

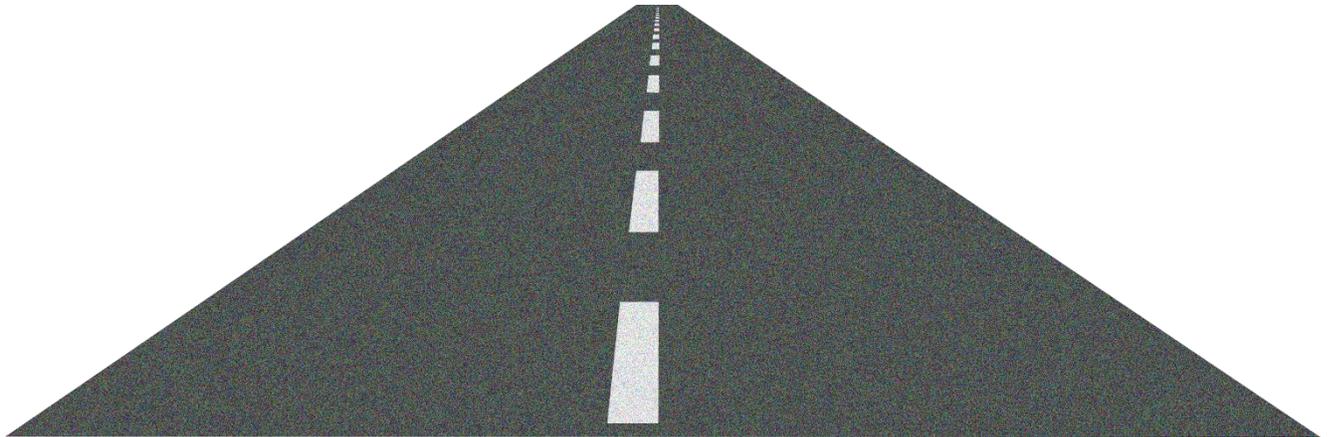
Louisiana Department of Transportation and Development



PAVEMENT MARKINGS MANUAL

FOR

DESIGNERS AND CONSTRUCTION SERVICES



Traffic Engineering Division

March 2022

PURPOSE

This manual serves as both a reference for selecting pavement markings and as a reference for the installation of markings. It is intended for use in design, maintenance and installation procedures. It provides a single reference for all personnel so that the benefits from pavement marking experts and best practices can be standardized on our state highways.

Disclaimer

This is a new manual and does not replace any documents. This manual does not constitute a standard, specification, or regulation. It should only be used as a reference to approved specifications, standard plans and special details.

This manual is reviewed for adequacy and updated as needed according to specifications, standards and policy.

Contact

Questions concerning information in the manual should be addressed to the Traffic Engineering Administrator at (225) 242-4632.

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INTRODUCTION

Pavement marking performance depends on proper material selection and installation.

Roadway pavement markings provide beneficial information to traveling motorist. Therefore, choosing the best marking materials that meets the needs of the public is essential for designers and maintenance operations.

It is recommended that existing roadway pavement markings should be inspected at night annually or as required by maintenance schedules to determine if replacement markings are needed to meet LADOTD minimums for retroreflectivity. Retroreflectivity may be checked with either a handheld or a mobile retroreflectometer to verify and document the deficient areas.

Traffic Engineering recommends replacement when retroreflectivity falls below 100 millicandela (mcd).

This manual is to serve as a single source of information for all design personnel to choose optimum pavement markings for various pavement types and locations.

This manual is divided into two parts: Material Selection for Designers and Inspection for Project Engineers.

Pavement Marking Standards (PM-01 thru PM-09) and the MUTCD are the only currently approved standard layouts. For non-standard layouts, DTOE shall approve.

MATERIAL SELECTION

LADOTD requires a passing evaluation from the National Transportation Product Evaluation Program before a manufacturer's pavement markings product is added to our AML (Approved Materials List) for use.

NTPEP conducts performance evaluations on a number of different pavement marking materials on various pavement surface types and under various traffic volume levels and environmental conditions. Reports documenting these evaluations are available through NTPEP or the American Association of State Highway and Transportation Officials (AASHTO).

TEMPORARY PAVEMENT MARKINGS

GLASS BEADS

(Section 1015) Spec. book

Description: Retroreflectivity for pavement markings is obtained by the use of glass beads that are partially embedded onto the surface of the marking material such as paint, thermoplastic or preformed tape. The glass beads return light from vehicle's headlights back to a driver's eye. Markings without beads will appear with little or no retroreflectivity at night thus providing little benefit to the driver.

This is the only LADOTD approved product for achieving retroreflectivity on pavement striping.

Uses: Added to waterborne traffic paint striping. Not for temporary tape as beads are included as part of the manufacturing process.

TEMPORARY REFLECTORIZED RAISED PAVEMENT MARKERS

(Section 713)(Section 1015) Spec. book

Description: ReflectORIZED raised pavement markers is a commonly used pavement marking material. Used as a temporary raised pavement marking on chip seals, overlays, etc.

Uses: Can be used as temporary markings within work zones for short term lane shifts. Typically used in conjunction with striping for added emphasis at night.

REFLECTORIZED TABS

(Section 713) Spec. book

Description: Flexible L-shaped plastic with reflectorized strip that faces driver and adhesive strip to secure it to roadway.

Uses: As a temporary marking only on surface treatment course (chip seals)

Pros: Very economical and easy to install.

Cons: Only for low ADT roadways.

WATERBORNE TRAFFIC PAINT

(Section 713)(Section 737)(Section 1015) Spec. book

Description: Traffic Paint is a common used, and the least expensive, of all pavement marking materials. Used as a temporary or permanent pavement marking. Is not durable – typically lasts, six months to one year depending on traffic.

Uses: Paint can be used as temporary markings (typically 15mils thick) within work zones for short term lane shifts. May also be used on asphalt overlays between lifts as lane lines and/or centerlines.

TEMPORARY PREFORMED TRAFFIC TAPE

(Section 713)(Section 732)(Section 1015) Spec. book

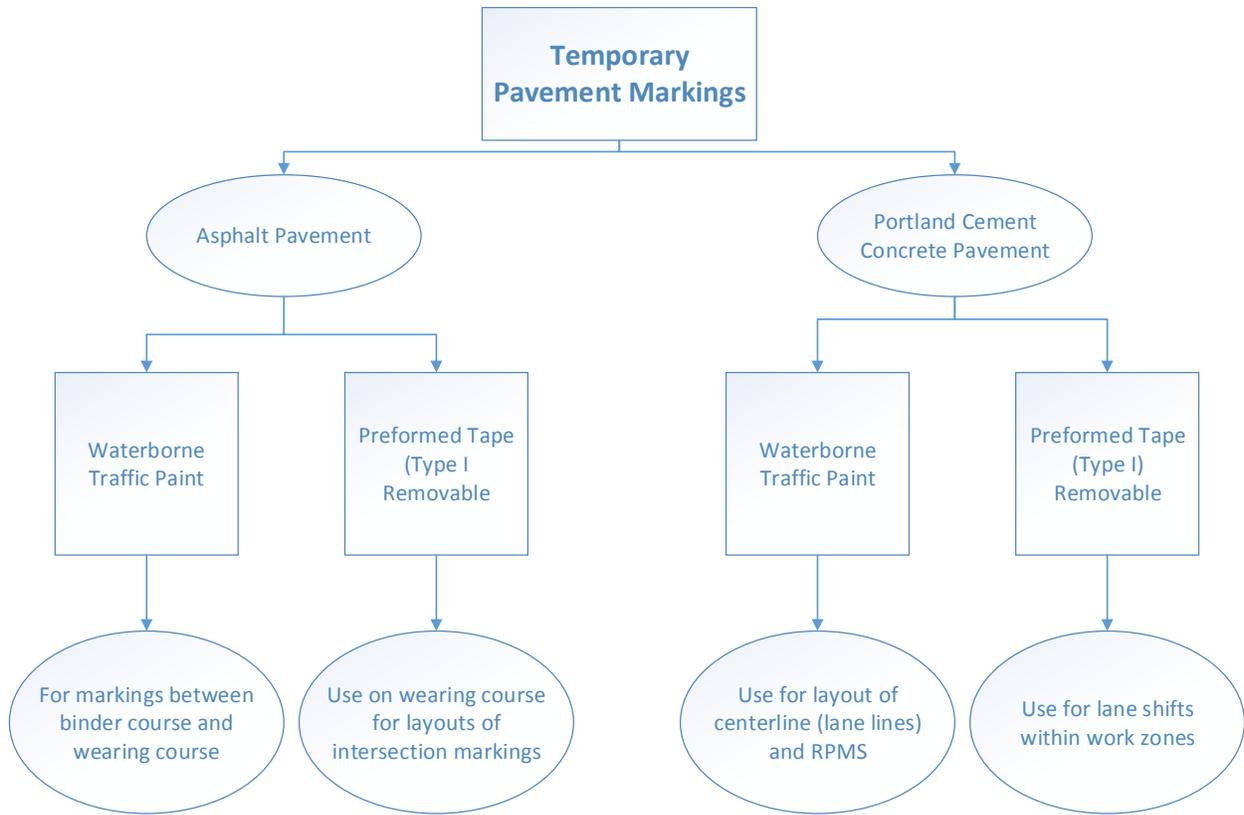
Description: Preformed tapes are cold-applied, preformed pavement marking materials that are supplied in continuous rolls of various lengths and widths. Preformed tapes have the advantage over sprayed or extruded materials because they do not require expensive application equipment or experienced operators to place, and they do not require drying or curing times.

While temporary preformed tapes have a significantly higher initial cost than most materials, the service lives are usually superior to most other pavement marking material, making them a cost-effective choice for high ADT roadways.

Uses: Thin foil-backed temporary tapes are typically used between asphalt binder and wearing courses and low adt workzone roads. Tapes (Type 1 removable) are thick mesh reinforced plastic with an adhesive to allow removal when needed. These are intended for Interstate work where lane closures shift will remain for more than one week.

Pros: Great longevity and visibility. Excellent short-term use for defining lanes and shifts within work zones. Easy removal with any pavement damage or scarring on non-high ADT.

Cons: High ADT and when used for extended lengths will require specialized equipment for removal; pavement scarring will most likely occur.



PERMANENT PAVEMENT MARKINGS

GLASS BEADS

(Section 1015) Spec. book

Description: Retroreflectivity for pavement markings is obtained by the use of glass beads that are partially embedded onto the surface of the marking material such as paint, thermoplastic or preformed tape. The glass beads return light from vehicle's headlights back to a driver's eye. Markings without beads will appear with little or no retroreflectivity at night thus providing little benefit to the driver.

This is the only LADOTD approved product for achieving retroreflectivity on pavement striping.

Uses: For use on all permanent plastic pavement striping. Not for permanent tape as beads are included as part of the manufacturing process.

RETROREFLECTIVE RAISED PAVEMENT MARKERS (RPM)

(Section 731)(Section 1015) Spec. book

Description: Retroreflective Raised Pavement Markers are widely used to supplement pavement marking striping due to its high profile, high intensity retroreflectivity during all weather conditions. RPM's are typically white/red and yellow to match centerline or edge lines. Installed RPM's should match the color of pavement marking its supplementing. Typically used in conjunction with striping for added emphasis at night.

Uses: As a supplement to broken centerline pavement striping, four-lane undivided highways and some edge lines applications. As a secondary benefit to its reflectivity, RPM's also provide a positive feedback to the driver by an audible and vibrating rumble effect.

Pros: Lowest price point of all markings. Highly visible during inclement weather conditions.

Cons: Typically provides the lowest longevity of all markings due to either failure of adhesion to pavement or reflectivity fail from repeated impact from vehicle wheels.

WATERBORNE TRAFFIC PAINT

(Section 713)(Section 737)(Section 1015) Spec. book

Special permission required to specify paint for permanent applications.

Paint is not a durable marking and **should not** be used in construction. Do not spec paint for construction projects without permission from District Traffic Operation Engineer.

Paint may be used for layout purposes or lane configuration before thermoplastic is applied.

THERMOPLASTIC PAVEMENT MARKINGS

(Section 732)(Section 1015) Spec. book

Description: Thermoplastics have been used as a pavement marking material in the United States since the late 1950s and have been the most common pavement marking material used on roadways in Louisiana for years. Thermoplastic is so named because the mixture of plasticizer and resins that serves to hold all of the other ingredients together exists as a solid at room temperature, but becomes liquid when heated to around 400° f. The popularity of thermoplastic markings can be attributed to several factors including readiness for immediate use, high durability, good retroreflectivity and relatively low cost.

When formulated properly for a given roadway surface and correctly applied, thermoplastic pavement markings have been known to last from 4 to 8 years depending on traffic volumes, but research has shown that usual service life range from 2 to 4 years depending on traffic volumes.

Uses: Durable marking for new and replacement of pavement striping on new and existing roadways for both asphalt and portland cement concrete (PCC). On new PCC, curing compound should be removed and a two-part epoxy sealer installed prior to the installation of new markings.

90 mil thickness for:

- edge lines
- centerlines
- lane lines (asphalt only)
- gore markings

125 mil thickness for:

- stop bars
- legend & symbols
- intersection markings

Pros: Great adhesion on asphalt due to its high installation temperatures that melt to the asphalt surface.

Cons: Poor adhesion to concrete (PCC) due to differences in thermo-expansion between pavement and the marking. Also dependent on the contractor mixing and applying materials correctly in the field. Longevity cannot be determined until months after the contractor has applied the materials. Difficult to get contrast markings without doing trailing.

PREFORMED TRAFFIC TAPE

(Section 713) (Section 732) (Section 1015) Spec. book

Description: Preformed tapes have the advantage over sprayed or extruded materials because they don't require expensive application equipment or experienced operators to place, and they don't require drying or curing times. While tapes have a significantly higher initial cost than most materials, the service lives are usually superior to most other pavement marking material, making them a cost-effective choice for high ADT concrete roadways, especially considering the cost of mobility and temporary traffic control.

Uses: For use on portland cement concrete (PCC); Not to be used on asphalt.

LADOTD currently uses 7" Preformed Tape (black/white contrast) on concrete interstate lane lines. DOTD encourages the use of all preformed markings on PCC roadways.

Pros: Extremely durable. Typically last up to ten years depending on ADT. Since these markings are made in a factory, they have consistent retroreflectivity unlike thermoplastic or paint that is installed in the field.

Cons: High initial cost.

PREFORMED LEGENDS & SYMBOLS

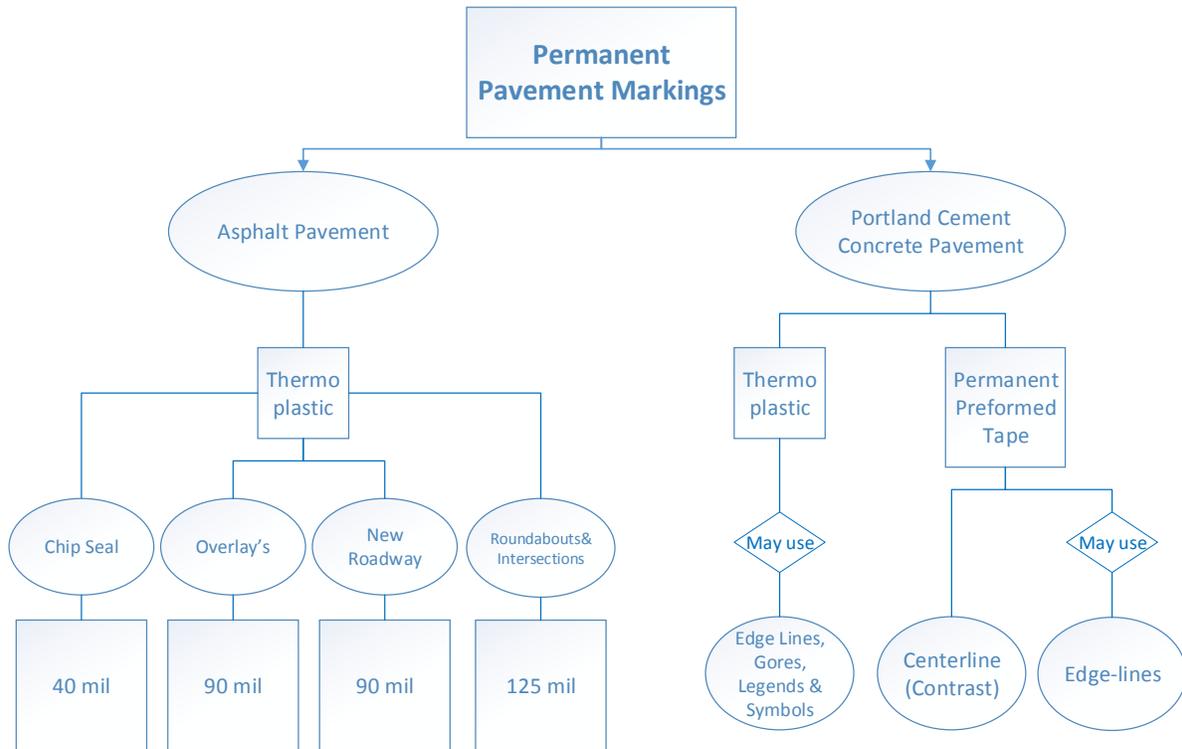
(Section 732) (Section 1015) Spec. book

Description: Preformed legends and symbols are premade thermoplastic shapes, numbers, or letters ready to be installed by applying heat (propane torch) to roadway surface and to the thermoplastic. Legends & symbols can also be installed by using melted thermoplastic and a stenciled shape or letters.

Uses: Preformed legends & symbols are typically thicker (125 mils) material since most of these marking would be installed within the wheel path of vehicles. These include but not limited to stop bars, left or right arrows, interstate shields, school crossing, etc.

Pros: Cost effective, durable and easy to install, as they are typically purchased in quantity and able to be installed in short notice with limited personnel and equipment.

Cons: Improper heating of material will result in reduced adhesion.



SPECIALITY PAVEMENT MARKING (*Special Approval Needed)

*The following materials are for experimental use only. Traffic Engineering Division Administrator must approve use and location. Approved project locations may serve as a test location for evaluation and study.

*AUDIBLE THERMOPLASTIC MARKINGS

Description: Flat line thermoplastic that has evenly spaced out raised bumps (inverted profiled) that produces an audible noise and positive feedback to the driver when driven over by the vehicle.

Uses: Currently under study. To be used for asphalt pavement that is too old or narrow for ground in rumble strips or for concrete pavement without cast in rumbles i.e. bridge decks.

Pros: Able to provide wet reflectance during heavy rains as the audible bump is above the water runoff.

Cons: Higher cost than typical thermoplastic markings and ground-in rumble strips. Requires more maintenance than ground-in rumble strips.

*PROFILED THERMOPLASTIC MARKINGS

Description: Profiled pavement markings are thermoplastic that is an inverted profile to produce a slight humming sound and a little positive feedback to the driver. This alerts the driver that the vehicle is encroaching over the centerline or edge line. Typically, these markings use a higher refractive index glass bead or wet reflective bead

Uses: A substitute for edge and centerlines (lane lines) in areas where visibility may be hindered from water runoff and or fog.

Pros: Provides better visibility in rain or fog than traditional flat line markings.

Cons: Higher cost than typically thermoplastic markings and ground-in rumble strips.

*METHYL METHACRYLATE (MMA) MARKINGS

DESCRIPTION: A nonhazardous, two-component, durable pavement marking material. The material exists as a solid that is mixed in a static mixer immediately prior to application. MMA can be sprayed, extruded, or rolled onto the pavement. The material forms a strong bond to the pavement surface by exothermic reaction (release of heat) that occurs during the mixing process.

MMA has been shown to provide much longer service life than standard traffic paint or thermoplastic. MMA reportedly bonds well to concrete pavement. MMA is temperature sensitive, since it does not rely on heat to cure, extremes in temperature would dictate application and curing times.

Uses: May be installed on new and existing roadways, both asphalt and portland cement concrete (PCC) for white and yellow intersection markings and within roundabouts.

Pros: Very durable and cost effective.

Cons: Sensitive to surface temperatures and humidity. Compatibility issues with thermoplastic bonding to MMA. Paint may be applied for maintenance purposes.

REMOVAL and RETROREFLECTIVITY

REMOVAL OF PAVEMENT MARKINGS

(Section 732) Spec. book

PAVEMENT STRIPING

Description: Removal of pavement striping shall be to such extent that 75% of the pavement surface or bridge deck under the marking is exposed. If removal is necessary, USE CAUTION as pavement damage will occur with most mechanical grinding methods leaving scarring or ghost lines. The current removal of existing marking specification does not state a specific removal method.

After markings are removed, properly dispose of striping debris and residue.

ASPHALT

No removal is required on asphalt pavement unless directed otherwise. Must check with District Traffic Operations Engineer if removal is required, as pavement scarring will result.

Black paint over markings is not acceptable because it wears off and the bead may show there thru the black paint confusing the drivers.

PORTLAND CEMENT CONCRETE PAVEMENT (PCCP)

Paint: 75% removal is not needed if paint is used for final layout or marker placement. Paint surface would only need to be scuffed for preparation for thermoplastic markings and permanent tape.

Thermoplastic: 75% removal is required before replacement markings are installed. Legends & Symbols need 100% removal due to installation equipment and procedures.

Preformed Tape: 75% removal is required before replacement markings are installed.

Other pavement markings: 100% removal maybe required if replacement materials are not compatible.

RETROREFLECTIVE RAISED PAVEMENT MARKERS (RPMS)

Description: Removal of raised pavement markers (RPMS) shall be such that it does not damage the pavement.

ASPHALT

Do not remove if the existing RPM is too deep (pressed in from being run over by vehicles) into the asphalt surface and removal would cause damage to pavement.

PCC

Required on all projects.

LIMITATIONS:

Concrete pavement: Pavement markings on PCC should always be removed and replaced.

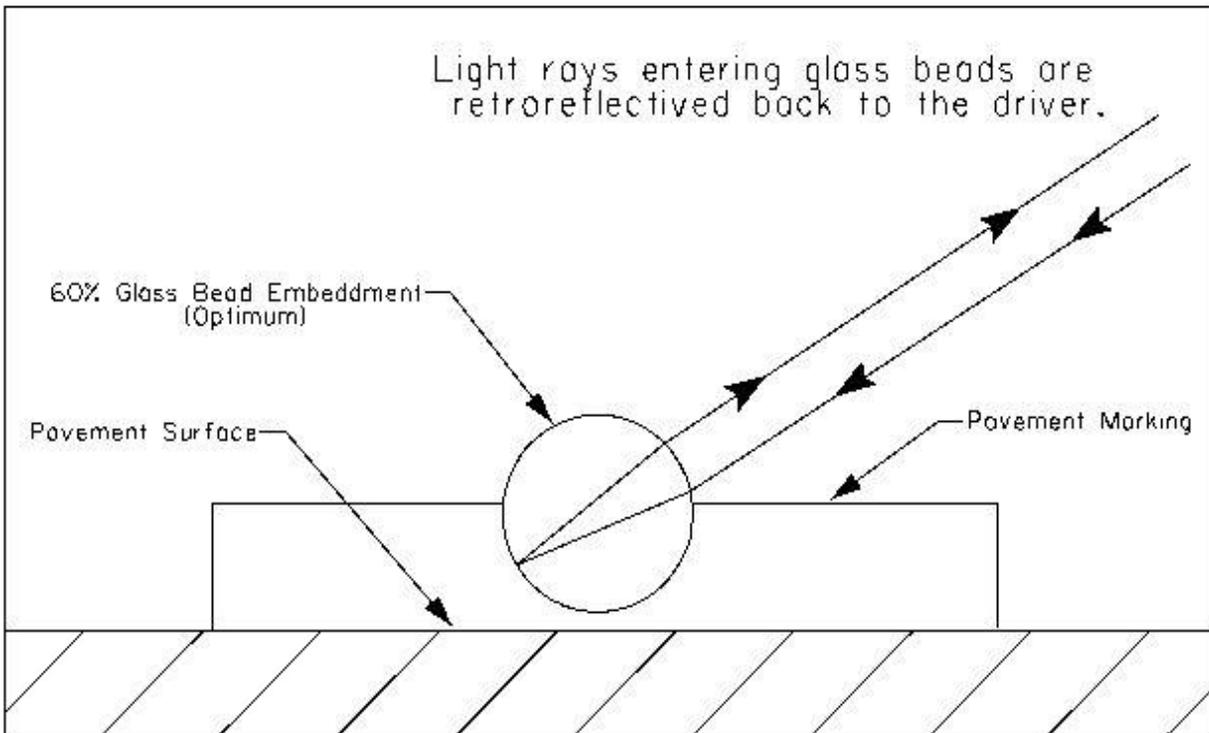
Asphaltic pavement: Pavement markings on asphalt pavement can be added without removal to a maximum of 180 to 200 mils thickness (typically no more than two layers – original stripe plus 1 overlay stripe).

RETROREFLECTIVITY

(Section 732) (Section 1015) Spec. book

Pavement marking retroreflectivity is accomplished through the use of glass beads partially embedded on the surface of the marking binder material. Glass beads are necessary in pavement marking retroreflectivity as markings would be useless at night without them. The bead returns light from the headlamp back to the driver as shown below.

GLASS BEADS RETROREFLECTIVITY



INSPECTION

Proper installation is the key to quality, long lasting pavement markings. Proper installation is achieved by surface preparation and field inspection procedures. Both are essential to ensure high-quality pavement markings. These inspections are for thermoplastic pavement striping, although some can pertain to other markings too.

Surface preparation and field inspection can be divided into three parts:

1. Inspection of equipment, roadway and weather conditions prior to installation.
 - Perform moisture test using the plastic or tarpaper on pavement for 15 minutes then check backside for moisture. May also apply hot thermoplastic line onto tarpaper and check backside for moisture. If pavement markings are applied with moisture present adhesion to pavement will be compromised, maybe not initially but will shorten overall longevity of markings. In addition, markings may show bubbling due to hot thermoplastic boiling off the moisture underneath.
 - Observe the contractor calibrating the bead guns.
2. Inspection of the pavement marking during the application process.
 - Check sealers prior to installation. For 90 mil thermo, a two part epoxy sealer is to be used. Typically mixed in two equal parts (Part A 50%\Part B 50% mix).
 - Do not allow traffic on sealer prior to installation of thermoplastic markings.
 - Observe molten thermoplastic that is being used to ensure that is not overheated. White will tend to brown or have a tannish tint and yellow will turn darker yellow when overheated.
 - Using a magnifying glass, check glass bead embedment is 60%, which is optimum. Although this is almost impossible to accurately gauge 60% in the field. Less than 60% will not adequately hold bead to thermoplastic line and greater than 60% embedment the retroreflectivity will start to diminish.
 - Check to ensure that the bead drop is evenly distributed over the entire line. An incorrect bead distribution will drop more bead in the center or the edges. This will produce an inconsistent retroreflectivity or poor line definition at night.
 - Check that the Type 4 (large) beads are on the first drop.
 - If available, use an infrared heat thermometer to check thermoplastic temperature out of ribbon gun.
 - Measure lines periodically to ensure correct widths ie. 4", 6", 8", 12"& 24". We are paying for 4" lines not 3 ¾" lines.
3. Inspection of the finished work for acceptance.
 - Always check markings at night on foot with flashlight and driving with low beam headlights looking for inconsistent beads coverage that would show dead (dark or spots of low reflectance).

APPENDIX A

Specifications, Standard Plans and Special Details

Pavement Marking Construction and Material Specifications

Specifications for pavement markings are in the current version of LADOTD's Standard Specifications for Roads and Bridges.

- 713 Temporary Traffic Control
- 731 Raised Pavement Markers
- 732 Plastic Pavement Markings
- 737 Painted Traffic Striping
- 1015 Signs and Pavement Markings

Traffic Engineering Manual

The [Traffic Engineering Manual](#) is intended to supplement the MUTCD by clarifying DOTD policy concerning the study and installation of traffic control devices

Manual On Uniform Traffic Control Devices (MUTCD)(2009)

Markings, Chapter 3

Temporary Traffic Control Control De(TTC), Chapter 6F

Traffic Control for School Areas, Chapter 7C

Traffic Control for Railroad and Light Rail Transit Grade Crossings (R/R), Chapter 8B

Traffic Control for Bicycles Facilities, Chapter 9C

Pavement Marking Standards

The following LADOT pavement marking standards pertain to pavement markings layouts:

- PM-01** Centerline and Edge Line Markings
- PM-02** Pavement Word and Symbol Markings for Non-Interstate Use
- PM-03** Pavement Word and Symbol Markings for Interstate Use
- PM-04** Auxillary, Deceleration and Acceleration Lanes and Gore Striping Layouts

PM-05	Typical Intersection Striping Layouts
PM-06	Lane Reduction and Island Layouts
PM-07	Railroad Crossing Layout
PM-08	Pedestrian / Bike Striping Layout
PM-09	Roundabout Striping Layout

Temporary Traffic Control Standard Plans.

The following LADOT standards pertain temporary traffic control for work zones:

TTC-00(A)	Temporary Traffic Control General Notes Sheet
TTC-00(B)	Temporary Traffic Control General Notes Sheet
TTC-00(C)	Temporary Traffic Control General Notes Sheet
TTC-00(D)	Temporary Traffic Control General Notes Sheet
TTC-01	Temporary Traffic Control Work Greater than 15ft from the Traveled Way
TTC-02	Temporary Traffic Control Work Less than 15ft from the Traveled Way
TTC-03	Temporary Traffic Control for Lane Closures on Two Lane Roads with Two-Way Traffic near Intersections (Flagging Operations)
TTC-04	Temporary Traffic Control for Lane Closures on Two Lane Roads with Two-Way Traffic (Flagging Operations)
TTC-05	Temporary Traffic Control for On Site Diversion with Two-Way Traffic
TTC-06	Temporary Traffic Control for Lane Closures Four-Lane Undivided Highways
TTC-07	Temporary Traffic Control for Closure of Two Adjacent Lanes on Four-Lane Undivided Highways
TTC-08	Temporary Traffic Control for Median Crossovers on Divided Highways
TTC-09	Temporary Traffic Control for Lane Closures on Divided Highways
TTC-10	Temporary Traffic Control Lane and Sidewalk Closures in Urban Areas with Speed Limit Less Than or Equal to 40 MPH
TTC-11	Temporary Traffic Control Lane Closure Using Temporary Barrier Rail on Divided Highways (Includes Freeway)

- TTC-12** Temporary Traffic Control for Lane Closures through Ramp Entrance and Exit Tapers
- TTC-13** Temporary Traffic Control for Closure of Two Lanes on a Multi-Lane Highway
- TTC-14** Temporary Traffic Control for Louisiana Left on Interstate Highways
- TTC-15** Temporary Traffic Control for Short Duration Closing of Divided Highways
- TTC-16** Temporary Traffic Control for Road Closures
- TTC-17** Temporary Traffic Control for Moving Operations for Interstate and Multi-Lane Roadways
- TTC-18** Temporary Traffic Control for Moving Operations on Two-Way Two-Lane Roadways
- TTC-19** Temporary Traffic Control for Traffic Signal Installation and Maintenance at an Intersection