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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), barrier reflectors and delineators.

300-2 Construction Projects

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

300-3 Force Account (ODOT Operations) Work

Districts performing force account markings work shall comply with the requirements in the OMUTCD and this Manual. It is recommended that the Districts also follow the provisions in the applicable markings-related Standard Construction Drawings (SCDs) and Construction and Materials Specifications (C&MS) sections as well. It should be recognized, however, that the information in the C&MS and SCDs does not necessarily provide the only method to achieve a given objective.
PAVEMENT & CURB MARKINGS

General

OMUTCD Chapters 3A and 3B present information on pavement markings. Additional standards and guidelines are provided herein. TEM Chapters 340 through 343, 350 and 360 present additional design, specification and Supplement information, and Traffic Standard Construction Drawings (SCDs) TC-71.10 and TC-72.20 also provide additional design and application information.

A raised pavement marker is a special form of pavement marking intended to be used as a positioning guide with longitudinal line markings, or to supplement or substitute for pavement markings. Raised pavement markers (RPMs) are addressed in OMUTCD Part 3 and in Chapter 302 of this Manual.

The general standards for curb markings are addressed in OMUTCD Section 3B.23.

Markings information specifically related to School Areas, Highway-Rail Grade Crossings and Bicycle Facilities is addressed in OMUTCD Chapters 7C, 8B and 9C, respectively. Additional information is also presented in TEM Chapters 704, 802 and 902, respectively.

Selection of Pavement Marking Materials

ODOT currently employs the following material types for pavement markings on ODOT-maintained highways: traffic paint, polyester, thermoplastic, preformed, epoxy, heat-fused preformed thermoplastic and spray 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.

All pavement marking materials will at some point reach the end of their useful life. On many occasions, rather than obliterating the existing stripe, it is more cost-effective and convenient to simply restripe over the old pavement markings without removing them, assuming that the old pavement markings still adhere well to the roadway. However, for restriping to be effective, the pavement marking material that is to be applied must be compatible with the existing pavement marking material.

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.

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 on any section of state highway within the limits of the village 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 (available from the Office of Maintenance Operations website) 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 C&MS 641.08, except center lines (note that center lines include two-way left-turn striping and the outline of left-turn islands), lane lines, edge lines and channelizing lines. However, channelizing line segments of 200 feet or less shall be considered auxiliary markings.

301-4 Longitudinal Markings

Longitudinal markings are center lines (which include two-way left-turn striping, excluding the arrows, and the outline of left-turn islands), lane lines, edge lines and channelizing lines.

For ODOT-maintained facilities, the standard width for center lines, lane lines, edge lines and channelizing lines shall be as follows:

<table>
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<th>Edge Line</th>
<th>Channelizing Line</th>
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<td>6&quot;</td>
<td>6&quot;</td>
<td>12&quot;</td>
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<td>Freeways and Expressways</td>
<td>N/A</td>
<td>6&quot;</td>
<td>6&quot;</td>
<td>12&quot;</td>
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<td>Multilane Divided Highway</td>
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<td>6&quot;</td>
<td>6&quot;</td>
<td>12&quot;</td>
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<td>Multilane Undivided Highway</td>
<td>4&quot;</td>
<td>6&quot;</td>
<td>6&quot;</td>
<td>12&quot;</td>
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<td>6&quot;</td>
<td>8&quot;</td>
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<tr>
<td>All Other Highways</td>
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However, wide lines may be used for additional emphasis, and OMUTCD Section 3A.06 defines a wide line as at least twice the width of a normal line with the width of the line indicating the degree of emphasis.

Center lines, lane lines and edge lines shall be placed as follows:

Edge line – Center of the edge line shall be applied 6 inches from the edge of pavement.
Lane line – Nearest edge of the lane line shall be applied 2 inches to the left of the construction joint. Broken lines shall be in a 40-foot cycle consisting of a 10-foot dash with a 30-foot gap between the lines.
Center line – Nearest edge of the center line shall be applied 2 inches to the left of the construction joint. Broken lines shall be in a 40-foot cycle consisting of a 10-foot dash with a 30-foot gap between the lines.

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 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, typically the point at which motorists have the optimum cross-corner sight distance. They are not typically located adjacent to the STOP sign.
301-6 Crosswalk Markings

301-6.1 General

The general standards for Crosswalk Markings are addressed in OMUTCD Section 3B.18. For ODOT-maintained highways, the standard width for Crosswalk Lines shall be 12 inches, except that for a mid-block crosswalk they shall be 24 inches wide.

As noted in OMUTCD Section 3B.18, warning signs should be installed for non-intersection pedestrian crossings.

NCHRP Web-Only Document 208 provides design guidance for channelized right-turn lanes. The report recommends a consistent practice for crosswalk location to help enable those with vision impairment to safely traverse the channelized right-turn lane. This document is available on-line at http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_w208.pdf.

301-6.2 Aesthetic Treatments

Brick pavers and colored decorative pavement treatments that simulate brick or other patterns may be used between the white crosswalk lines.

Such colored decorative pavements shall be devoid of retroreflective properties and not diminish the effectiveness of the legally required markings. They should also not use colors or patterns that might be mistaken by road user as a traffic control application.

Examples of acceptable treatments include brick lattice patterns, paving bricks, paving stones, setts, cobbles, or other resources designed to simulate such paving. Acceptable colors for these materials would be red, rust, brown, burgundy, clay, tan or similar earth tone equivalents. All elements of pattern and color for these treatments are to be uniform, consistent, repetitive, and expected so as not to be a source of distraction.

Murals or other similar crosswalk art shall not be used. Examples of such unacceptable treatments include, but is not limited to, random or unsystematic patterns, pictographs, symbols, multiple color arrangements, text or other attempts to communicate with any roadway user, etc.

301-6.3 Basis of Payment

Longitudinal 12-inch wide crosswalk lines and diagonal/transverse lines shall be calculated as follows:

1. Each longitudinal 12-inch wide crosswalk line shall be calculated separately.
2. The length of each crosswalk line and diagonal/transverse line shall be included in the total length.
3. Crosswalk line and diagonal/transverse line shall be paid per foot.

301-7 Parking Space Markings

The general standards for parking space markings are addressed in OMUTCD Section 3B.19. For ODOT facilities, the standard width for parking space lines shall be 4 inches.

When parking spaces reserved for persons with disabilities are provided, in addition to the required signing (OMUTCD Section 2B.46), the International Symbol of Accessibility (wheelchair symbol) shall be used to further identify the reserved stall(s). Unless there is a need for additional emphasis, the standard size pavement marking symbol shall be used (see OMUTCD Figure 3B.22 and TEM Table 397-2).

The Americans with Disabilities Administrative Guidelines (ADAAG) issued by the U.S. Access Board include requirements regarding the number and design of parking spaces reserved
301-8 Pavement Marking Words and Symbols

All pavement marking words (letters and numerals) and symbols should be in conformance with FHWA's Pavement Markings Alphabets and Symbols (see OMUTCD Figures 3B-22 through 3B-26, 3B-28 through 3B-30, and Appendix F of the Sign Designs and Markings Manual).

OMUTCD Section 3B.20 establishes general standards for pavement marking words, symbols and arrows, and Traffic SCD TC-71.10 establishes placement standards, as well as providing additional design detail information. Some standard applications of pavement marking words and symbols are illustrated in OMUTCD Figures 3B-27. As noted in Section 301-1, additional markings information specifically related to School Areas, Highway-Rail Grade Crossings and Bicycle Facilities are addressed in OMUTCD and TEM Parts 7, 8 and 9, respectively.

The optional narrow elongated arrow design mentioned in the note in OMUTCD Figure 3B-24 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 not more than ten times the height of the characters.

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

301-9 Two-Way Left-Turn Arrows

OMUTCD Sections 3B.03 and 3B.20, and Figures 3B-7 and 3B-24 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 Traffic SCD TC-71.10, these left-turn arrows, when used, should be spaced 8 to 16 feet apart, tip to tip. The “wing tips” of the arrows should be placed 4 inches from the center of the lane.

The arrow sets should be longitudinally spaced at intervals of 500 to 1000 feet for speeds up to 40 miles per hour, and at intervals of 1000 to 1500 feet for speeds over 40 miles per hour. In addition, an arrow set should be placed 100 to 200 feet 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.24.

301-10 Speed Measurement Markings

Speed Measurement Markings (see OMUTCD Section 3B.21 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 in width (measured in the direction of travel) and a total of 4 feet in length, with 2 feet on each side of the center line or 2 feet on each side of the edge line. However, when the shoulder is 4 feet or more in width, the air speed marking may be placed entirely on the shoulder. They shall be installed in accordance with OMUTCD Section 3B.21. Also (January 17, 2020) October 23, 2002 3-9
1. The following procedure has been established for installing and maintaining (i.e., replacing after resurfacing), or abolishing Air Speed Check Zones:

2. Local Ohio State Highway Patrol (OSHP) Posts shall submit requests for establishing, maintaining or abolishing Air Speed Check Zones on the Air Speed Check Zone Request Form (Form 396-1) to the OSHP Aviation Section Commander at Ohio State Highway Patrol, Aviation Section, 2829 W. Dublin-Granville Rd., Columbus, Ohio 43235.

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

4. If the Aviation Section Commander approves the request, it shall be forwarded to the appropriate ODOT District Highway Management Administrator.

5. 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).

6. 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 the address listed in item 2.

7. If for some reason the request is not practical, the District shall return the request to the OSHP Aviation Section Commander (at the address noted in item 2) explaining the reason for not complying with the request.

8. 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, 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.27, 8B-28 and 8B.29, and Figures 8B-6, 8B-7 and 8B-8. Additional railroad approach markings information is provided in TEM Section 802 and Traffic SCD TC-71.10.

301-12 Speed Hump Markings

Speed humps are “wave-shaped” paved humps/bumps in the street, spread over about 12 feet with a maximum height in the middle of about 3 inches. 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-29, 3B.25 and 3B.26. Examples of pavement markings for speed humps are shown in OMUTCD Figures 3C-29 and 3C-30. It is recommended that any jurisdiction considering speed humps establish guidelines for their design and use. Sample guidelines are available from the Institute of Transportation Engineers (ITE) and various local jurisdictions (e.g., the City of Columbus).

301-13 Dotted Lines

The general standards for Dotted Lines at exit and entrance ramps are addressed in OMUTCD Section 3B.04, OMUTCD Figures 3B-8, 3B-9 and 3B-10, and Traffic SCD TC-72.20.

For ODOT-maintained highways, Dotted Lines at exit and entrance ramps shall consist of white line segments that are 6 inches wide and are 3 feet in length, separated by 9-foot gaps.

The general standards for Dotted Lines through intersections are addressed in OMUTCD Section 3B.08 and OMUTCD Figure 3B-13.

Dotted lines through intersections are optional and may be used when engineering judgment indicates a need for it.

For ODOT-maintained highways, Dotted Lines through intersections shall consist of line segments that are 2 feet in length, separated by 6-foot gaps. The standard width and color shall match the width and color of the existing adjacent lane line or center line.

301-14 Chevron and Diagonal Crosshatch Markings

301-14.1 General

OMUTCD Section 3B.24 discusses Chevron Crosshatch Markings and Diagonal Crosshatch Markings. These markings are 24 inches wide and placed at approximately 45 degrees to the longitudinal lines that they intersect.

Chevron Crosshatch Markings are used in paved areas that separate traffic flows in the same general direction and shall be white with the point of each chevron facing toward approaching traffic.

Diagonal Crosshatch Markings are used in paved areas that separate opposing directions of traffic and shall be yellow and slant away from traffic in the adjacent travel lanes.

CROSSHATCH MARKINGS SPACING TABLE

<table>
<thead>
<tr>
<th>FROM*</th>
<th>TO</th>
<th>CROSSHATCH MARKINGS SPACING</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 feet</td>
<td>48 feet</td>
<td>12 feet on center</td>
</tr>
<tr>
<td>49 feet</td>
<td>96 feet</td>
<td>24 feet on center</td>
</tr>
<tr>
<td>97 feet</td>
<td>Greater than 97 feet</td>
<td>48 feet on center</td>
</tr>
</tbody>
</table>

* measured from the theoretical gore

301-14.2 Entrance and Exit Ramps
Chevron Crosshatch Markings should be used to mark neutral areas of exit ramps at freeway to freeway interchanges and lane drop exits, and when engineering judgment indicates a need for them. As noted in OMUTCD Section 3B.24, they may also be used to mark neutral areas of entrance ramps. When used for those situations, the spacing of markings shall be as noted in Section 301-14.1. Also see Traffic SCD TC-72.20, Freeway Entrance and Exit Pavement Markings, for a typical layout.

301-14.3 Obstructions

When there is an obstruction within the paved roadway, Chevron Crosshatch Markings or Diagonal Crosshatch Markings should be used as shown in OMUTCD Figure 3B-15 in the neutral area formed by the required approach markings, per OMUTCD Section 3B.10.

301-14.4 Island Markings

“Painted” islands, including turn lane markings, more than 6 feet in width at their widest part shall include Diagonal Crosshatch Markings in the open area in order to discourage use as a travel lane or parking space. Such markings shall not be used in the open area of islands that are less than 6 feet in width, except when engineering judgment indicates a need for them. The spacing of the markings shall be as shown in the table in Section 301-14.1; however, if the island separates opposing traffic, the 12-foot spacing begins at both ends of the island. Also see Traffic SCD TC-71.10, Word and Symbol Pavement Markings, for a typical island layout.

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 Crosshatch Markings may be used to discourage shoulder misuse where such problems exist. When such markings have been placed, appropriate signing (e.g., R4-17, DO NOT DRIVE ON SHOULDER) should be erected.

301-15 Elongated Route Shield Symbol Markings

301-15.1 General

The general standards for Elongated Route Shield Symbol Markings are addressed in OMUTCD Section 3B-20, Figure 3B-25 and Figure 3C-14.

301-15.2 Marking Materials

Installation of elongated route shield symbol and cardinal direction markings shall be in accordance with Supplemental Specification 814 - Heat-Fused Preformed Thermoplastic Shield Pavement Marking.

Installations of elongated route shield symbols using Traffic Paint (Item 642), Polyester (Item 643), Thermoplastic (Item 644), Preformed Thermoplastic (Item 645), Epoxy (item 646) and Spray Thermoplastic (Item 648) pavement marking materials shall not occur.

Approved materials can be found on the ODOT Approved List.

301-15.3 Size of Elongated Route Shield Symbol Markings

The size of the elongated shield symbol and size of the letters shall be according to the Ohio Sign Designs and Markings Manual (SDMM) Appendix F as follows:

1. On Interstate Routes the Shield Symbol shall be 8’ x 20’ with 10’ number size.
2. On US Routes the Shield Symbol shall be 6’ x 15’ with 7.5’ number size.
3. On State Routes the Shield Symbol shall be 6’ x 15’ with 7.5’ number size.
301-15.4 Color of Elongated Route Shield Symbol Markings

The Interstate Elongated Route Shield Symbol Markings are available in red/white/blue. US Route and State Route Shield Symbol Markings are available in black/white.

![Elongated Route Shield Symbols]

301-15.5 Cardinal Direction (NORTH, SOUTH, WEST & EAST) Markings

The size and spacing for the cardinal direction (NORTH, SOUTH, WEST & EAST) markings is based on OMUTCD Section 3B-20. See Figure 398-1 for size and spacing information.

301-15.6 Placement of Elongated Route Shield Symbol and Cardinal Direction Markings

The distance from the bottom of the elongated route shield to the bottom of the cardinal direction marking should be 50 feet. The spacing between multiple route shields should be 100 feet from the bottom of the first route shield to the bottom of the next route shield.

The elongated route shield and cardinal direction markings should be centered in the lane.

Single Shield Per Lane

Vertical Stacked Shields

![Cardinal Direction Markings]

301-16 Guidelines to Apply Pavement Markings over Chip Seal Surface or Chip Seal Surface Covered with Fog Seal

301-16.1 General

Fog sealing is a process using a diluted emulsion to cover the chip seal surface that fills in the voids in the chip seal.

301-16.2 Surface Prep

The surface shall be swept to remove loose chips prior to pavement marking application.
301-16.3 Work Zone Pavement Markings
Place Work Zone pavement markings per C&MS 614.11, except Class I pavement markings should be used instead of Class II. After the project is completed, C&MS 642 permanent pavement markings shall be placed per C&MS 614.11. This will increase the application thickness for the pavement markings allowing for the extra absorption of pavement marking material into the cover aggregate.

301-16.4 Striping Materials
Apply permanent pavement markings on chip seal or chip seal with fog seal surfaces as follows:

1. Use Item 642 Traffic Paint to install the permanent pavement markings. Monitor line wear as a second application of permanent pavement markings prior to winter may be needed.

Thermoplastic and epoxy pavement marking materials are not recommended for striping long line markings on routes with 2500 or less ADT since these materials must be removed before a chip seal coat can be applied to the pavement.

301-17 Wrong-Way Arrows
OMUTCD Section 3B.20 and Figure 3B-24 establish standards for the design of wrong-way arrow pavement markings.

For uniformity and consistency, additional guidelines have been established for placing the wrong-way arrows on exit ramps. Wrong-way arrow(s), when used, should be placed as follows:

1. On ramps where lane-use arrows are not used, place the first wrong-way arrow 10 to 30 feet in advance of the stop line. Place the second wrong-way arrow according to engineering judgement.
2. On ramps where lane-use arrows are used, place the wrong-way arrow in advance of first traffic control arrow at a spacing equal to or greater than the spacing between the lane-use arrows.
3. On multi-lane ramps, a wrong-way arrow should be placed in each lane, side-by-side.

Basic signing arrangements for wrong-way traffic control at exit ramps is addressed in OMUTCD Sections 2B.38, 2B.41 and Figure 2B-18.

Traffic SCD TC-73.20 (Enhanced Wrong-Way Traffic Control for Ramps) provides details where additional wrong-way traffic control will be used. The decision on where to apply the enhanced treatments should be made based on an engineering study or engineering judgment, taking into consideration the number of documented wrong way movements, crash data, geometric design, interchange complexity, and any other factors that could potentially contribute to wrong way movements.

SCD TC-73.20 is intended to be used at select locations and is not intended to be used at all interchange ramps.

Funding for enhanced treatments and guidance on selecting appropriate location for the enhancements may be requested from the Division of Planning’s State Highway Safety Program.

301-18 Lane-Reduction Arrows
OMUTCD Section 3B.20 and Figures 3B-14 and 3B-24 establish standards for the design and placement of lane-reduction arrow pavement markings. For uniformity and consistency, the following additional guidelines have been established for placing the lane-reduction arrows in the lane-reduction lanes.
As shown in OMUTCD Figures 3B-14, 3B-24 and Traffic SCD TC-71.10, lane-reduction arrows, when used, should be placed as follows:

1. Place the first lane-reduction arrow 100 feet in advance of the “Begin Taper Point”.
2. Place the second lane-reduction arrow at \( \frac{3}{4} d \) (d = advance warning sign distance).

Lane-reduction signing is addressed in OMUTCD Section 2C-42 and Figure 2C-8.

301-19 Guidelines to Apply Contrast Markings (Black and White)

301-19.1 General

OMUTCD Section 3A.05 briefly discusses Contrast Markings.

Many concrete and heavily oxidized asphalt pavements are so light in color that during day time, white pavement markings appear to blend in with the pavement surface.

To improve the visibility of white lane line pavement markings on light-colored pavements, contrast pavement markings may be applied as an option.

301-19.2 Marking Materials

The following pavement marking materials may be used for contrast markings (black and white) on the concrete pavements:

1. Item 642  Traffic Paint
2. Item 645  Preformed Thermoplastic
3. Item 646  Epoxy
4. Item 647  Heat-Fused Preformed Thermoplastic

For Item 642 Traffic Paint and Item 646 Epoxy, apply the black marking material that is recommended by the manufacturers.

When contrast markings are applied, black is not considered a marking color, but only a contrast-enhancing system for the markings.

301-19.3 Contrast Marking Application

1. Apply white lane line markings over the top of a compatible black marking material or
2. Apply a ten foot white lane line marking and a ten foot black marking end-to-end and then provide a twenty foot gap

301-19.4 Contrast Marking Application Guidelines for Item 642 and 646

1. First, apply the black pavement marking on the pavement. Second apply the white pavement marking on top of the black marking after the black marking has cured according to manufacturer’s recommendations. The black contrast marking and the white lane line marking shall be placed according to the following diagram:
2. The white lane line shall be centered on the black marking such that there will be a 1.5 inch black border on either side of the white lane line. The white lane line shall be centered within the black paint area with black on both the leading and trailing edges.

3. As an alternate to the above, apply contrast marking without leading or trailing edges according to the following diagram:

1. Apply a ten foot white lane line marking and a ten foot black marking end-to-end and then provide a twenty foot gap according to the following diagram:

301-19.5 Contrast Marking Application Guidelines for Item 645 and 647

Item 645 Preformed Thermoplastic and Item 647 Heat-Fused Preformed Thermoplastic contrast markings (black and white) shall be installed as recommended by the manufacturers.

301-19.6 Basis of Payment

Item 642 and 646
The quantity of black contrast pavement marking will be paid for at the contract unit price for the pay item as included in the contract.
The white intermittent or white solid markings will be paid for separately at the contract unit price for the pay item as included in the contract.
The quantity of black and white contrast pavement marking will be paid for at the contract unit price for the pay item as included in the contract.

### 301-20 Guidelines to Install Bicycle Facility Markings with Heat-Fused Preformed Thermoplastic Pavement Marking Material (Item 647)

#### 301-20.1 General

OMUTCD Section 9C.03 discusses Shared-Use Path markings.
OMUTCD Section 9C.04 discusses Bicycle Lane markings.
OMUTCD Section 9C.07 discusses Shared Lane markings.

#### 301-20.2 Marking Materials

Approved materials for Heat-Fused Preformed Thermoplastic Pavement Marking can be found on the ODOT Approved List.

In CMS Item 647, Heat-Fused Preformed Thermoplastic Pavement Marking, the following type of marking materials are available:

**Pre-heated Tape**
- Type A90 (90 mil thickness)
- Type A125 (125 mil thickness)

**Post-heated Tape**
- Type B90 (90 mil thickness)
- Type B125 (125 mil thickness)

#### 301-20.3 Marking Material Selection

When the bicycle facility markings are installed with Heat-Fused Preformed Thermoplastic Marking material (Item 647), the tape thickness (90 mil vs 125 mil) should be specified in accordance with the following guidelines:

**1. Shared-Use Path Markings**

<table>
<thead>
<tr>
<th>Marking Item</th>
<th>Item 647 Material Thickness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Auxiliary Symbol Markings</td>
<td>90 mil thick</td>
</tr>
<tr>
<td>Long Line Markings</td>
<td>90 mil thick</td>
</tr>
</tbody>
</table>

**2. Bicycle Lane Markings**

<table>
<thead>
<tr>
<th>Marking Item</th>
<th>Item 647 Material Thickness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Auxiliary Symbol Markings</td>
<td>90 mil thick</td>
</tr>
<tr>
<td>Long Line Markings</td>
<td>125 mil thick</td>
</tr>
</tbody>
</table>

**3. Shared Lane Markings**

<table>
<thead>
<tr>
<th>Marking Item</th>
<th>Item 647 Material Thickness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Auxiliary Symbol Markings</td>
<td>125 mil thick</td>
</tr>
<tr>
<td>Long Line Markings</td>
<td>125 mil thick</td>
</tr>
</tbody>
</table>
In addition to the requirements of Items 640 and 740, Section 342-6 presents optional procedures for applying the long line pavement markings in grooves on concrete bridge decks. Districts may choose to inlay the long line markings to extend pavement marking life.

Inlaying involves installing the marking in grooves cut into the concrete. This will help protect the markings from snow plowing operations.

When the decision is made to inlay the markings refer to Section 342-6 and Table 397-1d for additional information.
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. C&MS Item 621 and C&MS 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 Chapters 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.


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.

Traffic SCDs TC-65.10 and 65.11 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.

Except for edge lines on one-lane bridges (see SCD TC-65.11), RPMs shall not be installed on bridges less than 400 feet in length on tangent alignments. For bridges longer than 400 feet in length on tangent alignments, RPMs shall be installed at twice the normal spacing. For any length bridge in a curve, RPMs shall be installed at the normal spacing.

Each District should periodically inspect their RPMs to determine if nighttime retroreflectivity 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 Roadway Engineering (ORE) 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;

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 dependent 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 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 (available on-line at http://portal.dot.state.oh.us/Divisions/Operations/MaintAdmin/Pages/MandR.aspx, a web page maintained by the Office of Maintenance Administration) 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 Traffic SCD TC-65.11 at narrow and one-lane bridges. The center line pavement marking shall be stopped 150 feet in advance of a one-lane bridge. Figure 398-2 illustrates signing and markings guidelines for narrow and one-lane bridges. Additional information is also provided in Sections 202-5, 202-14.2 and 304-5.

302-7 Fire Hydrant Markers

OMUTCD Section 3B.11 states 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 Roadway 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, retroreflective 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) were mounted on the wall above the access points to identify them, using a local numbering system.
304 DELINEATORS

304-1 General

OMUTCD Chapter 3F establishes standards and guidelines for the design and use of delineators. Additional design and application information is provided herein, and in Traffic SCD TC-61.10, C&MS Item 620 and C&MS 720. Delineator reflector and flexible post color shall match that of the nearest edge line.

304-2 Delineator Types

For identification purposes, C&MS 620.02 designates the following color of each type of delineator: Type C, rectangular white; Type D, rectangular yellow; and Type E, rectangular red.

304-3 Application Guidelines

In accordance with the provisions of C&MS 620.02, on ODOT-maintained routes, only flexible delineator posts on the Qualified Products List shall be installed for roadside delineation (see Reflector Items).

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 multi-lane 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 3F-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 Narrow and One-Lane Bridges

Type C (white rectangular) delineators should be erected 50 feet apart along both sides of each approach to narrow and one-lane bridges in accordance with OMUTCD Chapter 3F and Traffic SCD TC-61.10. TEM Figure 398-2 illustrates the signing and markings guidelines for narrow and one-lane bridges. Additional information is also provided in Sections 202-5, 202-14.2 and 302-6.
305 COLored PAVEMENTS

The use of colored pavement as a traffic control device is addressed in OMUTCD Chapter 3G.

Information regarding green colored pavement for bike lanes is addressed in Plan Note 342-5 (Section 342-5) and Traffic Plan Insert Sheet (PIS) 207000.

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 channelizing devices in other situations is addressed in OMUTCD Chapter 3H. We do not currently have any additional ODOT-specific standards related to this use of these devices.

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 C&MS Item 626 and C&MS 726.

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, retroreflectorized glare screens, RPMs or highway lighting.

These reflectors may be used in highlighting the curb ends of medians.

Barrier Object Markers (Section 202-14.4) may also be considered for use in highlighting the curb ends of medians.

307-3 Reflector Color

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

One-way and bi-directional barrier reflectors shall be used in accordance with the following guidelines:

<table>
<thead>
<tr>
<th>BARRIER REFLECTORS COLOR &amp; DIRECTION</th>
<th>One-Way Reflector</th>
<th>Bi-Directional Reflector</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Left Edge</td>
<td>Right Edge</td>
</tr>
<tr>
<td>Two-Lane, Two-Way</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Interchange Ramp</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Multilane Undivided</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Multilane Divided with median barrier*</td>
<td>White</td>
<td></td>
</tr>
<tr>
<td>Multilane Divided without median barrier</td>
<td>NA</td>
<td>White</td>
</tr>
</tbody>
</table>
307-4 Reflector Types

The following five types of Barrier Reflectors are detailed in the C&MS Item 726.01:

1. Type 1 barrier reflector is for concrete barriers, retaining walls and bridge rails or bridge parapets.
2. Types 2 to 5 barrier reflectors are for guardrail blockouts.

The selection of a particular guardrail blockout reflector (Types 2-5) as described in C&MS Item 726.01 is a District preference based on engineering judgement and environmental conditions.

Approved Barrier Reflectors can be found on the ODOT Qualified Product List (QPL) at the following link:

http://www.odotonline.org/materialsmanagement/qpl.asp?specref=726.01
OMUTCD Chapter 3I addresses the functions, end protection and approach treatments for traffic control islands. As noted in OMUTCD Section 1A.13, item 102:

Island - a defined area between traffic lanes for control of vehicular movements, for toll collection, or for pedestrian refuge. Within an intersection area, a median or an outer separation is considered to be an island.

L&D Manual Volume 1 Section 300 includes additional information about medians and curbs.

Also see Sections 301-14.4 and 307-2 for additional information about marking islands.

320 MATERIALS AND HARDWARE

320-1 General

The Office of Materials Management maintains the Qualified Product List (QPL) for raised pavement markers, delineators and barrier reflectors and the Approved List for pavement marking materials. The QPL and the Approved List are available on that office’s web page. The list is available on-line at www.dot.state.oh.us/divisions/constructionmgt/materials/pages/default.aspx.

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

C&MS information may be viewed on-line at www.odotonline.org/cmsportal/.

320-2 Patented or Proprietary Materials, Specifications or Processes

The use of patented or proprietary materials, specifications or processes is discussed in Section 120-4.

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. Sections 120-5 and 120-6 describe processes that have been established whereby local agencies can purchase such items through ODOT.

320-4 Use of Type G and Type J Sheeting

Type G retroreflective sheeting (see C&MS 730.19) shall be used on cones and tubular markers used at night, barricades and drums, delineators, guardrail anchor assemblies, and impact attenuators. Information about guardrail anchor assemblies and impact attenuators is provided in the L&D Manual Volume 1, Section 603. Information about the use of Type J, ASTM D 4956 Type XI, sheeting on guardrail anchor assemblies and impact attenuators is found in Plan Notes R-112, R-113 and R-123 (see L&D Manual Volume 1, Appendix B).

Type J, ASTM D 4956 Type XI retroreflective sheeting (see C&MS 730.193) shall be used on permanent object markers and end-of-roadway markers.

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 C&MS 726. 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. The QPL is available on-line at: www.dot.state.oh.us/Divisions/ConstructionMgt/Materials/Pages/QPL.aspx).

330 PLANNING / PROGRAMMING

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

340 DESIGN INFORMATION

340-1 General

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

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

340-2 Stage 2 and 3 Plan Submittals

The following information has been provided here as checklists for Stage 2 and 3 plan submittals.

1. Stage 2 Plan Requirements:

   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 1:200 or 1:100 continuous for the entire project.

      ii. A second base plan drawn at a minimum scale of 1:50 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 1:50 or 1:20.

   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.

2. Stage 3 Plan Requirements:

   a. General Notes
b. Estimated quantities.

c. Special details.

d. Delineator locations (Table).

e. Raised Pavement Marker locations (Table).

f. Barrier Reflector locations (Table).
341 PLAN PREPARATION / PRODUCTION

341-1 General

The L&D Manual Volume 3 and TEM Chapter 140 generally describe ODOT plan preparation and production guidelines. Additional information is provided in this Chapter and Chapters 340 (markings plans), 342 (Plan Notes) and 343 (Specifications).

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 Traffic SCDs TC-71.10 and TC-72.20. 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 (C&MS) (i.e., C&MS Items 642, 643, 644, 645, 646, 647 and 648). 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
   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/Diagonal line (white)
   m. Transverse/Diagonal 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
   u. Railroad symbol marking
   v. School symbol marking, __ inch
   w. Handicap symbol marking
   x. Chevron Markings

4. Payment for all pavement marking items in the General Summary shall be carried as C&MS Items 642, 643, 644, 645, 646, 647 and 648 on a unit bid basis (no lump sum) as follows:
Typical line widths are described in Chapter 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” or “chevron markings.”

341-3 Work Zone Pavement Marking Materials

Work zone pavement markings are addressed in Section 605-11.11 and C&MS 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 district-wide 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.

**Plan Note 342-3 (Section 342-3)** may be used on district-wide RPM contracts when the castings should not be replaced due to poor pavement.

**341-5 Air Speed Zone Markings**

**Plan Note 342-4 (Section 342-4)** may be used when air speed zone markings are included in the plans.

**341-6 Bikeway Pavement Markings**

OMUTCD Chapter 3C and *TEM Chapter 902* address markings for bicycle facilities, and *Traffic Plan Insert Sheet 207000* provides additional bikeway pavement marking details.

**Plan Note 342-5 (Section 342-5)** should be used when green bike lanes are included in a plan.
Intentionally blank.
342 PLAN NOTES

342-1 General

Typical Plan Notes have been consolidated in this Chapter 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 C&MS, 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

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

2. The symbol of accessibility placed on the parking space shall be as shown in Figure 3B-22 of the current Ohio Manual of Uniform Traffic Control Devices, and in SCD TC-71.10, with the exception that a blue background/white border shall not be used.

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

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

5. 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, Type ___ Each
   Item 646, Handicap Symbol Marking Each
   Item 647, Handicap Symbol Marking, Type ___ Each

Designer Notes: This note shall be included on projects that include Handicap Symbol Markings. The area for this symbol is 2.7 square feet as shown in Table 397-2.

342-3 621 Raised Pavement Marker Removed

In areas where the raised pavement marker castings cannot be replaced because of pavement conditions, use this item instead of Item 621 RPM, Installation Only to compensate the Contractor for removal of the existing RPM and restoration of the pavement.

All broken, cracked, fragmented or partial remnants of raised pavement markers or missing raised pavement markers shall be totally removed and the pavement restored as described in Construction and Material Specification Item 621.08.
The following is an estimated quantity to be used as directed by the Engineer for the above work:

621 _________ EACH RAISED PAVEMENT MARKER REMOVED

**Designer Notes:** This note may be used on district-wide RPM contracts for times when the castings should not be replaced due to poor pavement.

### 342-4 Air Speed Zone Marking

Air speed zone markings shall be white and 24 inches wide measured in the direction of travel and 4 feet in length. On two-lane roadways with paved shoulders less than 4 feet in width, the air speed zone markings shall be placed with 2 feet on each side of the center line or edge line markings. When paved shoulders of sufficient width are available, the air speed zone markings shall be placed on the shoulders.

An Air Speed Zone consists of markings at 0.25-mile intervals for a minimum of 1 mile in length along the roadway.

It is the Contractor’s responsibility to have the markings laid out by a Registered Surveyor. A record is to be kept and one original signed and sealed document is to be sent to the District Traffic Engineer and one copy is to be sent to the District Construction Engineer.

Materials, equipment and application shall be according to the type of pavement marking material used.

Payment will be for each 24-inch-wide by 4 feet long marking and shall include the pavement marking material used and the surveying work.

**Designer Note:** This note should be used when air speed zone markings are included in the plan.

### 342-5 Green Colored Pavement for Bike Lanes

In addition to the requirements of C&MS 641 and 740; the following requirements shall apply:

1. The daytime and nighttime chromaticity coordinates for the color used for green colored pavement shall be as follows:

<table>
<thead>
<tr>
<th>Chromaticity Coordinates (Corner Points)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
</tr>
<tr>
<td>x</td>
</tr>
<tr>
<td>0.230</td>
</tr>
<tr>
<td>0.367</td>
</tr>
</tbody>
</table>

2. The daytime luminance factor (Y) shall be at least 7, but no more than 35.
3. Green colored pavement shall be [uniformly retroreflective or non-retroreflective].

Payment for “Item ____ Green Colored Pavement for Bike Lanes” will be at the contract unit price per square foot.

**Designer Note:** This note should be used when green colored pavement for bike lanes is desired. The blanks shall be filled in with the appropriate material specification item. The item that is enclosed in brackets [ ] should be carefully considered and the appropriate option chosen based on the maintaining agency’s preferences.
342-6  **Item Special – Inlaid Concrete Bridge Deck Long Line Markings**

In addition to the requirements of Items 640 and 740, the following requirements shall also apply.

The material used shall be *(select one)*:

1. Traffic Paint Type 1 – as listed on the Approved List
2. PolyCarb Mark 55.4, IPS HPS 4 modified urethane or PolyCarb Mark 75 polyurea.
3. IPS HPS 2 epoxy, Polycarb Mark 55.2 epoxy, Epoplex LS 60 epoxy, 3M 380WR ES preformed tape, Epoplex Glomarc 90 polyurea or IPS HPS 5 polyurea.

All materials shall be installed according to manufacturer’s directions.

Inlaid pavement marking on concrete bridge decks shall be installed in a 150 mil (4.0 mm) groove to match the depth of standard bridge deck groove per Item 511.17.

Payment shall be at the contract unit price per foot and shall include the groove.
343 SPECIFICATIONS

343-1 General

ODOT specifications for the furnishing and installation of markings are contained in the following C&MS sections:

- 620 and 720 Delineators
- 621 and 721 Raised Pavement Markers
- 626 and 726 Barrier Reflectors
- 630 and 730 Traffic Signs and Sign Supports
- 640 and 740 Pavement Markings

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

<table>
<thead>
<tr>
<th>C&amp;MS Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>642</td>
<td>Water-based Traffic Paint</td>
</tr>
<tr>
<td>643</td>
<td>Polyester Pavement Markings</td>
</tr>
<tr>
<td>644</td>
<td>Screed Extruded Thermoplastic Pavement Markings</td>
</tr>
<tr>
<td>645</td>
<td>Preformed Pavement Marking Material</td>
</tr>
<tr>
<td>646</td>
<td>Epoxy Pavement Markings</td>
</tr>
<tr>
<td>647</td>
<td>Heat-fused Preformed Thermoplastic for use as Auxiliary Pavement Markings</td>
</tr>
<tr>
<td>648</td>
<td>Spray Thermoplastic Pavement Markings</td>
</tr>
</tbody>
</table>

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

The C&MS information may be viewed on-line at: [www.odotonline.org/cmsportal/](http://www.odotonline.org/cmsportal/)

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. These Supplements may be viewed on-line at: [www.dot.state.oh.us/divisions/constructionmgt/pages/proposalnotessupplementalspecificationsandsupplements.aspx](http://www.dot.state.oh.us/divisions/constructionmgt/pages/proposalnotessupplementalspecificationsandsupplements.aspx)

343-2 Supplement 1047 Pavement Marking Evaluation on ODOT-Maintained Highways

When Supplement 1047 field service testing of pavement striping is conducted on ODOT-maintained highways it is imperative that the striping under evaluation not be removed or restriped until the after the official end of the evaluation period.

Pursuant to these stipulations, the Pavement Markings Engineer (PME) shall notify the District CPA in writing that pavement marking testing is underway by providing the following information.

<table>
<thead>
<tr>
<th>S1047 Pavement Marking Evaluation Notification</th>
</tr>
</thead>
<tbody>
<tr>
<td>C-R-S</td>
</tr>
<tr>
<td>Begin Mile Marker</td>
</tr>
<tr>
<td>End Mile Marker</td>
</tr>
<tr>
<td>Marking Type (e.g., CMS 642)</td>
</tr>
<tr>
<td>Manufacturer</td>
</tr>
<tr>
<td>Marking Model/Brand Name</td>
</tr>
<tr>
<td>Associated Construction Project Number</td>
</tr>
</tbody>
</table>
After receipt of notification from the PME, the District shall install appropriate signing as shown:

<table>
<thead>
<tr>
<th>Installation Date</th>
<th>Estimated Evaluation Completion Date</th>
</tr>
</thead>
</table>

Furthermore, the affected section of highway shall be excluded from future striping plans until after the evaluation completion date or as notified by the PME.
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 C&MS 614.11 shall be conducted according to the ratings given in Supplement 1047 Appendix C (color), Appendix D (night visibility) and Appendix E (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. 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 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 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.

5. Placement of RPM Casting shall be 2 inches from any construction joint (lateral or longitudinal).

350-4 Raised Pavement Marker (RPM) Reflector Replacement

Proper installation of the RPM reflector is also a key factor in the life of an RPM. 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. Remove all residual adhesive, rust and other contaminants from the “pocket.” 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) 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.

350-5 Remedial Action for Improperly Installed RPM Castings

RPM castings shall be installed properly in accordance with C&MS Item 621.03 (Layout), C&MS 621.04 (Installation of RPM Casting), and Traffic Standard Construction Drawings (SCDs) TC-65.10 and TC-65.11.

The following information is a guide for the necessary remedial action to be taken by construction and maintenance personnel when RPM castings are improperly installed.

1. Problem: The RPM is installed with one or more tabs not resting on the pavement surface. Note that a clipboard can fit in the gap between the leveling tabs and the pavement surface.
Remedial Action:

a. Remove and install the RPM casting at a new location.

b. The distance to the new RPM casting location shall not exceed 25 percent of the specified RPM spacing.

c. If it would be necessary to relocate the RPM casting to a distance greater than 25 percent of the specified spacing, do not reinstall the casting.

d. Fill the original cavity (from where the improperly installed RPM casting was removed) with epoxy or asphalt concrete.

2. Problem: The RPM casting is installed, but either the voids are not filled with epoxy all around the casting (Illustration 2a) or the epoxy is not to the roadway surface all around the casting (Illustration 2b).

Remedial Action:

a. Blow out dirt from around RPM casting with compressed air.

b. Fill the voids and seal the RPM casting all around with epoxy as shown in Illustration below.
3. Problem: The RPM casting is installed near or on a longitudinal joint or crack in the roadway surface (Illustration 4).

Remedial Action: Seal all the cracks up to a minimum of 9 inches from the RPM casting with epoxy (Illustration 5).

4. Problem: RPM casting is installed on construction joints which have extensive failure (Illustration 6).

Remedial Action:

a. Remove and install the RPM casting at a new location.

b. The distance to the new RPM casting location shall not exceed 25 percent of the specified RPM spacing.

c. If it would be necessary to relocate the RPM casting to a distance greater than 25 percent of the specified RPM spacing, do not reinstall the casting.

d. Fill the original cavity (from where the improperly installed RPM casting was removed) with epoxy or asphalt concrete.
5. Problem: The RPM casting is installed, but either the epoxy adhesive is not hardened or the epoxy adhesive is not uniform gray in color.

Remedial Action:

a. Remove and install the RPM casting at a new location.

b. The distance to the new RPM casting location shall not exceed 25 percent of the specified RPM spacing.

c. If it would be necessary to relocate the RPM casting to a distance greater than 25 percent of the specified RPM spacing, do not reinstall the casting.

d. Fill the original cavity (from where the improperly installed RPM casting was removed) with epoxy or asphalt concrete.

350-6 Delineators

350-6.1 Qualified Product List (QPL)

Only approved delineator materials listed on the Qualified Product List (on-line at [http://www.dot.state.oh.us/Divisions/ConstructionMgt/Materials/Pages/QPL.aspx](http://www.dot.state.oh.us/Divisions/ConstructionMgt/Materials/Pages/QPL.aspx)) shall be used on a project.

350-6.2 Delineator Lateral Placement

The top of the delineator post shall be 48 inches above the edge of pavement.

The delineator post shall be placed 12.5 feet outside the outer edge of the pavement, or 2.5 feet outside the outer edge of the shoulder.

350-6.3 Placement of Delineators on Curves and Tangent Sections

Delineators should be spaced approximately 400 feet apart on the tangent sections.

Delineators on the horizontal curves shall be spaced according to the table in the Traffic SCD TC-61.10.

Delineators should be provided on the outside of horizontal curves on interchange ramps.

The color of the delineator reflector and flexible post shall conform to the color of the pavement markings nearest the delineator.

350-6.4 Delineator Installation

Delineators shall be installed facing traffic, except for red reflectors which face wrong-way traffic, if used.
Protective paper covering the face of flexible post-mounted reflectors shall not be removed until after installation.

Ensure that delineator posts are not more than 1:50 out of plumb. If soil conditions may cause the post to be out of plumb, the contractor may drive a pilot shaft before installation.

Install the flexible posts using methods and equipment that conforms to the post manufacturer’s recommendations.

350-6.5 Use of Delineators with Guardrail Anchor Assemblies

Information about guardrail anchor assemblies is provided in L & D Manual Volume 1, Section 603. Information about the use of delineators with Type E-98 guardrail anchor assemblies is found in Plan Note R-113 (see L&D Manual Volume 1, Appendix B).

350-7 Barrier Reflectors

350-7.1 Qualified Product List (QPL)

Only approved barrier reflectors listed on the Qualified Product List shall be used. This list is on-line at http://www.dot.state.oh.us/Divisions/ConstructionMgt/Materials/Pages/QPL.aspx.

350-7.2 Barrier Reflector Installation

1. The color of the reflector shall match the color of the nearest edge line.

2. Install Type (2, 3, 4, or 5) (One-Way or Bi-Directional) reflectors on the guardrail blockout.

3. Install Type 1 (One-Way or Bi-Directional) with the top of the barrier reflector so its height is 26 inches above the near edge of pavement, except that the top of the barrier reflector is at least 3 inches below the top of the concrete barrier.

4. Type 1 (One-Way or Bi-Directional) barrier reflectors shall not extend further than 5 inches in a horizontal direction towards the traffic lanes.

5. Loose concrete, rust, dirt and other loose materials shall be removed from the surface of the concrete barrier using a wire brush. Apply adhesive to clean and moisture-free surface according to manufacturer’s recommendations.

350-8 Pavement Markings

350-8.1 General

Per C&MS Item 641.06, the contractor shall establish reference points to ensure proper placement of restored markings on projects where resurfacing or other operations will result in obliteration of the existing pavement markings.

350-8.2 Pavement Marking Materials

Pavement marking materials used on construction projects shall be from the Approved Lists, maintained by the Office of Material Management (OMM). The pavement marking materials are listed under the following Approved List on that OMM’s website at: http://www.dot.state.oh.us/Divisions/ConstructionMgt/Materials/Approved-List.

The appropriate type of glass beads shall be applied according to C&MS Item 740.09 for different types of pavement marking materials.
350-8.3 Application of Pavement Marking Materials

Pavement marking materials shall be applied according to C&MS Items 640 and 740 as follows:

1. Traffic paint, C&MS Item 642.
   a. Material Type, Item 740.02.
      i. Traffic paint Type 1, Fast dry, water-based paint.
      ii. Traffic paint Type 1A, Fast dry, water-based paint.
   b. Glass beads, Item 740.09 Type A.
   c. Application of Traffic Paint, Item 642, Type 1 and 1A.
      i. Traffic paint Type 1 shall be applied when the pavement and air temperature are 50°F and above. Traffic paint Type 1A shall be applied when the pavement and air temperature are between 35°F and 50°F.
      ii. Glass beads Type A shall be applied at the rate of 15 pounds per 100 square feet of Type 1 traffic paint applied.
      iii. Glass beads Type A shall be applied at the rate of 8 pounds per 100 square feet of Type 1A traffic paint applied.
      iv. Type 1 traffic paint shall be applied at the rate of 22 gallons per mile of 4-inch solid line and/or at 1.25 gallons per 100 square feet.
      v. Type 1A traffic paint shall be applied at the rate of 16 gallons per mile of 4-inch solid line and/or at 0.94 gallon per 100 square feet.
      vi. Coning of the line is required because the pavement marking is not track free in 2 minutes or less.

2. Polyester Pavement Marking, Item 643.
   a. Material Type, Item 740.03.
   b. Glass beads, Item 740.09 Type B.
   c. Application of Polyester, Item 643.
      i. Polyester shall be applied when the pavement and air temperature are 50°F and above.
      ii. Polyester shall be applied in two components (catalyst and resin) in proportions as recommended by the manufacturer.
      iii. Glass beads Type B shall be applied at the rate of 18 pounds per gallon (liter) of paint used.
      iv. Polyester shall be applied at the rate of 16 gallons per mile of 4-inch line and/or at 0.94 gallon per 100 square feet.
      v. Since dry time is 45 minutes and less:
(1) Coning is required to protect the line until track free.

(2) If tracking continues after 45 minutes cease marking operation until tracking problem is corrected.

3. Thermoplastic Pavement Marking, **C&MS Item 644**.
   a. Material Type, **Item 740.04**.
   b. Glass beads, **Item 740.09** Type C.
   c. Application of Thermoplastic, **Item 644**.
      i. For pavements less than six months old, thermoplastic shall be applied when the pavement surface and the ambient air temperature are 50°F and rising. At the end of the construction season, if the surface temperature is 50°F or less, apply Traffic Paint Type 1A.
      ii. For pavements one year or older, thermoplastic shall be applied when the pavement surface and the ambient air temperature are 70°F and rising.
      iii. The temperature of thermoplastic at the point of application shall be at least 400°F and not more than 440°F.
      iv. Glass beads, Type C shall be applied at the rate of 12 pounds per 100 square feet.
      v. Thermoplastic material shall be applied at a thickness of 125 mils using an applicator that has a shoe that rides on the pavement and extrudes the thermoplastic (no ribbon application).
      vi. Thermoplastic shall be applied at the rate of 2340 pounds per mile of 4-inch line and/or at 133 pounds per 100 square.

4. Preformed Pavement Marking, **C&MS Item 645**.
   a. Material Types, **Items 740.05 and 740.06**.
      i. For Type A, permanent markings, Type A1, A2 or A3 material from **Item 740.05** shall be used -
         (1) Type A1 material, 0.090 inch thick shall be applied with pre-coated adhesive layer.
         (2) Type A2 material, 0.060 inch thick shall be applied with pre-coated adhesive layer.
         (3) Type A3 material, 0.020 inch thick shall be applied with pre-coated adhesive layer.
      ii. For Type B work zone pavement markings, Type II (non-removable) material from **Item 740.06** shall be used. This material has a minimum thickness of 0.015 inch.
      iii. For Type C work zone pavement markings, Type I (removable) material from **Item 740.06** shall be used. This material has a minimum thickness of 0.030 inch.
   b. Glass beads - None.
c. Application of Preformed Pavement Marking, **Item 645**: Preformed pavement marking shall be applied according to the manufacturer's recommendations packed with material.

5. Epoxy Pavement Marking, **C&MS Item 646**.
   a. Material Type, **Item 740.07**.
   b. Glass beads, **Item 740.09** Type D.
   c. Application of Epoxy Pavement Marking, **Item 646**.
      i. Epoxy shall be applied at a surface temperature of 50°F and above.
      ii. Epoxy shall be applied in components, Part A and Part B, in the proportions recommended by the manufacturer.
      iii. Cleaning and Surface Preparation shall be done according to Item 646.04 for different pavement types and manufacturer's recommendations.
      iv. Glass beads Type D shall be apply at the rate of 31 pounds per 100 square feet. They shall be applied in a double-drop system with Size I, large gradation, first and Size II, regular graduation second in equal amounts by weight in the same pass.
      v. Epoxy shall be applied at the rate of 22 gallons per mile of 4-inch line and/or at 1.25 gallon per 100 square feet.

6. Heat-Fused Preformed Thermoplastic Pavement Marking, **Item 647**.
   a. Material Type, **Item 740.08**.
      i. Type A90 is 90 mil thick.
      ii. Type A125 is 125 mil thick.
      iii. Type B90 is 90 mil thick.
      iv. Type B125 is 125 mil thick.
   b. Glass beads - Type A and B shall contain intermix beads throughout. Drop-on glass beads are not required unless using a non-surface beaded markings.
   c. Application of Heat-Fused Preformed Thermoplastic Pavement Marking, **Item 647**.
      i. Heat-Fused Preformed Thermoplastic Pavement Marking shall be applied only as auxiliary markings according to the manufacturer's recommendations.
      ii. Apply primer sealer on Portland cement concrete pavements if recommended by the manufacturer.

7. Spray Thermoplastic Pavement Marking, **Item 648**.
   a. Material Type, **Item 740.10**.
   b. Glass Beads, **Item 740.09** Type G.
   c. Application of Spray Thermoplastic, **Item 648**.
      i. For pavements less than six months old, spray thermoplastic shall be applied when the pavement surface and the ambient air temperature are 50°F and rising
      ii. For pavements one year of older, spray thermoplastic shall be applied when the pavement surface and the ambient air temperature are 70°F.
The temperature of spray thermoplastic at the point of application shall be at least 400°F and not more than 440°F.

Glass beads, Type C shall be applied at the rate of 10 pounds per 100 square feet.

Spray thermoplastic material shall be applied at a thickness of 45 mils.

Spray thermoplastic shall be applied at the rate of 762-886 pounds per mile of 4-inch line.

350-8.4 Data Logging System (DLS)

According to C&MS Item 641.04, striping equipment for traffic paint, polyester, epoxy and work zone marking Item 642 shall be equipped with a computerized Data Logging System (DLS). The following shall be documented, for long line markings only:

1. Measure and record application vehicle speed to the nearest 0.1 miles per hour.
2. Measure and record the weight and/or volume amount of material used by color.
3. Measure and record the weight of glass beads.
4. Measure and record the pavement surface temperature.
5. Measure and record the air temperature.
6. Measure and record the dew point.
7. Measure and record the humidity.
8. Calculate and record average materials application rates and film thickness over the section painted.

ODOT provides standard DLS spreadsheets, which prescribes the correct DLS report format and content prior to beginning at work.

350-8.5 Construction Inspection During Pavement Marking Installation

1. Refer to C&MS Item 641, Pavement Marking - General.

2. Before the application of marking material, the pavement surface should be cleaned and dried by using:
   a. Power broom.
   b. Air jets (guns).

3. Approve the premarking for long lines and auxiliary markings to ensure proper layout placement.
   a. Center lines shall be “T” marked to establish no-passing lines.
   b. The District shall provide center line paint logs.
   c. Per Item 641.06, the contractor shall establish reference points to ensure proper placement of restored markings on projects where resurfacing or other operations will result in obliteration of the existing pavement markings.

4. Marking lines shall be applied to the width specified ± 1/4 inch.
5. Pavement markings shall be free of uneven edges, overspray and other visible defects.

6. As noted in Section 301-4, center lines, lane lines and edge lines shall be placed as follows:
a. Edge line – Center of the edge line shall be applied 6 inches from the edge of pavement.

b. Lane line – Nearest edge of the lane line shall be applied 2 inches to the left of the construction joint. Broken lines shall be in a 40-foot cycle consisting of a 10-foot dash with a 30-foot gap between the lines.

c. Center line – Nearest edge of the center line shall be applied 2 inches to the left of the construction joint. Broken lines shall be in a 40-foot cycle consisting of a 10-foot dash with a 30-foot gap between the lines.

7. Pavement marking lines shall be straight or smoothly curved true to the alignment of the pavement. If deviation is greater than 3 inches in 100 feet, it shall be corrected.

8. Gaps shall be filled that were not marked as a result of template use for spray-applied auxiliary markings with marking material after the template is removed. For extruded thermoplastics gaps may be left.

9. Pavement marking lines shall be sharp, well defined and uniformly retroreflective.

a. To check for retroreflectivity, put the sun over your shoulder.

b. If it is not sunny:

   i. A well-beaded line will appear dull in the daylight.

   ii. An unbeaded line will appear shiny.

c. Review the lines at night.
360-1 General

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

Although the information in Chapter 350 is primarily intended for construction inspectors or contractors working with markings, it is also 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.

360-2 Maintenance of Raised Pavement Markers (RPMs)

360-2.1 General

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

360-2.2 Types of RPMs

A recycled RPM can be identified in the field by observing either a saw cut or 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.

360-2.3 Inspection Guidelines for Existing RPM Installations

1. 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.
2. Poor Quality Installation: The following are considered poor quality installations:

a. Any of the four lugs/tabs are not resting on the pavement surface (see illustration 1, Section 350-5).

b. The epoxy adhesive does not fill all the voids around the casting (see illustration 2a, Section 350-5).

c. The epoxy adhesive is not all around the casting and level with the roadway surface. For example, illustration 2b in Section 350-5 shows a casting with space between the casting and the pavement on one side and in contact with the pavement on the other side.

d. The epoxy is not hardened and/or not a uniform gray color (see illustration 7, Section 350-5).

e. 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.

f. The leading casting rails are above the pavement so as to become a blunt edge which can become caught by a snowplow blade.
g. RPM installed on or close to a construction joint (see illustration 4, Section 350-5).

3. 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.

4. Adhesive Failure: Adhesive failure occurs when the bond between pavement surface and epoxy under the casting has failed. Usually surface of the underlaying old pavement is visible and the casting is missing.
370 OTHER CONSIDERATIONS

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

380 RESEARCH

This Chapter 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*.
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. A copy of the form is available on-line at the OTO forms web page.
Intentionally blank.
Air Speed Check Zone Request

**Request No.:** ____________  **Date:** __/__/____

**By Lt.** ________________  **County:** ________________

**OSP District Office**

**Post**  **Phone:** (____) ____-_____

**ZONE(S) DATA**

<table>
<thead>
<tr>
<th>Route Number</th>
<th>Request Type **</th>
<th>Road Type **</th>
<th>Direction of Travel</th>
<th>Begin MP</th>
<th>Ending MP</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**OSD Aviation Section**

Fax: 614-16-3967

**OSP District Office**

**Date Reviewed:** __/__/____

___ Approved

**Date Forwarded to ODOT District ___ Office:** __/__/____

**Necessity:** ________________________________

___ Disapproved

**Date Returned to OSP District Office:** __/__/____

c: Highway Patrol Post District # ___

**Reviewed by:** _______________________________  **Date:** __/__/____

___ Practical

**Date of Layout:** __/__/____  **By:** ____________________________

**Registered Surveyor**

**Date Work Completed:** __/__/____  **By:** ____________________________

**Traffic Control Supt.**

**Date Returned to the ODOT Aviation Section Commander:** __/__/____

___ Impractical

**Reason for Not Complying with Request:** ______________________________

**Date Returned to OSP Headquarters:** __/__/____

---

**Request Type**

- A New Zone Installation
- B Restoration of an Existing Zone that may have been obliterated due to roadway resurfacing or other highway construction projects.
- C Remark Existing Zone
- D Measure Existing Zone
- E Abolish Existing Zone

**Road Type**

- 10 Interstate
- 20 Major Thoroughfare Divided
- 30 Major Thoroughfare Other
- 40 Auxiliary
- 50 Local

**Note:** Air Speed Measurement Marking shall be laid out by a registered surveyor and where approved shall be installed in accordance with the standards contained in the OMUTCD.
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397-1  **Material Selection for Pavement Marking and Expected Marking 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  **Reserved for Future Use**

397-4  **Reserved for Future Use**

397-5  **Reserved for Future Use**

397-6  **Compatibility of Pavement Marking Materials for Restripe Situations**

*Table 397-6* is used to determine whether pavement marking materials are compatible when restriping, without removing the old pavement markings.
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### Table 397-1. Material Selection for Pavement Marking and Expected Marking Life in Years

#### a. Long Line Pavement Marking – 2 Lane or General System

| Remaining Pavement Surface Life * | Asphalt | | Concrete | | |
|---|---|---|---|---|
| | ADT < 5,000 Type | ADT > 5,000 Type | ADT < 5,000 Type | ADT > 5,000 Type |
| 0 - 2 years | Traffic Paint Type 1 1 | Polyester 2 | Traffic Paint Type 1 1 | Polyester 2 |
| | Traffic Paint Type 1 1 | Spray Thermo 2 | Traffic Paint Type 1 1 | Traffic Paint Type 1 1 |
| 3 - 4 years | Polyester 3 | Polyester 2 | Traffic Paint Type 1 1 | Epoxy 4 |
| | Spray Thermo 2 | Spray Thermo 2 | Traffic Paint Type 1 1 | Traffic Paint Type 1 1 |
| | Traffic Paint Type 1 1 | Traffic Paint Type 1 1 | Epoxy 4 | Epoxy 4 |
| > 4 years | Thermo 4 | Epoxy 4 | Epoxy 4 | Epoxy 4 |
| | Polyester 3 | Polyester 2 | Traffic Paint Type 1 1 | Traffic Paint Type 1 1 |
| | Spray Thermo 2 | Spray Thermo 2 | Traffic Paint Type 1 1 | Traffic Paint Type 1 1 |
| | Traffic Paint Type 1 1 | Traffic Paint Type 1 1 | Traffic Paint Type 1 1 | Traffic Paint Type 1 1 |

**New Surface**

- i) 35° to 50° F
- ii) > 50° F

| Remaining Pavement Surface Life * | Asphalt | | Concrete | | |
|---|---|---|---|---|
| | ADT < 5,000 Type | ADT > 5,000 Type | ADT < 5,000 Type | ADT > 5,000 Type |
| 0 - 2 years | Traffic Paint Type 1 A 1 | Traffic Paint Type 1 A 1 | Polyester 2 | Traffic Paint Type 1 1 |
| | Traffic Paint Type 1 A 1 | Traffic Paint Type 1 A 1 | Traffic Paint Type 1 1 | Traffic Paint Type 1 1 |
| 3 - 4 years | Polyester 3 | Polyester 2 | Traffic Paint Type 1 1 | Epoxy 4 |
| | Spray Thermo 2 | Spray Thermo 2 | Traffic Paint Type 1 1 | Traffic Paint Type 1 1 |
| | Traffic Paint Type 1 1 | Traffic Paint Type 1 1 | Traffic Paint Type 1 1 | Traffic Paint Type 1 1 |
| > 4 years | Thermo 4 | Epoxy 4 | Epoxy 4 | Epoxy 4 |
| | Polyester 3 | Polyester 2 | Traffic Paint Type 1 1 | Traffic Paint Type 1 1 |
| | Spray Thermo 2 | Spray Thermo 2 | Traffic Paint Type 1 1 | Traffic Paint Type 1 1 |
| | Traffic Paint Type 1 1 | Traffic Paint Type 1 1 | Traffic Paint Type 1 1 | Traffic Paint Type 1 1 |

**New Surface**

- i) 35° to 50° F
- ii) > 50° F
**Table 397-1. Material Selection for Pavement Marking and Expected Marking Life in Years (continued)**

| Remaining Pavement Surface Life | Asphalt | | Concrete | | |
|--------------------------------|----------|----------|----------|----------|
|                                | ADT < 5,000 | ADT > 5,000 | ADT < 5,000 | ADT > 5,000 |
| 0 - 2 years                    | Traffic Paint Type 1 | 1 | Traffic Paint Type 1 | 1 |
|                                | Heat-Fused Preformed Thermo Polyester | | Heat-Fused Preformed Thermo Epoxy Traffic Paint Type 1 | 4 |
| 3 - 4 years                    | Heat-Fused Preformed Polyester | 4 | Heat-Fused Preformed Polyester | 3 |
|                                | Heat-Fused Preformed Polyester Traffic Paint Type 1 | | Heat-Fused Preformed Polyester Epoxy Traffic Paint Type 1 | 4 |
| > 4 years                      | Heat-Fused Preformed Thermoplastic Traffic Paint Type 1 | 4 | Heat-Fused Preformed Thermoplastic Epoxy Traffic Paint Type 1 | 3 |
| New Surface                    | Same as used for long lines | | Same as used for long lines | Same as used for long lines |
| i) 35° to 50° F                | | | | |
| ii) > 50° F                    | | | | |

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

**Notes:**

1. **Polyester pavement marking material**
   a. 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.
   b. Polyester pavement marking material shall only be used on C&MS Item 441, 442, or 424 Type B.
   c. Polyester pavement marking material shall not be used on the following asphalt concrete surfaces due to poor bonding qualities:
      i. Open graded courses,
      ii. Slurry seal, C&MS Item 424 Type A or 443
      iii. Any Asphalt Concrete (Item Special) should be questioned before considering placement of polyester material on it.

2. **Thermoplastic pavement marking material**
   a. Thermoplastic pavement marking material is not recommended for striping long line markings on routes with 2500 or less ADT since these materials must be removed before a chip seal coat can be applied to the pavement.

3. **Preformed Thermoplastic pavement marking material**
   a. 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.

4. **Epoxy pavement marking material**
   a. Epoxy should only be used on pavements in good condition after surface preparation has been accomplished per manufacturer recommendations.
   b. Epoxy pavement marking material is not recommended for striping long line markings on routes with 2500 or less ADT since these materials must be removed before a chip seal coat can be applied to the pavement.

5. **Rumble Stripes**
   a. Due to installation and durability issues Preformed pavement marking (C&MS Item 645),...
and Heat-fused preformed thermoplastic (C&MS Item 647) shall not be used for rumble stripes.

6. **Microsurfacing and Chip Seal Pavements**
   a. Microsurfacing *(Item 421)* and Chip Seal *(Item 422)* falls under Asphalt Pavement.
   b. Thermoplastic *(Item 644)* pavement marking materials shall not be used on Microsurfacing pavements *(Item 421)* for long line pavement markings.

7. **Miscellaneous**
   a. Auxiliary markings not regularly run over by traffic will last 1.5 to 2 times longer.
   b. Surface preparation may be required to remove old markings as recommended by supplier.
   c. Remove curing compound completely from new concrete surfaces - follow *CMS Item 641.05*.

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

<table>
<thead>
<tr>
<th>Remaining Surface Life of Concrete Bridge Deck</th>
<th>Material Group</th>
<th>Product Name</th>
<th>Years</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 4 years</td>
<td>740.02 Traffic Paint Type 1</td>
<td>Traffic Paint Type 1 – as listed on the Approved List</td>
<td>1-2</td>
</tr>
<tr>
<td></td>
<td>740.07 Epoxy</td>
<td>PolyCarb Mark 55.4</td>
<td>3-4</td>
</tr>
<tr>
<td></td>
<td>Modified Urethane 1</td>
<td>IPS HPS 4</td>
<td>3-4</td>
</tr>
<tr>
<td></td>
<td>Polyurea 1,2</td>
<td>PolyCarb Mark 75</td>
<td>3-4</td>
</tr>
<tr>
<td>≥ 4 years</td>
<td>740.07 Epoxy</td>
<td>IPS HPS 2</td>
<td>4-5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>PolyCarb Mark 55.2</td>
<td>4-5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Epoplex LS 60</td>
<td>4-5</td>
</tr>
<tr>
<td></td>
<td>740.05 Preformed Tape</td>
<td>3M 380WR ES</td>
<td>4-5</td>
</tr>
<tr>
<td></td>
<td>Polyurea 1,2</td>
<td>Epoplex Glomarc 90</td>
<td>5-6</td>
</tr>
<tr>
<td></td>
<td></td>
<td>IPS HPS 5</td>
<td>5-6</td>
</tr>
</tbody>
</table>

**Notes:**

1. All inlaid pavement marking on concrete bridge decks shall be installed in a 150 mil (4.0 mm) groove to match the depth of standard bridge deck groove per Item 511.17.

2. Pavement marking materials listed for bridge deck of remaining surface life equal to or greater than (≥) 4 years can also be used on concrete bridge deck for remaining surface life less than (<) 4 years.

3. Modified Urethane and Polyurea are not listed on the Material Approved List but can be used on a limited basis.

4. Polyurea pavement marking materials need special striping equipment for installation.
Table 397-2. Area Calculations for Words and Symbols

<table>
<thead>
<tr>
<th>WORDS square feet</th>
<th>TYPE</th>
<th>HEIGHT</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>6 ft.</td>
</tr>
<tr>
<td>STOP</td>
<td></td>
<td>17</td>
</tr>
<tr>
<td>ONLY</td>
<td></td>
<td>17</td>
</tr>
<tr>
<td>SCHOOL¹</td>
<td></td>
<td>27</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>LANE-USE ARROWS square feet</th>
</tr>
</thead>
<tbody>
<tr>
<td>ARROW TYPE</td>
</tr>
<tr>
<td>------------</td>
</tr>
<tr>
<td>Turn Arrow</td>
</tr>
<tr>
<td>Straight Arrow</td>
</tr>
<tr>
<td>Combined Arrow</td>
</tr>
<tr>
<td>Lane-Reduction Arrow</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Handicap Symbol</th>
</tr>
</thead>
<tbody>
<tr>
<td>Height in.</td>
</tr>
<tr>
<td>41</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>R X R SYMBOL square feet</th>
<th>WIDTH (W)²</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>8 ft. min.</td>
</tr>
<tr>
<td></td>
<td>67</td>
</tr>
</tbody>
</table>

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 long.
<table>
<thead>
<tr>
<th>Table 397-3. Reserved for Future Use</th>
</tr>
</thead>
</table>


Table 397-4.  Reserved for Future Use
Table 397-5. Reserved for Future Use
### Table 397-6. Compatibility of Pavement Marking Materials for Restripe Situations

<table>
<thead>
<tr>
<th>Existing (Old) Pavement Marking Material</th>
<th>Restripe (New) Pavement Marking Material</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Traffic Paint</td>
</tr>
<tr>
<td>Traffic Paint</td>
<td>Y</td>
</tr>
<tr>
<td>Polyester</td>
<td>Y</td>
</tr>
<tr>
<td>Thermoplastic</td>
<td>Y</td>
</tr>
<tr>
<td>Preformed (Item 645)</td>
<td>N</td>
</tr>
<tr>
<td>Epoxy</td>
<td>Y</td>
</tr>
<tr>
<td>Heat-Fused Preformed</td>
<td>N</td>
</tr>
<tr>
<td>Spray Thermoplastic</td>
<td>Y</td>
</tr>
</tbody>
</table>

All pavement marking materials are compatible for striping over Class III Work Zone Markings.

**Notes:**

1. Do not use wet glass beads
2. Apply only if existing marking is at least 3 month old
3. Includes Class I and II Work Zone Markings
300 MARKINGS Traffic Engineering Manual

398 FIGURES INDEX

398-1 Cardinal Direction Markings

*Figure 398-1* provides sizing and spacing details for Cardinal Direction Markings.

398-2 Marking a Narrow or One-Lane Bridge

As noted in *Sections 202-5, 202-14.2, 302-6 and 304-5*, *Figure 398-2* provides detail guidelines marking of a narrow or one-lane bridge.

398-3 Reserved for Future Information
Figure 398-1. Cardinal Direction Markings
Figure 398-2. Marking a Narrow or One-Lane Bridge

Note: Center line should stop 150 feet before a one-lane bridge, but may be continued across a narrow bridge (see MUTCD Section 3B.01).
Figure 398-3. Reserved for Future Information