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Part 3 - MARKINGS

300 GENERAL

300-1 Introduction

The information provided in this Part of the **TEM** is intended to supplement the **OMUTCD** by presenting **ODOT** practices and procedures concerning the design, construction, operations and maintenance of various types of traffic marking devices such as pavement markings, including raised pavement markers, object markers, barrier reflectors and delineators.

300-2 Construction Projects

Section 140 addresses the general application of **ODOT** standards, specifications and standard construction drawings to construction projects and ***Section 350*** provides additional construction related information specific to traffic control markings.

300-3 Force Account (ODOT Operations) Work

Districts performing force account markings work must comply with the requirements in the **OMUTCD** and this Manual. It is recommended that the **Districts** follow the provisions in the applicable markings related **SCDs** and **CMS** sections as well. It should be recognized, however, that the information in the **CMS** and **SCDs** does not necessarily provide the only method to achieve a given objective.

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301 PAVEMENT & CURB MARKINGS

301-1 General

OMUTCD Chapters 3A and 3B present information on pavement markings. ***Sections 340, 350 and 360*** of this Manual present additional guidance information, and **Standard Construction Drawings TC-71.10, TC-72.20 and TC-73.10** provide additional design and application information. For District-wide Pavement Marking Projects, Pavement Marking Specifications are addressed in **Proposal Note 890**. Otherwise, pavement marking specifications are addressed in **CMS item 640, CMS Item 740 and Boiler Plate Proposal Note 101**. **Supplement 1047** addresses field service testing procedures and Supplement 1089 address markings certification requirements.

Raised Pavement Markers (RPMs) are a special form of pavement marking addressed in **OMUTCD Part 3** and in ***Part 302*** of this Manual.

The general standards for curb markings are addressed in **OMUTCD Section 3B.21**.

301-2 Selection of Pavement Marking Materials

ODOT currently employs the following material types for pavement markings on **ODOT**-maintained highways: fast dry paint, polyester, extruded thermoplastic, epoxy preformed plastic and heat-fused preformed thermoplastic. Pavement marking materials for application on **ODOT**-maintained highways should be selected from ***Table 397-1***.

The use of pavement marking materials which are capable of longer service lives than that of traffic paint can result in benefits of reduced frequency of renewal, less exposure of the public and workers to the hazards of the pavement marking operation, and a higher percent of time markings are present on the roadway. Therefore, such pavement marking materials shall be used on **ODOT**-maintained highways wherever pavement conditions permit the material to achieve its expected service life while providing comparable economy to alternative materials.

For highways not maintained by **ODOT**, the method of providing long-life pavement marking materials shall be the same as that described herein for **ODOT**-maintained highways except:

1. Local maintaining agencies shall agree in writing to maintain such markings in-kind in the future.

2. The policy regarding **ODOT**-maintained highways in **Villages** is contained in ***Section 301-3***.

301-3 Pavement Marking in Incorporated Villages

ORC Section 5521.01 provides that the **Director of Transportation**, upon request by, and approval of, the legislative authority of a **Village**, shall maintain, repair and apply standard longitudinal pavement markings as considered appropriate.

"Request by, and approval of, the legislative authority of a **Village**" shall be in the form of **ODOT Form No. MR-689** (see ***Form 1396-1***) and shall describe the state highway extensions covered by the Ordinance. All such maintenance ordinances **(MR-689)** shall be filed in the office of the **District Deputy Director**.

The pavement markings shall be maintained by the **District** in conformance with the **OMUTCD** and shall be applied in the course of regularly scheduled pavement marking work. An inventory of these markings shall be maintained in the **District**.

The placing of auxiliary markings shall not be **ODOT's** responsibility, but may be included in a contract

administered by **ODOT**. The **Village** shall bear all project costs of such auxiliary markings. Auxiliary markings shall be defined as all markings described in **CMS 641.08**, except center lines, lane lines, edge lines and channelizing lines. However, channelizing line segments of 200 feet (60.0 meters) or less shall be considered auxiliary markings.

301-4 Longitudinal Markings

Longitudinal markings include center lines, two-way left-turn only markings (excluding arrows), lane lines, edge lines and channelizing lines. The standard width for center lines, lane lines and edge lines on **ODOT**-maintained highways shall be 4 inches (100 millimeters), and the standard width for channelizing lines shall be 8 inches (200 millimeters). However, as noted in **OMUTCD Sections 3A.06 and 3B.05** slightly wider lines may be used for additional emphasis.

301-5 Stop Lines

The general standards for Stop Lines are addressed in **OMUTCD Section 3B.16**. For **ODOT**-maintained highways, Stop Lines shall be 24 inches (600 millimeters) wide. They should be used at all signalized intersections. They should also be used to supplement STOP signs where it is important to indicate the point behind which vehicles are required to stop.

301-6 Crosswalk Markings

The general standards for Crosswalk Lines are addressed in **OMUTCD Section 3B.17**. For **ODOT**-maintained highways, the standard width for Crosswalk Lines shall be 12 inches (300 millimeters), except that for a midblock crosswalk they shall be 24 inches (600 millimeters) wide.

301-7 Parking Space Markings

The general standards for parking space markings are addressed in **OMUTCD Section 3B.18**. For **ODOT** facilities, the standard width for parking space lines shall be 4 inches (100 millimeters).

When parking spaces reserved for handicapped persons are provided, in addition to the required signing (**OMUTCD Section 2B.34**), the International Symbol of Access (wheelchair symbol) shall be used to further identify the reserved stall(s). Unless there is a need for additional emphasis, the standard size symbol shall be used (**OMUTCD Figure 3B.18**).

The **Ohio Building Code** and the **Americans with Disabilities Act (ADA) of 1991** establish various requirements for the number and design of parking spaces reserved for the handicapped. Additional information is available upon request from the **OTE Standards Section**.

301-8 Pavement Marking Words and Symbols

All pavement marking words (letters and numerals) and symbols should be in conformance with **FHWA's Standard Alphabet for Highway Signs and Pavement Markings (see OMUTCD Figures 3B-19 and 3B-20)**. **OMUTCD Section 3B.19** establishes general standards for pavement marking word and symbols and **SCD TC-71.10** establishes placement standards, as well as providing additional design detail information. The standard pavement marking words and symbols are illustrated in **OMUTCD Figures 3B-18 through 3B-24**.

However, the alternate narrow elongated arrows described in the note in **OMUTCD Figure 3B-20** should not be used on **ODOT**-maintained highways, unless needed to match similar arrows used by another jurisdiction in the same area.

Lane-Use Arrow pavement markings should be used in all right-turn and left-turn bays. Signs or arrow markings should be repeated as necessary to prevent entrapment and to help the road users select

the appropriate lane early. When used, there should be a minimum of two arrows in each turn bay.

The ONLY word marking may be used only when engineering judgment indicates a need for it.

When used, spacing between the arrows, and arrow and ONLY word markings, should be ten times the height of the characters.

Table 397-2 shows the marking area in square feet and in square meters for various words and symbols.

301-9 Two-Way Left-Turn Arrows

OMUTCD Sections 3B.03 and 3B.19, and Figures 3B-7 and 3B-20 establish standards for the design and placement of pavement markings for two-way left-turn only (TWLTO) lanes. For uniformity and consistency, the following additional guidelines have been established for spacing two-way left-turn arrows within a TWLTO lane.

As shown in **OMUTCD Figure 3B-7** and ***TEM Figure 398-1***, these left-turn arrows, when used, should be spaced 8 to 16 feet (2.4 to 4.9 meters) apart, tip to tip. The "wing tips" of the arrows should be placed 4 inches (100 millimeters) from the center of the lane.

The arrow sets should be longitudinally spaced at intervals of 500 to 1000 feet (150 to 300 meters) for speeds up to 40 miles per hour (65 km/hr), and at intervals of 1000 to 1500 feet (300 to 450 meters) for speeds over 40 miles per hour (65 km/hr). In addition, an arrow set should be placed 100 to 200 feet (30 to 60 meters) from the near edge of an intersecting roadway or inside both ends of TWLTO lanes, to remind road users that they are approaching a TWLTO lane in the middle.

Signing for TWLTO facilities is addressed in **OMUTCD Section 2B.22**.

301-10 Speed Measurement Markings

Speed Measurement Markings **(see OMUTCD Section 3B.20 and Figure 3B-10)** are used to establish Air Speed Check Zones to assist in the enforcement of speed measurements. On **ODOT**-maintained highways, they shall be 24 inches (600 millimeters) in width, and they shall be installed in accordance with **OMUTCD Section 3B.20**.

The following procedure has been established for installing and maintaining (i.e., replacing after resurfacing), or abolishing Air Speed Check Zones:

1. Local **Ohio State Highway Patrol (OSHP) Posts** shall submit requests for establishing, maintaining or abolishing Air Speed Check Zones to the **OSHP Aviation Section Headquarters** on **Air speed Check Zone Request Form AZ-1** ***(Form 396-1)***.

2. The **Aviation Section Headquarters** shall determine the necessity of establishing, maintaining or abolishing an Air Speed Check Zone.

3. If the **Aviation Section Headquarters** approves the request, it shall be forwarded to the appropriate **ODOT District Highway Management Administrator**.

4. The **ODOT District** shall evaluate the practicality of establishing or maintaining the zone. If the request is determined to be practical, the **District** shall complete the requested work. A registered surveyor shall lay out the markings (when originally established and when replaced after resurfacing).

5. Upon completion of the requested work, the **District** shall:

a. Update its records, including its Air Speed Check Zone inventory,

b. Complete the **ODOT** portion of the request form, and

c. Return the completed request form to the **OSHP Aviation Section Commander**, at 2829 W. Dublin-Granville Rd., Don Scott Field, Columbus, Ohio 43235.

6. If for some reason the request is not practical, the **District** shall return the request to the **HPASH** (at the address noted in item 5) explaining the reason for not complying with the request.

7. If the request was to abolish an existing Air Speed Check Zone, the **District** shall:

a. Update its records,

b. Complete the **ODOT** portion of the request form,

c. Return the completed request form to the **OSHP Aviation Section Commander**, at 2829 W. Dublin-Granville Rd., Don Scott Field, Columbus, Ohio 43235, and

d. Allow the markings to wear out.

301-11 Railroad Approach Markings

The general standards for railroad approach markings are addressed in **OMUTCD Sections 8B.16, 8B.17 and 8B.18, and Figures 8B-2 and 8B-3**. Additional railroad approach markings information is provided in ***Section 802*** and **SCD TC-71.10.**

301-12 Speed Hump Markings

Speed humps are a “wave-shaped” paved humps/bumps in the street, spread over about 12 feet (3.6 meters) with a maximum height in the middle of about 3 inches (75 millimeters). They are considered a design feature, rather than a traffic control device. **ODOT** does not have an official policy or standard on the design or use of speed humps.

Drivers may respond to these humps/bumps with alarm or surprise, which could result in loss of control of the vehicle. The humps can also cause problems for ambulances and other emergency vehicles. Therefore, their use should be limited and we do not recommend their use on through public highways. However, since they can be a cost-effective traffic-calming measure for reducing speeds on existing residential streets, local jurisdictions periodically inquire about them. Signing and pavement markings standards for speed humps are addressed in **OMUTCD Sections 2C.22, 3B.26 and 3B.27**. It is recommended that any jurisdiction considering speed humps establish guidelines for their design and use. Sample guidelines (from the **City of Columbus**) are available upon request from the **Standards Section** of the **Office of Traffic Engineering (OTE)**.

301-13 Fire Hydrant Markers

OMUTCD Section 3B.11 indicates that blue raised pavement markers may be used to mark the position of fire hydrants.

In 1983, **FHWA** issued a memorandum on the use of blue retroreflective pavement markers to help identify fire hydrants and water supply locations. They also provided a good set of guidelines that had been developed by the **California Traffic Control Devices Committee** in consultation with fire officials. Over the years this information has been made available to local jurisdictions in response to

inquiries on the topic. Copies of the information are available from the **Office of Traffic Engineering**. Generally, this is an urban issue and has been left to local jurisdictions to address as needed.

The blue pavement markers are, of course, subject to the same problems as our standard raised pavement markers RPMs in areas subject to snowfall. It has been noted that, if the primary concern is to attract attention quickly to a nearby hydrant, there are other methods that can be used, such as small signs, reflective tape or paint. For example, **District 12** has had to address the problem of identifying fire hydrants locations. The hydrants were going to be hidden by a sound barrier. Access holes were provided in the barrier wall and small signs (12 x 6 inches (300 x150 millimeters)) were mounted on the wall above the access points to identify them, using a local numbering system.

301-14 Diagonal Transverse Lines

301-14.1 General

Transverse lines used to mark neutral areas of exit ramps and painted islands, to mark out excess pavement areas, to direct drivers away from obstructions, and on shoulders are 24 inch (600 millimeters) wide diagonal lines and are placed at 45°. **OMUTCD Sections 3B.05, 3B.10, 3B.15 and 3G.03** establish general standards for diagonal transverse markings.

DIAGONAL LINES SPACING TABLE

FROM	TO	DIAGONAL LINE SPACING
0 feet	48 feet (14.6 m)	12 feet (3.7 m) on center
49 feet (14.9 m)	96 feet (29.3 m)	24 feet (7.3 m) on center
97 feet (29.6 m)	Greater than 96 feet (29.3 m)	48 feet (14.6 m) on center

301-14.2 Exit Ramps

White diagonal lines shall not be used in the neutral area of exit ramps except at freeway to freeway interchanges and lane drop exits or when engineering judgment indicates a need for them. When used for those situations, diagonal lines shall be placed in the neutral area and the spacing of these markings should be as noted in ***Section 301-14.1***.

301-14.3 Obstructions

When there is an obstruction within the paved roadway, diagonal transverse lines should be used as shown in **OMUTCD Figure 3B-13** in the neutral area formed by the required approach markings per **OMUTCD Section 3B.10**.

301-14.4 Painted Islands

Painted islands more than 6 feet (1.8 meters) in width shall include diagonal lines in the median area in order to discourage its use as a travel lane or parking space. Such markings shall not be used in the median area of painted islands that are less than 6 feet (1.8 meters) in width, except when engineering judgment indicates a need for them. The spacing of diagonal lines shall be as shown in the table in ***Section 301-14.1***. However, if painted island separates opposing traffic, the 12 feet (3.7 meters) spacing begins at both ends of the painted island.

301-14.5 Shoulders

Highways with paved shoulders may experience operational problems due to vehicles misusing the shoulder (e.g., using the shoulder as a travel lane). Diagonal lines may be used to discourage shoulder misuse where such problems exist.

When such markings have been placed, appropriate signing (e.g., NO DRIVING ON MARKED SHOULDER) should be erected.

302 RAISED PAVEMENT MARKERS

302-1 General

Raised Pavement Markers (RPMs) are a special form of pavement markings described in **OMUTCD Sections 3B.11 through 3B.14**. Plowable RPMs were developed for use in states that typically have to deal with snow. **CMS Item 621** and **CMS 721** establish the specifications for RPMs and **Supplement 1062** addresses testing procedures. Information about the proper installation of RPM castings and reflectors, and inspection guidelines are provided in ***Sections 350 and 360***, respectively.

As noted in **OMUTCD Sections 3B.12 through 3B.14**, RPMs may be used as positioning guides, or to supplement or substitute for the standard pavement markings. **ODOT's** RPM program basically uses them as positioning guides.

Temporary raised pavement markers are addressed in ***Section 605-11.12*** **and SCD MT-95.70, 96.10 and 101.20**.

302-2 Guidelines and Placement Standards

RPMs should be used on **ODOT**-maintained highways. They should be included in new construction and resurfacing projects on **ODOT**-maintained highways. They may also be included in the plans at other locations.

SCDs TC-65.10, 65.11 and 65.12 detail the placement standards and guidelines for RPMs used with center lines, lane lines, edge lines and channelizing lines in general. Various specific typical situations, such as one-lane bridges, stop approaches, curves, two-way left-turn lanes and intersections are also addressed in these **SCDs**.

Each **District** should periodically inspect their RPMs to determine if nighttime reflectivity is still adequate. Reflectors that are cracked, abraded, missing or have marginal optical performance should be scheduled for maintenance. Cracked or loose castings should be removed and replaced as soon as practicable. Systematic replacement of RPM reflectors should be scheduled on a two to four year cycle. A statewide average reflector maintenance rate of 33 percent per year is expected.

302-3 Administrative Responsibilities

Responsibilities for this program are as follows:

1. The **Office of Traffic Engineering (OTE)** shall:

    a. Develop specifications and standards;

    b. Evaluate new RPM materials; determine the method of RPM installation, maintenance and replacement;

    c. Administer the term purchase contract for RPM materials; and

    d. Conduct Quality Assurance Reviews (QARs) at least every two years in each **District**.

2. The **District** shall:

    a. Carry out the RPM program in a manner to install 100 percent of the RPMs on all eligible **ODOT**-maintained highways;

b. Replace RPMs that are removed/disturbed, for whatever reason, as soon as practicable;

c. Maintain a roadway inventory of all RPMs; and

d. Systematically replace RPM prismatic reflectors.

302-4 Maintenance

To be effective, RPMs must be properly maintained to keep prismatic reflectors and castings in good condition. Proper maintenance can be best accomplished by a program which emphasizes replacement of removed/disturbed RPMs as soon as practicable in conjunction with a systematic replacement of RPM reflectors on a two to four year cycle. The length of the replacement cycle would be dependant upon factors such as traffic volumes, traffic composition and environmental conditions. Most highways should have reflectors replaced on a three year cycle. A four year replacement cycle might prove to be adequate for low-volume highways; while heavily traveled freeways and expressways with high volumes of truck traffic might need reflector replacement based on a two year cycle.

RPMs shall be removed prior to resurfacing and disposed of by the contractor.

302-5 Raised Pavement Markers in Villages

The **District** may install the RPMs on state highway extensions in **Villages**, upon request by and approval of the legislative authority of a **Village**. "Request by, and approval of, the legislative authority of a **Village**" shall be in the form of **ODOT Form No. MR-689** (see ***Form 1396-1***) and shall describe the state highway extensions covered by the Ordinance. All such maintenance ordinances **(MR-689)** shall be filed in the office of the **District Deputy Director**. The installation of RPMs upon request of a **Village** does not obligate **ODOT** to maintain them.

302-6 Narrow and One-Lane Bridges

RPMs shall be installed in accordance with **SCD TC-65.12** at narrow and one-lane bridges. The center line pavement marking shall be stopped 160 feet (48 meters) in advance of a one-lane bridge. ***Figure 398-3*** illustrates signing and markings guidelines for narrow and one-lane bridges. Additional information is also provided in ***Sections 202-5, 303-2 and 304-5***.

303 OBJECT MARKERS

303-1 General

OMUTCD Chapter 3C establishes standards and guidelines for the design and use of object markers. Additional design and application information is provided herein. As noted in ***Section 340-5***, for plan purposes object markers shall be treated as flatsheet signs.

303-2 Narrow and One-Lane Bridges

Type 3 object markers shall be used in accordance with **OMUTCD Sections 3C.03** to mark narrow and one-lane bridges. ***Figure 398-3*** illustrates the signing and markings guidelines for narrow and one-lane bridges. Additional information is also provided in ***Sections 202-5, 302-6 and 304-5***.

303-3 Delineation of Left-Turn Lanes in Medians

Delineation is recommended for parallel and tapered left-turn lanes at intersections which are not illuminated. ***Section 304-6*** addresses the use of delineators, Keep Right signs and object markers at these locations. ***Figures 398-4 and 398-5*** illustrate delination of left-turn lanes in medians.

303-4 Barrier Object Marker

Barrier Object Markers are a special type of marker which is mounted on top of 32-inch (0.81meter) PCB and may be used on other temporary traffic barriers. See ***Section 605-19*** for details.

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304 DELINEATORS

304-1 General

OMUTCD Chapter 3D establishes standards and guidelines for the design and use of delineators. Additional design and application information is provided herein, and in **SCD TC-61.10**, **CMS Item 620** and **CMS 720**. Delineator reflector color shall match that of the nearest edge line.

304-2 Delineator Types

For identification purposes, **CMS 620.02** designates the following color of each type of delineator: Type C, rectangular white (or "colorless"); Type D, rectangular yellow; and Type E, rectangular red.

304-3 Application Guidelines

In accordance with the provisions of **CMS 620.02**, on **ODOT**-maintained routes, only flexible delineator posts on the prequalified list maintained by the **Office of Materials Management** shall be installed for roadside delineation.

On **ODOT**-maintained freeways and expressways, delineators shall be used except as noted below.

Delineators should be used on freeway and expressway tangent sections in snowbelt areas (i.e., **District 12** and the northern portions of **Districts 3 and 4**). In other areas of the State, roadside delineators shall not be placed on roadway tangent sections of expressways, freeways and other multilane divided highways when **all** the following conditions are met:

1. Raised pavement markers (RPMs) are used continuously on lane lines throughout all curves and on all tangents to supplement pavement markings.

2. Where whole routes or substantial portions of routes have large sections of tangent alignment (where, if roadside delineators were not required on tangents, only short sections of curved alignment would need delineators).

3. Roadside delineators are used to lead into all curves as shown in **OMUTCD Figure 3D-1**.

Once delineators are installed, they shall be maintained. Periodic reviews shall be conducted to assure that good appearance and effectiveness are maintained.

304-4 Median Openings for Private Access

When it is determined that delineation of a median opening for private access is needed, a rectangular yellow (Type D) delineator should be erected at the median nose on the centerline of the median, on each side of the opening ***(see Figure 398-2)***. If the median width exceeds 40 feet (12 meters), this delineator should be erected 20 feet (6 meters) from the pavement edge. Additional delineators may be erected up to 200 feet (60 meters) upstream from the median nose.

304-5 Narrow and One-Lane Bridges

Type C (white rectangular) delineators should be erected 50 feet (15 meters) apart along both sides of each approach to narrow and one-lane bridges in accordance with **OMUTCD Chapter 3D** and **SCD TC-61.10**. ***Figure 398-3*** illustrates the signing and markings guidelines for narrow and one-lane bridges. Additional information is also provided in ***Sections 202-5, 302-6 and 303-2***.

304-6 Delineation for Left-Turn Lanes in Medians

Delineation is recommended for parallel and tapered left-turn lanes at intersections which are not illuminated. Delineators should be erected 4 to 6 feet (1.2 to 1.8 meters) from the edge of roadway, but not less than 2 feet (0.6 meter) from the edge of a paved or usable shoulder. This is illustrated in ***Figures 398-4 and 398-5***. On curbed sections, the delineators should be erected 2 feet (0.6 meter) behind the face of the curb.

The R4-7b-36 Keep Right sign shall be erected only when the median width is 5 feet (1.5 meters) or more at the sign location. When the median width is less than 5 feet (1.5 meters) at the sign location, the R4-7b-24 may be erected. If the median width does not permit use of the R4-7b sign, a Type 2 object marker should be erected 15 to 30 feet (4.5 to 9.0 meters) from the nose of the median.

OMUTCD Section 2B.28 provides information on the R4-7b sign. **Chapter 3C of the OMUTCD** and ***Section 303*** of this Manual provide information on object markers.

305 COLORED PAVEMENTS

The use of colored pavement as a traffic control device is addressed in **OMUTCD Chapter 3E**. We do not currently have any additional **ODOT**-specific standards related to colored pavements.

306 BARRICADES AND CHANNELIZING DEVICES

The use of barricades and channelizing devices in Temporary Traffic Control Zones is addressed in **OMUTCD Part 6** and ***Part 6*** of this manual. Use of these devices in other situations is addressed in **OMUTCD Chapter 3F**. We do not currently have any additional **ODOT**-specific standards related to this use of these devices.

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307 BARRIER REFLECTORS

307-1 General

Although not considered traffic control devices, barrier reflectors are used to help mark guardrail and concrete barriers, including bridge parapets. Specifications for these reflectors are covered in **CMS Item 626** and **CMS 720.04**.

Once barrier reflectors are installed, they should be maintained in good condition.

307-2 Application on ODOT-Maintained Highways

Barrier reflectors shall be erected on all new or reconstructed guardrail, new concrete barrier and new or reconditioned bridge parapets. This applies to all state and/or federally-funded projects regardless of the presence of edge lines, reflectorized glare screens, RPMs or highway lighting.

The color of a barrier reflector shall match that of the nearest edge line.

Barrier reflectors shall also be used on temporary traffic barriers in work zones (see ***Section 605-19***). Although they are paid for under **CMS Item 614**, these reflectors are identical to those described in **CMS Item 626**.

310 ISLANDS

OMUTCD Chapter 3G addresses the functions, end protection and approach treatments for traffic control islands. As noted in **OMUTCD Section 3G.01**:

> An island for traffic control purposes shall be the defined area between traffic lanes for control of vehicle movements or for pedestrian refuge. Within an intersection area, a median or an outer separation is considered to be an island.

L&D Manual Volume One Section 300 includes additional information about medians and curbs.

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320 MATERIALS AND HARDWARE

320-1 General

The **Office of Materials Management** maintains the qualified product lists (QPL) for pavement markings, raised pavement markers and barrier reflectors. The QPLs are available on that office's web page.

Specifications and testing procedures for markings materials are addressed in ***Section 343***. ***Section 350-2*** addresses work zone performance evaluations.

320-2 Patented or Proprietary Materials, Specifications or Processes

The use of patented or proprietary materials, specifications or processes is discussed in ***Section 1220-3***.

320-3 Purchasing Materials for Installation and Use by Local Agencies

To help encourage uniformity and provide a method whereby local agencies can buy traffic control materials and equipment using federal funds, a process has been established whereby local agencies can purchase such items through **ODOT**. The process is described in ***Section 1220-5.***

320-4 Use of Type G Sheeting

Type G reflective sheeting **(see CMS 730.19)** shall be used on cones, weighted channelizers ***(see Part 6)*** and tubular markers used at night, barricades and drums, delineators, object markers, guardrail anchor assemblies and impact attenuators. Information about guardrail anchor assemblies and impact attenuators is provided in **L&D Manual Volume One Section 603** and additional information about marking them is noted in **Plan Notes R-112, R-113 and R-123 (see L&D Manual Volume Three)**.

320-5 Barrier Reflectors

There is not a testing procedure for barrier reflectors; however, the following approval process has been established:

Barrier reflectors shall be purchased only from companies on the QPL maintained by the **Office of Materials Management**. The manufacturer shall submit to **ODOT** a sample of the reflector along with a catalog description showing recommended installation procedures and certified test data from an independent test laboratory. **ODOT** will evaluate these samples to determine conformance with **CMS 720.04**. Reflectors meeting the specifications will be included on the QPL maintained by the **Office of Materials Management**. Poor field performance or a change in materials will be cause for removal from the prequalified list. Substitutes will not be accepted.

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330 PLANNING / PROGRAMMING

This area has been reserved for information regarding planning/programming information related to traffic control markings.

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340 DESIGN INFORMATION

340-1 General

Section 140 provides general background regarding design information for **ODOT** projects, including the three-stage review process typically used for traffic control plans. This part of the **TEM** provides additional design information specific to markings.

Additional plan preparation information specific to markings is provided in ***Section 341***. **Plan Notes** for marking-related items are addressed in ***Section 342.*** Marking specifications and testing information are addressed in ***Section 343.***

340-2 Preliminary Pavement Marking Plan and Stage 2 and 3 Plan Submittals

The following information has been provided here as checklists for Preliminary Pavement Marking Plans, and Stage 2 and 3 plan submittals.

1. Preliminary Pavement Marking Plan (PDP Steps 7 and 8 Major Projects / Step 4 Minor Projects): On the plan view sheets show the lane alignment, lane assignments and turn lane storage lengths.

2. Stage 2 Plan Requirements (PDP Step 9 Major Projects / Step 5 Minor Projects):

    a. On most projects, markings should be shown on the same plan sheets as the signing. If a separate marking plan is determined to be necessary, the following shall apply:

        i. Base plan drawn at a scale of 1 inch equals 200 feet or 1 inch equals 100 feet continuous for the entire project.

        ii. A second base plan drawn at a minimum scale of 1 inch equals 50 feet for all interchanged crossroads and mainline intersections, and for other critical at-grade intersections in urban areas.

        iii. All proposed roadways and connections to existing construction shall be shown.

        iv. On some projects, particularly in urban areas, it may be more efficient to show the entire project on one plan drawn at a scale of 1 inch equals 50 feet or 1 inch equals 20 feet.

    b. Location of pavement edges, number of lanes, speed change lanes, transitions, raised medians and all structures. Lane widths if other than 12 feet.

    c. Directional arrows (one per lane) indicating the number of lanes.

    d. Pavement marking at merging, diverging or intersecting roadways. Show painted gores for merging and diverging roadways. Show auxiliary markings.

3. Stage 3 Plan Requirements (PDP Step 11 Major Projects / Step 7 Minor Projects / Step 2 Minimal Projects):

    a. General Notes.

    b. Estimated quantities.

    c. Special details.

d. Delineator locations (Table).

e. Raised Pavement Marker locations (Table).

f. Barrier Reflector locations (Table).

g. Object Marker locations (Table).

For Minimal Projects, Stage 3 plans shall include all the requirements of Stage 2 plans.

341 PLAN PREPARATION / PRODUCTION

341-1 General

The **L&D Manual Volume Three** and ***Section 140*** generally describe **ODOT** plan preparation and production guidelines. Additional information is provided in this section and ***Section 340*** regarding markings plans.

341-2 Pavement Marking

In a pavement marking plan the following information should be included:

1. All markings on the main roadway, ramps, cross streets and new street intersections, where needed and the type of material to be used (see ***Sections 301-2 and 320***).

2. Special details should be shown in the plans for markings not covered by typical layouts included on **SCDs TC-71.10, TC-72.20 and TC-73.10**. These should be drawn to appropriate scale for the contractor to properly place the markings.

3. Subsummary tabulations shall be made of the various markings, as required in the **Construction and Materials Specifications (CMS), Proposal Note 890** and **Supplemental Specifications (SS)** (i.e., **CMS Items 642, 643, 644, 645, 646 and 647**). All measurements shall be the length of the completed line, including the gaps, intersections and other sections of pavement not normally marked. Station limits and totals for each item shall be shown as follows:

   a. Edge line (white)
   b. Edge line (yellow)
   c. Lane line
   d. Dotted line, ___ inch (millimeter)
   e. Center line: solid, double
   f. Center line: broken, double
   g. Center line: broken, single
   h. Center line: broken and solid, double
   i. Channelizing line
   j. Stop line
   k. Crosswalk line
   l. Transverse line (white)
   m. Transverse line (yellow)
   n. Curb marking (white)
   o. Curb marking (yellow)
   p. Island marking (white)
   q. Island marking (yellow)
   r. Parking lot stall marking
   s. Lane arrow
   t. Word on pavement, ___ inch (millimeter)
   u. Railroad symbol marking
   v. School symbol marking, ___ inch (millimeter)
   w. Handicap symbol marking

4. Payment for all pavement marking items in the General Summary shall be carried as **CMS Items 642, 643, 644, 645, 646 and 647** on a unit bid basis (no lump sum) as follows:

Description Title	Sum These Items From *Sec. 341-2(3)*	Unit
Edge Line	a, b	Mile (Kilometer)
Lane Line	c	Mile (Kilometer)
Center Line	e, f, g, h	Mile (Kilometer)
Channelizing Line	i	Linear Foot (Meter)
Stop Line	j	Linear Foot (Meter)
Crosswalk Line	k	Linear Foot (Meter)
Transverse Line	l, m	Linear Foot (Meter)
Curb Marking	n, o	Linear Foot (Meter)
Island Marking	p, q	Square Foot (Square Meter)
Parking Lot Stall Marking	r	Linear Foot (Meter)
Lane Arrow	s	Each
Word on Pavement, ____ inch (millimeter)	t	Each
Railroad Symbol Marking	u	Each
Dotted Line, ____ inch (millimeter)	d	Linear Foot (Meter)
School Symbol Marking, ____ inch (millimeter)	v	Each
Handicap Symbol Marking	w	Each

Typical line widths are described in ***Section 301*** of this Manual and in the specifications, and should not be included in the bid item descriptions. Non-typical line widths, when required and approved, shall use “As Per Plan” in the description.

The outline of crosshatched yellow islands shall be constructed with "center line: solid, double." The outline of crosshatched white islands shall be constructed with "channelizing line."

341-3 Work Zone Pavement Marking Materials

Work zone pavement markings are addressed in ***Section 605-11.11*** and **CMS 614.11**.

341-4 Raised Pavement Markers

As noted in ***Section 302-2***, raised pavement markers (RPMs) should be included in new and resurfacing construction projects on **ODOT**-maintained highways. They may also be included in the plans at other locations as specified in the districtwide RPM plans.

The plans shall call for the removal of existing RPM castings which would otherwise be abandoned and paved over, and disposal by the contractor.

Testing procedures for RPMs are covered in **Supplement 1062**.

341-5 Object Markers

For plan purposes, object markers shall be considered flatsheet signs.

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342 PLAN NOTES

342-1 General

Typical **Plan Notes** have been consolidated here for convenience in preparing plans. The number used for the **Plan Note** will be the same as the section number. When a **Plan Note** revises the material or contractor requirements from that which is specified in the **CMS**, both the note and the bid item will be "as per plan." Where there are design instructions pertaining to a specific note, they are listed at the end of the note. These notes may be modified to further define the conditions of a project or maintaining agency.

In keeping with traditional format of **Plan Notes**, various format changes are used here that are not typical throughout the **TEM**, e.g., the terms Contractor and Engineer are capitalized.

342-2 Handicap Symbol Marking

Work shall consist of the placement of a Handicap Symbol Marking to conform with the following:

1. The symbol of accessibility parking space shall be as shown in the Figure 3B-18 of the Ohio Manual of Uniform Traffic Control Devices, 2003 edition, with the exception that a blue background/white border shall not be used.

2. The height of the symbol shall be 41 inches, the width shall be 36 inches, and the stroke width shall be 4 inches.

3. Materials, equipment, and application shall be according to the type of pavement marking material (642 - Traffic Paint, 643 - Polyester, 644 - Thermoplastic, 645 - Preformed Pavement Marking, 646 Epoxy or 647 - Heat-Fused Performed Thermoplastic) used.

4. Payment shall be according to the pavement marking material used as follow:

Item 642,	Handicap Symbol Marking, Type ___	Each
Item 643,	Handicap Symbol Marking	Each
Item 644,	Handicap Symbol Marking	Each
Item 645,	Handicap Symbol Marking	Each
Item 646,	Handicap Symbol Marking	Each
Item 647,	Handicap Symbol Marking	Each

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343 SPECIFICATIONS

ODOT specifications for the furnishing and installation of markings are contained in the following **CMS** sections:

620 and 720	**Delineators**
621 and 721	**Raised Pavement Markers**
626 and 720.04	**Barrier Reflectors**
630 and 730	**Traffic Signs and Sign Supports**
640 and 740	**Pavement Markings**

and

Proposal Note 890	**Pavement Markings (District-wide Pavement Marking Projects**
Proposal Note 101	**(Boiler-Plate Proposal Note for CMS Item 640 and 640)**

Individually, the different types of pavement marking material are addressed as follows:

CMS Item	Description
642	Alkyd or Waterbase Traffic Paint
643	Polyester Pavement Marking
644	Thermoplastic Pavement Marking
645	Preformed (cold) Pavement Marking
646	Epoxy Pavement Marking
647	Heat-fused Preformed Thermoplastic Pavement Marking

CMS specifications related to specific markings items have been referenced individually as they have been discussed in this Part.

Supplement 1047 addresses the field service testing procedure for pavement marking materials. **Supplement 1020** and **Supplement 1062** cover testing procedures for delineator posts and raised pavement markers, respectively. **Supplement 1089** covers traffic marking certification requirements.

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350 CONSTRUCTION

350-1 General

This information is intended to serve as a guide for construction personnel where the contractor furnishes and installs traffic control devices. However, it may also be useful for maintenance personnel performing the same functions.

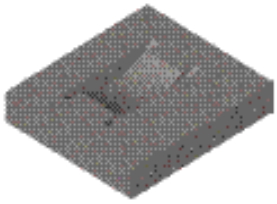
350-2 Work Zone Performance Evaluations

The performance evaluation described in **CMS 614.11** shall be conducted according to the ratings given in ***Table 397-3*** for color, ***Table 397-4*** for night visibility and ***Figure 398-6*** for test line durability.

350-3 Raised Pavement Marker (RPM) Casting Installation

Proper installation is key to getting the epoxy to form a good bond between the pavement and an RPM casting. A separate brochure providing a reprint of the information in this section and ***Section 350-4*** is available upon request from the **Office of Traffic Engineering**. The following describes the procedure for installing an RPM casting:

1. The pavement shall be cut to the dimensions for the casting being used. The list of approved castings for **ODOT** projects, as well as drawings and sample of them are available for review in the **Office of Material Management**.



2. Prior to adding the epoxy, pavement cuts shall be inspected for the following:

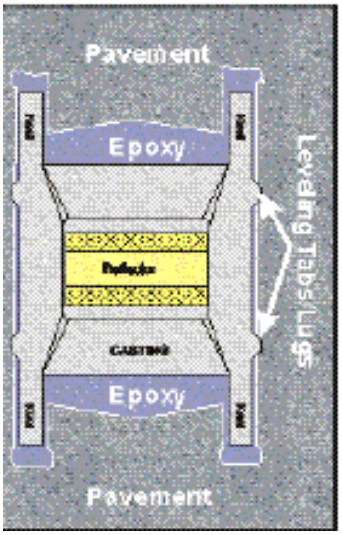
   a. When a casting is inserted in the cut without epoxy to test proper cut, all four leveling lugs/tabs must contact the pavement surface and all four keel-ends of the casting must be below the surrounding pavement surface.

   b. Each casting must be centered lengthwise in the pavement cut, and there should be a 1/8 inch (3 millimeters) clearance between the pavement cut and the casting. Only the leveling lugs/tabs should be in contact with the pavement surface after insertion of the casting in the pavement.

c. The pavement cut must be completely dry and free of dust, dirt or any other material that will interfere with the adhesive bond. Epoxy spilled or dropped on the active reflector face shall be removed immediately.

3. Two-component approved epoxy adhesive shall be used to fill the pavement cut to within 3/8 inch (9 millimeters) of the top of the pavement cut. The four leveling lugs/tabs must be in contact with the pavement. The epoxy should ooze out from under the casting from all sides, filling all voids around the casting, and it should be level with the pavement surface.

4. An acceptable installation should have a minimum of 1/8 inch of epoxy showing around the outside of the casting.

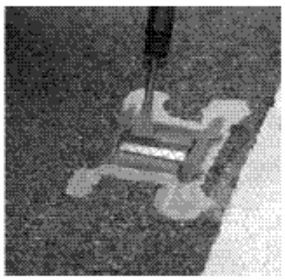


350-4 Raised Pavement Marker (RPM) Reflector Replacement

Proper installation of the RPM reflector is also key factor in the life of an RPM. A separate brochure providing a reprint of the information in this section and ***Section 350-3*** is available upon request from the **Office of Traffic Engineering**. The following describes the procedure for replacing an RPM reflector:

1. Eye protection should be worn when replacing an RPM reflector.

2. Pry the old reflector out of the casting.



3. Scrape the old pad material and adhesive out of the reflector “pocket.” Use an air hammer or wire brush.

4. Sandblast the “pocket” to remove all residual adhesive, rust and other contaminants. It is important that the casting is clean to ensure long-lasting performance.

5. Peel the release liner from the back of the reflector. Apply a wide bead (approximately 1/2 inch (13 millimeters)) of an **ODOT**-approved adhesive in the center of the adhesive pad on the back of the reflector.

6. Place the reflector into the “pocket.” Apply foot pressure on the reflector for one to three seconds. Adhesive flowing out around all edges of the reflector is an indicator that the adhesive completely covers the entire bottom of the reflector and provides a uniform adhesive layer between the reflector and the casting.

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360 MAINTENANCE / OPERATIONS

360-1 General

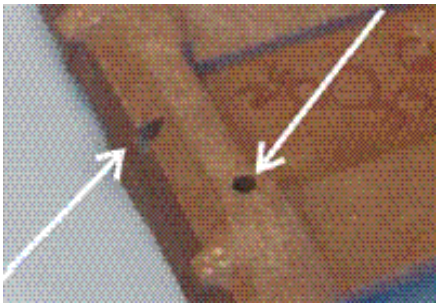
Because markings by their very nature often need replacement, it is imperative that they be well maintained in order for them to function reliably. The consequence of poor maintenance practices are a reduction in safety to road users and exposure to liability claims.

Although the information in ***Section 350*** is primarily intended for construction inspectors or contractors working with markings, it should also be of use to **ODOT** maintenance workers performing the same work. For example, ***Section 350-2*** references ***Tables 397-3 and 397-4, and Figure 398-6.*** This information can also be used to help evaluate existing pavement markings.

Sections 302-2 through 302-6 include information about maintenance of **ODOT** RPM installations. Additional information is provided herein.

360-2 Types of RPMs

A recycled RPM can be identified in the field by observing either a saw cut of a drilled hole in the surface of the RPM casting.



To identify the source of other castings, the manufacturer's name is imprinted on the casting.

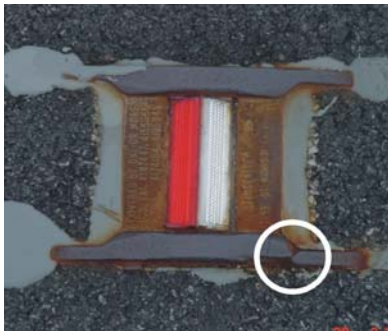
360-3 RPM Inspection Guidelines

360-3.1 General

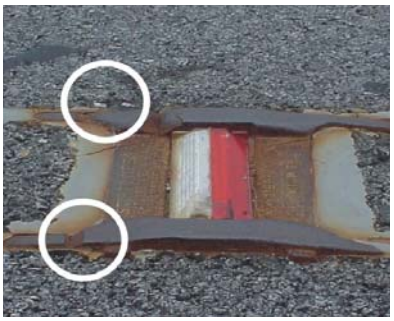
These guidelines are for use in performing maintenance inspections of existing RPM installations.

360-3.2 Casting Failure

An RPM casting has "failed" if it is broken, cracked fully or partially, or if the casting is gouged. Broken leveling lugs/tabs or minor shaving or scratches on the casting do not constitute failure of the casting.



Keel is cracked.



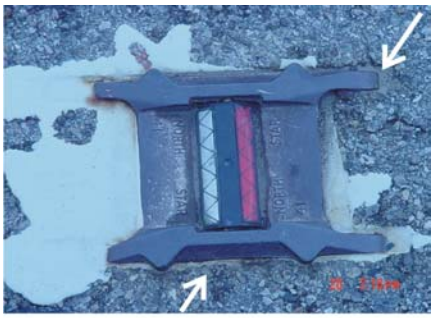
Keels are gouged.

360-3.3 Poor Quality Installation

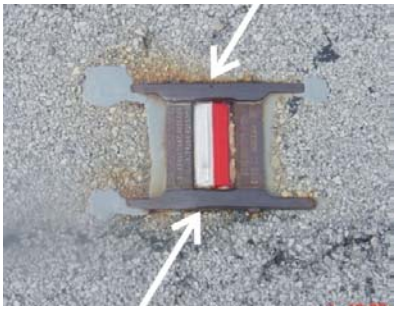
The following are considered poor quality installations:

1. Any of the four lugs/tabs are not resting on the pavement surface. For example, in the illustration a clipboard can fit in the gaps between the leveling tabs and the pavement surface.

2. The epoxy adhesive does not fill all the voids around the casting.



3. The epoxy adhesive is not all around the casting and level with the roadway surface. For example, the illustration shows a casting with space between the casting and the pavement on one side and in contact with the pavement on the other side.



4. The epoxy is not hardened and/or not a uniform gray color.

5. The slot or cut for the RPM is intact and the casting is missing. This indicates that there was a poor bond between epoxy and pavement.

6. The leading casting rails are above the pavement so as to become a blunt edge which can become caught by a snowplow blade.

7. RPM installed on or close to a construction joint.

360-3.4 Pavement Failure

A missing casting with the surrounding pavement also missing is an indication of pavement failure. Typically, as shown in the illustration, the slot or cut made for the casting has lost its shape.

360-3.5 Adhesive Failure

Adhesive failure occurs when the bond between pavement surface and epoxy under the casting has failed. Usually surface of the under laying old pavement is visible and the casting is missing.

370 OTHER CONSIDERATIONS

This area has been reserved for information regarding other considerations related to traffic control markings.

380 RESEARCH

This area has been reserved for information about pertinent research regarding traffic control markings.

395 REFERENCE RESOURCES

Various reference resources that may be useful have been noted in ***Sections 193, 194 and 195***.

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396 FORMS INDEX

396-1 Air Speed Check Zone Request Form

As noted in ***Section 301-10***, the ***Form 396-1*** should be used when requesting a new or revised Air Speed Check Zone. The same form is used to abolish an Air Speed Check Zone.

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Form 396-1. Air Speed Check Zone Request

Request No.: _____ **Date**: ___/___/___

By Lt. _____, _____ **Post County**: _____

Phone: (____) _____-_____

Date Reviewed by OSP Central Office: ___/___/___

☐ **Approved**

Date Forwarded to ODOT District _____ Office ___/___/___

Necessity: ☐ Establish New Zone ☐ Maintain Existing Zone ☐ Abolish Zone

Comments: _____

☐ **Disapproved**

Date Returned to OSP District Office ___/___/___

c: Highway Patrol District Post #_____

Request Reviewed by ODOT District: By _____ Date ___/___/___
Name/Title

☐ **Practical**

Date of Layout ___/___/___ BY_____
Registered Surveyor

Date Work Completed ___/___/___ BY_____
Traffic Control Supt.

☐ **Impractical**

Reason for Not Complying with Request: _____

Date Returned to OSHP Headquarters: ___/___/___

REQUEST TYPE		ROAD TYPE	
(A)	New Zone Installation	(10)	Interstate
(B)	Restoration of an Existing Zone that may have been obliterated due to roadway resurfacing or other highway construction projects.	(20)	Major Throughfare Divided
(C)	Remark Existing Zone	(30)	Major Throughfare Other
(D)	Measure Existing Zone	(40)	Auxiliary
(E)	Abolish Existing Zone	(50)	Local

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397 TABLES INDEX

397-1 Material Selection for Pavement Marking and Expected Life in Years

As noted in ***Section 301-2***, ***Table 397-1*** is used to determine the appropriate type of pavement marking material to use.

397-2 Area Calculations for Words and Symbols

As noted in ***Section 301-8***, to help in calculating materials quantities, ***Table 397-2*** provides information on the area for various auxiliary pavement markings.

397-3 Test Line Color

As noted in ***Section 350-2***, when conducting the performance evaluation described in **CMS Item 614.11** the ratings given in ***Table 397-3*** shall be used.

397-4 Night Visibility

As noted in ***Section 350-2***, when conducting the performance evaluation described in **CMS Item 614.11** the ratings given in ***Table 397-4*** shall be used.

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Table 397-1. Material Selection for Pavement Marking and Expected Life** in Years

a. Long Line Pavement Marking – 2 Lane or General System
(See next page for related notes.)

Remaining Pavement Surface Life *	Asphalt		Concrete	
	ADT < 5,000	ADT > 5,000	ADT < 5,000	ADT > 5,000
0 - 2 years	Water-Based Paint 1	Polyester 2 Spray Thermo 2 Water-Based Paint 1	Polyester 2 Water-Based Paint 1	Polyester Spray 2 Thermo 2 Water-Based Paint 1
3 - 4 years	Polyester 3 Spray Thermo 2 Water-Based Paint 1	Polyester 2 Spray Thermo 2 Water-Based Paint 1	Spray Thermo 2 Water-Based Paint 1	Epoxy 4 Spray Thermo 2 Water-Based Paint 1
> 4 years	Thermo 4 Polyester 3	Epoxy 4 Thermo 4 Polyester 2 Spray Thermo 2	Epoxy 4 Spray Thermo 2 Water-Based Paint 1	Epoxy 4
New Surface				
i) <40° F	Alkyd Paint 1	Alkyd Paint 1	Alkyd Paint 1	Alkyd Paint 1
ii) 40 to 50° F	Water-Based Paint 1	Water-Based Paint 1	Water-Based Paint 1	Water-Based Paint 1
iii) > 50° F	Thermo 4	Thermo 4	Epoxy 4	Epoxy 4

b. Long Line Pavement Marking – Multilane or Priority System
(See next page for related notes.)

Remaining Pavement Surface Life *	Asphalt		Concrete	
	ADT < 5,000	ADT > 5,000	ADT < 5,000	ADT > 5,000
0 - 2 years	Polyester 2 Water-Based Paint 1	Polyester 2 Spray Thermo 2 Water-Based Paint 1	Polyester 2 Water-Based Paint 1	Polyester 2 Spray Thermo 2 Water-Based Paint 1
3 - 4 years	Polyester 3 Spray Thermo 2 Water-Based Paint 1	Polyester 2 Spray Thermo 2 Water-Based Paint 1	Polyester 2 Spray Thermo 2 Water-Based Paint 1	Epoxy 4 Spray Thermo 2
> 4 years	Thermo 4 Polyester 3 Spray Thermo Water-Based Paint 2 1	Epoxy 4 Thermo 4 Polyester 2	Epoxy 4 Spray Thermo 2	Epoxy 4
New Surface				
i) <40° F	Alkyd Paint 1	Alkyd Paint 1	Alkyd Paint 1	Alkyd Paint 1
ii) 40 to 50° F	Water-Based Paint 1	Water-Based Paint 1	Water-Based Paint 1	Water-Based Paint 1
iii) > 50° F	Thermo 4	Thermo 4	Epoxy 4	Epoxy 4

Table 397-1. Material Selection for Pavement Marking and Expected Life in Years (continued)

c. Auxiliary Pavement Marking – 2-Lane and Multilane or Priority System				
Remaining Pavement Surface Life *	**Asphalt**		**Concrete**	
	ADT < 5,000	ADT > 5,000	ADT < 5,000	ADT > 5,000
0 - 2 years	Water-Based Paint 1	Water-Based Paint 1	Spray Thermoplastic 2 Alkyd Paint 1 Water-Based Paint 1	Heat Fused Preformed Tape 2 Spray Thermoplastic 2 Alkyd Paint 1 Water-Based Paint 1
3 - 4 years	Heat Fused Preformed Tape 4 Polyester 1-2	Heat Fused Preformed Tape 2	Heat Fused Preformed Tape 3 Thermoplastic 2 Spray Thermoplastic 2 Water-Based Paint 1	Heat Fused Preformed Tape 2
> 4 years	Heat Fused Preformed Tape 4 Polyester 1-2 Water-Based Paint 1	Heat Fused Preformed Tape 2	Heat Fused Preformed Tape 3 Thermoplastic 2 Spray Thermoplastic 2	Heat Fused Preformed Tape 2
New Surface i) <40° F ii) 40 to 50° F iii) > 50° F	Same as used for long lines	Same as used for long lines	Same as used for long lines	Same as used for long lines

Notes:

* Remaining pavement surface life is the life before resurfacing, reconstruction or before crack sealant will cover the pavement markings.

** The expected life of edge line pavement marking is typically 20 to 30 percent longer as compared to center line and lane line pavement markings expected life as shown in this table.

1. Spray thermoplastic works well for retracing existing thermoplastic. For other materials, check with material suppliers.
2. Auxiliary markings not regularly run over by traffic will last 1.5 to 2 times longer.
3. Surface preparation may be required to remove old markings as recommended by supplier.
4. Remove curing compound completely from new concrete surfaces - follow CMS Item 641.05.
5. Polyester pavement marking material is addressed in CMS Item 643. Since it adheres best to a worn surface, polyester is not to be placed until new asphalt pavement has been open to traffic at least fourteen days. Polyester pavement marking material shall only be used on CMS Item 446 or 448 pavements. This material shall not be used on the following asphalt concrete surfaces due to poor bonding qualities: open graded courses, slurry seal, Supplemental Specification (SS) 805 Rubberized Sand Asphalt, and SS 807 Latex Modified Emulsified Asphalt Pavement Course. Any Asphalt Concrete (Item Special) should be questioned before considering placement of polyester material on it.
6. Primer is required for thermoplastic when used on concrete.
7. Due to the high cost of preformed material, it should only be considered for use where extra long life is needed or in certain applications, such as bridge decks where thermoplastic has not adhered well.
8. Epoxy should only be used on pavements in good condition after surface preparation has been accomplished per manufacturer recommendations.

Table 397-2. Area Calculations for Words and Symbols

LANE-USE ARROWS square feet (square meters)		
ARROW TYPE	**SIZE**	**AREA**
Turn Arrow	8.0 (2.5)	15.8 (1.47)
Straight Arrow	9.5 (3.0)	11.4 (1.06)
Combined Arrow	12.75 (4.0)	26.3 (2.45)

WORDS square feet (square meters)		
TYPE	**HEIGHT**	
	6 ft. (1800 mm)	**8 ft. (2400 mm)**
STOP	12.1 (1.13)	21.5 (2.0)
ONLY	11.9 (1.11)	21.2 (1.97)
SCHOOL[1]	18.6 (1.73)	33.1 (3.08)

R X R SYMBOL square feet (square meters)[1]					
	WIDTH (W)[2]				
	8 ft. min. (2400 mm)	**9 ft. (2700 mm)**	**10 ft. (3000)**	**11 ft. (3300)**	**12 ft. (3600)**
	59.5 (5.54.)	60.5 (5.63)	61.6 (5.73)	62.8 (5.84)	64.1 (5.96)

Notes:

1. The area for transverse lines for the Railroad and SCHOOL Pavement Marking Symbols varies with the width of the pavement; therefore, it must be added to the values in the above tables.

2. Width varies according to lane width, except that the “R” is 6 feet (1800 millimeter) long.

Table 397-3. Test Line Color

Scale	Description
10	White and yellow highly visible and effective in delineation when viewed from further than 10 feet (3 meters).
9 8 7	White and yellow definite in color; visible and effective from further than 10 feet (3 meters).
6 5 4	White appears grayish; yellow has a brownish or greenish tint. Lines are visible and effective at 10 feet (3 meters).
3 2 1	White appears gray; yellow appears brown or green. When viewed at 10 feet (3 meters), material does not delineate a 4-inch (100 millimeter) stripe.
0	No visible material remain.

Table 397-4. Night Visibility

Scale	Description
10	Intensely bright; like a light running across the road; firey.
9 8 7	Bright; uniformly retroreflective. White is very bright. Yellow appears as lemon colored light.
6 5 4	Non-uniform in retroreflectivity. White appears reflective white. Yellow appears reflective medium yellow.
3 2 1	Line evident but no retroreflectivity. Material reflects stray light. White appears grayish. Yellow appears dark yellow.
0	Line not visible.

398 FIGURES INDEX

398-1 Two-Way Left-Turn Arrows

As noted in ***Section 301-9***, ***Figure 398-1*** provides design information on the spacing between the two arrows used in marking two-way left-turn only lanes.

398-2 Standard Delineation for Median Opening for Private Access

As noted in ***Section 304-4***, ***Figure 398-2*** provides detail guidelines in marking a median opening for private drive access.

398-3 Marking a Narrow or One-Lane Bridge

As noted in ***Sections 202-5, 302-6, 303-2 and 304-5***, ***Figure 398-3*** provides detail guidelines marking of a narrow or one-lane bridge.

398-4 Standard Delineation for Parallel Left-Turn Lane

As noted in ***Sections 303-3 and 304-5***, ***Figure 398-4*** provides detail guidelines for marking a parallel left-turn lane.

398-5 Standard Delineation for Tapered Left-Turn Lane

As noted in ***Sections 303-3 and 304-5***, ***Figure 398-5*** provides detail guidelines for marking a tapered left-turn lane.

398-6 Test Line Durability

As noted in ***Section 350-2***, ***Figure 398-6*** illustrates the test line durability guidelines used in evaluating performance of pavement markings.

Intentionally blank.

Figure 398-1. Two-Way Left-Turn Arrows

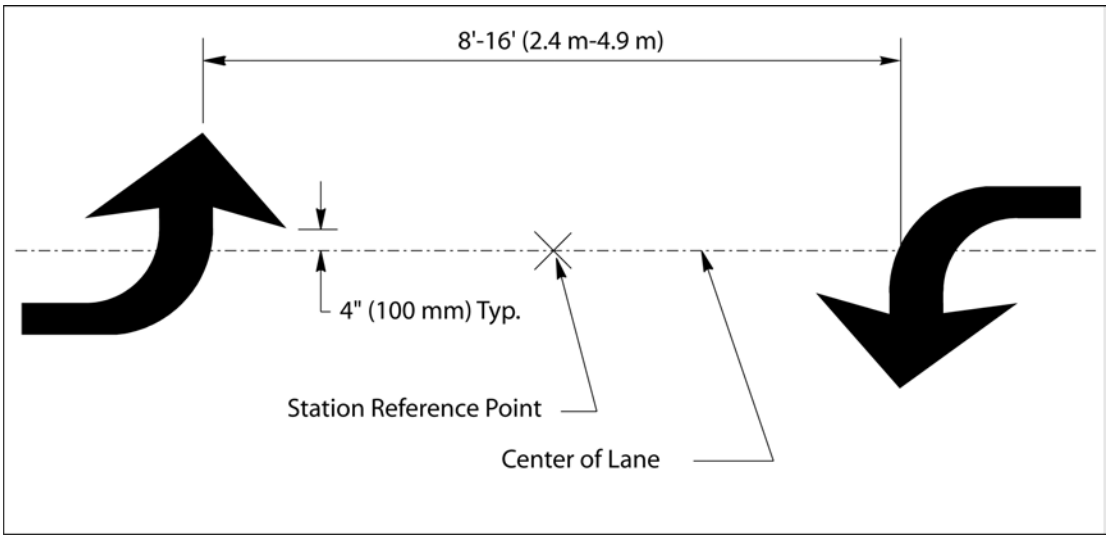


Figure 398-2. Standard Delineation for Median Opening for Private Access

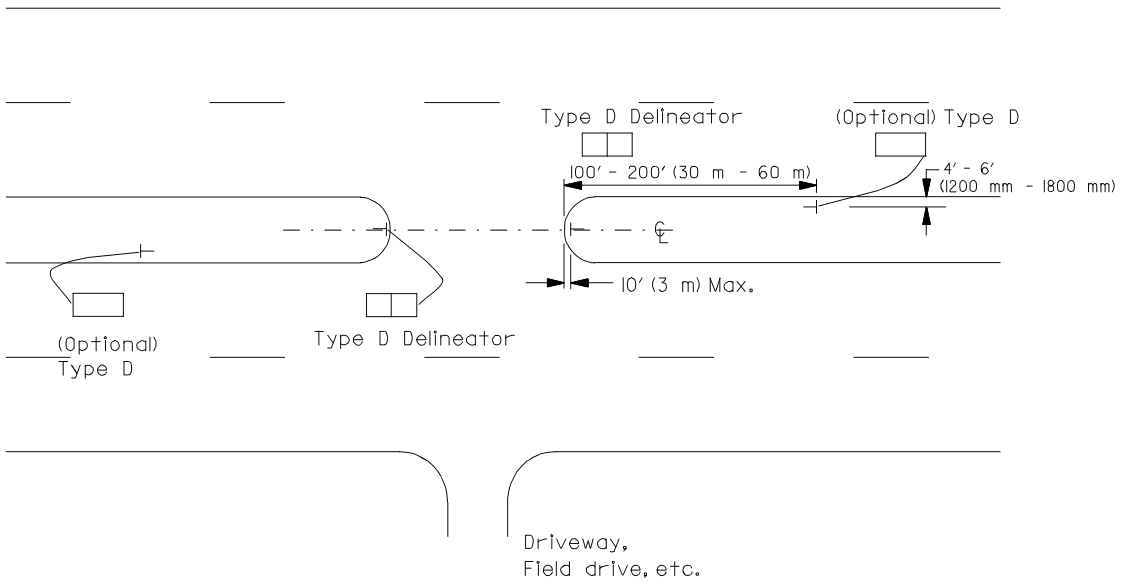


Figure 398-3. Marking a Narrow or One-Lane Bridge

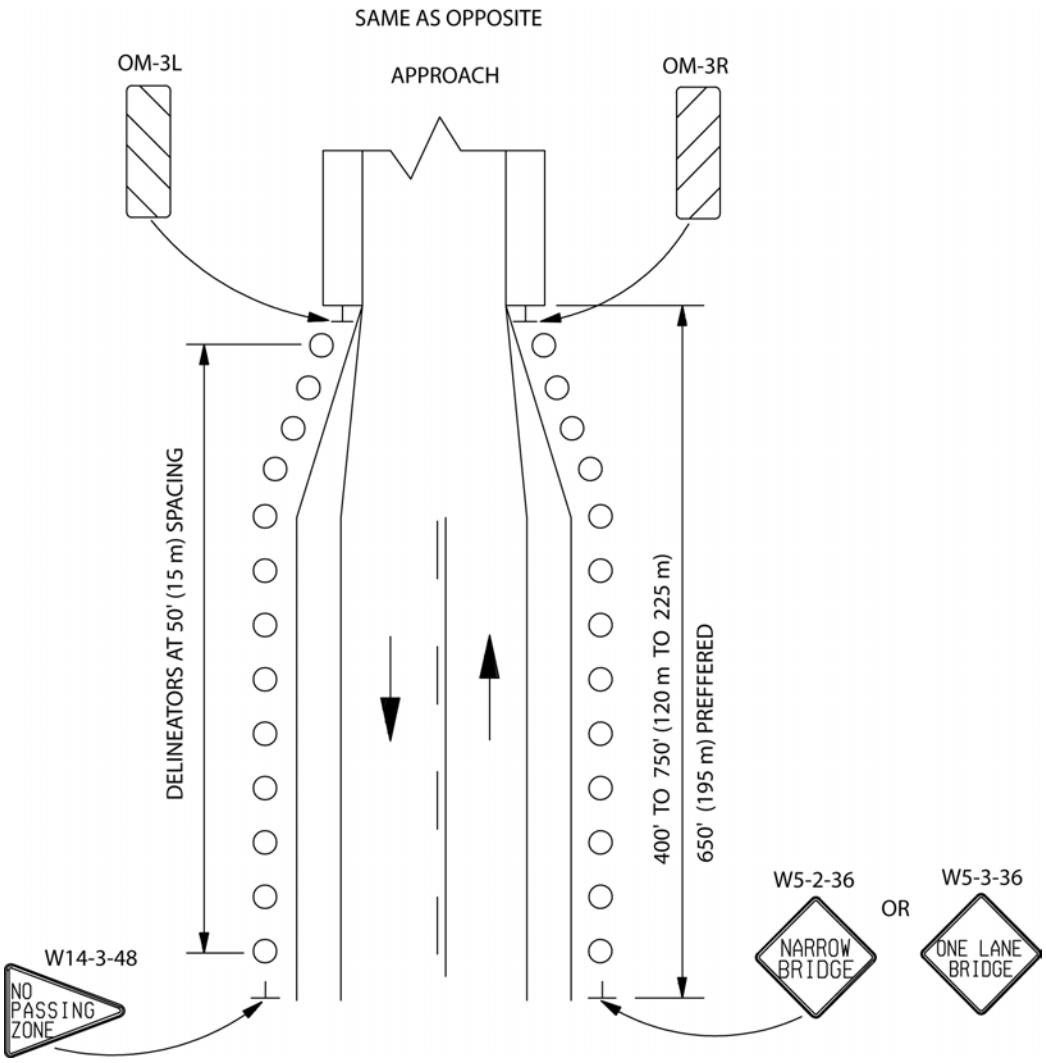


Figure 398-4. Standard Delineation for Parallel Left-Turn Lane

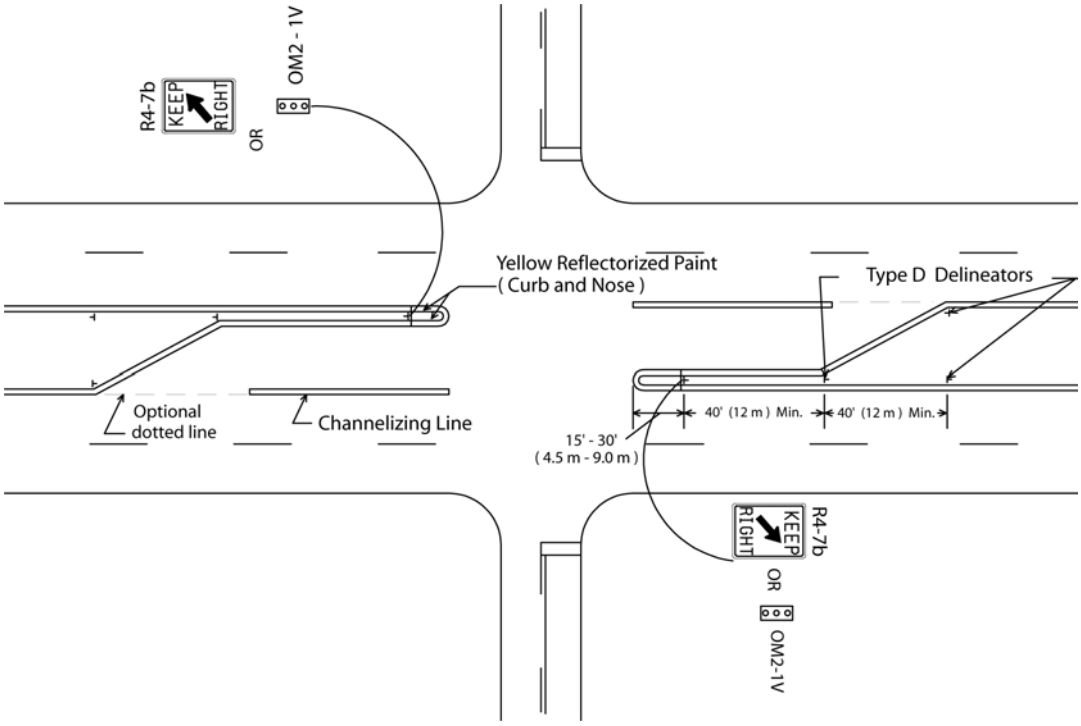


Figure 398-5. Standard Delineation for Tapered Left-Turn Lane

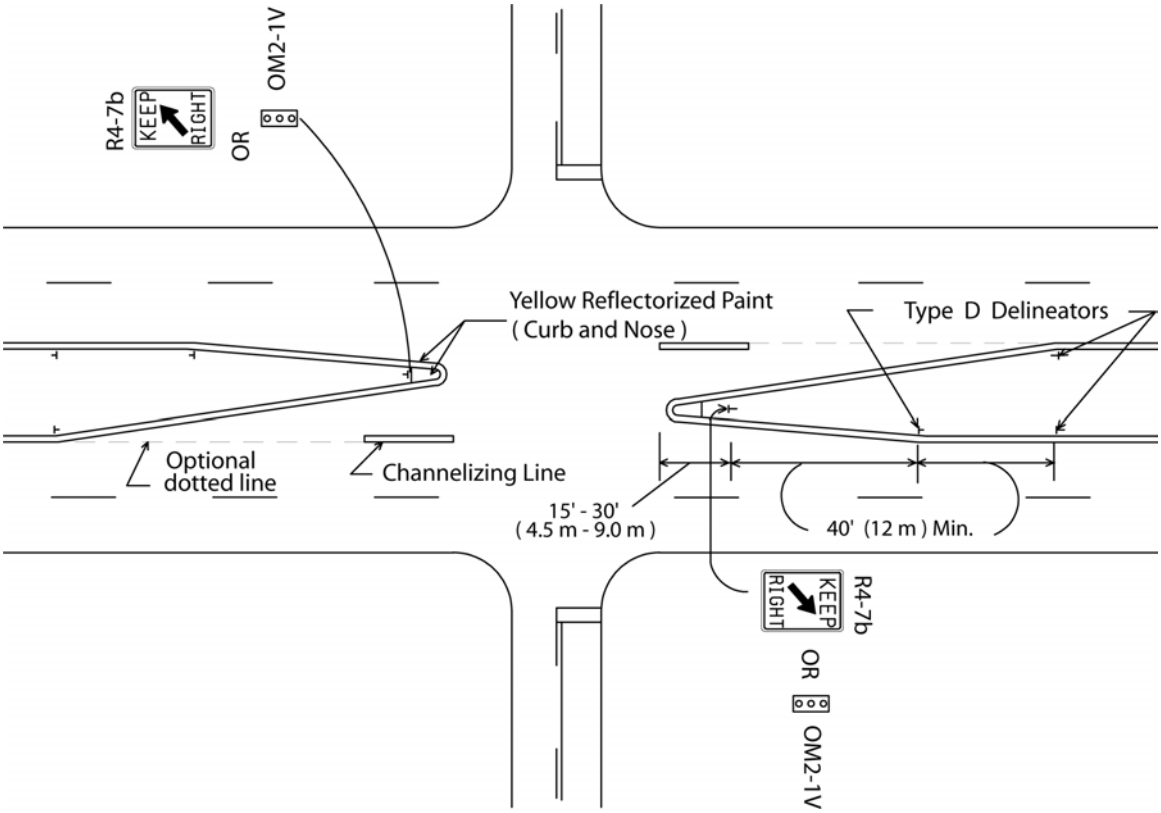
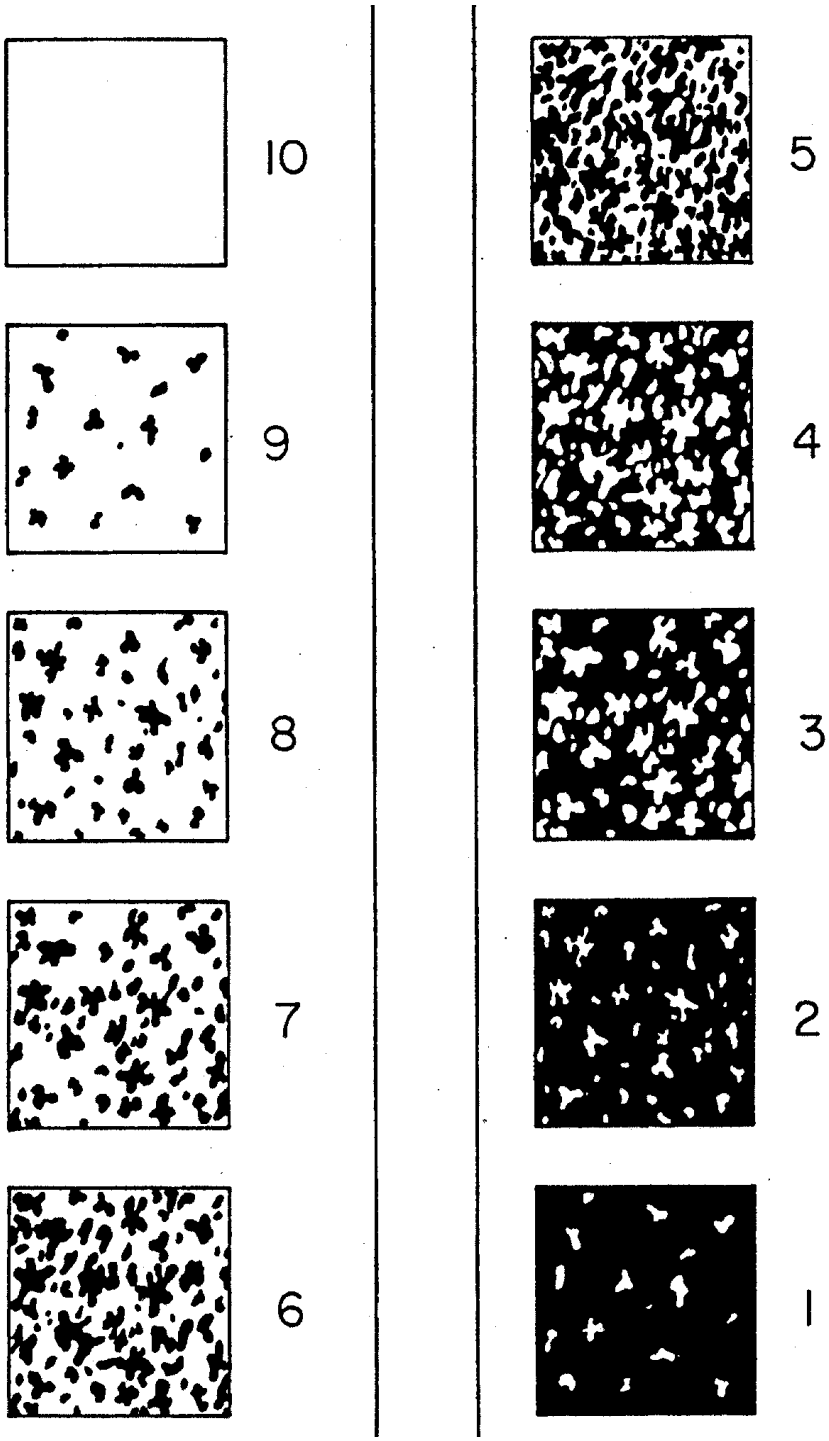


Figure 398-6. Test Line Durability



☐ Marking Material
■ Wear Area