing air pressure Increase material tank pressure Rotate material stock Secure paint gun tip and/or shroud Increase heat Install shroud

Source "MnDOT Pavement Marking Field Guide"

Table 2: Epoxy Spray Application Troubleshooting

PROBLEM	CAUSE	REMEDY
Heavy or Light centers	<ul style="list-style-type: none"> Inadequate fluid delivery 	<ul style="list-style-type: none"> Increase fluid pressure Decrease tip size
Surging pattern	<ul style="list-style-type: none"> Pulsating fluid delivery 	<ul style="list-style-type: none"> Reduce demand Remove restrictions in supply system Check individual pump pressures for unequal pressure Check supply hose for leaks
"Lop-sided" millage	<ul style="list-style-type: none"> Worn tip sides Clogged tip 	<ul style="list-style-type: none"> Replace tips Clean tips
Line too wide	<ul style="list-style-type: none"> Gun too high Too wide a fan angle on tip 	<ul style="list-style-type: none"> Lower gun Adjust tip size if necessary
Line too narrow	<ul style="list-style-type: none"> Gun too low Too narrow a fan angle on tip 	<ul style="list-style-type: none"> Change tip size Decrease speed of application Verify pressure settings
Too much or too little hardener	<ul style="list-style-type: none"> Displacement pumps not properly synchronized 	<ul style="list-style-type: none"> Adjust pumps

Source "MnDOT Pavement Marking Field Guide"

Table 3: Reflective Bead Application Troubleshooting

PROBLEM	CAUSE	REMEDY
Beads on one side	<ul style="list-style-type: none"> Bead gun out of alignment Clogged bead gun 	<ul style="list-style-type: none"> Adjust alignment of gun cap
Excessive bead use	<ul style="list-style-type: none"> Worn gun needle, seat and orifice Excessive glass bead pressure 	<ul style="list-style-type: none"> Rebuild gun Decrease pressure
Beads in middle of line	<ul style="list-style-type: none"> Bead tank pressure too low Bead gun "off" and "on" control screw not adjusted Bead gun cap out of alignment Too big of a bead gun tip 	<ul style="list-style-type: none"> Increase pressure Adjust control screw Align cap deflector Change to a smaller tip
All beads buried	<ul style="list-style-type: none"> Bead gun too close to paint Bead gun angle too shallow Excessive paint millage 	<ul style="list-style-type: none"> Re-align bead gun Adjust angle of bead gun Check wet millage thickness
All beads on top of line	<ul style="list-style-type: none"> Bead gun too far from paint gun 	<ul style="list-style-type: none"> Re-align bead gun
Pulsed bead application	<ul style="list-style-type: none"> Bead tank pressure inadequate 	<ul style="list-style-type: none"> Raise tank pressure Rebuild applicator to increase pressure
Excessive amount of beads beside line	<ul style="list-style-type: none"> Too much overlap of bead pattern on line pattern 	<ul style="list-style-type: none"> Move bead gun closer to roadway

Source "MnDOT Pavement Marking Field Guide"

CONTACTS

DOT Contacts			
Region	Contact Person	Number	Email
Pavement Marking Staff 3609 Pierstorff St Madison, WI 53704	Jeannie Silver	608-246-5408	jeannie.silver@dot.wi.gov
SW Region- La Crosse 3550 Mormon Coulee Rd. La Crosse, WI 54601	Kory Keppel	608-785-9953	kory.keppel@dot.wi.gov
SW Region- Madison 3601 Pierstorff St Madison, WI 53704	Jeff Holloway	608-246-3268	jeffrey.holloway@dot.wi.gov
SE Region- West Allis 935 S. 60th St. West Allis, WI 53214	Chuck Saldivar Bree Johns-Konkol	414-266-1164 414-266-1171	chuck.saldivar@dot.wi.gov bree.johnskonkol@dot.wi.gov
NE Region- Green Bay 944 Vander Perren Way Green Bay, WI 54304	Steven Herlache	920-492-3512	steven.herlache@dot.wi.gov
NC Region- Wis Rapids 2841 Industrial St Wis Rapids, WI 54495	Al Smith	715-421-8364	alan.smith@dot.wi.gov
NC Region- Rhinelander Hanson Lake Rd Rhinelander, WI 54501	Al Smith	715-421-8364	alan.smith@dot.wi.gov
NW Region- Spooner W7102 Green Valley Rd Spooner, WI 54801	Ken Jansky	715-225-9318	kenneth.jansky@dot.wi.gov
NW Region- Eau Claire 5009 USH 53 South Eau Claire, WI 54701	Ken Jansky	715-225-9318	kenneth.jansky@dot.wi.gov

South West

Adams	David Johnson	(608) 339-3355
Dane	Robert Peterson	(608) 575-5209
Dodge	Joe Lechner	(920) 210-1760
Iowa	Neil Wegner	(608) 574 2936
Vernon	Phil Hewitt	(608) 606-3777

Southeast

Milwaukee	Jake Reinke	(414) 587-5012
Ozaukee	Joe Thoennes	(262) 770-8732
Racine	Mike Kirshling	(262) 770-9690
Walworth	Dave Gross	(262) 949-7835
Washington	Tim Herman	(262) 483-3081
Waukesha	B Kerr	(262) 442-9161

Northeast

Brown	Andy Sell	(920) 609-4020
Calumet	Chad Scheinoho	(920) 929-3491
Fond du Lac	John Hoffman	(920) 929-3491
Kewaunee	Ron Schleis	(920) 255-1026
Marinette	Joe Baranek	(715) 923-6874
Sheboygan	Dustin Hammel	(920) 459-9182

North Central

Adams	Joshua Oleson	(608) 547-0644
Iron	Kasey Krall	(715) 561-4965
Langlade	Brian Lowry	(715) 853-4742
Portage	David Johnson	(715) 247-4821
Shawano	Brian Lowry	(715) 526-9182
Waushara	George Nigh	(920) 787-3327

Northwest

Taylor	Lonnie Ulrich	(715) 965-3141
Trempealeau	Tanner Kidd	(715) 538-3035
Washburn	Fred Gruenhagen	(715) 205-9960

PERSONAL SAFETY

All Department of Transportation (DOT) personnel **and** any personnel working for the state are required to follow the safety policies stated in the DOT Transportation Administrative Manual (TAM). DOT, county, and contractor personnel **shall** wear:

- Eye Protection: (TAM SD 36)
 - Safety glasses with attached shields
- Foot Protection: Steel-toe boot or shoe (TAM SD30)
- Protective Headgear: (TAM SD 51)
 - Hard hat
- High Visibility Safety Apparel: (TAM SD 57)
 - Reflectorized Safety Vest at all times on or along the roadway
 - Reflectorized Safety Pants during nighttime hours.

Hazard Warning Information - Treated Wood Management (See Exhibit 5)

(Material Safety Data Sheets *should* be requested from the wood post vendor)

EMPLOYEE RECOMMENDED TRAINING

All agencies doing work for the DOT *should* make sure their employees are properly trained in the following areas:

1. Field Operations Awareness
2. Shop Tools
3. Major Equipment Operations
4. Utilities Locate. Call Diggers Hotline 811
5. Retraining
6. Vehicle Safety and Inspection

WORK AREA TRAFFIC CONTROL

All traffic control **shall** be in compliance with the WMUTCD and Departmental policies. See Standard detail drawings.

Vehicles used in highway signing operations **shall** be equipped with at least two (2) yellow, high intensity rotating beacons, clearly visible from the front, rear and both sides of the vehicle. These beacons **shall** be placed as high as possible on each vehicle. Vehicles **shall** have all warning lights operating when stopped or moving slowly along any highway. Warning lights **SHALL NOT** be displayed while the vehicle is traveling at highway speeds or when traveling between jobs.

When conditions are less than ideal, additional advance warning signs or devices *should* be added to the traffic control layouts. In some cases, the work *should* be deferred until the conditions are more favorable.

All lane closures on two lane roadways require flagging of traffic as well as advance signing and cone placement in the work area. Remember that all flaggers **shall** use stop/slow paddles.

An encroachment into a lane of traffic *may* require cones and/or flagging. The amount of encroachment, the volume and speed of passing vehicles will determine traffic control measures required. For example, a cone *may* be sufficient to mark the point where an outrigger makes contact with the pavement outside the overall width of the truck.

PUBLIC SAFETY

Workers **shall** park vehicles off the road as far as practical. Care *should* be taken to not block the vision of existing traffic control devices such as stop signs and signals. Work activities *should* be performed with an assumption the motorist does not know what the workers are going to do.

UTILITIES

Utility Locates. Diggers Hotline (811) **shall** be called and located before any work is performed. They *should* be given at least a 3 working day notice.

The following is a five-point plan for utility locates before digging in the highway right-of-way, which covers the routine steps required by Diggers Hotline:

1. Prepare a plan or work location sketch or drawing. Indicate a 25-foot radius around the stake or lath for "MARKING INSTRUCTIONS" for Diggers Hotline.

2. At each locate site, mark with a stake or by painting the pavement or shoulder of the highway. White or pink are the approved colors for ribbons, flags or paint when marking sign locations for utility locates.
3. Identify the exact location by measuring the distance from the nearest intersecting street or highway. Indicate which side of the highway the locate is on.
4. Contact Diggers Hotline to request the area to be located. Retain ticket number for a minimum of six years after work is completed.
5. Investigate the possibility of other utilities having services at the locate site.

Utility Damage Procedure. Damage prevention is the ultimate goal. As stated above it is essential to get clearance from utilities before doing any digging.

- BEFORE YOU DIG, CONFIRM UTILITIES HAVE BEEN LOCATED

IF UTILITY DAMAGE OCCURS:

- CALL THE UTILITY FROM A SAFE LOCATION AS SOON AS POSSIBLE.
- CLEAR AREA IF NECESSARY.
- EXTINGUISH ALL FIRE SOURCES; BE MINDFUL OF LOSS OF LIFE.
- NOTIFY EMERGENCY SERVICES (IF NECESSARY).
- NOTIFY SUPERVISOR.
- BE AVAILABLE ON OR NEAR THE SITE UNTIL REPAIR CREW ARRIVES.

MAJOR EQUIPMENT OPERATIONS

It is recommended that field operations that involve digger derricks or bucket trucks will NOT be performed with fewer than two crew persons on the job site.

HAVING A UTILITY LOCATE CLEARANCE DOESN'T NECESSARILY MEAN ALL DANGER HAS BEEN REMOVED.

Derrick operators must be aware of overhead lines to be certain the boom or its attachments remain the required distance away from the overhead lines.

ACRONYMS & DESCRIPTIONS

- HMA - Hot Mix Asphalt
- MSDS - Material Safety Data Sheets
- PCC - Portland Cement Concrete
- PMC - Pavement Marking Coordinator
- TMA - Transportation Maintenance Agreement
- Type H Sheeting - Prismatic High Intensity
- Type F Sheeting - Prismatic High Intensity Fluorescent Sheeting

3-25-3 Field Inspections

December 2024

PURPOSE

This subject was provided to provide guidance to traffic operations staff on quality control of pavement markings on the state system. The goal is to provide safe and efficient ways to spot check the statewide pavement marking program.

These guidelines are intended to provide a framework for checking pavement markings across the state for improvement programs and regionwide LETs.

SAFETY

All inspectors **shall** wear a high visibility safety vests during the day and high visibility safety vests and pants during nighttime hours. No out-of-vehicle inspections *should* be completed in inclement weather conditions. All vehicles **shall** be parked as far off the road as practical and be equip with lights on the top of the vehicle and hazards on when off the roadway. High ADT roadways 2 people is recommended to act as a spotter.

INSPECTION

Inspection will consist of durability or presence of the pavement marking as well as retroreflectivity of the pavement markings. The QA/QC form will be filled out including the date, inspection, route and segment collecting data on. The exact location of the reading *should* be:

- Easy to relocate (i.e., xx feet past intersection, house number, mile marker, etc.)
- Not at a high wear area (no turn lanes, driveways)

Readings must be taken on days when the roadway is dry, and temperatures are above 45F. ASTM E1710 (retro) and E1349 (color) will be followed.

DATA COLLECTION PROCESS

Step 1: Calibrate handheld meter in accordance with manufacturers' recommendations at the office.

Step 2: Record exact location following requirements above.

Step 3: All measurements **shall** be taken in the direction of travel. Centerline markings **shall** be taken in both directions.

Step 4: Take picture of each location.

Step 5: On all traffic lanes take 10 retroreflectivity readings every 25 feet or 2 readings per skip for 5 skips. Record findings.

Step 6: Record durability based on ASTM D913-15. Examples can be found [here](#).

Step 7: Repeat Steps 2-6 approximately 3 miles down the road. If the meters are placed back in the box, please recalibrate before collecting readings.

Step 8: Repeat Steps 2-6 approximately 3 miles down the road. If the meters are placed back in the box, please recalibrate before collecting readings.

Step 9: Visually inspect roadway at highway speed. For mobile retroreflectivity routes only one county per route needs to be evaluated.

Step 10: Upload records to [\BoxDrv\Box\DTSD\DTSD-BTO\Traffic\Marking\RegionwideLETS](#)

WHEN TO COLLECT READINGS - REGIONWIDE LETS

Collect readings 2-3 weeks after crew has placed markings and before payment of invoices. Readings will be collected on 2 route per month per crew. Regions will be able to select which routes they want to collect data on. BTO can be asked to check color of the yellow marking if regions deem it necessary. Forms **shall** be saved as the project ID in this folder: [\BoxDrv\Box\DTSD\DTSD-BTO\Traffic\Marking\RegionwideLETS](#)

WHEN TO COLLECT READINGS – COUNTY WORK

Collect retro readings 2-3 weeks after crew has placed markings and before payment of invoices. Readings will be collected on 2 route per month per crew. Regions will be able to select which routes they want to collect data on. BTO can be asked to check color of the yellow marking if regions deem it necessary. If possible collect mil thickness of the markings on 2 routes per month. Forms **shall** be saved as the project ID in this folder: [\BoxDrv\Box\DTSD\DTSD-BTO\Traffic\Marking\RegionwideLETS](#)

WHEN TO COLLECT READINGS – IMPROVEMENT PROJECTS

Collect readings at least 2 weeks after crew has placed markings. Readings will be collected on 10 improvement projects per summer depending on weather and time of year. Temperatures must be higher than 45F. If possible, collect mil thickness of the markings. Regions will be able to select which projects they want to collect data on. Regions can also have a consultant collect this data using the regions or consultant's meters. Contractors' meters *should not* be used. BTO can be asked to check color of the yellow marking if regions deem it necessary. Forms **shall** be saved as the project ID in this folder: [\BoxDrv\Box\DTSD\DTSD-BTO\Traffic\Marking\RegionwideLETS](#)

RECALIBRATION

Recalibrations *should* be done every 5 years.