To Holders of the Traffic Engineering Manual (TEM):

As of January 18, 2013, this publication has been revised.

This revision involves updates of the Cover, the Title Sheet and other preface materials, and Parts 2 (Signs), 4 (Signals), 6 (Temporary Traffic Control), 9 (Bicycles) and 11 (Highway Lighting).

As part of the recent reorganization of the Office of Traffic Engineering and the Office of Roadway Engineering, responsibility for the TEM has been transferred to the Office of Roadway Engineering. This change in the ODOT organization will also result in some changes in responsibilities for some of the material in the TEM, for example, not every reference in the TEM to the Office of Traffic Engineering will be replaced by a reference to the Office of Roadway Engineering. Therefore, there will be extensive updating of text in the TEM, and this may be a lengthy process. We appreciate your patience as we work through the task of updating this publication.

The January 2013 TEM Revision reflects some initial changes to address this reorganization; however, the changes made to the text at this time are basically just on those pages that were being updated for other reasons.

The updated publication and the separate revision package are available from the links below, the ODOT Design Reference Resource Center [http://www.dot.state.oh.us/drrc/Pages/default.aspx](http://www.dot.state.oh.us/drrc/Pages/default.aspx), or from the Office of Roadway Engineering’s Traffic Standards website at [http://www.dot.state.oh.us/Divisions/Engineering/Roadway/DesignStandards/traffic/Pages/default.aspx](http://www.dot.state.oh.us/Divisions/Engineering/Roadway/DesignStandards/traffic/Pages/default.aspx)

The revision package includes a detailed Revision Log.

The TEM Revision package is set up to print double-sided sheets.

Per ODOT policy, revisions will only be available via the web pages noted above.

For questions, comments, or concerns please contact either:

Maria Ruppe, P.E. Roadway Standards Engineer
(614-466-2847 or Maria.Ruppe@dot.state.oh.us)

Or

Juanita Elliott, P.E., Traffic Standards Engineer
(614-644-8143 or Juanita.Elliott@dot.state.oh.us)
Traffic Engineering Manual Revision Log  
January 18, 2013 Revision  
(of the October 2002 Edition)

The following is a detailed list of the changes made in the Preface Materials and Parts 2, 4, 6, 9 and 11 of the Traffic Engineering Manual (TEM) as of January 18, 2013:

<table>
<thead>
<tr>
<th>Preface Materials</th>
<th>Part 2 (Signs)</th>
<th>Part 3 (Markings)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Part 7 (School Areas)</td>
<td>Part 8 (Rail Grade Crossings)</td>
<td>Part 9 (Bicycles)</td>
</tr>
<tr>
<td>Part 10 (Reserved for Future Use)</td>
<td>Part 11 (Highway Lighting)</td>
<td>Part 12 (Zones and Traffic Studies)</td>
</tr>
<tr>
<td>Part 13 (ITS)</td>
<td>Part 14 (Miscellaneous)</td>
<td>Part 15 (Appendix)</td>
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</table>

### Revision Involves:

<table>
<thead>
<tr>
<th>Chapter or Section</th>
<th>Page</th>
<th>New Page</th>
<th>Type *</th>
<th>Section Title and Revision Description</th>
</tr>
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<tbody>
<tr>
<td><strong>Preface materials</strong></td>
<td>[top of page]</td>
<td></td>
<td>Updated to reflect the January 18, 2013 date for this revision.</td>
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<tr>
<td>Title Page</td>
<td>i</td>
<td>i</td>
<td>Editorial</td>
<td>Updated.</td>
</tr>
<tr>
<td>Table of Contents</td>
<td>Xvi – xlvi</td>
<td>xvii – xlvi</td>
<td>Editorial</td>
<td>Updated per this revision.</td>
</tr>
<tr>
<td>Part 1, General</td>
<td>[top of page]</td>
<td></td>
<td>Table of Contents.</td>
<td></td>
</tr>
<tr>
<td>Part 2, Signs</td>
<td>[top of page]</td>
<td></td>
<td>Updated per this revision and made some format adjustments.</td>
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</tr>
<tr>
<td>2-1 – 2-8</td>
<td>2-1 – 2-8</td>
<td>__</td>
<td>Table of Contents.</td>
<td></td>
</tr>
<tr>
<td>2-93</td>
<td>2-93</td>
<td>__</td>
<td>Reprinted as part of the revision set.</td>
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</tr>
<tr>
<td>240-4</td>
<td>2-94</td>
<td>2-94</td>
<td>Change</td>
<td>Design Info., Overhead Sign Supports.</td>
</tr>
<tr>
<td>240-9 New</td>
<td>2-101</td>
<td>Change</td>
<td>Design Information, RRFB.</td>
<td></td>
</tr>
<tr>
<td>2-102</td>
<td>2-102</td>
<td>__</td>
<td>Added text about this device.</td>
<td></td>
</tr>
<tr>
<td>241-7</td>
<td>2-103</td>
<td>2-103</td>
<td>Change</td>
<td>Plan Prep. / Production, Sign Support, Detail...</td>
</tr>
<tr>
<td>2-104 – 2-105</td>
<td>2-104 – 2-105</td>
<td>__</td>
<td>Updated “TC-16.20” reference to “TC-16.21.”.</td>
<td></td>
</tr>
</tbody>
</table>

* Key for Revision Type:  
  - **Change** - change in a standard, new information, revising text to provide clarification, updating references, or correcting a mistake in the text, more than simple editorial change;  
  - **Deletion** - deleting a section, form, table or figure;  
  - **Editorial** - correcting a simple typing or drawing mistake, simple editorial changes such as rephrasing a statement or making a format change.  

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1
## Revision Involves:

<table>
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<th>Chapter or Section</th>
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<th>Section Title and Revision Description</th>
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<tr>
<td>242-5</td>
<td>2-106</td>
<td>2-106</td>
<td>Change</td>
<td>Plan Notes, (630-C) 630 Modification of Barrier...&lt;br&gt;In the Designer Note, revised “with existing barrier wall assemblies” to “with this type of barrier wall assemblies.”</td>
</tr>
<tr>
<td>242-8 New</td>
<td>2-107 – 2-110</td>
<td>Change</td>
<td>Plan Notes, 630 Signing...Solar Powered RRFB...&lt;br&gt;In the Designer Note, corrected SDMM website address, and added information about where in the SDMM to find the alphabet information.</td>
<td></td>
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<tr>
<td></td>
<td>2-163</td>
<td>2-163</td>
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<td>Reprinted as part of the revision set</td>
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<tr>
<td>297-4</td>
<td>2-164 – 2-165</td>
<td>Change</td>
<td>Table 297-4. Signing for Traffic Generators...&lt;br&gt;Replaced the references to E3-H1 and E3-H2 in the table with “Supplemental Guide Sign.”</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2-166</td>
<td>2-166</td>
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<td>Reprinted as part of the revision set</td>
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### Part 4, Highway Signals

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<td>4-1 – 4-8</td>
<td>4-1 – 4-8</td>
<td></td>
<td>Table of Contents. Updated per this revision.</td>
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<tr>
<td>403-9</td>
<td>4-29</td>
<td>Change</td>
<td>TCSs – Gen., Yellow Trap. In the third paragraph revised “is” to “are” and added descriptions of the signs referenced.</td>
</tr>
<tr>
<td>4-30</td>
<td>4-30</td>
<td></td>
<td>Reprinted as part of the revision set.</td>
</tr>
<tr>
<td>405-3 New</td>
<td>4-37</td>
<td>Change</td>
<td>Flashing Beacons, Rectangular Rapid Flashing... Added Section about this device.</td>
</tr>
<tr>
<td>4-38</td>
<td>4-38</td>
<td></td>
<td>Reprinted as part of the revision set.</td>
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<tr>
<td>420-1</td>
<td>4-47</td>
<td>Change</td>
<td>Materials and Signal Hardware, General. Updated the web address for the SCDs.</td>
</tr>
<tr>
<td>4-48</td>
<td>4-48</td>
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<td>Reprinted as part of the revision set.</td>
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<tr>
<td>420-5</td>
<td>4-49</td>
<td>Change</td>
<td>Materials and Signal Hardware, Detector Loop...&lt;br&gt;In Subsection 420-5.2, revised “Video detection” to “Video stop line detection” in item 2.&lt;br&gt;In Subsection 420-5.3, revised the title by adding “Inductive Loop” to the beginning.&lt;br&gt;Added Subsection 420-5.4, Video Detection Prohibited for Dilemma Zone Applications.&lt;br&gt;Added Subsection 420-5.5, Second-Car Detection.</td>
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<tr>
<td>421-1</td>
<td>4-51</td>
<td>Change</td>
<td>Signal Supports, General. Updated the SCD website address.</td>
</tr>
<tr>
<td>440-3</td>
<td>4-55 – 4-57</td>
<td>Change</td>
<td>Design Info., Single-Arm Overhead Signal Support. Added a item 9 on page 56 and revised the drawing to show 3 feet, instead of 1 foot, for the A3 dimension. Text shifted.</td>
</tr>
<tr>
<td>440-5</td>
<td>4-58</td>
<td>Change</td>
<td>Design Info., SWISS. Added “(SWISS)” to the Section title; revised the Office name in paragraph one to Roadway; added a new second paragraph; and revised “OTE” to “ORE” in the last paragraph.</td>
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<tr>
<td>440-7</td>
<td>4-59</td>
<td>Change</td>
<td>Design Info., Stage 2 and 3 Plan Submittals. Revised item j to “Signal phasing diagram, method of addressing yellow trap (where applicable) or field hook-up chart...”</td>
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<td>Chapter or Section</td>
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<td>442-48</td>
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<td>443</td>
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<td>4-91</td>
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<td>4-90</td>
<td>4-92</td>
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<td>450-3</td>
<td>4-91</td>
<td>4-93</td>
<td>Change</td>
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<td>4-92 – 4-94</td>
<td>4-94 – 4-96</td>
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<td>4-95</td>
<td>4-97</td>
<td>Change</td>
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<td>4-96 – 4-102</td>
<td>4-98 – 4-104</td>
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<th>Section Title and Revision Description</th>
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<tr>
<td>Part 5, Low-Volume Roads</td>
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<td>Part 6, Temporary Traffic Control</td>
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<tr>
<td>642-41</td>
<td>6-161</td>
<td>6-161</td>
<td>Change</td>
<td>Plan Notes, Item 614, PCMS, As Per Plan. In the Designer Note, in paragraph two on page 161, revised “three” to “two” in the third line, and revised “ft” to “feet” in two places.</td>
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<tr>
<td>6-162</td>
<td>6-162</td>
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<td>6-181</td>
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<td>670-6</td>
<td>6-182</td>
<td>6-182</td>
<td>Change</td>
<td>Other Considerations, Rest Areas. In Subsection 670-6.2, Rest Area Closures, revised “MT-98.19” in the fourth paragraph to “MT-98.29” and deleted “, as per CMS 614.03” at the end of the sentence.</td>
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<tr>
<td>Part 7, School Area Traffic Control</td>
<td>[top of page]</td>
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<td></td>
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<td>Part 8, Rail Grade Crossings</td>
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<tr>
<td>Part 9, Bicycles</td>
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<td>9-1 – 9-2</td>
<td>9-1 – 9-2</td>
<td>Editorial</td>
<td>Table of Contents. Corrected to show Sections 902-1 and 902-2.</td>
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<tr>
<td>902-2</td>
<td>9-5</td>
<td>9-5</td>
<td>Change</td>
<td>Markings, Bike Box. Revisied “the City of Columbus” to “Columbus and Canton.” Deleted the third paragraph, regarding PIS 20700</td>
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<td>9-6</td>
<td>9-6</td>
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<tr>
<td>Part 11, Highway Lighting</td>
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<tr>
<td>1103-6</td>
<td>11-15 – 11-18</td>
<td>11-15 – 11-18</td>
<td>Change</td>
<td>Warrants and Guidelines, Special Locations. Minor fix of formatting at bottom of page 15, which moved some text. In Subsection 1103-6.9, Underpasses, revised “the Illuminating Engineering Society’s Recommended Practice (RP-222)” to “the latest version of Illuminating Engineering Society’s Recommended Practice (RP-22).” Text shifted on pages 17 and 18, and they were reprinted as part of the revision set.</td>
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<tr>
<td>1120-5</td>
<td>11-27 – 11-18</td>
<td>11-27 – 11-18</td>
<td>Editorial</td>
<td>Materials and Hardware, Local Preferences. In the third paragraph, third line, revised “alternate of proprietary” to “alternate or proprietary.”</td>
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<td>11-28</td>
<td>11-28</td>
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<tr>
<td>Part 14, Miscellaneous</td>
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<tr>
<td>Part 15, Appendix (new)</td>
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</table>
Revisions of this Manual are published on a quarterly basis, as needed. They are published only on-line, at the Office of Roadway Engineering (ORE) and DRRC websites noted below.

Ohio Department of Transportation
Office of Roadway Engineering
1980 W. Broad St., P.O. Box 899
Columbus, OH 43216-0899

Web addresses:
ODOT: http://www.dot.state.oh.us
Office of Roadway Engineering (ORE):
http://www.dot.state.oh.us/divisions/Engineering/Roadway
Office of Traffic Engineering (OTE):
http://www.dot.state.oh.us/divisions/Operations/traffic/

ODOT Publications (Design Reference Resource Center (DRRC)):
http://www.dot.state.oh.us/drrc

An Equal Opportunity Employer
PREFACE

The Traffic Engineering Manual (TEM) has been developed to assure uniformity in application of ODOT traffic engineering policies, guidelines, standards and practices. The OMUTCD establishes the basic, minimum traffic control standards for all public highways in Ohio, and all supplemental ODOT traffic engineering design, construction and operations related information is either contained in the TEM or referenced from it.

This Manual contains standards, policies, etc. established for use in ODOT work; however, various situations will present themselves where engineering knowledge, experience and judgment will have to be used to determine how to apply the information included herein to specific situations. Comments, questions and proposed revisions should be submitted to the Office of Roadway Engineering, Design Standards Section, Ohio Department of Transportation at the address noted on page ii.
Ohio Department of Transportation
MISSION STATEMENT

To provide easy conveyance of people and goods from place to place, we will:

• Take care of what we have
• Make our system work better
• Improve safety
• Enhance capacity
PUBLICATION RECORD


2003 January 17, 2003

Revision consists of the following (as well as related pages needed for double-sided printing of the revised pages):

- a new Cover Sheet, Publication Record, and Table of Contents;
- in Part 1, a revised Table 197-1;
- in Part 2, a revised Section 208-3, and editorial changes in Section 205-2.3.1;
- in Part 3, a revised Table of Content, revised Sections 304-2, 342-2, 342-3, 342-4, 342-5 and 343, and editorial changes in Sections 301-1, 301-3, 302-1, 304-1, 304-3, 304-6, 306, 307, 320-4, 320-5, 340-1, 340-2, 340-3 and 350-2;
- in Part 7, a revised Table of Content, revised Sections 301-4 thru 301-13, respectively; a revised Table of Contents, and revised Sections 301-1, 301-4 thru 301-11, 302-1, 303-1, 303-2, 304-1, 304-3, 304-5, 304-6, 305, 306 and 310, and Figures 398-1, and 398-3 through 398-5; deleted Sections 301-1 thru 301-12; editorial changes in Sections 301-1 thru 301-12; editorial changes in Sections 301-2 and 302-1; and general editorial/formating changes;
- in Part 8, new Sections 401-6 through 401-8, 402-3.5, 403-7, 408-2, 404-5 and 440-6, and Forms 496-8 through 496-18; a revised Table of Contents, and revised Sections 400-1, 401-1, 401-3, 401-4, 402-1, 402-3.1 through 402-3.4, 403-1 through 403-3, 403-5, 403-6.1, 404-1 through 404-3, 405-1, 405-6.1 through 406-3, 407-2, 408-1, 420-4.1 through 420-4.4,
2004 January 16, 2004

Revision consists of the following (as well as related pages needed for double-sided printing of the revised pages):

- a new Cover Sheet and Table of Contents, and an updated Publication Record;
- in Part 3, editorial corrections in Section 398;
- in Part 11, revised Section 1141-3.1;
- in Part 12, a revised Table of Contents, and revised Sections 1210, 1211, 1212-1, 1212-2.2, 1212-2.3, 1213-1, 1213-2, 1213-3, 1214, 1215, 1220-3, 1220-5.1, 1230-2.1 and 1230-6.13; and editorial corrections in Sections 1220-5.7 and 1230-6.9;
- in Part 13, a revised Table of Contents, and revised Sections 1301-2, 1301-3, 1305, 1312 and 1399, and general editorial/formatting changes.

2004 April 16, 2004

Revision consists of the following (as well as related pages needed for double-sided printing of the revised pages):

- a new Cover Sheet and Table of Contents, and an updated Publication Record;
- in Part 1, a new Section 140-7; and revised Tables 197-1 and 197-10;
- in Part 2, a new Section 240-8; a revised Table of Contents and Sections 240-1 and 295-2;
- in Part 3, a new Section 350-3; a revised Table of Contents, revised Sections 301-1, 301-2, 301-14, 302-2 thru 302-4, 304-4, 320-1, 320-5, 340-2 thru 340-4, 342-2, 343 and 397, and revised Table 397-1; deleted Sections 342-3 thru 342-5; and a minor editorial correction in Section 301-10;
- in Part 4, a new Section 440-7; and a revised Table of Contents and Section 440-1;
- in Part 6, new Sections 630-5, 641-23 and 642-46, and Figures 698-5 through 698-9; a revised Table of Contents, revised Sections 606-16, 606-17, 607-10, 607-12, 607-13, 607-15, 630-1, 640-12.1, 640-12.4, 640-23.3.1 and 698; and editorial corrections/changes in Sections 640-2, 642-44 and 642-45

2004 July 16, 2004

Revision consists of the following (as well as related pages needed for double-sided printing of the revised pages):

- a new Cover Sheet and Table of Contents, and an updated Publication Record;

• in Part 11, new Sections 1141-3.7 thru 1141-3.9; a revised Table of Contents and Sections 1140-6.1.1.4, 1140-6.1.2.2, 1141-2, 1141-3.1 thru 1141-3.6 and 1141-4; and an editorial corrections in Section 1142-35.

• in Part 14, a revised listing.

2004 October 22, 2004

Revision consists of the following (as well as related pages needed for double-sided printing of the revised pages):

• a new Cover Sheet and Table of Contents, and an updated Publication Record;

• in Part 1, a revised Table of Contents and Section 103-3.2; and editorial corrections/changes in Sections 100-3.3 and 104-7;

• in Part 4, editorial corrections/changes in Sections 442-20, 442-21 and 442-23; and


2005 January 21, 2005

Revision consists of the following (as well as related pages needed for double-sided printing of the revised pages):

• a revised Preface and an updated Cover Sheet, Revision Record and Table of Contents;


• in Part 2, new Sections 205-6 and 210-3; revised Table of Contents and Sections 205-4, 209-4 and 240-8, and Table 297-7;

• in Part 4, new Forms 496-19 and 496-20, and Table 497-6; a revised Table of Contents, revised Sections 403-5, 403-6, 403-6.1, 403-6.4, 403-7, 440-3, 440-5 thru 440-7, 441-2, 441-3, 441-8, 496 and 497, and revised Forms 496-3 and 496-4; editorial corrections in Form 496-6; and deleted Section 403-6.5; and

• in Part 6, a revised Table of Contents, revised Sections 605-4.3, 605-10.1, 642-21, 642-28, 642-30 thru 642-32 and 642-44; and editorial corrections or changes in Sections 642-33, 642-34, 642-36, 642-37, 642-40 thru 642-43, 642-45 and 642-47; and Tables 697-3 thru 697-5.

2005 April 15, 2005

Revision consists of the following (as well as related pages needed for double-sided printing of the revised pages):

• a new Cover Sheet and Table of Contents, and an updated Publication Record;

• in Part 1, revised Tables 197-2 and 197-3;

• in Part 3, a revised Table of Contents, revised Sections 301-1, 301-7, 301-14.4, 302-2, 302-6, 307-2, 310, 320-1, 320-4, 341-1, 342-2 and 343, and Table 397-2; and minor editorial/format changes;
Revision consists of the following (as well as related pages needed for double-sided printing of the revised pages):

- in Part 4, a revised Table of Contents, Sections 401-6, 401-7, 404-2, 442-20, 442-21, 442-22 and 442-23, Form 496-2, and Table 497-5; deleted Forms 496-12 through 496-18; editorial revisions in Forms 496-8 through 496-20, and 496-19, Table 497-5, and Figure 498-37; and minor editorial/format changes;
- in Part 6, a revised Table of Contents, revised Sections 630-4, 630-5, 640-23.4, 640-23.5, 641-9.6, 641-23, 642-46 and Form 696-1; and minor editorial/format changes;
- in Part 11, a revised Section 1142-30;
- in Part 12, a revised Section 1220-5.6; and
- in Part 13, added copies of ODOT Policies 16-004(P), 22-007(P), 25-005(P), 122-002(P), 322-002(P), 512-002(P), and Standard Procedures 122-004(SP) and 510-005(SP); revised Sections 1301-2, 1310, 1312, 1314 and 1399; and minor editorial/format changes.

2006 January 20, 2006

Revision consists of the following (as well as related pages needed for double-sided printing of the revised pages):

- a new Cover Sheet and an updated Preface, Publication Record and Table of Contents;

2006 April 21, 2006

Revision consists of the following (as well as related pages needed for double-sided printing of the revised pages):

- a new Cover Sheet and an updated Publication Record and Table of Contents;

2006 July 21, 2006

Revision consists of the following (as well as related pages needed for double-sided printing of the revised pages):

- a new Cover Sheet and an updated Publication Record and Table of Contents;
Traffic Engineering Manual

Revision consists of the following (as well as related pages needed for double-sided printing of the revised pages):

- a new Cover Sheet and an updated Publication Record and Table of Contents; and
- in Part 6, deleted Table 697-6; a revised Table of Contents, Sections 605-8.4, 605-12.2, 605-15.2, 606-10, 606-16, 607-10, 630-5.1, 640-9, 641-5, 641-6.2, 641-6.4, 641-11, 641-18, 641-19, 642-10, 642-42, Tables Index, and Figures 698-6 and 698-8; and editorial revisions in Sections 601-2, 630-4, 630-6, and Table 697-10; and minor editorial/format changes.

2006  September 5, 2006

Revision consists of the following (as well as related pages needed for double-sided printing of the revised pages):

- a new Cover Sheet and an updated Publication Record and Table of Contents;
- in Part 3, revised Form 396-1;
- in Part 4, revised Section 420-4.2;
- in Part 6, a revised Table of Contents and Sections 642-26, 642-50 and 642-51;
- in Part 8, revised Chapter 805; and
- in Part 12, new Sections 1215-1 thru 1215-4 and 1230-7, Form 1296-13, Table 1297-5 and Figures 1298-17 thru 1298-40; a revised Table of Contents, Chapters 1210 and 1211, Sections 1201-1 thru 1201-5, 1202-1, 1202-2, 1212-2, 1213-1, 1213-2, 1220-2, 1220-6, 1230-1 thru 1230-3, 1230-6, 1250-2, Forms Index, 1296-1, 1296-2, 1296-11, 1296-12, Tables Index, Figures Index and Figures 1298-2, 1298-6, 1298-7, 1298-9, 1298-10, 1298-11, 1298-12, 1298-16; and editorial revisions in Chapters 1200, 1214, 1280 and 1295, Sections 1212-1, 1212-4, 1213-3, 1220-1, 1220-3 thru 1220-5, 1250-1; and minor editorial/format changes.

2007  January 19, 2007

Revision consists of the following (as well as related pages needed for double-sided printing of the revised pages):

- a new Cover Sheet and an updated Publication Record and Table of Contents;
- in Part 1, revised Figure 198-1;
- in Part 2, new Sections 202-9, 202-10, 204-5, 204-6, 220-10 and 221-6, Tables 297-12 and 297-13, and Figures 298-38 through 298-44; a revised Table of Contents, Sections 201-1, 201-5, 202-1, 203-6, 205-3, 208-1 and 221-5, Tables Index, Figures Index, Figure 298-6, 298-14, 298-15 and 298-27; editorial corrections in Sections 200-1, 201-5, 201-7, 204-4, 207-5, 207-6, 240-4, 250-4, 250-7 and 260-5, Table 297-4, and Figures 298-26 and 298-28 through 298-32; and minor editorial/format changes;
- in Part 4, new Sections 442-30, 442-31 and 442-32, and Figures 498-39, 498-40, 498-41 and 498-42; a revised Table of Contents and Figures Index; editorial corrections in Sections 407-2 and 450-10, and Figure 498-1; and minor editorial/format changes;
- in Part 5, a new section 620-7; a revised Table of Contents and Sections 605-1, 605-2, 605-11, 605-20, 620-4, 640-18, 642-24, 642-27, 642-33 and 642-34; editorial corrections in Sections 605-4, 605-5, 605-1, 641-17 and 641-19; and minor editorial/format changes; and
- in Part 7, revised Chapter 704.

October 23, 2002  (January 18, 2013)
2007 April 20, 2007

Revision consists of the following (as well as related pages needed for double-sided printing of the revised pages):

- a new Cover Sheet and an updated Publication Record and Table of Contents;
- in Part 1, revised Sections 103-3, 103-4, 104-2 and 104-3, Table Index, and Tables 197-1 through 197-3, and 197-5 through 197-10;
- in Part 2, a revised Table of Contents, Section 207-4, Figures 298-15 and 298-22; and editorial corrections in Figures 298-12, and 298-13;
- in Part 4, new Sections 402-5 and 402-6, and Tables 497-7 and 497-8; a revised Table of Contents, Forms Index, Forms 496-12 and 496-13, and Tables Index; editorial corrections in Sections 402-3, 404-2, 404-3 and 450-8, and Figures 498-6 through 498-8, 498-21, 498-26, and 498-28 through 498-35; and minor editorial/format changes;
- in Part 6, new Sections 641-24 and 642-53, a revised Table of Contents and Sections 602-2, 605-14, 607-12, 607-13, 640-1, 640-12, 641-23, 642-9, 642-21, 642-22, 642-30, 642-31, 642-44 and 642-48; editorial corrections in Sections 640-2, 641-6, 641-7, 641-19, 642-10, 642-11, 642-16 and 642-42; and minor editorial/format changes;
- in Part 11, revised Section 1140-5; and
- in Part 12, a revised Table of Contents and Section 1220-3.

2007 July 20, 2007

Revision consists of the following (as well as related pages needed for double-sided printing of the revised pages):

- a new Cover Sheet and an updated Publication Record and Table of Contents;
- in Part 1, new Sections 120-7, 150-3, 195-3 through 195-7 and Figures 195-3 through 195-6; revised Table of Contents, Chapters 106, 160, 180 and 195, Sections 100-1, 100-4, 101-2, 101-5, 102-1 through 102-3, 120-1 through 120-6, 130-2, 140-7, 195-8 and 195-19, Forms 196-1 and 196-3, Tables 197-2, 197-3, 197-9 and 197-10, and Figures Index; editorial corrections in Sections 193-7, 193-10, 193-15 and 193-16; and minor editorial/format changes;
- in Part 2, a revised Table of Contents and Sections 220-2, 220-3, 240-4, 260-4 and 295-2;
- in Part 3, revised Sections 320-2 and 320-3;
- in Part 4, new Sections 401-9 and 440-8; a revised Table of Contents and Sections 401-2, 404-3, 420-2, 420-3 and 420-4;
- in Part 6, new Sections 608, Section 695-7, Forms 696-2 through 696-9, and Figure 698-10; a revised Table of Contents, Sections 600-4, 600-6, 601-2, 602-3, 602-5, 605-3, 605-14, 605-17, 605-19, 606-14, 606-20, 630-4, 630-5, 640-12 through 640-14, 640-18, 641-2, 641-24, 642-35, 642-51, 642-52, 695-6, Forms Index, Form 696-1 and Figures Index; editorial corrections in Sections 607-13, 620-7, 630-1, 630-6, 640-23, 640-26, 641-6 and Figure 698-1; and minor editorial/format changes;
- in Part 8, revised Chapter 805;
- in Part 11, a revised Table of Contents and Sections 1120-3 through 1120-5;
- in Part 12, new Chapters 1203, 1204 and 1205, a revised Table of Contents, Chapters 1200, 1201, 1202, 1210, 1211, 1212, 1213, 1220, 1250, 1280, Forms Index, Form 1296-1, Tables Index, Figures Index, and Figures 1298-1, 1298-3 through 1298-5, 1298-21 and 1298-24; deleted Chapters 1213 through 1215, and 1230; editorial corrections in Form 1296-2 and Figures 1298-21 and 1298-24; and minor editorial/format changes;
- in Part 13, new title, Table of Contents and Chapters replaced existing text, which was relocated Part 15;
- in Part 14, new title, Table of Contents, Chapters 1400, 1401, 1402, 1415, 1420, 1430, 1450, 1480, 1495, Forms Index, and Form 1496-1; and deleted the index; and
- added Part 15.

2007 October 19, 2007

Revision consists of the following (as well as related pages needed for double-sided printing of the revised pages):

- a new Cover Sheet and an updated Publication Record and Table of Contents;
- in Part 1, revised Table of Contents, Section 120-4, and Tables 197-1 and 197-2; an editorial correction in Sections 101-2; and minor editorial/format changes;
- in Part 2, revised Figures 298-10 and 298-29 through 298-32; editorial corrections in Section 240-4 and Figures 298-8, 298-9, 298-11 and 298-26; and minor editorial/format changes;
- in Part 3, an editorial correction in Table 397-1;
- in Part 4, a revised Table of Contents and Section 406-3; deletion of Section 402-6; and an editorial correction in Section 401-9;
- in Part 6, revised Table of Contents and Sections 641-12, 641-13, 641-14, 641-15, 642-30, 642-39 and 642-41;
- in Part 11, a revised Table of Contents; and editorial corrections to Chapters 1103 and 1120, and Section 1150-3;
- in Part 13, a revised Section 1301-3, Forms Index, and Form 1396-1.

2008 January 18, 2008

Revision consists of the following (as well as related pages needed for double-sided printing of the revised pages):

- a new Cover Sheet and an updated Publication Record and Table of Contents;
- in Part 4, new Section 460-10 and Table 497-9; a revised Table of Contents, Sections 440-4, 442-13, 442-17, 442-24, and Tables Index; and minor editorial/format changes;
• in Part 6, new Form 696-6; renumbered Forms 696-1 through 696-9 (now Forms 696-1a, 696-1b, 696-2a, 696-2b, 696-3a, 696-3b, 696-4a, 696-4b and 696-5); a revised Table of Contents, Sections 605-2, 605-9, 605-13, 605-14, 605-18, 606-6, 606-16, 630-5, 640-2, 640-12, 640-19, 641-9, 641-10, 642-18, 642-39, 642-44 and 695-7, and Forms Index; editorial corrections in Sections 606-1, 640-11, 641-1, 641-12 through 641-15, and Figure 698-3a; and minor editorial/format changes; and
• in Part 13, revised Sections 1301-1 and 1301-2, Forms 1396-1 and 1396-2, and Table 1397-1.

2008    April 18, 2008

Revision consists of the following (as well as related pages needed for double-sided printing of the revised pages):
• a new Cover Sheet and an updated Publication Record and Table of Contents;
• in Part 1, revised Tables 197-2 and 197-9; ;
• in Part 2, revised Table of Contents and Sections 240-4 through 240-6; and minor editorial/format changes;
• in Part 3, revised Table of Contents, Sections 342-3, 350-7 and 350-8; and minor editorial/format changes;
• in Part 4, new Section 401-10; a revised Table of Contents, Chapter 443, Sections 403-6, 403-7, 440-2, 440-6, 441-6, 441-9, 442-1, 442-3, 442-6, 442-11, 442-17 through 442-19, 442-24, 450-3, 450-8, 450-10, 450-11, 460-4, 460-7, 460-8, Forms Index, Forms 496-14, 496-15, 496-19, Tables 497-1, 497-4, and Figures 498-10, 498-22, 498-25, 498-34 and 498-37; editorial corrections in Section 442-32, the Figures Index and Figure 498-37; and minor editorial/format changes;
• in Part 6, new Section/Plan Note 642-54; a revised Table of Contents, Sections 605-9, 605-11, 605-13, 620-6, 640-2, 641-10, 642-39; and minor editorial/format changes; and;
• in Part 7, new Chapter 742 with new Sections 742-1 and 742-2; a revised Table of Contents, and Section 702-4; and minor editorial/format changes;
• in Part 11, editorial correction in Section 1142-25; and minor editorial/format changes;
• in Part 13, deleted Form 1396-2; revised Table of Contents, Section 1301-1, Forms Index and Figures Index; and minor editorial/format changes.

2008    July 18, 2008

Revision consists of the following (as well as related pages needed for double-sided printing of the revised pages):
• a new Cover Sheet and an updated Publication Record and Table of Contents;
• in Part 2, new Section 206-17 and Table 297-14; a revised Table of Contents and Sections 201-6, 240-4, 260-5, the Table Index and Figure 298-18; and minor editorial/format changes;
• in Part 3, revised Table of Contents; deleted Sections 341-6, 342-4 and 342-5;
• in Part 4, new Section 440-5; a revised Table of Contents and Section 440-3;
• in Part 6, new Section 604-21, a revised Table of Contents, Sections 605-11, 605-18, 605-20, 607-15, 640-2, 642-24, 642-39, 642-41 and 642-50; and minor editorial/format changes;
• in Part 7, revised Table of Contents and Section 702-4; and minor editorial/format changes; and
• in Part 12, new Forms 1296-14 through 1296-16, and Table 1297-6; revised Table of Contents, Chapters 1201 and 1202, Sections 1203-1 through 1203-5, the Forms Index, Forms 1296-1, 1296-3, 1296-4, 1296-11, the Tables Index, the Figures Index, Figures 1298-3 through 1298-5; and minor editorial/format changes.

2008    October 17, 2008

Revision consists of the following (as well as related pages needed for double-sided printing of the revised pages):
• a new Cover Sheet and an updated Publication Record and Table of Contents;
• in Part 2, new Section 201-14; a revised Table of Contents and Section 210-3;
• in Part 3, new Table 397-5; revised Table of Contents, Section 350-2 and Tables 397-1, 397-3 and 397-4; deleted Figure 398-6; editorial changes in Sections 301-13, 302-2, 303-3, 307-2, 320-4, 350-6, 350-7, 350-8, the Tables Index and the Figures Index; and minor editorial changes;
• in Part 4, a revised Table of Contents, Chapter 430, and Sections 401-3, 442-26, 442-28, 460-2 and 460-2; editorial changes in Sections 401-10 and 403-3; and minor editorial changes;
• in Part 6, a revised Table of Contents, Sections 605-13, 605-20, 620-6, 640-18, 640-23, 641-23, 642-24, 642-25, 642-48 and 642-50; editorial changes in Sections 602-6, 605-2, 605-9, 605-10, 605-11, 605-19, 608-2, 620-3, 620-7, 641-9, 641-10, 641-24, 642-21, 642-27, 642-41, 642-54 and 670-6; and minor editorial/format changes;
• in Part 7, revised Table of Contents; and an editorial change in Section 702-2; 
• in Part 11, revised Figure 1198-12;
• in Part 12, new Section 1213-6; revised Table of Contents, Chapter 1210, Section 1213-1 and Forms 1296-1 and 1296-14; editorial changes in Section 1212-10; and minor editorial/format changes; and
• in Part 13, new Figures 1398-2 and 1398-3; revised Table of Contents, Sections 1301-1, 1301-2, 1301-3, Form 1396-1 and Table 1397-3; and editorial changes in the Forms Index and the Figures.

2009    January 16, 2009

Revision consists of the following (as well as related pages needed for double-sided printing of the revised pages):
• a new Cover Sheet and an updated Publication Record and Table of Contents;
• in Part 2, a revised Table of Contents and Sections 201-3 and 240-5; and minor editorial/format changes;
• in Part 3, new Section 342-4; and a revised Table of Contents;

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• in Part 4, new Sections 442-33 through 442-39; a revised Table of Contents, Sections 403-5, 440-4 and 450-8; Tables Index, Tables 497-4 and 497-5; Figures Index and Figures 498-3 through 498-5, 498-12, 498-35 and 498-37; editorial change for Section 401-10; and minor editorial changes;

• in Part 6, new Section 641-19 and renumbered existing Sections 641-19 through 641-24, a revised Table of Contents, Sections 603-2, 605-5, 605-11, 605-13, 640-6, 640-22, 640-24, 640-25, 641-9, 641-10, new 641-21 (formerly 641-20), new 641-22 (formerly 641-21), 642-4, 642-6, 642-14, 642-15, 642-35, 642-38 and 642-39; editorial change in Section 642-41; and minor editorial/format changes;

• in Part 11, revised Figure 1198-12; and

• in Part 13, new Section 1301-4 and Form 1396-2; deleted Figure 1398-1 and renumbered Figures 1398-2 and 1398-3; revised Table of Contents; Sections 1301-1 through 1301-3, Forms Index, Form 1396-1, Tables Index, Table 1397-1, and the Figures Index; editorial corrections in Table 1397-3; and minor editorial/format changes.

2009 March 6, 2009

Revision consists of the following (as well as related pages needed for double-sided printing of the revised pages):

• a new Cover Sheet and an updated Publication Record and Table of Contents; and

• in Part 2, a revised Section 240-4.

2009 April 17, 2009

Revision consists of the following (as well as related pages needed for double-sided printing of the revised pages):

• a new Cover Sheet and an updated Publication Record and Table of Contents; and

• in Part 2, new Tables 297-15, 297-16, 297-17 and 297-18; a revised Table of Contents, Sections 206-8, 206-13, 207-2, 207-3, 240-4, the Table Index, and Figures 298-5a and 298-5b; editorial change in Section 207-4; and minor editorial/format changes;

• in Part 3, new Sections 301-15 and 341-6; and a revised Table of Contents and Sections 301-10, 302-1 and 341-4; and editorial changes in Chapters 350, 360, 370, 380, 395 and Table 397-2;

• in Part 4, a revised Table of Contents, Chapters 443, Sections 401-7, 403-2, 440-3, 440-6, 442-7, 442-8, 442-13, 442-17, 442-18, 442-25 and 442-32; and Figure 498-5; editorial changes for Sections 442-20 and 442-22; and minor editorial changes;


• in Part 9, new Sections 940-1 and 940-2, and a new Chapter 942, with new Sections 942-1 and 942-2; a revised Table of Contents and Chapter 940;

• in Part 12, a new Section 1213-7; a revised Table of Contents, Chapter 1210, Sections 1203-2, 1203-3, 1213-1, the Forms Index, Form 1296-2 and Form 1296-14; editorial changes in Sections 1203-1 and Form 1296-1; and minor editorial/format changes;

• in Part 13, a revised Table of Contents, Sections 1301-1, 1301-2, 1301-3 and 1301-4; and Form 1396-1; and minor editorial/format changes; and

• in Part 15, a revised Table of Contents, Chapter 1505, and Section 1501-3; and minor editorial/format changes.

2009 July 17, 2009

Revision consists of the following (as well as related pages needed for double-sided printing of the revised pages):

• a new Cover Sheet and an updated Publication Record and Table of Contents;

• in Part 1, new Section 195-8, a revised Table of Contents, Chapter 106, Sections 100-1, 100-4, 100-5, 101-4, 101-5, 102-1, 102-3 through 102-5, 103-1, 103-3 through 103-5, 104-1 through 104-4, 105-1, 120-3, 120-4, 130-3 through 130-4, 140-7, 193-7, 193-11, 194-1, 194-17, 194-18, 195-3 through 195-6, Forms Index, Forms 196-1 and 196-3, Tables Index, Tables 197-1 through 197-3, Tables 197-9 and 197-10, and Figure 198-2; editorial changes in Section 140-2 and Figure 198-6; and minor editorial/format changes;

• in Part 2, new Sections 202-11 and 242-6; a revised Table of Contents, Sections 201-3, 201-6, 201-8, 201-11, and Section 295-2; editorial changes in Sections 202-6 and 206-11; and minor editorial/format changes;

• in Part 3, revised Chapter 343, Sections 302-5, 304-3, 320-1, 320-5, and Form 396-1; editorial changes in Sections 301-3, 301-7, 301-10, 301-14, 350-7 and Table 397-1; and minor editorial changes;

• in Part 4, new Section 403-8; a revised Table of Contents, Chapter 443; Sections 402-2, 402-3, 408-2, 420-1, 421-1, 421-2, 440-3, 440-8, 441-7, 442-27, 442-29, 450-1, 460-7, 460-9, and the Forms Index; editorial changes in Sections 440-4, 442-5, 442-22, 442-32 and 442-33; and minor editorial changes;


• in Part 13, revised Sections 1301-3 and 1301-4, the Forms Index, and the Tables Index; editorial change in Section 1301-1; and minor editorial/format changes.

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2009  October 16, 2009

Revision consists of the following (as well as related pages needed for double-sided printing of the revised pages):

- a new Cover Sheet and an updated Publication Record and Table of Contents;
- in Part 1, new Section 140-8, a revised Table of Contents; revised Sections 120-4 and 193-19, and Table 197-2; and minor editorial/format changes;
- in Part 3, a revised Section 342-2;
- in Part 4, a revised Table of Contents, Sections 420-5, 440-7, 450-10, 450-11, Forms 496-4 and 496-6, the Figures Index, and Figures 498-3 through 498-5, 498-23, 498-27, 498-29, 498-30 and 498-33; an editorial correction in Sections 420-4; and minor editorial changes;
- in Part 11, a revised Table of Contents; revised Sections 1140-4, 1142-24 and 1142-26, and Figure 1198-12; editorial corrections in Sections 1140-6, 1140-8, 1142-25; and minor editorial/format changes.

2010  January 15, 2010

Revision consists of the following (as well as related pages needed for double-sided printing of the revised pages):

- a new Cover Sheet and an updated Publication Record and Table of Contents;
- in Part 1, revised Section 101-5, Forms 196-3 and 196-4, and Table 197-2;
- in Part 2, new Sections 202-12, 202-13 and 260-7, a revised Table of Contents and Sections 201-8 and 240-2;
- in Part 3, new Section 301-16, and a revised Table of Contents, Section 301-14 and Table 397-2;
- in Part 4, a revised Table of Contents and Section 440-3; and minor editorial changes.

2010  April 16, 2010

Revision consists of the following (as well as related pages needed for double-sided printing of the revised pages):

- a new Cover Sheet and an updated Publication Record and Table of Contents;
- in Part 1, new Sections 130-7 and 140-9; a revised Table of Contents and Sections 140-8, 195-2, and Tables 197-2 and 197-9; and an editorial correction in Section 130-6;
- in Part 4, new Sections 403-9, 403-10, 442-40, 442-41 and 442-42; a revised Table of Contents and Sections 402-3, 403-3, 403-6 and 420-5; and minor editorial/format changes;
- in Part 8, new Sections 804-1 through 804-4, 830-3, 830-4, 840-1 through 840-4, 895-5, a new Forms Index and Form 896-1, and a new Figures Index and Figure 898-1; a revised Table of Contents, Chapters 804 and 840, Section 830-1; and minor editorial/format changes; and
- in Part 10, a revised Chapter 1000.

2010  May 14, 2010

Revision consists of the following (as well as related pages needed for double-sided printing of the revised pages):

- a new Cover Sheet and an updated Publication Record and Table of Contents;
- in Part 6, new Section 660-4 and new Figures 698-13 and 698-14; a revised Table of Contents and Section 660-1, and a revised Figures Index; editorial corrections in Sections 601-2, 608-4, 608-6, 608-8, 630-4, 630-5, 640-1, 640-13, 640-14, and Figure 698-1; and minor editorial/format changes.

2010  July 16, 2010

Revision consists of the following (as well as related pages needed for double-sided printing of the revised pages):

- a new Cover Sheet and an updated Publication Record and Table of Contents;
- in Part 2, a revised Table of Contents and Sections 202-4, 202-12, 202-13 and 205-3, Tables 297-1, 297-4, 297-12, 297-13 and 297-17, and Figures 298-20, 298-22 and 298-28; editorial corrections in the Figures Index and Figure 298-10; and minor editorial/format changes;
- in Part 3, a revised Table of Contents and Sections 301-1, 301-8 and 301-15; and an editorial correction in Section 301-16;
- in Part 4, a revised Table of Contents and Sections 440-3, 442-25, 442-26, 442-27, 442-28, 442-29, 442-31, 442-40, 442-41 and 450-8;
- in Part 6, a revised Table of Contents and Sections 605-6, 605-8, 642-41, 642-44 and 670-4, Table 697-1b, and Figure 698-3b;
- in Part 7, a revised Section 742-2; and
- in Part 9, new Chapters 901 and 902; a revised Table of Contents and Chapter 900, and Sections 940-1 and 940-2.

2010  October 15, 2010

Revision consists of the following (as well as related pages needed for double-sided printing of the revised pages):

- a new Cover Sheet and an updated Publication Record and Table of Contents;
- in Part 1, a revised Table of Contents and Sections 140-7 and 195-8, and Table 197-9;
in Part 2, a revised Table of Contents and Sections 209-2, 211-1 through 211-4 and 240-8; editorial corrections in Tables 297-16 and 297-17; and minor editorial/format changes;

• in Part 3, revised Chapter 343, Sections 302-1, 304-1, 304-3, 307-1, 320-5, 341-2, 350-3, 350-6 and 350-8; and minor editorial changes;

• in Part 4, a revised Figure 498-21;

• in Part 6, a revised Table of Contents and Sections 602-8, 605-11, 606-16, 607-10, 640-12, 641-9, 641-21, 641-25 and 695-4; an editorial correction in Section 640-18; and minor editorial changes; and

• in Part 9, a revised Table of Contents and Chapter 930 (replacing the existing text with new Sections 930-1 and 930-2).

Revision consists of the following (as well as related pages needed for double-sided printing of the revised pages):

• a new Cover Sheet and an updated Publication Record and Table of Contents;

• in Part 2, a revised Table of Contents and Sections 212-1 through 212-3, 240-4 , 240-7, 250-4, 250-7 and 250-8; and minor editorial/format changes;

• in Part 3, revised Table of Contents and Section 301-9, the Figures Index, and Figure 398-1;

• in Part 4, a revised Table of Contents and Sections 403-6, 420-4, 440-2, 440-5, 440-7, 442-27, 442-29, Tables 497-1 and 497-6; and an editorial change in Figure 498-38;

• in Part 6, a revised Table of Contents and Sections 605-19, 605-20, 607-10, 642-50 and 642-51 and Figures 698-3a and 698-3b;

• in Part 8, a revised Section 804-4; and

• in Part 11, a revised Table of Contents and Chapter 1142, deleting fourteen Plan Notes, while renumbering and revising the others.

Revision consists of the following (as well as related pages needed for double-sided printing of the revised pages):

• a new Cover Sheet and an updated Publication Record and Table of Contents;

• in Part 1, revised Forms 196-3, 196-4 and 197-9, and Figure 198-1;

• in Part 2, revised Sections 241-6;

• in Part 4, a revised Sections 440-5, 441-7, 441-10, 442-10, 460-2 and 460-3; editorial changes in Sections 440-3, 440-8, 441-3, 441-5, 441-6, 442-12 and 442-14; and other minor editorial/format changes;


• in Part 8, a revised Section 804-4.

• in Part 12, new Forms 1296-6b, 1297-7b, 1296-17, 1296-18 and 1296-19; a revised Table of Contents, Chapter 1250, Sections 1203-1, 1203-2, 1203-3, 1203-4, 1203-5, 1204-5, 1204-7, the Forms Index, Forms 1296-6a, 1296-7a and 1296-16, the Tables Index, Table1297-7, the Figures Index and Figure 1298-1; and editorial changes in Forms 1296-2, 1296-4, 1296-11 and 1296-12; and other minor editorial/format changes; and

• in Part 14, a revised Table of Contents, the Chapter 1415 title and Sections 1401-1, 1401-2, 1401-3, 1401-6, 1402-1, 1415-1, 1415-2, 1415-3; editorial changes in Sections 1401-4 and 1401-5, the Form Index, and Form 1496-1; and other minor editorial/format changes.

Revision consists of the following (as well as related pages needed for double-sided printing of the revised pages):

• a new Cover Sheet and an updated Publication Record and Table of Contents;

• in Part 2, a revised Table of Contents and Section 206-5;

• in Part 4, an editorial change in Section 460-8; and

• in Part 11, a revised Table of Contents, Section 1140-4, the Figure Index, and Figure 1198-6; and other minor editorial/format changes.

Revision consists of the following (as well as related pages needed for double-sided printing of the revised pages):

• a new Cover Sheet and an updated Publication Record and Table of Contents;

• in Part 3, revised Sections 301-5 and 350-4; and other minor editorial changes;

• in Part 4, revised Sections 420-4 and 450-8; and other minor editorial changes;

• in Part 5, revised Sections 642-37 and 642-41; and a minor editorial correction; and

• in Part 11 a revised Table of Contents; revised Section 1120-5; deleted Section 1142-15; and other minor editorial changes.
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2012

January 20, 2012

Revision consists of the following (as well as related pages needed for double-sided printing of the revised pages):
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2012

a new Cover Sheet and an updated Publication Record and Table of Contents;
in Part 1, revised Forms 196-3 and 193-4, and Table 197-3; and made editorial corrections in Sections 100-1 100-4, 101-4,
101-5, 102-4, 102-5, 103-1, 103-4, 103-5, 104-1 104-3, 104-4, 105-1, 106, 195-3, 195-5, 195-6, 195-8, 196-1, 196-2, 196-3,
and 196-4;
in Part 3, revised Chapters 305, 306, and 310, Sections 300-1, 301-1, 301-4, 301-5, 301-6, 301-7, 301-8, 301-9, 301-10, 30111, 301-12, 301-14, 303-1, 303-2, 304-1, 304-3, 304-5, 304-6, 341-2, 342-2, 342-4, 350-3, 350-5, 350-6, 350-7, 350-8, Table
397-2, and Figures 398-2, and 398-3;
in Part 4, a revised Table of Contents; Sections 400-1, 401-7, 403-2, 403-6, 403-10, 404-3, 405-1, 406-1, 406-3, 407-2, 408-1,
408-2, 420-4, 420-5, 421-1, 441-3, 450-10, Table 497-3; and deleted Section 403-7;
in Part 5, revised Chapter 500;
in Part 6, revised Sections 602-5, 602-6, 604-5, 604-6, 604-7, 605-3, 605-5, 605-6, 605-7, 605-9, 605-10. 605-11, 605-12,
in Part 8, a new Part Title; a revised Table of Contents, Chapters 800, 803 and Sections 802-1, 804-1, 804-2, 804-3, 830-3,
840-2, 840-3, and 840-4;
in Part 9, revised Chapter 900;
in Part 10, contents have been incorporated into Part 8; Part 10 now reserved for future use; and
in Part 11, a revised Table of Contents, and Section 1141-4.
April 20, 2012

Revision consists of the following (as well as related pages needed for double-sided printing of the revised pages):
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a new Cover Sheet and an updated Publication Record and Table of Contents;
in Part 1, a revised Table of Contents; revised Sections 101-2, 101-3, 101-4, 102-2, 102-3, 102-5, 103-2, 103-3, 103-5, 120-4,
120-6, 120-7, 130-6, 140-7, 193-7, 193-15, 193-19, 194-6, 194-10, 194-14, 195-3, and 195-4; revised Tables 197-1, 197-2,
197-9, 197-10; and revised Figures 198-1, 198-5 and 198-6.
in Part 2, a revised Table of Contents; new Sections 202-14 and 242-7; revised Sections 200-1, 201-1, 201-2, 201-3, 201-5,
220-6, 220-7, 220-10, 221-1, 221-2, 221-3, 221-4, 221-5, 221-6, 240-2, 240-3, 240-4, 240-5, 240-6, 240-7, 240-8, 241-5, 2423, 242-4, 242-5, 242-6, 250-3, 250-4, 250-5, 250-6. 250-7, 260-2, 260-4, 260-5, 295-2; deleted Section 210-2; revised Tables
297-1, 297-2, 297-8f, 297-9, 297-10, 297-12; and deleted Table 297-13; revised Figures Index, revised Figures, 298-4a, 2984b, 298-5a, 298-5b, 298-7, 298-9, 298-11, 298-12, 298-13, 298-15, 298-18, 298-29, 298-30, 298-31, 298-32, 298-42; and
deleted Figure 298-10
in Part 3, a revised Table of Contents, new Section 342-5; revised Sections 301-4, 301-9, 301-10, 301-13, 301-14, 302-6. 3044, 304-5, 304-6, 340-2, 341-2, 342-2, and 350-8; revised Chapter 305, deleted Chapter 303; and other minor editorial/format
changes.
in Part 4, a revised Table of Contents, new Sections 442-43 and 442-44; revised Sections 401-7, 402-2, 402-3, 403-2, 404-2,
442-40, 442-41, 450-3, 450-6., 450-8, 450-10, 460-3; revised Forms 496-2 and 496-5; revised Table 497-3, revised Figures
Index, and revised Figures 498-1, 498-3, 498-4, and 498-5; and other minor editorial/format changes.
in Part, 6, a revised Table of Contents, revised Chapter 643; revised Sections 602-4, 602-8, 605-10, 606-7, 607-1, 607-15,
620-7, 640-21, 640-26, 640-28, 641-5, 641-6, 641-9, 641-17, 642-41, 650-2, 660-2, and 660-3; and revised Figures 698-13 and
698-14.
in Part 11, a revised Table of Contents; and deleted Section 1142-4.
July 20, 2012

Revision consists of the following (as well as related pages needed for double-sided printing of the revised pages):
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a new Cover Sheet and an updated Publication Record and Table of Contents;
in Part 1, a revised Table of Contents; revised Chapter 106; revised Sections 100-1, 100-4, 100-5, 100-6, 101-4, 102-4, 102-5,
103-1, 103-3, 103-4, 105-1, 105-2, 120-5, 193-1, 193-3, 194-1, 194-22, 195-1, and 195-2; revised Form 196-3; revised Tables
Index; deleted Tables 197-1 and 197-2 (with subsequent Tables renumbered).
in Part 2, a revised Table of Contents; new Section 241-8; revised Sections 202-14, 240-4; and Revised Figures 298-5b, 2986a, 298-6b, 298-6c, 298-6d, 298-7, 298-8, 298-9, 298-22, 298-28, 298-29, 298-30, 298-31, 298-32, 298-33, 298-34, 298-35,
in Part 3, a revised Table of Contents; new Section 341-6; revised Sections 301-8, 301-12, 301-14, 302-6, 304-4, 304-5, 3046, and 307-2, revised Figures Index; deleted Section 341-5; and deleted Figure 398-1 (with subsequent Figures renumbered).
in Part 4, a revised Table of Contents; new Sections 403-7, 442-45, 442-46, and 442-47; revised Sections 440-3, 442-4, 44221, and 442-44; and deleted Section 442-42.

October 23, 2002

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(January 18, 2013)


• in Part, 6, a revised Table of Contents; new Section 642-46; revised Chapters 643, and 695; revised Sections 604-5, 605-14, 605-18, 605-19, 605-20, 608-10, 620-7, 630-5, 640-2, 640-6, 640-19, 640-28, 641-5, 641-6, 641-9, 641-10, 641-13, 641-17, 641-19, 641-20, 641-21, 642-26, 642-35, 642-41, 642-45, 642-50, 660-2, and 660-4; revised Table 697-5; revised Forms Index; revised Figures Index; deleted Form 696-5: and deleted Figures 698-11 and 698-12 (with subsequent Figures renumbered).

• in Part, 7, a revised Table of Contents; new Section 702-8; revised Chapters 701 and 704; revised Sections 702-2, 702-3, 702-4, 702-5, 702-6, 702-7, 705-1, 705-2 and 705-4; revised Forms Index 796; revised Forms 796-2 and 796-3; and an editorial correction in Table 797-1.

• In Part, 11, a revised Table of Contents; and revised Sections 1140-5, 1140-6, 1142-10, 1142-12, 1142-16 and 1142-18.

• in Part, 12, a revised Table of Contents; revised Chapter 1202; revised Sections 1211-1, 1211-4, 1211-10, 1212-1, 1212-8, 1212-10, 1213-6, and 1213-7; revised Forms Index; deleted Form 1296-13; revised Tables Index; deleted Table 1297-5; and an editorial correction in Table 1297-4.

2012 October 19, 2012

Revision consists of the following (as well as related pages needed for double-sided printing of the revised pages):

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• in Part, 2, revised Sections 207-7, 208-6, 220-8 and 242-6; an editorial correction in Section 208-4;

• in Part, 3, revised Section 302-5; and editorial corrections in Sections 301-16 and 341-6;

• in Part, 4, a revised Table of Contents; a new Figure 498-43; revised Chapter 443, Sections 401-8, 403-3, 403-6, 403-8, 403-9, 404-2, 407-2, 420-1, 420-4, 421-1, 421-2 and 450-10, the Forms Index, and the Figures Index; and an editorial correction in Section 440-3;

• in Part, 6, a revised Table of Contents; revised Sections 605-5, 606-6, 641-3, 641-4 and 642-37; and

• in Part, 12, revised Sections 1213-6 and 1213-7.

2013 January 18, 2013

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• in Part, 2, a revised Table of Contents; new Sections 240-9 and 242-8; revised Sections 240-4, 241-7, 242-5 and Table 297-4; and an editorial correction in Section 240-8;

• in Part, 4, a revised Table of Contents; new Sections 405-3, 442-48, 442-49 and 442-50; revised Chapter 443; revised Sections 403-9, 420-1, 420-5, 421-1, 440-3, 440-5, 440-7, 442-44, 450-3, 450-6, 450-8 and 450-10; and miscellaneous minor editorial/format corrections;

• in Part, 6, revised Sections 642-41 and 670-6;

• in Part, 9, a revised Table of Contents; and revised Section 902-2; and

• in Part, 11, a revised Table of Contents; revised Sections 1103-6 and 1140-4; and an editorial correction in Section 1120-5.
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100-1 Uniformity in Traffic Control Standards

100-1.1 General

Uniform traffic control standards throughout the country have long been recognized as necessary to meet the ever increasing demands of modern transportation. Once established, it is very important that standards are kept current. Developments in traffic control devices often lead to changes in the design or application of them. As improvements (or problems/concerns with existing devices) are identified, needed changes should be incorporated into the standards and the revisions disseminated in a way to assure that they are implemented.

100-1.2 National Standards

To meet the need for nationwide uniformity of standards for signs, signals, markings and other devices on or adjacent to streets and highways, the Federal Highway Administration (FHWA) publishes the Manual on Uniform Traffic Control Devices (MUTCD) (see Section 193-10) and periodic revisions. Federal regulations (23 CFR Part 655), as well as Section 4511.09 of the Ohio Revised Code (ORC), require that the Ohio Department of Transportation (ODOT) adopt a State manual of uniform traffic control devices.

The national MUTCD is available on-line at http://mutcd.fhwa.dot.gov/ (also see Table 197-1). Proposed changes to the national standards in the MUTCD are published by FHWA using the Federal Register Docket system.

100-1.3 State Standards

The Ohio Manual of Uniform Traffic Control Devices (OMUTCD) (see Chapter 101) is the State manual adopted by the ODOT Director of Transportation to establish standards for traffic control devices in Ohio in general conformance to the national manual. The OMUTCD standards apply to all public streets and highways regardless of type or the level of governmental agency having jurisdiction, promoting statewide uniformity in the design and application of traffic control devices. The OMUTCD is available on-line at:
http://www.dot.state.oh.us/omutcd

100-1.4 Agency-Specific Standards

Each highway agency is responsible for applying the State standards on the streets and highways under its jurisdiction (see ORC Sections 4511.10 and 4511.11).

For ODOT, the Traffic Engineering Manual (TEM), Traffic Standard Construction Drawings (Traffic SCDs), Traffic Plan Insert Sheets (Traffic PISs) and the Construction and Materials Specifications (CMS) establish traffic control policies, standards, guidelines and specifications which supplement the basic standards established in the OMUTCD. These publications are discussed in detail in Chapters 102, 103, 104 and 105, respectively. See Table 197-7 for a complete list of available publications from the ODOT Office of Traffic Engineering (OTE). As noted on page ii of this manual, the OTE web address is:
100-2 Office of Traffic Engineering’s Role/Responsibility

As required by law (ORC Section 4511.09), the Ohio Department of Transportation (ODOT) is responsible for adopting a manual which establishes traffic control standards that apply to all public streets and highways in Ohio, regardless of facility type or the level of governmental agency having jurisdiction.

The Office of Traffic Engineering (OTE) is responsible for developing and maintaining the Ohio Manual of Uniform Traffic Control Devices (OMUTCD), and any additional ODOT traffic engineering policies, guidelines, standards, etc.

The OTE Standards Section is also responsible for coordinating ODOT’s review of proposed changes to the national MUTCD (see Section 193-10). Comments are solicited from related offices in Central Office and, time permitting, the Districts and others. The OTE Standards Section prepares ODOT’s response.

The procedures for revising the OMUTCD, TEM, SCDs, PISs and the CMS are addressed in Sections 101-5, 102-5, 103-5, 104-4 and 105-3, respectively.

100-3 Jurisdiction

The OMUTCD establishes standards for all public streets and highways in Ohio. Unless noted otherwise, all other OTE policies, guidelines, standards, manuals and handbooks apply only to highways under ODOT’s jurisdiction, but are also recommended for use by local jurisdictions.

When referring to highways under ODOT’s jurisdiction, generally this involves State Routes and U.S. Routes outside municipal limits and Interstate Routes.

Some TEM standards and guidelines are referenced in the OMUTCD as recommended practice or examples. Also, due to publishing constraints, guidelines that ODOT is sometimes required by legislation to develop for use by ODOT and other highway agencies may be contained in this publication, rather than the OMUTCD.

100-4 OTE Contacts

General traffic engineering inquiries should be directed to the Ohio Department of Transportation, Administrator, Office of Traffic Engineering, at the address shown on page ii of this Manual and in Table 197-1.

Comments, questions and proposed revisions of this Manual should be submitted to the Ohio Department of Transportation, Office of Traffic Engineering Standards Section at that same address. Forms for submitting proposed revisions as well as changes of address are included in Chapter 196.

Comments or questions involving a specific area of concern handled by one of the OTE section supervisors or their staff may be referred directly to the appropriate area. For your convenience in addressing questions or concerns related to specific topics, a roster of OTE personnel is available on the ODOT Office of Traffic Engineering website (see Table 197-3) at: http://www.dot.state.oh.us/Divisions/Operations/Traffic/Pages/OTEPersonnel.aspx.

The OTE Procedures Manual (currently being updated) establishes guidelines for both written and e-mail correspondence. In part, the guidelines require that OTE employees obtain the Administrator’s approval (signature or initial) prior to distributing drafts or final versions of proposed policies, manuals, handbooks, specifications, standards or other such documents. This also includes correspondence regarding an interpretation of any of these documents, expressing an opinion regarding the adequacy of any of them, or discussing potential changes. However, this does not apply to informational copies of existing documents that may need to be sent to
someone.

100-5 ODOT Organization

Figure 198-1 presents an overall organization chart for ODOT. The most current update of this information is available from the Ohio Department of Transportation (ODOT) website (see Table 197-1) http://www.dot.state.oh.us. Information is also provided in Table 197-2 and Figure 198-2 about the ODOT Districts, including addresses and phone numbers for contacting each District. Current information on the Districts and contact information for them can also be found on the website at: http://www.dot.state.oh.us/Districts/Pages/default.aspx.

100-6 Other Resource Reference and Contact Information

Table 197-1 provides information to help in locating various resource references and contacting agencies and organizations at the local, State (including ODOT) and national levels. In addition to mailing addresses, when available, telephone and fax numbers and web and e-mail addresses have been provided. Suggestions for additions to this list are welcome.
Intentionally blank.
101-1 Legal Authority

As noted in Section 100-1.3, the Ohio Manual of Uniform Traffic Control Devices (OMUTCD) is the State manual adopted by the ODOT Director of Transportation to establish standards for traffic control devices in Ohio in general conformance to the national manual (see Section 193-10). This is also addressed in the OMUTCD Introduction and in Section 1A.07.

As noted in Section 100-1.4, ORC Sections 4511.10 and 4511.11 make ODOT and local authorities within their respective jurisdictions responsible for placing and maintaining traffic control devices that conform to this manual. The OMUTCD and subsequent revisions apply to all traffic control devices erected in Ohio after the date of their adoption.

101-2 Organization

The organization of the OMUTCD is very similar to that of the national manual and most of the text is the same. Currently, the OMUTCD is organized as follows:

► Part 1 provides general information about the purpose of, and requirements for, traffic control devices, the legal authority of the manual, definitions and procedural information.

► Part 2 provides information about signs, and includes barricades, gates, and object markers.

► Part 3 provides information about Markings, i.e., Pavement and Curb Markings, Delineators, Colored Pavements, and Channelizing Devices. Information about traffic control islands is also located in Part 3.

► Part 4 provides information about highway traffic signals.

► Part 5 provides information about low-volume roads.

► Part 6 provides information about temporary traffic control, including traffic incident management.

► Part 7 provides information about traffic controls for school areas.

► Part 8 provides information about traffic controls for highway-rail grade crossings and light rail transit grade crossings.

► Part 9 provides information about traffic controls for bicycle facilities.

► Appendix A provides information about federal legislation related to the national MUTCD.

► Appendix B provides a cross-reference to various related ORC sections, and provides reprints of some of the most often referenced sections.

► Appendix C provides a visual quick reference of sign cuts for signs addressed in the manual, with cross-referencing to related sections in the manual.
101-3  Format

101-3.1  General

For the convenience of those who may not be familiar with the OMUTCD (and as a record and reminder for those developing text for it), various format conventions used in that manual have been consolidated in this Section.

101-3.2  Numbering/Labeling Conventions

Given the size of the publication and for convenience in handling future revisions, the following numbering conventions have been used for the text, figures and tables in the OMUTCD:

1. Page numbers are sequential beginning with Page 1 in Chapter 1 and ending with Page 926 in Chapter 9. The Table of Contents is numbered separately, and consists of a “TC” designation and the page number within the Table of Contents. Page numbers in Appendices A, B, and C consist of the first letter of the particular appendix and the page number within it (e.g., Page C-3).

2. Section, figure and table numbers consist of the Chapter number and a sequential number for the Section, figure or table within the Chapter. For example, “2C” identifies Sections, figures and tables from the Warning Signs and Object Markers Chapter.

3. Text in the header has been used as a reminder that the page is part of the 2012 Edition.

101-3.3  Text

The following formatting conventions have been used in the OMUTCD:

1. Numbers related to time and quantities are usually written out, but dimensions are generally shown as numbers.

2. Dimensions are shown in English units. (Metric equivalents can be determined by using the appropriate tables in OMUTCD Appendix B.)

3. For consistency, the terms “Standard,” “Guidance,” “Option” and “Support” are defined in the OMUTCD Introduction, and a general listing of definitions of other terms used in the manual is provided in Part 1.

4. To provide emphasis and to differentiate between Standard, Guidance, Option and Support text, the text has been separated using these titles.

5. The format of the text copied from the MUTCD has also been used to help differentiate between the types of information.

   a. Text addressing Standards information is in bold, 11 point Times New Roman font.

   b. Text addressing Guidance information is italicized in 11 point Times New Roman font.

   c. Text addressing Support and Option information is in 11 point Times New Roman font.

6. The format of the text has also been used to help identify Ohio text, as opposed to that copied from the MUTCD. The Ohio text is shown in 10 point Arial font (the same font used in the TEM).
7. In referring to a sign by name, if the name used is also the sign legend it will be shown in all capital letters, if not, just the initial letters will be capitalized, e.g., STOP sign and Winding Road sign.

101-3.4 Artwork

The following formatting conventions have been used in the OMUTCD:

1. The numbering format for the figures is described in Section 101-3.2.
2. Dimensions are as described in Section 101-3.3.
3. A gray background is typically used to depict the pavement.
4. Colors, conforming to the Federal Color Tolerance charts, are used in depicting the traffic control devices illustrated.
5. Sign cuts are shown in figures as groupings of similar signs.
6. Sign size tables have been included in signing related chapters showing groups of signs, instead of individual notations about sign sizes with the sign cuts.
7. A sign index (OMUTCD Appendix C) has been included to provide a quick visual cross reference guide to text about signs discussed in the manual.

101-4 Distribution

The OMUTCD is available electronically from both the ODOT Office of Traffic Engineering (OTE) and the ODOT Design Reference Resource Center (DRRC) websites (see Table 197-1) at http://www.dot.state.oh.us/Divisions/Operations/Traffic/Pages/OTEHomePage.aspx and http://www.dot.state.oh.us/drrc , respectively.

It is also available in paper format. Copies are distributed free to local jurisdictions, other government agencies and public libraries. Free copies are distributed by the Office of Traffic Engineering. For those that involve a charge, the Office of Contracts handles the invoicing and distribution.

An Address Verification Form (Form 196-4) is included with each manual. To avoid duplications, the distribution list is not updated until this form is received in the OTE Standards Section.

It is also important for holders of this manual to notify the OTE Traffic Standards Engineer of any change in address. Form 196-1 can be copied and used for this purpose.

101-5 Revisions

For convenience in reviewing and updating the OMUTCD, the basic OTE policy (since publication of Revision 13 of the OMUTCD 1972 Edition) has been to adopt the related text from the national manual (MUTCD) when preparing an OMUTCD revision, unless it is determined that there is a good reason to be different.

Maintaining/updating of the OMUTCD is an ongoing OTE function. OMUTCD Table I-1 depicts the evolution of the OMUTCD, listing the various editions and revisions.

Comments and suggestions from users of the manual about the Manual or proposed revisions of it are anticipated and welcome. OMUTCD Section 1A.10 addresses the procedures for requesting interpretations, experimentations, changes and interim approvals. Design, application and placement of traffic control devices other than those adopted in the OMUTCD are prohibited.
unless the procedures of Section 1A.10 are followed. Requests for interpretations or changes in the OMUTCD shall be submitted to the ODOT Office of Traffic Engineering. As noted in Chapter 180, OMUTCD Section 1A.10 requires that requests for permission to experiment or interim approval be submitted to the Federal Highway Administration (FHWA).

Please use Form 196-2, the Traffic Engineering Publications Revision Proposal Form, to make comments and to submit requests for revisions. A copy of the form is also available on-line at http://www.dot.state.oh.us/Divisions/Operations/Traffic/Pages/Forms.aspx. All revisions to this manual will be reviewed according to the following process:

1. All proposed revisions should be submitted to the OTE Administrator, using the Revision Proposal Form (Form 196-2). Preferably, a proposal for a revision of the text should include a marked-up copy of the related manual text.

2. The OTE Standards Section will review the proposal and circulate it within OTE for review and comment. For major revisions, a special task team or advisory committee, including representatives from the ODOT Districts as well as agencies and organizations outside ODOT, including FHWA, may be established to review the matter and provide comments. If a change is recommended, a draft revision will be prepared.

3. If approved by the OTE Administrator, the draft revision will be circulated among the Districts, related offices in Central Office, and other agencies and organizations as appropriate for review and comment.

4. The Standards Section will coordinate review of comments received and preparation of revised text as needed. A final draft plus a list of any major technical difficulties, and proposed solutions, will be submitted to the OTE Administrator for approval.

5. If a revision of the OMUTCD is to be made, it will be prepared by the Standards Section and a copy will be submitted to the local FHWA office for review.

6. If the scope of the revision results in a complete new edition of the OMUTCD an announcement will be sent with an order form to all holders of the manual on the current distribution list. Otherwise, a copy of the Revision Set will be posted on the OMUTCD website with an updated copy of the Manual, and a notice will be sent to all holders on the current distribution list. In either case, an e-mail announcement will also be sent to all those who have subscribed to the list service for the OMUTCD (on the ODOT Design Reference Resource Center (DRCC) web page).
102 TRAFFIC ENGINEERING MANUAL

102-1 General

Over the years, as a supplement to the information in the OMOVUC, a variety of policies, standards, procedures, guidelines, standard drawings, typical drawings and publications regarding ODOT’s traffic engineering practices have been developed and disseminated in various ways. Many of these were originally published in the ODOT Traffic Control Application Standards Manual (ASM); however, others were issued separately.

As noted in the Preface, the purpose of the Traffic Engineering Manual (TEM) is to assure, as much as possible, uniformity within ODOT regarding traffic engineering concerns by consolidating all this supplemental information into one manual. Some of this information can be critical in addressing the needs of our customers, and some may just be useful in simplifying or clarifying information published elsewhere. The TEM should be a useful tool in training personnel new to the subject, as well as providing a resource in addressing the wide range of inquiries from our customers, ODOT personnel, consultants, contractors, other government agencies and private citizens.

Except as noted in specific Sections, the policies, guidelines, procedures and standards established in this Manual are applicable only to ODOT-maintained highways and not local roads and streets. However, local jurisdictions are encouraged to use this publication and, as noted in Section 100-3, may need to reference it at times, e.g., the OMOVUC references the TEM for some information.

102-2 Organization

The TEM has been arranged generally in the sequence of topics addressed in the OMOVUC. The Manual includes fifteen parts, arranged in the following sequence:

- **Part 1, General**, provides information about the organization and use of this and other publications, as well as general traffic-related materials, planning/programming, design, construction and maintenance/operations information.
- **Part 2, Signs**, provides information about traffic control signs that supplements information in OMOVUC Part 2.
- **Part 3, Markings**, provides information about markings and islands that supplements OMOVUC Part 3.
- **Part 4, Signals**, provides information about traffic signals that supplements the basic standards in OMOVUC Part 4.
- **Part 5, Low-Volume Roads**, has been reserved to address additional information, as needed, supplementing OMOVUC Part 5.
- **Part 6, Temporary Traffic Control**, provides information about temporary traffic control devices and applications, including traffic incident management, supplementing information in OMOVUC Part 6.
- **Part 7, School Areas**, provides information about standards for traffic control in school areas, including school zone extensions, supplementing information found in OMOVUC Part 7.
- **Part 8, Railroad and Light Rail Transit Grade Crossings**, provides information about traffic controls at railroad-highway and light rail grade crossings, supplementing information in
OMUTCD Part 8.

- **Part 9, Bicycle Facilities**, provides information about traffic control devices related to Bicycle Facilities and supplements information found in OMUTCD Part 9.

- **Part 10**, has been reserved for future use.

- **Part 11, Highway Lighting**, provides information about highway lighting.

- **Part 12, Zones and Traffic Engineering Studies**, provides information about traffic control zones and traffic engineering studies.

- **Part 13, Intelligent Transportation Systems (ITS)** provides information about various aspects of this subject, such as Freeway Management Systems, Ramp Metering, etc.

- **Part 14, Miscellaneous**, provides information about miscellaneous related devices, procedures, etc., including rumble strips, that are not directly related to any single topic discussed in one of the other Parts of the TEM.

- **Part 15, Appendix** provides information about definitions for terms used in this Manual which are not already defined in the OMUTCD and an explanation of various acronyms (see Chapter 1501). Information about other ODOT policies and guidelines is also provided, as well as copies of traffic-related items.

### 102-3 Format

#### 102-3.1 General

Various format conventions have been adopted. For convenience (and as a record and reminder for those developing text for the Manual), they have been consolidated in this Section.

A Table of Contents has been provided for each Part, listing each Section, form, table or figure. An overall Table of Contents has also been provided in the front of the Manual; however, to conserve space, only the Part and Chapter headings and the underlined Section headings are shown (including the forms, tables and figures).

#### 102-3.2 Numbering/Labeling Conventions

The following numbering conventions have been used in this Manual to provide a consistent organization for each Part. This is intended to help locate information and to simplify cross-references within the TEM:

1. Chapters and Sections within each Part are numbered based on the Part or Chapter number. For example, in Part 1 the Chapter and Section numbers start with 100. The Chapter headings in each Part are identified with a slightly larger font shown in bold and all capital letters. In general, the Chapter headings also begin on a new odd-numbered page.

2. Material within each Part is generally arranged in a set pattern, with the general standards and guidelines information presented first (for example, Chapters 100 through 129). Planning/Programming information generally starts with Chapter x30. Design Information starts with Chapter x40, with Plan Preparation / Production information in Chapter x41, with Plan Note information in Chapter x42, and a listing of related CMS items in Chapter x43. Construction material starts with Chapter x50 and is generally intended to include information used in inspecting installation of traffic control devices.
However, this information may also be useful for ODOT force account installation of various devices. Maintenance/Operations information starts in Chapter x60 and generally addresses preventive maintenance and other operational issues.

3. Chapter x95 has been reserved in each Part to incorporate discussion, as appropriate, about related, but separately published publications. For example, although the Sign Designs and Markings Manual (SDMM) has formally been "incorporated" into the TEM (Section 295-2), due to its size, and the fact that some people will need it but not the rest of the TEM, it is published separately. The title sheet and cover of that manual, and any other publications similarly 'incorporated,' reflect the fact that they are considered part of the TEM. To help avoid unnecessary reference to these other volumes, a brief description of each of these manuals is included in the TEM text, with an indication of how it relates to the other information in this Manual (see Sections 295-2).

4. Forms, tables and figures in each Part have been consolidated into Chapters numbered x96, x 97 and x98, respectively, where x is the Part number. The figures may include charts.

5. Subdivisions of Chapters, Sections, have been labeled with a hyphenated number based on the Chapter number, e.g., Section 102-3. The titles of these Sections are bold and underlined.

6. If further subdividing of information in a Section is needed, decimals are used with the number, e.g., Section 102-3.2 and Section 205-2.3.1. The titles of these subdivisions are bold, but not underlined.

102-3.3 Text

Text format in the TEM generally follows that used in the OMUTCD; however, a few additional conventions have also been used.

1. The type font used is Arial. The default font size is 10; however, size 12 has been used for the Chapter headings and the titles for the forms, tables and figures.

2. References to Sections, forms, tables and figures within the TEM are highlighted using bold/italic text, e.g., Chapter 102.

3. References to organizations, titles, documents, etc. are highlighted using bold text, e.g., OMUTCD.

102-3.4 Units of Measure

ODOT’s policy is to use English units as the standard.

If metric equivalents are required on a particular project and they are not available herein or in OMUTCD Appendix A2 or a related SCD, the English units shall be converted to metric units using the English to SI (Metric) Conversion Factors provided in Table 109.02-1 of the Construction and Materials Specifications. The appendix of ASTM E 380 shall be utilized for any additional conversion factors required. Conversions shall be appropriately precise and shall reflect standard industry English values where suitable. The contractor and the project engineer are responsible for the accuracy of the conversions used for a construction project.

102-3.5 Definitions

As noted earlier (Section 102-2), in addition to OMUTCD Part 1, Chapter 1501 of this Manual provides definitions of terms (including acronyms) used in this and related documents.
102-3.6  Artwork

Sign cuts for signs addressed in the TEM and not shown in the O MUT CD are included in the TEM. They are accurate, proportional representations of the signs.

Each form, table and figure is individually numbered and appears in the Table of Contents. The Form, Table and Figure Index pages (x96, x97 and x98) include cross-references to related text Sections.

102-4  Distribution

The TEM is available electronically from the ODOT Office of Traffic Engineering (OTE) and the ODOT Design Reference Resource Center (DRRC) websites (see Table 197-1) (the addresses are http://www.dot.state.oh.us/Divisions/Operations/Traffic/Pages/OTEHomePage.aspx and http://www.dot.state.oh.us/drrc, respectively).

Revisions are available from the OTE and DRRC websites. As needed, they will be posted to the web on a quarterly basis (January, April, July and October). It is the responsibility of the individual receiving or downloading the Manual to update it as needed. A subscription service is available on the DRRC website to allow interested individuals to receive e-mail notifications when updates and notices are posted.

102-5  Revisions

Maintaining/updating the TEM is an ongoing OTE function. The Publication Record documents the revisions of this Manual. Comments and suggestions from users of the Manual are anticipated and welcome. Please use the Revision Request Form (Form 196-2) or a similar format to make comments and to submit requests for revisions. A copy of the form is also available on-line from the OTE Forms web page at: http://www.dot.state.oh.us/Divisions/Operations/Traffic/Pages/Forms.aspx.

All revisions to this Manual will be reviewed according to the following process:

1. All proposed revisions from outside OTE should be submitted to the OTE Administrator, using the Revision Proposal Form (Form 196-2). Preferably, a revision proposal should include a marked-up copy of the related Manual text.

2. One of the OTE Section will review the proposal and circulate it within OTE for review and comment. For major revisions, a special task team, including representatives from outside OTE, may be established to review the matter and provide comments. If a change is recommended, a draft revision will be prepared. The Standards Section will update the TEM workprogram.

3. If approved by the OTE Administrator, the draft revision will be circulated among the Districts and related offices in Central Office for review and comment.

4. If a revision of the TEM is to be made, it will be prepared by the OTE Standards Section and with the approval of the OTE Administrator will be posted to both the ODOT Office of Traffic Engineering and the ODOT Design Reference Resource Center (DRRC) websites (see Table 197-1). An e-mail announcement will be sent to all those who have subscribed to the list service for the TEM/SDMM (on the DRRC web page).
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103 STANDARD CONSTRUCTION DRAWINGS

103-1 General

Numbered Standard Construction Drawings (SCDs) published by OTE have been established to standardize inclusion of certain traffic control information in ODOT contract plans. The drawings are developed and published by OTE. In addition to contract plans, they should also be used by ODOT operational forces as directed in this Manual and at other times when considered appropriate. Designer Notes have been developed to help define the intended use of SCDs (see Section 140-3).

Copies of the drawings are available on-line from the OTE website at: http://www.dot.state.oh.us/Divisions/Operations/Traffic/publications2/SCD/Pages/default.aspx, and may be purchased from the Office of Contracts (see Table 197-8).

103-2 Organization

The OTE Standard Construction Drawings (SCDs) set is composed of individual standard drawings, grouped in three general categories, Highway Lighting (HL), Maintenance of Traffic (MT) and other Traffic Control items (TC). The drawings in the Traffic Control group are also subdivided into the following groups:

- Overhead Sign Supports, beginning with TC-7.65;
- Overhead Sign Supports - Associated Details, beginning with TC-21.10;
- Signing Electrical Details, beginning with TC-32.10;
- Ground-Mounted Sign Supports and Signs, beginning with TC-41.10;
- Delineation and Pavement Marking, beginning with TC-61.10; and
- Traffic Signals, beginning with TC-81.10.

103-3 Format

103-3.1 ODOT SCDs in General

To promote uniformity within ODOT, CADD standards have been established for published documents. Generally, these standards should be used in all MicroStation drawings that are intended to be incorporated within the various publications. The CADD Engineering Standards Manual establishes specific CADD standards for use in developing plan sheets, including plan detail sheets developed for individual plans.

At this time, there is not one set of CADD standards for all SCDs; however, each Office developing SCDs (e.g., Roadway Engineering, Structural Engineering and Traffic Engineering) has established general guidelines for its standard drawings which are, at least in part, based on the standards established in the CADD Engineering Standards Manual for the regular plan sheets.

The following standards are established to insure consistency for all OTE SCDs. Although no set of criteria can cover all the possible designs which may occur, these standards shall be followed as closely as possible to allow other users a reasonable expectation of what each drawing will contain. If, in developing an OTE SCD, there is a reason for the designer to vary significantly from these standards, the variations should be noted within the drawing itself or as an attachment.
Each person developing or creating OTE SCDs should use good graphical judgment in the arrangement and placement of both graphic objects and blocks of text. A drawing that is loaded with text or too many highly detailed drawings may be overwhelming to the end user.

103-3.2 OTE SCD Format

The standard OTE title block and outline for all drawings (see Section 103-3.3) shall be used.

As noted in Section 102-3.4, all drawings are to be developed in English units. For the dimensions, abbreviations of the units (without periods) should be used in the drawing (e.g., ft, in), but in the notes, the units should be spelled out. Decimals should be used, where needed, and the decimal places should be limited to one, unless there is a specific design reason to show a greater tolerance.

When multiple pages under a specific topic are required, they shall maintain the same title and drawing number with page numbering used. The page number is to appear in a rectangular block located in the lower right portion of the title block. The number to the left shall be the actual page number in consecutive order and the number on the right shall be the total pages. Occasionally, additional pages may need to be inserted in a given drawing that has already been numbered. These pages may be labeled with the number of the preceding page followed by consecutive letters (e.g., 1A, 1B, etc.). It is not intended that a given drawing contain many different pages. As multiple pages are added, the designer should consider reorganizing the material into more specific topics.

Interim “date of revision” notations should be shown on draft copies for review purposes, but they shall be removed and the official revision date will be added to the drawing after federal approval. The date shall use the month-day-year convention, with a two-digit year (e.g., 01-01-00).

The preparer’s initials are to be shown in the bottom right corner, just under the border.

103-3.3 Seed File

All OTE SCDs shall use the seed file trstdseed_V8.dgn (i:\tr\trstd\seed). This file contains the template for all the OTE SCDs. New drawings should begin by copying this file (or a recently approved OTE SCD) and then renaming it for the appropriate drawing. The new drawing should be drawn as a design sheet file.

103-3.4 Text

The fonts for all drawing items shall be as listed in Table 197-3. Examples of these fonts can be found in the CADD Engineering Manual.

The text size and weight shall also be as specified in Table 197-3. In general, spacing between text lines should equal the text height.

The style shall be upper/lowercase for all items listed under the NOTES section. All other drawing items shall be all CAPS, except for unit designations (e.g., ft, in, m and mm).

The line weights and styles (codes) shall be as specified in Table 197-4. The “Standard"
should be used for all dimensioning lines, table lines (including border) and the construction of most drawing elements. The designer may use other weights and one of the other line styles not assigned here for special design details, but such use should be limited. When dimensioning, a filled arrowhead design should be used.

Custom line styles are not to be used unless prior approval from the OTE Standards Section is obtained.

Thick line weights or multiple lines should not be used in lieu of filling appropriate areas (e.g., pavement markings).

### 103-3.5 Color Table

Although color perception varies with each user, a standard color table should be used for the final drawing. This use insures that the pen tables specified will print as desired and that elements obtained from cell libraries display consistent characteristics throughout all drawings. Use of the standard color table will also assist future users in identifying those elements in a consistent manner. Therefore, the standard ODOT color table shall be used, unless prior approval to use a different one is obtained from the OTE Standards Section.

All elements used on a SCD should be drawn in black and white. Colors should not be used on an SCD. Using colors in the drawing may lessen the clarity when the drawing is printed on a non-color printer.

### 103-3.6 Level Assignments

OTE Standard Construction Drawings use the level assignments shown in Table 197-5.

### 103-3.7 Cell Libraries

Cells placed in drawings should retain their symbology (color, fill, line weight, line style and level) unless the designer has a specific reason to make changes. Any such changes should be noted.

The following cell libraries contain symbols which shall be used with these drawings, whenever possible):

1. ODOT_Symbols.cel (i:\v8std\): This library was created by the Office of Production and contains many of the existing and proposed symbols used in most ODOT highway plans. Graphic representations of these cells can be found in the CADD Engineering Manual. To assist in placing cells from this library, an MDL Application (FEATBL) is available for use. If needed, Traffic cell libraries for use with MicroStation J files are located in the folder i:\tr\trstd\cell\Version J. MicroStation J cells shall not be used in MicroStation V8 drawings unless first converted to the V8 format.

2. fontz_V8.cel (i:\trstd\cell\signcutcells_V8): This library contains individual letters for use in creating sign drawings. The cells are for capital and lowercase letters, for example “W_cap” would be the capital letter W and “w” would be a lowercase w.

3. signcuts_V8.cel (i:\trstd\cell\signcutcells_V8): This library contains sign cuts based on the Sign Designs and Markings Manual. It is not the same as the sign cell library used for ODOT highway plans (i:\std\cel\signs). The sign cuts are identified by their pre-OMUTCD 2003 standard sign code numbers and the new sign code numbers. For sign cuts not appearing in this library, contact the OTE Standards Section. A sign cut using other colors should be modified to appear as a black and white image.

4. traf_V8.cel (i:\trstd\cell): This library contains a collection of standard cells used in
many of the OTE SCDs. Graphic representations of these cells can be found in Table 197-6.

5. Cells specifically created for a given drawing or set of drawings that the designer feels will be used in subsequent drawings, should be incorporated into the traffic standard cell library (traf_v8.cel) upon approval of the drawing. Contact the Standards Section to have the new cells incorporated into this library.

103-3.8 Plotting

All completed drawings shall be plotted as 11 x 17 inch drawings (i.e., quarter size) and using pen tables to match ODOT’s current plotting standards. The Standard V8 MicroStation and IPlot pen tables are available for download on ODOT’s Pen Tables web page.

All elements shall be plotted black, unless prior approval for a variation has been obtained from the OTE Standards Section.

103-4 Distribution

OTE SCDs, and the index for them, are available for downloading, as MicroStation or .pdf files, from both the ODOT Office of Traffic Engineering (OTE) and the ODOT Design Reference Resource Center (DRRC) websites (see Table 197-1) (the web addresses are http://www.dot.state.oh.us/Divisions/Operations/Traffic/Pages/OTEHomePage.aspx and http://www.dot.state.oh.us/drcc, respectively).

The MicroStation files are also available from the ODOT shared network O drive, in the O:\Traffic\SCDs directory.

Revisions are generally posted on a quarterly basis. It is the responsibility of the individual receiving or downloading the drawings to update them as needed. A subscription service is available on the DRRC website to allow interested individuals to receive e-mail notifications when updates and notices are posted.

103-5 Revisions

Comments or questions about the drawings should be directed to the OTE Standards Section or the OTE Specialty Area responsible for a particular drawing. Form 196-2 may be used in submitting comments or questions. A copy of the form is also available on-line from the OTE Forms web page at: http://www.dot.state.oh.us/Divisions/Operations/Traffic/Pages/Forms.aspx.

The OTE Standards Section maintains a log of work needed on the OTE SCDs, assigns drawing numbers as needed, and generally coordinates development and approval of the drawings. The OTE Sections develop new or revised drawings and submit them to the Standards Section in both .dgn and .pdf formats for final processing. The Standards Section makes final editing changes as needed, and when considered complete, prepares a transmittal letter to submit the drawing(s) to the local FHWA office for review and approval. (For minor editorial type revisions, this FHWA review/approval process is handled by e-mail.) When approved by FHWA, the Standards Section adds the official “revision date” to the drawing and schedules it for distribution in the next quarterly revision. (The quarterly revision date is used as the official “revision date” for each drawing.)

If, based on FHWA comments, additional changes are made or if other needed changes are noted before publication of the OTE SCDs, revised drawings are submitted to FHWA for approval.
104 PLAN INSERT SHEETS

104-1 General

Plan Insert Sheets (PISs) are standardized drawings that may be included in plans, to modify standard details to more closely depict conditions for an individual location, to show methods of work that are not currently shown in an SCD, or to show a modification or variation of an existing SCD. They are drawings that are expected to be used in more than one plan, but for various reasons have not been developed into an official SCD.

OTE has created and will maintain a set of these drawings. OTE PISs will be created only if the modification is widely used, or is intended eventually to evolve into an OTE SCD. For other situations, a Plan Detail Sheet (prepared for the individual plan) should be used. OTE PISs are available on-line at http://www.dot.state.oh.us/Divisions/Operations/Traffic/publications2/PISs/Pages/default.aspx.

As with SCDs, OTE PISs should be developed using good graphical judgment in the arrangement and placement of both graphic objects and blocks of text. A drawing that is loaded with text, or too many highly detailed drawings may be overwhelming to the end user.

104-2 Format

OTE PISs shall follow the CADD standards described for OTE SCDs (Section 103-3), except that:

1. All OTE PIS sheets shall use the seed file “trstdseed_PISV8.dgn (i:/tr/trstd/seed). This file contains the template for all OTE PISs. New drawings should begin by copying this file (or a recently approved OTE PIS) and then renaming it for the appropriate drawing; and

2. They shall be numbered as noted in this Section. The first two numerals of the drawing number shall be A20”, and the next four (or five) digits shall be the number of the related SCD (minus any decimals), if applicable. For example, a drawing designated “209711” would be an OTE PIS based on the SCD MT-97.11. The Standards Section will establish an OTE PIS number if a related SCD does not currently exist.

104-3 Distribution

A log of approved OTE PISs is maintained by the OTE Standards Section, and like the SCDs, they have been published on the web, as well as on the ODOT network in the O:\Traffic\PISs directory. The web address for the OTE PIS website is: http://www.dot.state.oh.us/Divisions/Operations/Traffic/publications2/PISs/Pages/default.aspx.

New and revised drawings are posted to the ODOT website on a quarterly basis. They are available from the OTE and DRRC websites. It is the responsibility of the individual receiving or downloading the drawings to update them as needed. A subscription service is available on the DRRC website to allow interested individuals to receive e-mail notifications when updates and notices are posted.

104-4 Revisions

Comments or questions about the drawings should be directed to the OTE Standards Section or the OTE Specialty Area responsible for a particular drawing. The drawings will be revised as needed by the responsible Section and submitted to the Standards Section for review and publication. Form 196-2 may be used in submitting comments or questions. A copy of the form is also available on-line at http://www.dot.state.oh.us/Divisions/Operations/Traffic/Pages/Forms.aspx.
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105 CONSTRUCTION & MATERIAL SPECIFICATIONS

105-1 General

The general term “construction and material specifications” includes: the Construction & Materials Specifications Book (CMS), Supplemental Specifications (SS), Supplements, Special Provision Specifications, Proposal Notes and Plan Notes. As needed, these are addressed individually by number reference within the TEM Parts.

The Construction and Material Specifications Book (CMS) contains detailed provisions, which, together with the plans and the Proposal, constitute the Contract for the performance of required work. It is the official legal and technical document by which ODOT bids and constructs highway projects. Provisions within the CMS are numbered as individual items, and the reference format used herein is CMS Item xx when a specific bid item is involved and CMS xxx when the referenced section does not involve a bid item. For convenience, as appropriate, Chapter x43 (where x is the Part number) has been reserved in each Part to provide a consolidation of information about specifications related to the topic addressed in that TEM Part. For example, Chapter 443 provides a summary of CMS sections related to traffic signal equipment.

Supplemental Specifications (SS) are individual numbered documents describing the construction and material specifications for new items.

Special Provision Specifications are individual numbered specifications prepared in loose-leaf form describing the construction and material specifications for items whose requirements are not covered in the CMS or in Supplemental Specifications.

Supplements provide necessary information such as laboratory methods of test, and certification or pre-qualification procedures for materials.

Proposal Notes contain a wide variety of legal and technical requirements necessary for the proper bidding and sale of an individual project. These notes override all other requirements in the Plan, CMS, Supplemental Specifications and Standard Construction Drawings.

Plan Notes describe non-standard pay items that deviate from the CMS, Supplemental Specifications or Standard Construction Drawings. As appropriate, these notes are addressed in TEM Parts in Chapter x42, where x is the Part number.

The current CMS is available on-line from the Division of Construction Management website at http://www.dot.state.oh.us/Divisions/ConstructionMgt/OnlineDocs/Pages/2010CMS.aspx, and from the DRRC website at http://www.dot.state.oh.us/drrc. It may also be purchased from the Office of Contracts (see Table 197-8).

The Supplemental Specifications (SS), Supplements, Proposal Notes are also available on-line via the Division of Construction Management website.

105-2 Distribution

ODOT construction and material specifications are available from the ODOT Office of Contracts. The CMS, Proposal Notes and Supplemental Specifications are also available from the Design Reference Resource Center (DRRC) website (see Table 197-1).

105-3 Revisions

The Division of Construction Management is assigned the responsibility and authority to develop, implement, maintain and update construction and material specifications. This is to ensure construction quality and a uniform and consistent administration of construction projects.
by all Districts.

Five specification committees process specifications in the major work items: Pavement Materials and Construction, Structures, Earthwork and Hydraulics, Contract Administration, Traffic and Other Miscellaneous Items. Each working committee reviews existing specifications, and recommends revised and new specifications as needed.

An Executive Committee gives final review and approval of all ODOT specifications.

All specification and new product issues are to be addressed to the specific Committee Chairs. The Chair for Traffic is the Administrator of the Office of Traffic Engineering.
106 OTHER PUBLICATIONS

It is intended that, as much as possible, all ODOT traffic engineering information will be incorporated into the TEM, eliminating separate publications, guidelines, standard operating procedures, etc. However, for various reasons some related OTE publications have not been physically incorporated into the text of this Manual. In some cases, they are expected to remain physically separate publications. In others, this is expected to be a temporary situation. For example, some new publications may initially be developed separately and incorporated (physically or by reference) later.

Table 197-7 provides a consolidated list of all OTE publications. All OTE publications (except the wallchart described in Section 195-2) are available electronically from both the ODOT Office of Traffic Engineering Publications website and the ODOT Design Reference Resource Center (DRRC) websites (see Table 197-1). The respective addresses for these two websites are: http://www.dot.state.oh.us/DIVISIONS/OPERATIONS/TRAFFIC/PUBLICATIONS2/Pages/default.aspx, and http://www.dot.state.oh.us/drrc.

Chapter 195 provides information about OTE publications not addressed in Chapters 101 through 105.

Chapter 193 provides a listing of related national publications and Chapter 194 addresses other ODOT publications which may contain information needed, or useful, for traffic engineering projects or studies.
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120-1 General

In general, only traffic control devices addressed in the OMUTCD are approved for use on public highways. However, new devices are being developed regularly and the fact that they are not addressed specifically in the OMUTCD is not intended to exclude them from use. OMUTCD Section 1A.10 states that “Design, application, and placement of traffic control devices other than those adopted in this Manual shall be prohibited unless the provisions of this Section are followed.” OMUTCD Section 1A.10 then describes the review and approval processes for experimentation, interim approval, interpretation and changes related to traffic control devices. Section 120-3 provides additional details regarding ODOT’s procedures for reviewing and evaluating new products.

In general, information about traffic control materials is located within each TEM Part according to the type of material involved. Information that addresses more than one type of material, such as the guidelines for handling patented or proprietary materials, or the process whereby local agencies can purchase traffic control materials and equipment using Federal funds, is addressed in this Chapter.

120-2 Specifications

ODOT Policy No: 27-005(P), Construction and Materials Specification Development Policy (Section 1512) assigns the responsibility and authority to develop, implement, maintain and update construction and material specifications to the Division of Construction Management. It also establishes five Specification Committees to process specifications. The Traffic and Miscellaneous Items Committee is responsible for reviewing traffic control items. The various types of specifications are noted in Section 105-1.

The procedures for development and implementation of new or modified specifications are established in ODOT Standard Procedure 510-005(SP), Construction and Materials Specification Development Standard Procedures (Section 1512).

120-3 New Products

ODOT Standard Procedure 515-001(SP) establishes the process by which new products are evaluated and approved/disapproved for use. Information about the ODOT new products program is available on-line from the Office of Materials Management’s New Products web page at http://www.dot.state.oh.us/Divisions/ConstructionMgt/Materials/newproducts/Pages/default.aspx. Also see OMUTCD Section 1A.10.

120-4 Patented or Proprietary Materials, Specifications or Processes

Patented or proprietary materials, specifications, or processes shall not be included in a contract unless one of the following conditions applies:

1. The item is to be purchased or obtained through competitive bidding with equally suitable items. In which case, the plans shall specify a minimum of two acceptable items and include the phrase “or approved equal.”

2. No equally suitable alternate exists.

3. The item is essential for compatibility with existing highway facilities.

4. The item is used for research or for a distinctive type of construction on relatively short sections of road for experimental purposes.
5. There is a determination by the District Deputy Director (DDD) that it is in the best public interest to specify one such item to the exclusion of any other acceptable alternate.

Where a single item is specified, a request and justification shall be submitted by the maintaining agency to the Office of Traffic Engineering (OTE) with a copy to the appropriate District. OTE shall evaluate the request; coordinate with FHWA if appropriate; and subsequently notify the requesting agency of the disposition of the request. The request shall include a table listing all signalized intersections under the agency's jurisdiction, the brand of equipment installed at each and the date of installation.

Requests shall be submitted in accordance with the Project Development Process (PDP) or the Local-let procedures, whichever is applicable.

Where research or experimentation is proposed, it will also be necessary to set up an evaluation program as per the New Product Development Policy 27-041(P).

In the case of traffic signals, the vast majority of alternate bid requests are made for controllers or emergency vehicle preemption. Proprietary bids shall be considered instead of alternate bids when:

1. The signal controllers are an extension of an existing arterial coordinated signal system. Typically the number of controllers being added is less than the number of existing controllers in the system. The coordinated arterial may be controlled by on-street masters, directly by a central control center or simple hardwire with time based control.

2. Greater than fifty percent of the agency's controllers are of a single brand.

3. Greater than fifty percent of the agency's signalized intersections operate with a single brand of emergency vehicle preemption equipment. The extension of preemption equipment on an existing preempted arterial will not be a basis for approval of proprietary bids for preemption equipment. Specifying the type of preemption (light, sound, radio, etc.) is a proprietary bid that requires ODOT's approval.

4. Greater than fifty percent of the agency's signalized intersections operate with a single brand of video detection equipment.

5. Greater than fifty percent of the agency's signalized intersections operate with a single brand of spread spectrum radio equipment. Proprietary bids will be considered if the spread spectrum radios are an extension of an existing coordinated signal system and the number of radios being added is less than the number of existing radios in the system.

There should be no upgrading of the existing equipment (controllers, preemption, video detection, spread spectrum radio, etc.), or the upgraded existing equipment will be evaluated as new/added equipment.

In accordance with FHWA guidance, items provided to an agency at any price below normal fair market value shall not be included as part of the proprietary calculation. Documentation may be requested verifying purchase at fair market value.

If greater than fifty percent of the agency's equipment is comprised of two brands, consideration may be given to limiting the bids to the two brands without the use of the phrase “or approved equal.”

If at least fifty percent of the agency's controllers are of a single brand, central control software upgrades may be considered. The single brand controllers do not have to be currently connected to the central control. Upgraded existing controllers will be evaluated as new/added controllers.
The addition of an interconnection card to an existing controller is not considered an upgrade to the controller.

Proprietary bids for aesthetically designed luminaries, highway lighting or signal supports shall not be considered because of the numerous manufacturers of similar support designs.

In lieu of proprietary bids for aesthetically designed signal or lighting supports, alternate bids may be taken using three brands of similar aesthetically designed supports for the generic bid and an alternate bid for the preferred choice. If three brands of similarly designed signal supports are not utilized, the generic bid will be for a standard painted TC-81.20 mast arm support.

When the Office of Traffic Engineering (OTE) determines that a proprietary bid is justified, written documentation must be kept on file supporting the use of proprietary items. Should the request not be approved, OTE will inform the requesting agency they may consider alternate bidding procedures and that Federal-aid participation will be based on the lowest price so established. OTE will copy the District on all correspondence related to the proprietary bid request.

120-5 Cooperative Purchasing Program

Under the Cooperative Purchasing Program, political subdivisions may purchase machinery, materials, supplies and other articles from the ODOT Annual Term Contracts and the ODOT Single Purchase Contracts with their own funds. A copy of the program may be obtained from the ODOT Office of Contracts, Purchasing Services (see Table 197-1).

120-6 Alternative Purchasing Program for Local Agencies

120-6.1 General

ODOT also sponsors another program with respect to the purchase of traffic control materials for installation and use by local government agencies. In this program, funding for the purchase of traffic control materials for installation and use by a requesting local governmental agency is allocated by ODOT to the local governmental agency and does not involve the use of ODOT term purchase contracts. This method was developed primarily for traffic control materials, but can encompass the purchase of other roadway appurtenances such as roadway lighting, signing and street beautification items.

This purchase order procedure was originally created to provide local agencies with a means of purchasing traffic signal materials with Federal project funds. The procedure has also been used to purchase signing materials and can be expanded to include other roadway appurtenances. All materials acquired using this procedure are to be installed by the local agency without cost to ODOT.

If traffic signal material is involved, data must be submitted for evaluation of traffic signal warrants as contained in OMUTCD Part 4. The signal warrant data shall be evaluated and approved by the District. Assistance is available from OTE upon request. Only the intersections with District approved signal warrants are eligible for Federal funding of traffic signal materials.

The following procedure has been the process to be followed in procuring materials and equipment for purchase order contracts. These functions are also shown as a flow chart in Figure 198-3. The steps shown in Sections 120-6.7 through 120-6.10 are initiated concurrently.

120-6.2 Programming and Funding

The District shall prepare and submit the programming package to the Office of Systems.
Planning and Program Management. Any State or Federal funds allocated to the agency that are eligible may be utilized, except for nontraditional transportation funds. Funds shall be sufficient to encompass the material costs, plus preliminary and construction engineering if requested. Any additional cost in the procurement of materials due to increased costs, or to insure a completed installation, shall be the agency’s responsibility unless changes are approved in advance and funds are available.

The agency’s cost participation, the local share, whether due to normal project funding splits or 100 percent local cost items, shall be based on the estimate as provided by the agency in Section 120-6.6(2a).

120-6.3 Alternate Bids

Alternate bids cannot be used in the automated purchase order system. There must be only one bid item for each item.

120-6.4 Proprietary Bids (also see Section 120-4)

The purchasing regulations allow a vendor to supply a comparable item for any proprietary brand listed in the bid package. There are two ways to purchase approved proprietary items:

1. Appear before the State Controlling Board and request an exemption from the Department of Administrative Services purchasing regulations.

2. Have the agency use their own purchasing system to purchase the approved proprietary items. ODOT utilizes a “Pass Through of Federal Funds” account in the Office of Accounting so that the agency does not have to use their own funds in the purchase. The agency submits the invoices from the vendors to the District for payment. This process requires that all preliminary engineering documents and approvals be processed as if ODOT were the sole purchasing agent.

120-6.5 Prequalification of Materials

The agency can prequalify a number of manufacturers of a purchase order item. A minimum of three brands should be listed and the supplied item must be one of these specified brands. The agency must document the procedure or reasons for limiting bidding.

120-6.6 Bid Documents Package

The agency shall prepare the bid documents package and submit it to the District. The District shall coordinate and consolidate review comments and respond to the agency. The bid documents package shall include the following information as required:

1. Preliminary Plans or Sketches.

   a. For traffic signal projects, plans or sketches should depict existing and proposed signal operation and equipment locations. The complexity of the detail drawings will be determined by the District based on the extent of the signal work involved.

   b. If the work is not signal related, the drawings shall show the locations of all proposed items and any existing conditions that will be affected. Roadway lighting work may require an illumination review to determine the effect the proposed lighting will have on the roadway. Based on the scope of the roadway lighting, the District will determine if this review is necessary.

   c. Plans and sketches shall show right-of-way.

a. Detailed sub-summaries with item descriptions and quantities shall be prepared. They shall be subdivided by each intersection and separately subtotaled for any funding splits.

b. Two general summaries shall also be submitted; one with the cost estimate included for ODOT’s use and the other without the cost estimate. The general summary without the cost estimate is used in the bid package that will be sent to the vendors and will provide places for the bid prices to be stated by the vendors.

c. Usually, the project must be separated into multiple bid packages in order to group similar items so that the various vendors can bid on only the item group that they can supply.


   a. ODOT’s Construction and Material Specifications (CMS) and Supplemental Specifications shall be used where feasible, but may be supplemented by the agency’s requirements, as necessary.

   b. ODOT does not review and approve shop drawings or catalog sheets. If the agency wants to review and approve these items, this requirement must be included in the material specifications.


   a. Assurance that all pavement markings, signing and signal installations within the project area are, or will be, in compliance with the OMUTCD. This should be accomplished by a field inspection by District and agency personnel, with any deficiencies documented.

      The deficiencies shall be corrected by the agency prior to completion of their installation of the purchased materials. By performing this inspection early in the project development, materials can be included in the bid package to correct the deficiencies.

   b. Assurance that all work is within the right-of-way.

   c. A proposal for disposition of removed equipment.

   d. Justification of any proprietary items or specialized equipment.

   e. A schedule of the agency’s installation work, based on equipment delivery dates. This should also be referenced in the agreement.

   f. Maintenance of Traffic standards which will govern the agency’s work.

All plans and documents in the bid document package shall be on 8 ½ x 11 inch (21.6 by 28 millimeter) sheets, and the agency shall submit all computerized plans and document files to the District by disk or by electronic file transfer.

After the agency provides the District with the final, District approved, version of the bid documents package, the District will provide OTE with the originals of the bid documents package.

120-6.7 Requisitions

The District or the Office of Accounting will enter the project into the automated purchasing system. The OTE Administrator shall be added as a required authorization on the requisition.
120-6.8 Agreement

OTE will send to the District an agreement to be forwarded to the agency for signature.

The agreement will be reviewed by the agency, signed by the agency’s contractual officer, and returned to the District for the Deputy Director to sign.

The District will keep the original of the executed agreement and provide copies to the agency and OTE.

If the agency is responsible for a share of the project costs:

1. A check shall accompany the agreement when returned to the District.

2. The District shall forward the check to the Office of Payroll and Project Accounting and that office will ensure that the agency’s check is properly credited to the project and processed. The District will furnish OTE with a copy of the check transmittal letter.

120-6.9 Federal Approval

If Federal funding is involved, OTE will submit a bid document package, excluding the agreement, to the Office of Payroll and Project Accounting to obtain PS&E approval from FHWA.

120-6.10 Pass Through of Federal Funds

If a “Pass Through of Federal Funds” process is used, as described in Section 120-6.4:

OTE will request that the Office of Accounting establish the account and create the requisition for the agency’s items. The Office of Accounting shall add the OTE Administrator as a required authorization on the requisition.

120-6.11 Approval and Invitation to Bid

When all of the concurrently initiated actions in Sections 120-6.7 through 6.10 are finalized, OTE will:

1. Approve the electronic requisitions so they proceed to Purchasing Services in the ODOT Office of Contracts;

2. Forward the bid documents package to Purchasing Services to process an Invitation to Bid; and

3. Advise the agency to proceed with their purchase process if a “Pass Through of Federal Funds” process is used (see Section 120-6.4).

120-6.12 Recommendation for Award of Bids

After the bids have been received and reviewed by Purchasing Services, they will be tabulated and sent to OTE. OTE shall process the bids as follows:

1. Discuss the bids with the District and the agency and make award recommendations.

2. In the case of Federal projects with active Federal oversight, obtain FHWA’s concurrence with the award recommendations.

3. Forward award recommendations to Purchasing Services for further processing.
120-6.13 Purchase Order

Purchasing Services will create the purchase orders to be issued to the supplier. The purchase order shall include:

1. A “Shop Drawing” note indicating that material catalog sheets or data sheets shall be submitted to the agency before any material is shipped; and

2. A note that all invoices are to be mailed directly to the District and materials shipped to the agency.

For those items requiring certified test data as determined by the District, the Purchase Order shall also indicate that submissions are required to be submitted to the District by the supplier. This would include any submissions which contain a material composition analysis which must be in accordance with a recognized standard.

120-6.14 Catalog Sheets, Certified Test Data and Testing

If specified in the project specifications, catalog sheets shall be received and reviewed by the agency. The agency will indicate comments on the catalog sheets as to the acceptability of the submitted items and their compliance with the material specifications. The submittal shall be marked “Approved,” “Approved as Noted,” or “Not Approved,” and will be transmitted to the various affected parties.

The agency shall notify the material supplier as to the acceptability of the submitted product, thus enabling them to commence fabrication and/or shipping in the case of an approval, or to make other arrangements in the case of disapproval. The supplier will be advised to send invoices to the District.

Certified test data shall be received by the agency with material shipment. It shall be sent to the District for review and retention.

Submittals requiring testing shall be conveyed to the District Highway Management Administrator and the Office of Materials Management for review and approval.

120-6.15 Inspection of Material Received

Upon receipt of materials, the agency shall contact the District to arrange for the inspection of the materials and completion of the necessary Receiving Forms (MR-541) and Field Inspection Report (TE-30) if required. If only Receiving Forms (MR-541) are necessary, the District may direct the agency to fulfill this function.

120-6.16 Invoice Payment

The following shall be submitted to the District for payment: invoice, Invoice Coding Strip (AU-60), Receiving Form (MR-541), Field Inspection Report (TE-30) if required, and certified test data if required.

120-6.17 Project Completion

Upon project completion, the agency shall contact the District to arrange a final field inspection. If Federal funding was used and the project has direct Federal oversight, FHWA shall be included in the process and its representative should be given copies of all approved certified test data submittals.

After completion of the inspection and correction of any deficiencies, the District will document that ODOT accepts the physical work as performed by the agency. The District
will also document that any deficiencies identified in the engineering phase of project development have been corrected.

The District shall formally advise the Office of Payroll and Project Accounting when the project is completed and acceptable to ODOT and FHWA. With this information the Office of Payroll and Project Accounting will seek final Federal reimbursement of project funds. This process will finalize the project.

120-7 Alternate Bids for Traffic Control and Lighting Items

120-7.1 General

The alternate bid procedure has been established to permit a local agency to obtain a specific brand, feature or design of traffic control or lighting device for use on a project.

Some of the generalized uses of the procedure are as follows:

1. To obtain a specific brand and model of equipment, which is expected to simplify maintenance and operation or reduce operating costs.

2. To obtain supports which include architectural features or designs used exclusively within the jurisdiction of the local agency, and which are more expensive than the support designs normally used in ODOT plans. This may include items in local areas with historic or theme backgrounds.

3. To obtain a specialized design feature which is patented or manufactured by only one supplier, and which the agency expects will improve maintenance or operation.

4. To obtain devices which are not presently justified for efficient use on the project or are not acceptably justified by agreed future conditions, but which the local agency believes will be necessary at some future time.

5. To obtain items whose extra costs are not justified when lower cost items can provide acceptable results.

120-7.2 Eligibility

The local agency should inquire from the District Planning and Engineering Administrator as to whether or not an item is eligible for normal project participation. In many cases where a precedent has not been established, the request is reviewed with FHWA (when Federal funds are involved) and a decision is rendered. This request may be made informally or in writing depending on the nature of items involved and precedents already established. If it is determined that alternate bids are necessary, the local agency shall submit a request in writing through the appropriate District that alternate bids be taken. Figure 198-5 shows a sample letter which may be used by local authorities to request alternate bids.

Each request must include the following information:

1. Specific brand (and model) or design features desired.

2. Reasons why the local agency desires the product or feature in question.

3. Locations for use on the project under consideration.

4. Past history or experience with the product where applicable.
5. Confirmation that the local agency understands the procedures of the alternate bid process (Section 120-7.3).

6. Name and telephone number of the responsible authority within the local agency to be contacted after the bid opening to determine the disposition of the alternate bids.

120-7.3 Procedure

The alternate bid procedure consists of adding a second bid item (alternate bid) for each general (generic) bid item which is affected by the local agency's special requirements. The generic bid item reflects the customary item that is sufficient to meet the needs of the project and is eligible for normal project participation. The alternate bid item describes a similar item that will satisfy the same needs of the project but also contains the local agency's special requirements. After bid opening, ODOT compares the costs of generic versus alternate bids for the affected bid items. In the event the generic items are bid at a higher price than the alternate items by the successful bidder, the award will normally be made on the basis of the alternate items with no additional cost incurred by the local agency. In the event the alternate items are bid at a higher price than the generic items, the maintaining agency will have the opportunity to either reject the alternate bids or to agree to accept the alternate bids with the understanding that local agency funds will pay the entire cost differential between the alternate bid and the generic bid.

A representative of the District will contact the responsible authority of the maintaining agency (see Section 120-7.2, item 6) by telephone and furnish unit prices and total bids for the generic and alternate bid items involved, including cost differentials for the apparent low bidder. Where the alternate bid process involves more than one item description, alternate bids can be selectively accepted or rejected; however, similar equipment types should be grouped together, such as all controller bid items or all preemption bid items. Only a limited period of time (one or two days) will be available for the maintaining agency to make known their preference by return telephone call (if time is needed to deliberate the preference) and to forward a letter with written confirmation to the District.

The apparent low bidder for the project will be determined solely on the lowest bid prices submitted. The cost differential presented to the local agency will be based only upon generic and alternate bid prices submitted by the apparent low bidder. Alternate bid prices submitted by other bidders will not be considered when determining the local agency's added costs.

The project must be awarded or rejected within ten days of the bid opening; therefore, ODOT must receive the local agency's written acceptance of the alternate bids within the time period or ODOT may award the project on the basis of the lowest bids. If the local agency refuses the alternate bids, written confirmation is still required for ODOT documentation. The letter of confirmation must be sent directly to the District Planning and Engineering Administrator. The letter shall also include a statement of willingness of the maintaining agency to pay the entire difference in cost, if the local choice is alternate bids involving a higher cost than that for generic bid items. The letter shall be signed by the contractual officer for the local agency. Figure 198-6 shows a sample letter that may be used by local authorities to acknowledge acceptance or rejection of the alternate bids.
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130-1 General

This Chapter is intended to provide general background information in the planning and programming areas. Specific planning and programming concerns will be addressed as needed in the individual Parts.

130-2 Engineering Studies

130-2.1 General

OMUTCD Section 1A.09 states that “the decision to use a particular device at a particular location should be made on the basis of either an engineering study or the application of engineering judgment.” Therefore, while the OMUTCD and this Manual provide standards and policy information, neither manual can be a substitute for engineering judgment.

130-2.2 Scope of Studies

The scope of the study needed to determine what traffic control device to use, and how to use it, in a particular situation will depend on the specifics of the situation. As noted in Section 193-9, the ITE Manual of Transportation Engineering Studies is useful in providing guidance on preparing, conducting and analyzing different types of traffic studies. Additional information about specific types of traffic engineering studies (e.g., Safety Studies, Speed Studies, Ball Banking Studies and Systematic Signal Timing and Phasing Program and Road Safety Audits) is provided in Part 12.

130-2.3 Assistance to Other Jurisdictions

For those jurisdictions with responsibility for traffic control that do not have engineers on their staff, OMUTCD Section 1A.09 indicates that they should seek such advice from others, including ODOT. Aside from the community service aspect, this sharing of experience and ideas will help encourage uniformity in the design and use of traffic control devices. Hopefully, this Manual will provide some help in supporting these jurisdictions. However, it is inevitable that questions will arise, and ODOT will continue to help other jurisdictions as much as possible within the constraints of ODOT's personnel and workload limitations. To help in this effort, OTE will continue to try to improve our communications systems to help disseminate information.

The Circuit Rider Program sponsored by Ohio LTAP (Local Technical Assistance Program) Center is designed to provide free on-site training classes on subjects such as work zone traffic control and safety to local governments. The Ohio LTAP Center also has other resources available to help local agencies, including a quarterly newsletter.

130-3 Design and Roadside Safety Issues

Generally, the OMUTCD addresses design and roadside safety issues only as they apply to the application of specific traffic control devices. Additional detail information on such issues as clear zone, barriers, supports, impact attenuators and rumble strips are available in the L&D Manual Volume One, the CMS, and in the Roadway and Traffic SCDs.

130-4 Functional Classification

The Functional Classification System is a method of classifying streets and highways based on their general characteristics. This classification system has been used over the years to establish a systematic method of categorizing the range of facilities that make up the overall highway.
network. Historically, one of the most important and common uses of this tool has been to identify streets and highways eligible for certain types of funding.

The Functional Classification System groups streets and highways in a hierarchy based on the type of highway service they provide. The *Highway Functional Classification - Concepts, Criteria and Procedures* manual, published by FHWA, basically established the current system in 1974. The different functional systems are defined in that manual, and general concepts and characteristics used to identify each are presented, as well as the procedure to follow in designating a system. The Office of Systems Planning and Program Management is responsible for administering this system.

In general, highways can be categorized as arterials, collectors or locals. However, depending on whether the route is considered urban or rural, the classifications are also broken down into smaller categories, e.g., rural principal arterial, rural minor arterial, rural major collectors and urban collectors. Additional information, as well as an inventory of the functional classifications of streets and highways in Ohio is available from the Systems Planning and Program Management website at http://www.dot.state.oh.us/Divisions/TransSysDev/ProgramMgt/Pages/default.aspx. The Office of Innovation, Partnerships and Energy maintains maps and road inventories of the system at http://www.dot.state.oh.us/Divisions/TransSysDev/Innovation/Prod_Services/Pages/default.aspx.

130-5 National Highway System (NHS)

The National Highway System (NHS) consists of interconnected urban and rural principal arterials and highways (including toll facilities) which serve major population centers, international border crossings, ports, airports, public transportation facilities, other intermodal transportation facilities and other major travel destinations. NHS routes meet national defense requirements and serve interstate and interregional travel. All routes on the Interstate System are a part of the NHS.

The NHS includes the Strategic Highway Corridor Network (STRAHNET) and its highway connectors to major military installations. The STRAHNET includes highways which are important to the United States strategic defense policy and which provide defense access, continuity, and emergency capabilities for the movement of personnel, materials and equipment in both peace time and war time.

The NHS includes all high-priority corridors identified in Section 1105(c) of the ISTEA. It is not permitted to exceed 178,250 miles (286,983 kilometers). Most of the state highway system is on this national network; however, to identify specific routes on this system, contact the Office of Innovation, Partnerships and Energy.

130-6 Access Management

Access is critical to the usefulness of any transportation system. However, the combination of increasing travel demands and an increasing demand for access points (intersections and driveways) along the highways can result in increased congestion and delay, and can contribute to an increase in accidents. By controlling access to our highway system, a better balance can be achieved between these competing demands.

ODOT has developed an Access Management Program based on the functional classification of roadways (Section 130-4). The program is administered by Central Office with input from the Districts. The State Highway Access Management Manual (see Section 194-17) was developed to support this program. It is available from the Office of Roadway Engineering website (http://www.dot.state.oh.us/Divisions/ProdMgt/Roadway/Pages/default.aspx). The purpose of this program and the manual is to establish uniform permit procedures for use in considering requests for new or revised highway access.

Access management involves many areas of concern, including planning, design, construction, maintenance and traffic operations. Anyone expected to address traffic operations concerns
should become familiar with the permit procedures and best practice information contained in the Access Management Manual.

130-7 Railroads and Highway-Rail Grade Crossings

The presence of a railroad within a project creates an area where specific planning is necessary in order to successfully complete a project. Generally, railroads have very specific requirements in regards to working within their property, commonly referred to as the right-of-way. Access is granted through an agreement intended for such purpose and may impact many stakeholders including ODOT, local agencies, engineering firms and contractors. Many of the requirements are imposed upon the railroad by the Federal Railroad Administration and for which the railroad has no authority to grant a waiver or exception. These include items such as working distance from an active track, flagging, protection of train moves, railroad protective insurance, etc. Each of the parties involved in the project will usually be required to execute an agreement prior to having access to the right-of-way. Time must be allocated for execution of agreements as well as funding for railroad work.

When a project involves a highway-rail grade crossing, it requires attention from the beginning of the project to properly plan for railroad related costs. Any work regarding surface or signal improvements will require coordination with the railroad which will result in the production of an estimate of cost for the proposed improvements. The process adds time and complexity whenever a traffic signal is located within the distance from the crossing that preemption and interconnection with the railroad warning system is required. In some cases, the cost of the railroad signal work may well exceed the cost of the entire signal project. The Ohio Rail Development Commission and the Public Utilities Commission of Ohio are both valuable assets to assist with railroad coordination. Refer to TEM Part 800 for additional information required to properly plan for projects which require railroad signal work.
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140 DESIGN INFORMATION

140-1 General

This Chapter addresses information related to traffic control design in general. Design information related to specific areas of traffic control is located in the individual TEM Parts.

140-2 Traffic Control Plan Requirements

140-2.1 General

Submissions of traffic control plans shall conform to the requirements noted herein.

140-2.2 Base Plan Scale

The Base Plan shall consist of two parts:

1. Part A, to a scale of 1" = 200' (1:2000) or 1" = 100' (1:1000) continuous for the entire project, shall show all proposed roadways and connections to existing construction.

2. Part B of the Base Plan shall show supplemental coverage to a minimum scale of 1" = 50' (1:500) for all interchanged crossroads and mainline at-grade intersections, and for other critical at-grade intersections in urban areas.

On some projects, particularly in urban areas, it may be more efficient to show the entire project on one plan at 1" = 50' (1:500) or 1" = 20' (1:200) scale.

Information on traffic signal Base Plans is contained in Section 441-2.

140-2.3 Plan Information

Base Plans shall contain the following design information:

1. Clearly defined pavement edges, speed change lanes, ramps, transitions, raised medians, islands and bridge structures on mainline, ramps and crossroads.

2. Number of lanes on each roadway, shown by directional arrows (one for each lane); and lane widths (plans should show all lane widths).

3. Pavement width at each overhead sign support spanning the roadway at a location not conforming to the typical roadway section.

4. Location of proposed traffic control devices, using the OMUTCD as a guide. Plan symbols, levels, weights and colors for CADD drawings shall conform to standards contained in the CADD Engineering Standards Manual.
   a. Proposed sign legends at each sign location. All the Regulatory and Warning Signs proposed for the crossroads or at-grade intersections may be shown on Part B.
   b. For Part A show pavement marking at merging, diverging or intersecting roadways. Show painted gore stations for merging and diverging roadways. For Part B, complete pavement marking should be shown.
   c. Indicate "Signalized Intersection," if existing or proposed.
   d. Other special devices that may be required.
140-2.4 Miscellaneous Data

Each submission should include:

1. Existing overhead electrical and communication lines.

2. Underground utility facilities as required by ORC Section 153.64. "Underground utility facilities" includes any item buried or placed below ground or submerged under water for use in connection with the storage or conveyance of water or sewage; or electronic, telephonic, or telegraphic communications; electricity; electric energy; petroleum products; manufactured, mixed, or natural gas; synthetic or liquefied natural gas; propane gas; or other substances. "Underground utility facilities" includes, but is not limited to, all operational underground pipes, sewers, tubing, conduits, cables, valves, lines, wires, manholes, and attachments…"

3. Available power source service points and poles available.

4. Location of existing traffic control items and ownership in the project area (this can be a separate plan and/or listing).

5. Corporation lines.

6. Right-of-way lines.

140-2.5 Supplemental Plan Information

Each submission shall be accompanied by one print of each of the following:

1. Roadway profiles for all roadways within the project showing vertical clearance at grade separations (i.e., copy of line and grade submission, as approved).

2. Typical sections for all roadways within project.

140-2.6 Supplemental Design Information

Each submission shall include a summary or checklist addressing the following items:

1. Signs.

   a. Level of signing proposed, ground mounted or overhead.

   b. Comment or indication on the Base Plan whether signs or other traffic control devices on adjoining projects under construction, or open to traffic, should be revised to fit the traffic pattern change resulting from the proposed project.

2. Highway lighting.

   Extent of lighting proposed to be installed for the project, or status of determination; and type of voltages available.


   a. A review of traffic volumes at each intersection shall be made to determine the possible need for traffic signals.

   b. If the geometric design is predicated on signalization (submit statement to this effect) or a review of volumes reveals the need, an analysis of traffic signal warrants...
(OMUTCD Chapter 4C) shall be made for the intersection, based on the traffic projected to the estimated construction completion year.

c. If signals are warranted, a warrant analysis for each intersection shall be submitted along with capacity analysis.

d. Indication of location and reason for any temporary signalization that may be required for traffic control during construction.

e. If any existing traffic signals are affected by the proposed project, furnish complete information on the existing signal to the extent possible, including type of controller, location of poles, type of poles, ownership of poles, signal heads, detectors, etc.

4. Miscellaneous Data

a. Design Year, Design Speed, Legal Speed Limit and Directional Design Hourly Volume for all roadways. At intersections show all through and turning volumes.

b. A list of all design exceptions.

140-2.7 Reuse of Equipment

Any signs or overhead sign supports to be reused should be indicated on the plans. Ground-mounted supports may be reused in place, but shall not be removed and re-erected. Any decision to reuse existing equipment must be based on a field check of the structural integrity and condition of the devices.

140-3 Designer Notes

As deemed necessary, Designer Notes are prepared to help define the intended use of SCDs and Plan Notes. The information is also addressed in Chapter x41 (Plan Preparation / Production), where x is the related TEM Part number. Designer Notes related specifically to the use of the Plan Notes are located in this Manual with the individual Plan Notes (Section 140-4).

140-4 Plan Notes

Plan Notes for Maintenance of Traffic concerns and other traffic control items are currently in Chapter x42 (where x is the Part number) in each Part.

140-5 Plan Detail Sheets

Plan Detail Sheets are similar to Traffic Plan Insert Sheets, but are prepared for use in a specific plan (see Chapter 104).

140-6 Estimating

Compilations of previous Contract Bid Item information are available for use. The Office of Estimating should be contacted for any additional information needed on estimating.

140-7 Review Submissions

As part of the Project Development Process (see Section 194-21), the following traffic control design submissions may be required:

a. Maintenance of Traffic Alternative Analysis (MOTAA) including Queue Analysis (for interstate or interstate look-alikes) (see Section 630-5).

b. Documentation of highway lighting considerations and warrants (see Chapter 1103).

c. Maintenance of Traffic investigations (for non-interstate or non-interstate look-alikes).

d. Lane Closure Exception Request (MOTEC), if necessary per Policy 516-003(P) (see Section 601-2).

e. Signal warrants (see Chapter 402). This submission, based upon an analysis of traffic counts, traffic projections, pedestrian information, intersection geometrics and physical conditions, speeds, gaps, delay data and accident history is prepared according to the requirements of the Ohio Manual of Uniform Traffic Control Devices (OMUTCD). It is intended to determine locations where traffic signals are justified. New traffic signals, or significant modifications to existing signals, will not be included in contract plans unless acceptably justified.

f. Documentation of Proprietary Bid Justification (see Section 120-4).

g. Documentation of alternate bid considerations for signal and lighting equipment (see Section 120-7).

2. Stage 1 Design – Task 2.7 – ITS Systems Engineering Analysis (see Section 1301-3).

3. Stage 2 Design – Task 3.3.

This submission is intended to present a complete concept of how traffic control devices (signing, signals, markings, highway lighting and maintenance of traffic) will control traffic in relation to the roadway geometric design, physical conditions, traffic characteristics, and the surrounding environment. These submissions portray the type, approximate locations, size, color, shape, legend and operational characteristics of the proposed traffic control devices. These concepts, applications and preliminary designs shall be in accord with the OMUTCD. They should also conform to the criteria and recommendations of the ODOT Construction and Material Specifications, SCDs, and TEM, as well as other current publications dealing with the proper use of traffic control devices.

a. Maintenance of Traffic sequence of operations and local alternated detour notes.

b. Maintenance of Traffic Phasing Plans including:

   i. Location of proposed work, by phase.

   ii. Existing and maintenance of traffic signing and pavement marking.

   iii. Median crossovers.

   iv. Channelizing devices (e.g., barriers, drums).

   v. Work zone lane widths.

   vi. Pavement for maintaining traffic.

   vii. Sections showing existing and proposed pavement and lane widths.

   viii. Crash cushions.
c. Detour map.

d. Pavement Marking and Signing Plan Sheets *(see Chapter 211 and Sections 240-8, 340-2 and 341-2)* with SignCad files on a CD *(see Section 211-4)*.

e. Signal Plan sheets *(see Section 440-7)*.
   i. SWISS files on a CD *(see Section 440-5)*.
   ii. Synchro files on a CD *(see Section 440-6)*.

f. Lighting Plan sheets *(see Chapter 1141)*.

4. Stage 3 Detailed Design – Task 4.2

   These are a complete set of construction plans, submitted as ready for Contract Sales *(see Sections 240-8, 340-2 and 440-7 and Chapter 1141)*. It contains, or properly refers to, all information and details necessary to furnish, erect and complete the required traffic control devices. It includes notes, details, calculations, specifications, quantities and information on payment and other contractual obligations.

140-8 Salvage of Project Materials

The costs associated with delivery of salvaged project materials are eligible for Federal funds. The contractor may be directed to deliver the salvaged items to a maintaining agency’s facility. The facility shall be located a limited distance from the project; within the same County for an ODOT project.

If the maintaining agency elects not to have the salvaged materials delivered, the contractor shall be directed to temporarily store salvaged project materials on site for pick-up by the maintaining agency. If the maintaining agency does not pick up the materials within the designated time period with their own forces, then the materials shall become the property of the contractor.

140-9 Spare Parts

Spare parts purchased as part of a project are not eligible for Federal participation.
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150 CONSTRUCTION

150-1 General

The CMS, together with the plans and Proposal, constitute the contract for the performance of required work. It is the legal and technical document by which ODOT bids and constructs highway projects. Traffic control provisions in these documents are required to be in conformance with the OUMTCD.

Temporary traffic control issues are addressed in Part 6 of this Manual. Other construction issues that are related to specific areas of traffic engineering are addressed in the applicable TEM Parts.

Although the related information provided in individual TEM Parts is intended to serve as a guide for construction personnel where the contractor furnishes and installs traffic control devices, it may also be useful for maintenance personnel performing the same functions. Typically, inspection procedures for the various types of traffic control devices are outlined to assist project personnel in performing their duties. The information points out the various important features of each device and references the applicable specification or standard drawing. Illustrations are often used for easy recognition of the device or feature being discussed.

150-2 Pre-Construction Conference

During the Pre-Construction Conference held for the project the following items relative to traffic control devices may be reviewed:

1. Inspection of signs, supports and other traffic control devices.
2. Traffic control devices for maintaining traffic.
3. Certifications of sign and signal supports.
4. Approval requirements for catalog cuts of traffic control devices.
5. Delivery schedule of traffic control devices.
6. Storage and special care for traffic control devices.
7. Plans for maintenance of traffic.
8. Staking of foundations for sign and signal supports and pull boxes.
9. Location of overhead utilities and underground facilities.
10. Coordination required with utilities for necessary relocations and attachments to their facilities.
11. Sequence of construction for traffic control devices.
12. Coordination required with local agencies for erection of new devices and removal or relocation of existing devices.
13. Work by other contractors and agencies.
14. Layout procedure for pavement markings.
15. Visibility inspection of traffic control devices.
16. Partial and final acceptance and opening to the motoring public.

150-3 Local Government Agency / Utility Force Account Work

150-3.1 General

Procedures for administering force account work (see Section 1501-3) associated with an active construction project are described herein, and they are also shown as a flow chart in Figure 198-4.

Federal procedures for requesting approval of force account work are contained in the Federal-Aid Policy Guide, Subchapter G, Part 635, Subpart B. This guide is available in the ODOT Library.

150-3.2 Procedure

Force account proposals shall be submitted and evaluated prior to PS&E so that funds can be encumbered in a timely manner.

The agency proposing to perform the work shall submit the following information to the appropriate District for review and approval:

1. A Force Account Proposal documenting the work to be performed and why. It should include a detailed work description, an estimate, and explanation of the need for the work and why it is best performed by the force account method.

2. Plan Drawings that are clear enough to be followed by an engineer not familiar with the project. They shall define the extent and details of the necessary work, and they should include or refer to standards of quality which the work must meet (i.e., ODOT Specifications, Ohio Manual of Uniform Traffic Control Devices, National Electric Code, National Electric Safety Code, etc.)

3. A cost comparison which includes a comparison between the agency’s proposed cost and the cost of having the work performed by the contractor.

In order to be approved, the above submittal must show that the force account method is cost effective assuring the lowest overall cost.

The District shall: review the submittal; and if it finds the proposal and other documentation to be acceptable, draft a tentative agreement between ODOT and the requesting agency. The agreement shall be sent to the requesting agency for signature.

In the case of Federally funded projects, which are not Certified Acceptance Projects, the request, including the draft agreement, shall be sent to FHWA for concurrence.

Upon its return, the agreement shall be sent to the Office of Project Coordination which will arrange to obtain the Director’s signature. As part of the transmittal IOC to the Office of Estimating, an encumbrance number shall be requested for the force account work. The IOC shall also contain the estimated cost associated with the force account work.

After the agreement is signed and an encumbrance number assigned, the District shall return a copy of the executed agreement along with formal approval of the proposal to the agency.

At such time as the work is being performed, the responsible agency will submit its billings to the District for review and approval. If the charges are reasonable and are in conformance with the proposal, they shall be forwarded to the District Business and Human Services Administrator for payment.
160 MAINTENANCE / OPERATIONS

As needed, specific operational issues will be addressed in the related TEM Parts. In general, it is intended that, when included, these issues will be addressed in Chapters numbered in the x60’s, where x is the TEM Part number.

Although the construction information provided in the individual Parts (in Chapters numbered in the x50s, where x is the TEM Part number) is intended to serve as a guide for construction personnel where the contractor furnishes and installs traffic control devices, it may also be useful for maintenance personnel performing the same functions. Typically, inspection procedures for the various types of traffic control devices are outlined to assist project personnel in performing their duties. The information points out the various important features of each device and references the applicable specification or standard drawing. Illustrations are often used for easy recognition of the device or feature being discussed.

ODOT personnel performing work involving signing, traffic signals, lighting, markings or maintenance of traffic are required to comply with the requirements of the MUTCD. Other requirements, such as ODOT policies, standards, procedures, etc. that are related to specific areas of traffic engineering will be addressed in the applicable TEM Parts.

The CMS and the SCDs should be used by ODOT operational forces as directed by this Manual and at other times when considered appropriate. They provide a wealth of information on construction requirements, materials and details that should prove helpful in the performance of maintenance, upgrading, removal and inspection of traffic control devices. However, it should be recognized that the information in the CMS and the SCDs is designed for contract work and does not necessarily provide the only acceptable method or materials to achieve a given objective.

ODOT has established statewide practices and procedures to provide acceptable operating conditions for preventive maintenance. Policy 22-007(P), Preventive Maintenance Policy addresses many activities, including raised pavement markers, electrical traffic control devices, signing and highway lighting (see Chapter 1512).
170 OTHER CONSIDERATIONS

Depending on the specifics of a particular location, various special considerations, such as pedestrians, bicycles, motorcycles, public transit vehicles, commercial vehicles, airports and waterways, may have to be addressed in developing traffic control standards. As needed, we will incorporate information on these concerns within the individual Parts of this Manual.

180 RESEARCH

This Chapter in each TEM Part has been reserved to document pertinent research information.

OMUTCD Section 1A.10 prohibits the design, application and placement of traffic control devices other than those adopted in the OMUTCD unless the provisions of Section 1A.10 are followed. All such requests are sent to FHWA. For ODOT, the Office of Traffic Engineering (OTE) coordinates this process. Local authorities submit such requests to FHWA with a copy to the OTE Administrator.
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193 NATIONAL REFERENCE RESOURCES

193-1 General

This Chapter provides a brief description of related national publications, and how they apply to ODOT projects and work. A copy of many of these publications can be found in OTE and the ODOT Library. Copies of these publications can be ordered by contacting the agency or organization publishing the document. For documents published by FHWA, contact the Government Printing Office (GPO). See Table 197-1 for contact information for the GPO and other resource agencies and organizations.

The following publications have been listed generally in alphabetical order; however, for convenience later additions to the list may be added to the end of the group, rather than renumbering all other entries.


A Policy on Geometric Design of Highways and Streets, published by the American Association of State Highway and Transportation Officials (AASHTO) and commonly known as the AASHTO Design Guide or the “Green Book,” discusses the nationwide policies, practices and criteria for the geometric design of highways and streets. It is intended to present a consensus view on the most widely accepted approach to the design of a variety of geometric design elements including design speed, horizontal and vertical alignment, cross section widths, intersections and interchanges.

The geometric design treatments addressed in the ODOT L&D Manuals are based, at least in part, on the AASHTO Design Guide.

193-3 ADA Accessibility Guidelines for Buildings and Facilities

The ADA Accessibility Guidelines for Building and Facilities, published by the U.S. Architectural and Transportation Barrier Compliance Board, presents the nationwide accessibility criteria to buildings and facilities for individuals with disabilities. The basic objective of this document is to establish the criteria mandated by the Americans with Disabilities Act (ADA) of 1990. It provides accessibility criteria for both interior and exterior facilities, including parking spaces, sidewalks, hallways, doorways, curb ramps, ramps, stairs, telephones, drinking fountains, rest rooms, elevators, etc. These guidelines can be accessed on the web at the address noted in Table 197-1.

The Code of Federal Regulations (CFR) 49 Transportation contains the most current version of ADA Accessibility Guidelines.

193-4 Roadway Lighting Design Guide

The Roadway Lighting Design Guide, published by AASHTO, replaces the 1984 publication entitled An Informational Guide for Roadway Lighting. It has been revised and brought up to date to reflect current practices in roadway lighting. The guide provides a general overview of lighting systems from the point of view of the transportation departments and recommends minimum levels of quality. The guide incorporates the illuminance and luminance design methods, but does not include the small target visibility (STV) method.

The TEM addresses highway lighting in Part 11. The highway lighting criteria in that Part are based on this AASHTO publication and other documents, and tailored to the prevailing practices and conditions in Ohio. Also, the TEM is intended to clarify, where needed, the issues presented in this AASHTO publication and to discuss lighting information not included in it.
193-5 **Guide for the Development of Bicycle Facilities**

The AASHTO Guide for the Development of Bicycle provides information on the development of new facilities to enhance and encourage safe bicycle travel. Planning considerations, design and construction guidelines, and operation and maintenance recommendations are included.

193-6 **PCMS Handbook**

The ATSSA publication entitled PCMS Handbook is a 34-page pocket size on-the-job reference source which presents basic guidelines for the proper use of the portable changeable message sign (PCMS). Designed to withstand heavy usage, the handbook provides practitioners with succinct information on PCMS usage, screen characteristics, message design, placement as well as other operational issues.

193-7 **Highway Capacity Manual (HCM)**

The Highway Capacity Manual (HCM), published by the Transportation Research Board (TRB), presents the nationwide criteria for capacity analyses for highway projects. The HCM includes methodologies for freeways, weaving areas, freeway/ramp junctions, two-way two-lane facilities, signalized intersections, non-signalized intersections, etc. HCM 2010 also is available on a CD-ROM, which adds tutorials, narrated example problems, explanatory videos, navigation tools, and hyperlinks between sections.

ODOT uses the HCM for capacity analyses with some adjustments for local factors. Contact the Office of Innovation, Partnerships and Energy for further information.

193-8 **Manual of Traffic Signal Design**

The Manual of Traffic Signal Design, published by the Institute of Transportation Engineers (ITE), presents fundamental concepts and standard practices related to traffic signal design commensurate with the state of the art. It contains information on operational requirements, signal display and design configuration, traffic signal controllers, detectors, wiring, cabling, signal timing, etc.

This manual may be used by designers for additional guidance on design elements not addressed in the TEM.

193-9 **Manual of Transportation Engineering Studies**

The Manual of Transportation Engineering Studies, published by ITE, shows in detail how to conduct several transportation engineering studies in the field; discusses experimental design, survey design, statistical analyses, data presentation techniques, and report writing concepts; and provides guidelines for both oral and written presentation of study results. Useful forms for various transportation studies are included.

Sections 130-2, 1203-3 and 1204-3 of the TEM address engineering studies. For additional guidance on the actual procedures for conducting these studies, the designer may reference the ITE manual.

193-10 **Manual on Uniform Traffic Control Devices (MUTCD)**

193-10.1 **General**

As noted in Section 100-1.2, the Manual on Uniform Traffic Control Devices (MUTCD), published by FHWA, in coordination with the National Committee on Uniform Traffic Control Devices (NCUTCD), presents nationwide criteria for the selection, design and placement of signs, pavement markings, traffic signals, temporary traffic control, and
traffic controls for school areas, highway-rail grade crossings, bicycle facilities, and highway-light rail transit grade crossings. The basic objective of the MUTCD is to establish effective means to convey traffic control information to the driver for uniform nationwide application.

**ORC Section 4511.09** requires ODOT to adopt a manual which conforms as much as possible to this national MUTCD. The OMUTCD is that manual (see Chapter 101). In Ohio, the MUTCD is basically a resource manual which supports the OMUTCD.

### 193-10.2 MUTCD Review Process

Proposed changes to the national standards in the MUTCD are published by FHWA using the Federal Register Docket system. The OTE Standards Section is responsible for coordinating ODOT’s review of these proposals. Comments are solicited from the Districts and related offices in Central Office, as well as others outside ODOT, as appropriate. A response is prepared by the Standards Section.

Proposed changes to the national standards are also reviewed by the National Committee on Uniform Traffic Control Devices (NCUTCD). As a member of this committee, AASHTO periodically circulates Ballots to its member agencies, including ODOT, to solicit comments on proposed changes that have been posted in the Docket, as well as other proposed changes its technical subcommittees may be reviewing. As with the Docket proposals, the OTE Standards Section is responsible for coordinating ODOT’s review and preparing the response to the AASHTO Ballots.

### 193-11 Railroad Grade Separation Program Policies and Procedures Manual

The Railroad Grade Separation Program was created in 2000 as a ten-year program to construct grade separations to mitigate the negative impacts of the most heavily congested rail lines which resulted in blocked grade crossings and numerous problems for communities. The manual is available in the ODOT Library.

### 193-12 Railroad-Highway Grade Crossing Handbook

The Railroad-Highway Grade Crossing Handbook, published by FHWA, presents guidelines for prioritizing improvements to highway-rail grade crossings and information on the various types of improvements that can be made to the crossing. This handbook provides formulas which can be used to determine the risk at the crossing, to identify locations in need of improvement and to prioritize hazardous locations which are scattered throughout the State. Also, various types of at-grade crossing improvements are described including: active warning devices, passive warning devices, sight distance improvements, operational improvements, and crossing surface improvements. Grade separations or crossing closures are suggested as improvement solutions where either extremely high or low demand for the crossing exists. The ultimate choice for a crossing improvement is determined by balancing the benefits in accident reduction and reduced user costs against costs for the improvement. Procedures, models and computer programs which will assist making these selections are described.

### 193-13 Roadside Design Guide

The Roadside Design Guide (RDG), published by AASHTO is a synthesis of current information and operating practices related to roadside safety presented both in metric and U.S. customary units. It focuses on safety treatments that can minimize the likelihood of serious injuries when a motorist leaves the roadway.

The OMUTCD, the TEM and the L&D Manuals address roadside safety issues. The roadside safety criteria are generally based on the criteria presented in the Roadside Design Guide.
193-14 Roadway Lighting Handbook

The Roadway Lighting Handbook, published by FHWA in 1978, presents guidance in the planning, design, operation and maintenance of roadway lighting systems. It is intended to present a consensus view on the most widely accepted approach to providing a reasonable roadway lighting system. The Roadway Lighting Handbook discusses warrants for roadway lighting, selecting lighting equipment, selecting lighting system configurations, designing the lighting system using both the illuminance techniques, designing the lighting hardware, operating and maintaining the lighting system and analyzing its economics.

The TEM addresses highway lighting in Part 11. The lighting criteria in it are based on the criteria presented in the Roadway Lighting Handbook and other documents. They are tailored to meet the prevailing practices and conditions in Ohio.

193-15 Standard Highway Signs and Markings Book

The Standard Highway Signs and Markings book, published by FHWA, presents criteria for presenting and laying out information on highway signs. It is to be used in conjunction with the MUTCD. Dimensions are provided for the borders, symbols, words and overall sign outline based on the sign size. Symbols which are used on signs are provided on grids to allow the designer to change the symbol size and yet present it in proper proportion.

Information that was formerly published separately regarding the FHWA standard alphabets for highway signs and pavement markings has been incorporated into the Standard Highway Signs and Markings book in Chapters 9 and 10 of that manual. Chapter 9 presents criteria for determining the width, height, spacing and stroke widths for letters and numerals for use on highway signs. Values for signs are provided for letter Series B, C, D, E, E(M) and F. Chapter 10 provides guidelines for pavement marking symbols including turn arrows, freeway/ramp arrows, preferential lane symbols, railroad crossing symbols and bicycle symbols.

ODOT has adopted the information found in Chapters 9 and 10 of the Standard Highway Signs and Markings book for all of its signs and pavement markings. TEM Parts 2 and 3 and the SCDs provide additional guidance on the application of letters and numerals on the highway signs and pavement markings.

In Ohio, the Standard Highway Signs and Markings book is currently used as a reference resource for the design and layout of all signs. Designs shown in the Sign Designs and Markings Manual (SDMM) (see Section 295-2) include some which are basically duplicates of those in the Standard Highway Signs and Markings book and others developed by ODOT.

193-16 Traffic Control Devices Handbook (TCDH)

The Traffic Control Devices Handbook (TCDH), published by ITE, provides guidance and information to implement the provisions of the MUTCD. The objective of the handbook is to bridge the gap between the MUTCD requirements and field applications. Additional guidance is provided on the MUTCD requirements to clarify these Manual provisions. The information is specifically written for smaller jurisdictions, replacing the need for outside technical expertise. It is meant as guidance material to assist in determining the appropriate device(s) for a specific condition based on judgment and/or study.

193-17 Traffic Engineering Handbook

The Traffic Engineering Handbook, published by ITE, provides a current, updated source of information for people entering the practice and for those already practicing. It is a reference for state-of-the-art of established traffic engineering practice and a primary reference sources for study to become certified as a Professional Traffic Operations Engineer. It provides a convenient desk reference of the principles and proven techniques in traffic engineering. Where appropriate,
reference is made to significant traffic engineering practice outside North America. Updated chapters include Introduction to Traffic Engineering; Road Users; Vehicles; Traffic and Flow Characteristics; Community Safety; Traffic Regulation and Control; Geometric Design of Highways; Traffic Signs and Markings; Traffic Control Signals; Parking and Terminals; Traffic Management; and Intelligent Transportation Systems. Four new chapters have been added that address Statistics for Engineers; Public Involvement; Traffic Calming; and Access Management.

This handbook may be used by the designer for additional guidance on design elements not addressed in the TEM.

193-18 Trip Generation

Trip Generation, published by ITE, provides guidance for various types of traffic generators. It contains data from more than 4,250 individual trip generation studies and provides information on multi-use projects and pass-by trips. It includes trip generation data for commercial development, office development, residential, etc. New land uses include: assisted living; continuing care retirement community; batting cages; adult cabaret; multiplex movie theater; soccer fields; athletic club; private school (kindergarten to grade 8); baby superstore; pet supply superstore; office supply superstore; book superstore; discount home furnishing superstore; arts and craft store; automobile parts and service center; and automated car wash.

Unless local data is available or where a developer can substantiate its basis, ODOT requires that all traffic impact analyses use the ITE Trip Generation data.

193-19 Tunnel Lighting ANSI Approved (RP-22-11)

The information in the Illuminating Engineering Society’s Recommended Practice Tunnel Lighting (RP-22-11) assists engineers and designers in determining lighting needs, recommending solutions, and evaluating resulting visibility at tunnel approaches and interiors. The designer’s task is not simple, particularly for a new tunnel, when only partial information about the portal and about the approach roads is available. Important variables include geographic orientation, geometric design, traffic volume and speed, service levels, light source used and modes of light application. The design criteria and procedures included in this Recommended Practice (RP) are based on theory and on information drawn from practical experience and engineering judgment.

193-20 American National Standard Practice for Roadway Lighting (RP-8-00)

This Recommended Practice (RP) for Roadway Lighting (RP-8-00) provides the design basis for lighting roadways, adjacent bikeways and pedestrian ways. It deals entirely with lighting and does not give advice on construction. It is not intended to be applied to existing lighting systems until such systems are redesigned. Roadway lighting is intended to produce quick, accurate and comfortable vision at night that will safeguard, facilitate, and encourage vehicular and pedestrian traffic. The proper use of roadway lighting is also associated here with certain economic and social benefits including a reduction in nighttime accidents, aid to the police, facilitation of traffic flow, and the promotion of business during nighttime hours.

Following an introduction that covers background material on the design criteria, there are three general subject areas discussed in this RP: classification definitions that carefully define key words and concepts as they are used in the RP, with caveats regarding alternate definitions found elsewhere; design criteria that thoroughly analyzes and illustrates the design process involving illuminance, luminance and small target visibility (STV); and design considerations that identify major roadway issues (rural and urban) affecting driver visibility, discuss design aesthetics (coordination of light poles with landscaping), and address public scrutiny of glare and sky glow that can lead to lighting ordinances.
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194  ODOT REFERENCE RESOURCES

194-1  General

ODOT traffic engineering information and publications have been addressed in Chapters 101 through 106 and 195. ODOT also has various other publications which may provide needed or useful information for traffic engineering projects or studies. This Chapter briefly discusses these ODOT publications maintained by Offices other than OTE.

ODOT’s design-related publications are also listed on the Design Reference Resource Center (DRRC) website, http://www.dot.state.oh.us/drcc. When posted electronically, the references are also available by hyperlink from the DRRC website (see Table 197-1). Some of these publications can be ordered through the responsible Office or the Office of Contracts (see Table 197-8); however, some may be available only from the website.

The following publications have been listed generally in alphabetical order; however, for convenience later additions to the list may be added to the end of the group, rather than renumbering all other entries.

194-2  9 Step Transportation Development Process

This process has been replaced with ODOT’s Project Development Process (see Sections 140-7 and 194-21) which includes the Environmental Process Manual from the Office of Environmental Services.

194-3  Bridge Design Manual

The Office of Structural Engineering publishes the Bridge Design Manual. The purpose of this manual, and its addendum, is to provide general guidelines, procedures and instructions, for the design and preparation of bridge plans and specifications for ODOT. The manual includes information on preliminary and detail design, structure rehabilitation and repair, general and detail Plan Notes, temporary structures, noise barriers and bridge structure ratings. This manual is available only on-line from the DRRC web site.

194-4  Construction and Materials Specifications

The specifications used in ODOT contract plans are contained in the CMS and Supplemental Specifications published on the web site and discussed earlier in Chapter 105.

194-5  Consultant Contract Administration Manual

The Consultant Contract Administration Manual is intended to provide uniform guidelines for ODOT employees to follow in administering contractual agreements between ODOT and consultants who are hired to provide technical services. These services include, but are not limited to environmental studies, design and plan preparation, construction inspection, bridge inspection and right-of-way acquisition. Also see the Specifications for Consulting Engineers described in Section 194-11.

194-6  L&D Manual Volume One - Roadway Design

This manual is intended to establish uniform procedures for implementing design decisions, assure quality and continuity in design of state highways, and assure compliance with Federal criteria. The manual is considered a primary source of reference by ODOT roadway design personnel; however, as noted in the Preface of the manual “it must be recognized that the practices suggested in it may be inappropriate for some projects because of fiscal limitations or other reasons.” Also, design standards adopted by city, county or other local agencies must be taken into consideration on projects under their jurisdiction. This manual is available only on-line from the DRRC web site.

194-7  **L&D Manual Volume Two - Drainage Design**

The purpose of **L&D Manual Volume Two - Drainage Design**, published by the Office of Structural Engineering, is to provide guidance for the hydraulic design of highway drainage features. As noted in the Preface of the manual, adhering to the recommended design procedures and controls outlined in the manual should result in drainage facilities that will not cause: “a) damaging flooding of private property; b) undue inconvenience to the motorist during moderate to heavy rainfall; [or] c) undue disturbance to the environment.”

This manual is intended to establish uniform procedures for implementing drainage design decisions, assure quality and continuity in design of state highways, and assure compliance with Federal criteria. The manual is considered a primary source of reference by ODOT roadway design personnel; however, as noted in the Preface of the manual “it must be recognized that the practices suggested in it may be inappropriate for some projects because of fiscal limitations or other reasons.” Also, design standards adopted by city, county or other local agencies must be taken into consideration on projects under their jurisdiction. This manual is available only on-line from the DRRC web site.

194-8  **L&D Manual Volume Three - Highway Plans**

The purpose of **L&D Manual Volume Three - Highway Plans**, published by the Office of Production, is to standardize the form and process for ODOT highway plan preparation. However, it is also recognized that many projects will involve unusual circumstances requiring deviations from the manual guidelines. This manual is available only on-line from the DRRC web site.

194-9  **Manual of Procedures for Construction Inspection**

The manual addresses procedures in various areas of construction, e.g., concrete, earthwork, flexible pavement, rigid pavement, structures and pipe. It is intended to serve as a guide to the engineer and inspector during construction. Personnel need to have a thorough knowledge of the plans, specifications, proposal notes, and standard drawings. The manual does not in any manner alter or replace these governing regulations, but is a supplement to them. The normal sequence of inspection procedures are outlined to assist project personnel in performing their duties.

194-10  **Pavement Design Manual**

The purpose of the **Pavement Design Manual** is to bring all pavement design and rehabilitation procedures together in one document, reduce the selection of design variables to those most appropriate for Ohio, to document Ohio’s interpretation of various policies and to include design criteria which may be unique to Ohio.

Information in this manual is based on the results of the AASHTO Road Test, the AASHTO Guide for Design of Pavement Structures, FHWA guidelines and technical advisories, various training course manuals, as well as the experience of the authors. In addition, the application of other studies, experiences and engineering judgment have been included to fit Ohio’s conditions.
The pavement engineering concepts described are intended for use with all new or reconstruction projects, major and minor maintenance projects, and with all preventative maintenance projects, which are under the jurisdiction of ODOT.

194-11 Specifications for Consulting Engineers

The ORC authorizes the Director of Transportation to “employ consulting engineers and with the consent of the controlling board may enter into contracts for consulting engineering services...” The Specifications for Consulting Engineers is written from the standpoint of a contractual relationship between ODOT and a consultant. It includes definitions, general conditions, auditing and bidding aspects of all agreements, the consultant selection process, the agreement modification process, requirements for price proposals and explains preparation of consultant cost data for supporting documentation. The specifications are included by reference in each agreement, thereby substantially reducing the agreement text. Also see the Consultant Contract Administration Manual described in Section 194-5.

194-12 Specification for Subsurface Investigations

The purpose of the Specifications for Subsurface Investigations is to prescribe the policies, procedures and guidelines governing the performance of subsurface investigations of soil and rock related to highway design and construction for the State of Ohio.

The specifications define the scope of the various investigations, the engineering services to be rendered, and the responsibility for the direction and performance of the work. Guidelines are given for types of equipment utilized, methods of drilling and sampling, test procedures, presentation of field and laboratory information, and development of findings and recommendations.

194-13 Standard Bridge Drawings

Bridge standard drawings are published by the Office of Structural Engineering. They consist of SCDs, Plan Insert Sheets and Design Data Sheets. They include details for bridge railings, abutments, vandal protection, fence and approach slabs, etc.

194-14 Standard Roadway Construction Drawings

Roadway Standard Construction Drawings (Roadway SCDs) are published by the Office of Roadway Engineering. These drawings cover two specific areas: Roadway Design Features and Roadside Development. On the Office of Contract’s list, these drawing are currently referenced as “Standard Construction Drawings.”

194-15 Standard Pavement Construction Drawings

Pavement Standard Construction Drawings (Pavement SCDs) are maintained by the Office of Pavement Engineering. These drawings cover Pavement Design Features (BP Series).

194-16 Standard Hydraulic Construction Drawings

Hydraulic Standard Construction Drawings (Hydraulic SCDs) are maintained by the Office of Structural Engineering. These drawings cover Drainage Design Features.

194-17 State Highway Access Management Manual

The purpose of the State Highway Access Management Manual is to establish statewide uniform, equitable standards and procedures, prolong the service life of the state highway system, reduce public maintenance costs, promote orderly development, and maintain accessibility to adjacent land uses, and to accomplish all of this while preserving traffic mobility.
The manual establishes access classes, uniform permit application procedures, variance and appeal procedures, and change of use conditions. It provides for monitoring access construction. The manual also encourages local jurisdictions to develop access control plans consistent with ODOT and/or local access policies. See Section 130-6 for additional information.

194-18 Straight Line Diagrams (SLDs)

A Straight Line Diagram (SLD) is a two dimensional graphic representation of the physical roadway characteristics of a highway as if it had no turns or curves. Mileage is based on the centerline of the roadway as measured from the western or southern county line or other true beginning. All routes on the Interstate, U. S. and State Route Systems are shown on these diagrams. These diagrams are available at: http://www.dot.state.oh.us/Divisions/TransSysDev/Innovation/Prod_Services/SLD/Pages/default.aspx.

194-19 Supplemental Specifications

As noted in Section 105-1, Supplemental Specifications are part of ODOT’s construction and materials specifications. They are individual numbered documents describing the construction and material specifications for new items. These are available only on-line from the DRRC web site.

194-20 Supplements

As noted in Section 105-1, Supplements are part of ODOT’s construction and materials specifications. They provide necessary information such as laboratory methods of test, and certification or pre-qualification procedures for materials.

194-21 Project Development Process Manual

This manual is a product of the Department’s Strategic Initiative to “Improve the Quality of Construction Plans.” It was published in November 2004 by the Office of Production. It provides a detailed process designed to improve not only the quality of highway construction plans, but also the reliability of project delivery.

The PDP Manual is to be used on all newly scoped ODOT-let projects and ODOT-funded planning studies.

194-22 Ohio Interstate Exit Guide

This publication provides information about hotels, service stations and other attractions along Ohio’s Interstates. The publication is now available only from the website (see Table 197-1).
100 GENERAL  
Traffic Engineering Manual

195  OTE REFERENCE RESOURCES

195-1  General

Table 197-7 provides a consolidated list of all OTE publications. This Chapter provides brief descriptions of OTE publications/reference resources not discussed in detail in the earlier Sections of this Part.

195-2  Ohio Uniform Traffic Control Signs Wallchart

The Ohio Uniform Traffic Control Signs Wallchart (typically referred to as the Signs Wallchart or poster), although not a standard, provides a visual sampling of traffic signs. It has proved to be a popular tool for teaching children in school and for drivers' training classes. However, at this time we are out of stock of this publication and we are not sure when it will be available again. This Section and the reference in Table 197-7 will be updated when we again have copies of the Wallchart available.

195-3  Sign Designs and Markings Manual (SDMM)

Although published separately because of its size, the Sign Designs and Markings Manual (SDMM) has been incorporated into the TEM by reference, as Section 295-2. The SDMM contains standard Sign Designs, design guidelines and letter spacing information, for standard traffic control signs and major Guide Signs addressed in the OMUTCD and the TEM, as well as some additional signs that are not presently addressed in either of these manuals. The pavement marking alphabet and symbols are also provided. The SDMM is referenced in the OMUTCD and is used to assure uniformity in the design of standard traffic signs in Ohio. See Section 295-2 in Part 2 for further information about the SDMM, and view the SDMM on-line at http://www.dot.state.oh.us/Divisions/Operations/Traffic/publications2/SDM/Pages/default.aspx.

195-4  Pavement Marking Alphabet and Symbols

In keeping with the Standard Highway Signs and Markings book published by FHWA and OMUTCD Figure 3B-24, the FHWA pavement marking alphabet and symbols have been incorporated into the Sign Designs and Markings Manual (SDMM), as Appendix F.

195-5  Temporary Traffic Control Manual (TTCM)

Parts 1 (General), 5 (Low-Volume Roads) and 6 (Temporary Traffic Control) of the OMUTCD have been reprinted in a separate Temporary Traffic Control Manual (TTCM) to provide a convenient size copy of this information. See Section 695-2 for further information, and view this manual on-line at http://www.dot.state.oh.us/Divisions/Operations/Traffic/publications2/TTCM/Pages/default.aspx.

195-6  Guidelines for Traffic Control in Work Zones

This is basically a pocket-sized consolidation of information regarding temporary traffic control. The information is based on that in the Ohio Manual of Uniform Traffic Control Devices (OMUTCD), but some additional guidelines/handbook information is included. See Section 695-7 for additional information. The publication may be viewed on-line at: http://www.dot.state.oh.us/Divisions/Operations/Traffic/publications2/pocketguide/Pages/default.aspx.

195-7  Traffic Signal Maintenance Inspection Manual

The Traffic Signal Maintenance Inspection Manual (Section 495-2) outlines the performance measures for the Organizational Performance Index (OPI) for traffic signal maintenance performed by ODOT District forces.
195-8  **Quality Standards for Temporary Traffic Control Devices and Acceptable Delineation Methods for Vehicles**

This document sets standards for acceptability of conditions of temporary traffic control devices and addresses delineation methods for vehicles. This guide may be viewed on-line at: [http://www.dot.state.oh.us/Divisions/Operations/Traffic/publications2/qualityguidelines/Pages/default.aspx](http://www.dot.state.oh.us/Divisions/Operations/Traffic/publications2/qualityguidelines/Pages/default.aspx).

See *Section 695-4* for further information.
196 FORMS INDEX

196-1Change of Address Form

*Form 196-1* should be used to advise the OTE Standards Section of any changes in contact information. An electronic copy of this form is available on-line from the OTE Forms web page at [http://www.dot.state.oh.us/Divisions/Operations/Traffic/Pages/Forms.aspx](http://www.dot.state.oh.us/Divisions/Operations/Traffic/Pages/Forms.aspx).

196-2Revision Proposal Form

*Form 196-2* should be used to submit suggestions for revisions to OTE publications. When submitting a proposed change of text, it is helpful to include a marked-up copy of the existing text. See *Sections 101-5, 102-5, 103-5 and 104-4* for further details. This form is also available on-line at [http://www.dot.state.oh.us/Divisions/Operations/Traffic/Pages/Forms.aspx](http://www.dot.state.oh.us/Divisions/Operations/Traffic/Pages/Forms.aspx).

196-3Publications Order Form

*Form 196-3* may be used by a local jurisdiction or public agency to order OTE publications. An electronic copy of this form is available on-line from the OTE Forms web page at [http://www.dot.state.oh.us/Divisions/Operations/Traffic/Pages/Forms.aspx](http://www.dot.state.oh.us/Divisions/Operations/Traffic/Pages/Forms.aspx).

196-4Address Verification Form for OTE Publications

*Form 196-4* is a sample Address Verification Form included with those OTE publications for which a distribution list is currently maintained. This form serves to verify receipt of the publication, and when returned to the OTE Standards Section, is then used to update the list used to distribute notices and revisions of the publications. This form is also available on-line at [http://www.dot.state.oh.us/Divisions/Operations/Traffic/Pages/Forms.aspx](http://www.dot.state.oh.us/Divisions/Operations/Traffic/Pages/Forms.aspx).
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Form 196-1. Change of Address Form

In order for us to properly maintain our database for distribution of future notices/revisions of the Ohio Manual of Uniform Traffic Control Devices, please notify the Office of Traffic Engineering Traffic Control Section of any changes in your address.

Old Address —

Name and/or Title: ________________________________________________________________

Organization: ___________________________________________________________________

*Street Address: ___________________________________________________________________

City: __________________ State: ______ Zip Code: ________

Telephone: __________________ Fax: ____________________________

Email: _________________________________________________________________________

New Address – (show changes only)

Name and/or Title: ________________________________________________________________

Organization: ___________________________________________________________________

*Street Address: ___________________________________________________________________

City: __________________ State: ______ Zip Code: ________

Telephone: __________________ Fax: ____________________________

E-mail: _________________________________________________________________________

* If available, please provide street address, not a P.O. Box. Whenever possible we use UPS to ship our publications.

Please return the completed form by fax to (614) 644-8199, or by mail to:

Ohio Department of Transportation
Office of Traffic Engineering - Traffic Control Section
Attention: Traffic Standards Engineer
1980 West Broad Street
P.O. Box 899
Columbus, Ohio 43216-0899
Form 196-2. Revision Proposal Form

Name: __________________________________________ Date: ________________
Organization: ___________________________________________________________________
Street Address: ___________________________________________________________________
City: __________________ State: _______________ Zip Code: _____________
Telephone: __________________ Fax: ____________________
E-mail: __________________________________________________________________________
Publication(s): _________________________________________________________________
Section No./Title/Pg. Nos.: _______________________________________________________
Description and Justification for Proposed Revision: ________________________________
______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________

Continue on additional page(s) as necessary. Attach drawings, schematics, tables or other
information as needed for clarification and/or support of your proposed revision.

Check here if additional items are attached: ______

Please list other sections of this Manual or other ODOT manuals and/or Standard
Drawings that will be affected by the proposed revision (if known):
______________________________________________________________________________
______________________________________________________________________________

Please return the completed form by fax to (614) 644-8199, or by mail to:
Ohio Department of Transportation
Administrator, Office of Traffic Engineering
Attention: Traffic Standards Engineer
1980 West Broad Street
P.O. Box 899
Columbus, Ohio 43216-0899
Form 196-3. OTE Publication Order Form

Date ___________________

OTE PUBLICATION ORDER FORM
FOR
LOCAL JURISDICTIONS AND PUBLIC AGENCIES

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<tbody>
<tr>
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(To order the free publications, you may also contact Gerri Parker directly at 614-466-4700.)

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<tbody>
<tr>
<td>2012 Temporary Traffic Control Manual (TTCM) (Reprint of OMUTCD Parts 1, 5 and 6)</td>
<td>$7.50 *</td>
<td>_______</td>
</tr>
<tr>
<td>2012 Guidelines for Traffic Control in Work Zones (Pocket Guide)</td>
<td>$2.50 *</td>
<td>_______</td>
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</table>

(The TTCM and Pocket Guide may also be ordered directly from the Office of Contracts at 1-800-459-3778 or 614-466-3778.)

* Price per copy, plus sales tax and shipping based on quantities ordered.

Name: _____________________________________________________________________
Title: ___________________________________________________________________
Organization: ___________________________________________________________________
**Street Address _________________________________________________________________
City: ____________________________ State: ___________ Zip Code: _________________________________
Telephone: ___________________________________________________________________

** If available, please provide street address, not a P.O. Box. Whenever possible we use UPS to ship our publications.

Please return the completed form by fax to (614) 644-8199, or by mail to:

Ohio Department of Transportation
Office of Traffic Engineering - Traffic Control Section
Attention: Traffic Standards Engineer
1980 W. Broad Street
P.O. Box 899
Columbus, OH 43216-0899
Form 196-4.  OMUTCD Address Verification Form

To confirm receipt of this manual(s) and verify that we have your contact information correct, please complete this form and return it to:

Juanita Elliott, P.E., Traffic Standards Engineer
Office of Traffic Engineering
Ohio Department of Transportation
1980 W. Broad St.
P.O. Box 899
Columbus, OH 43216-0899

fax: 614-644-8199

Or email the following information to: Juanita.Elliott@dot.state.oh.us

<table>
<thead>
<tr>
<th>No. of Copies You Have of the OMUTCD (2012 Edition)</th>
</tr>
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</table>

Name and/or Title: ____________________________________________________________

Organization: ______________________________________________________________

Street Address: _____________________________________________________________

_________________________________________________________________________

Phone number: _____________________________________________________________

E-mail address: _____________________________________________________________

Questions/Comments? _______________________________________________________

_________________________________________________________________________

_________________________________________________________________________

_________________________________________________________________________

_________________________________________________________________________
197 TABLES INDEX

197-1 Resource Reference/Contact Information

As noted in Section 100-6, Table 197-3 provides contact information for various agencies and organizations (including ODOT), and other resource references that may be useful.

197-2 Ohio Counties and ODOT Districts

As noted in Section 100-5, Table 197-4 provides a list of the eighty-eight counties in Ohio with the three-letter designation used in ODOT records and cross-references to the related Districts.

197-3 SCD CADD Standards - Text Weight, Size and Font

As noted in Section 103-3.4, Table 197-5 presents information on the text weight, size and font established as CADD standards for OTE SCDs.

197-4 SCD CADD Standards - Line Weight and Style

As noted in Section 103-3.4, Table 197-6 presents information on the line weight and style established as CADD standards for OTE SCDs.

197-5 SCD CADD Standards - Traffic Level Assignments

As noted in Section 103-3.6, Table 197-7 presents information on the levels established as CADD standards for OTE SCDs.

197-6 SCD CADD Standards - Traffic Elements

As noted in Section 103-3.7, Table 197-8 presents information on the elements established as CADD standards for OTE SCDs.

197-7 OTE Publications

As noted in Section 195-1, Table 197-9 presents a consolidated list of all OTE publications. All OTE publications listed, except for the Signs Wallchart, are available for viewing and downloading from the OTE and DRRC websites. Those that are also available in paper format are noted in the comments column of this table.

197-8 Office of Contracts Publication List

Table 197-10 depicts the listing provided by the Office of Contracts for publications distributed through that Office, with a price list for those publications for which there is a charge.
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## Table 197-1. Resource Reference/Contact Information

<table>
<thead>
<tr>
<th>Resource Name / Mailing Address</th>
<th>Telephone / Fax / Web Address</th>
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</thead>
<tbody>
<tr>
<td>ADA Accessibility Guidelines</td>
<td>Web sites: <a href="http://www.access-board.gov">www.access-board.gov</a> and <a href="http://www.ada-ohio.org">www.ada-ohio.org</a></td>
</tr>
<tr>
<td>American Association of State Highway and Transportation Officials (AASHTO)</td>
<td>444 North Capitol Street, NW, Suite 249 Washington, DC 20001</td>
</tr>
<tr>
<td></td>
<td>Telephone: 202-624-5800</td>
</tr>
<tr>
<td></td>
<td>Fax: 202-624-5806</td>
</tr>
<tr>
<td></td>
<td>Web site: <a href="http://www.transportation.org">www.transportation.org</a></td>
</tr>
<tr>
<td>American Traffic Safety Services Association (ATSSA)</td>
<td>15 Riverside Parkway, Suite 100 Fredericksburg, VA 22406-1022</td>
</tr>
<tr>
<td></td>
<td>Telephone: 540-368-1701</td>
</tr>
<tr>
<td></td>
<td>Toll Free 1-800-272-8772</td>
</tr>
<tr>
<td></td>
<td>Fax: 540-368-1717</td>
</tr>
<tr>
<td></td>
<td>Web site: <a href="http://www.atssa.com">www.atssa.com</a></td>
</tr>
<tr>
<td>American National Standards Institute (ANSI)</td>
<td>1819 L Street, NW, Suite 600 Washington, DC 20036</td>
</tr>
<tr>
<td></td>
<td>Telephone: 202-293-8020</td>
</tr>
<tr>
<td></td>
<td>General Inquiries: 212-642-4900</td>
</tr>
<tr>
<td></td>
<td>Fax: 202-293-9287</td>
</tr>
<tr>
<td></td>
<td>Web site: <a href="http://www.ansi.org">www.ansi.org</a></td>
</tr>
<tr>
<td>Bureau of Transportation Statistics</td>
<td>Research and Innovative Technology Admin. U.S. Department of Transportation 400 7th Street, SW, Room 3430 Washington, DC 20590</td>
</tr>
<tr>
<td></td>
<td>Telephone: 800-853-1351</td>
</tr>
<tr>
<td></td>
<td>Main Fax: 202-366-3759</td>
</tr>
<tr>
<td></td>
<td>Web site: <a href="http://www.bts.gov">www.bts.gov</a></td>
</tr>
<tr>
<td>U.S. Army Corps of Engineers, Great Lakes and Ohio River Division</td>
<td>550 Main Street, Room 10122 P.O. Box 1159 Cincinnati, Ohio 45201-1159 (Includes Buffalo, Huntington, Louisville, and Pittsburg Districts)</td>
</tr>
<tr>
<td></td>
<td>Telephone: (513) 684-3010</td>
</tr>
<tr>
<td></td>
<td>Executive Fax: 513-684-2085</td>
</tr>
<tr>
<td></td>
<td>Web site: <a href="http://www.lrd.usace.army.mil">www.lrd.usace.army.mil</a></td>
</tr>
<tr>
<td>County Engineers Association of Ohio</td>
<td>37 West Broad Street, Suite 660 Columbus, OH 43215</td>
</tr>
<tr>
<td></td>
<td>Telephone: 614-221-0707</td>
</tr>
<tr>
<td></td>
<td>Fax: 614-221-5761</td>
</tr>
<tr>
<td></td>
<td>Web site: <a href="http://www.ceao.org">www.ceao.org</a></td>
</tr>
<tr>
<td>Design Reference Resource Center (ODOT)</td>
<td>Web site: <a href="http://www.dot.state.oh.us/drcc">www.dot.state.oh.us/drcc</a></td>
</tr>
<tr>
<td>Federal Emergency Management Administration (FEMA) Region V</td>
<td>536 South Clark Street, 6th Floor Chicago, IL 60605</td>
</tr>
<tr>
<td></td>
<td>Telephone: 312-408-5500</td>
</tr>
<tr>
<td></td>
<td>Web site: <a href="http://www.fema.gov/about/contact/regionv.shtml">http://www.fema.gov/about/contact/regionv.shtml</a></td>
</tr>
<tr>
<td>Federal Highway Administration (FHWA) Ohio Division Office</td>
<td>400 7th Street, SW Washington, DC 20590</td>
</tr>
<tr>
<td></td>
<td>Telephone: 202-366-0537 (Personnel locator)</td>
</tr>
<tr>
<td></td>
<td>Web site: <a href="http://www.fhwa.dot.gov">www.fhwa.dot.gov</a></td>
</tr>
<tr>
<td>Federal Highway Administration (FHWA)</td>
<td>200 North High Street, Room 328 Columbus, OH 43215-2408</td>
</tr>
<tr>
<td></td>
<td>Telephone: 614-280-6896</td>
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<td>ITS Standards</td>
<td><a href="http://www.standards.its.dot.gov">http://www.standards.its.dot.gov</a></td>
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<td>Links to other states</td>
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<tr>
<td>Roadside Hardware (includes NCHRP 350 information)</td>
<td><a href="http://safety.fhwa.dot.gov/programs/roadside_hardware.htm">http://safety.fhwa.dot.gov/programs/roadside_hardware.htm</a></td>
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**Federal Register information**

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<tbody>
<tr>
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**U.S. Government Online Bookstore**

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<tr>
<td>120 Wall Street, Floor 17</td>
<td>Telephone: 212-248-5000</td>
</tr>
<tr>
<td>New York, NY 10005</td>
<td>Fax: 212-248-5017/8</td>
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**Institute of Transportation Engineers (ITE)**

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<tbody>
<tr>
<td>1099 14th St, SW, Suite 300 West</td>
<td>Telephone: 222-289-0222</td>
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<tr>
<td>Washington, DC 20005-3438</td>
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**ITS Architecture, National**

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**ITS Architecture, Turbo**

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**McTrans**

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<th>McTrans</th>
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<tr>
<td>Center for Microcomputers in Transportation University of Florida</td>
<td>Telephone: 352-392-0378</td>
</tr>
<tr>
<td>P.O. Box 116585</td>
<td>Toll Free: 1-800-226-1013</td>
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<tr>
<td>Gainesville, FL 32611-6585</td>
<td>Fax: 352-392-6629</td>
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### Metropolitan Planning Organizations (MPOs)

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<tr>
<td>Cincinnati/Northern Kentucky</td>
<td></td>
<td><a href="http://www.oki.org">www.oki.org</a></td>
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<td><a href="http://www.noaca.org">www.noaca.org</a></td>
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<td><a href="http://www.morpc.org">www.morpc.org</a></td>
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<td><a href="http://www.mvrpc.org">www.mvrpc.org</a></td>
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<tr>
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<td><a href="http://www.eastgatecog.org">www.eastgatecog.org</a></td>
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<td>Regional ITS architecture:</td>
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### MUTCD (Manual on Uniform Traffic Control Devices)

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<td></td>
</tr>
<tr>
<td>4600 North Fairfax Drive, Suite 800</td>
<td></td>
</tr>
<tr>
<td>Arlington, VA 22203</td>
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### National Highway Institute

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### National Highway Traffic Safety Administration (NHTSA)

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### National Incident Management System (NIMS)

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### National Transportation Safety Board

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### NCHRP 350 (FHWA web site)

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### Ohio (State of)

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### Ohio Building Authority

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### Ohio Contractors Association

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<td>Telephone: 614-466-3601</td>
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<td>Ohio Historical Society</td>
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<td>Ohio Interstate Exit Guide</td>
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<td>Ohio Local Technical Assistance Program (LTAP) Center</td>
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<tr>
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(July 20, 2012)          October 23, 2006  1-79
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| The Ohio Turnpike Commission                                      | Telephone: 440-234-2081  
| PC Trans                                                          | Telephone: 785-864-5658  
Fax: 785-864-3199  
| Public Utilities Commission of Ohio (PUCO)                        | Telephone: 614-466-3292  
Toll Free (Ohio) 1-800-686-7826  
Fax: 614-752-8351  
Web site: [http://www.puco.ohio.gov/puco.cfm](http://www.puco.ohio.gov/puco.cfm) |
| State web sites (links to other states)                           | Web site: [http://www.fhwa.dot.gov/webstate.htm](http://www.fhwa.dot.gov/webstate.htm) |
| Keck Center of the National Academies  
Transportation Research Board                                     | Telephone: 202-334-2934  
Fax: 202-334-2003  
| U.S. Department of Transportation                                 | Telephone: 202-366-4000  
### Table 197-2. Ohio Counties and ODOT Districts

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### Table 197-3. SCD CADD Standards - Text Weight, Size and Font

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<td>Standard</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Cross-Section Match Line</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Hidden line</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Centerline (in structure)</td>
<td>0</td>
<td>7</td>
</tr>
</tbody>
</table>

### Table 197-5. SCD CADD Standards - Traffic Level Assignments

<table>
<thead>
<tr>
<th>Level</th>
<th>Item Description</th>
<th>Cell Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>SH_Border</td>
<td>Template (trimline, border and title block), Preparer’s initials</td>
<td></td>
</tr>
<tr>
<td>ST_Text</td>
<td>General Notes</td>
<td></td>
</tr>
<tr>
<td>ST_Details</td>
<td>All Traffic SCD elements not assigned to another level</td>
<td></td>
</tr>
<tr>
<td>ST_Details</td>
<td>Sign cuts</td>
<td>Signcuts_V8.cel</td>
</tr>
<tr>
<td>ST_Text</td>
<td>Dimensioning (includes dimension line, terminator, dimension text and extension line)</td>
<td></td>
</tr>
</tbody>
</table>
Table 197-6.  SCD CADD Standards – Traf_V8.cel Elements

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Symbol</th>
<th>Symbology</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Weight</td>
</tr>
<tr>
<td>DTA</td>
<td>Direction of Traffic Arrow</td>
<td><img src="image" alt="箭头" /></td>
<td>1</td>
</tr>
<tr>
<td>PVT</td>
<td>Protection Vehicle</td>
<td><img src="image" alt="汽车" /></td>
<td>1</td>
</tr>
</tbody>
</table>

Note: These are only examples of items which comprise this library.
Table 197-7. OTE Publications

<table>
<thead>
<tr>
<th>Publication Name</th>
<th>Audience</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ohio Manual of Uniform Traffic Control Devices (OMUTCD), 2012 Edition</td>
<td>State, county officials and other local jurisdictions, contractors, consultants, utilities, public</td>
<td>Available in paper, on CD and on-line from the DRRC and OTE websites. * <a href="http://www.dot.state.oh.us/omutcd">www.dot.state.oh.us/omutcd</a></td>
</tr>
<tr>
<td>Guidelines for Traffic Control in Work Zones (pocket guide)</td>
<td>State, county officials and other local jurisdictions, contractors, utilities</td>
<td>Available on-line and by contacting LTAP.</td>
</tr>
<tr>
<td>Ohio Uniform Traffic Control Signs Wallchart</td>
<td>State, county officials and other local jurisdictions, contractors, consultants</td>
<td>Out of Stock.</td>
</tr>
<tr>
<td>Plan Insert Sheets (PISs)</td>
<td>State, county officials and other local jurisdictions, contractors, schools, public</td>
<td>Available on-line from the DRRC and OTE websites.</td>
</tr>
<tr>
<td>Quality Standards for Temporary Traffic Control Devices and Acceptable Delineation Methods for Vehicles</td>
<td>State, county officials, and other local jurisdictions, contractors</td>
<td>Available on-line from the DRRC and OTE websites.</td>
</tr>
<tr>
<td>Sign Designs and Markings Manual (SDMM) – TEM Section 295-2</td>
<td>State, county officials and other local jurisdictions, contractors, consultants</td>
<td>Incorporated by reference into the TEM. Available on-line from the DRRC and OTE websites.</td>
</tr>
<tr>
<td>Standard Construction Drawings (SCDs)</td>
<td>State, county officials and other local jurisdictions, contractors, consultants</td>
<td>Available on-line from the DRRC and OTE websites.*</td>
</tr>
<tr>
<td>Temporary Traffic Control Manual (TTCM), 2012 Edition (Reprint of Parts 1, 5 and 6 of the OMUTCD.)</td>
<td>State, county officials and other local jurisdictions, contractors, consultants, utilities, public</td>
<td>Available in paper, on CD and on-line from the DRRC and OTE websites. *</td>
</tr>
<tr>
<td>Traffic Engineering Manual (TEM)</td>
<td>State, county officials and other local jurisdictions, contractors, consultants</td>
<td>Available on-line from the DRRC and OTE websites.</td>
</tr>
</tbody>
</table>

* See Table 197-8 for pricing information.
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<thead>
<tr>
<th>Publication</th>
<th>Pricing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construction and Material Specifications</td>
<td>$12.00</td>
</tr>
<tr>
<td>County Maps on CD</td>
<td>$15.00</td>
</tr>
<tr>
<td>Construction Inspection Manual</td>
<td>$22.00</td>
</tr>
<tr>
<td>Ohio Manual of Uniform Traffic Control Devices</td>
<td>$34.50</td>
</tr>
<tr>
<td>Standard Drawings</td>
<td></td>
</tr>
<tr>
<td>Bridge Standard Bridge Drawings</td>
<td>$17.00</td>
</tr>
<tr>
<td>Construction Standard Construction Drawings</td>
<td>$19.00</td>
</tr>
<tr>
<td>Traffic Standard Construction Drawings</td>
<td>$27.00</td>
</tr>
<tr>
<td>Temporary Traffic Control Manual (Parts 1, 5 and 6 of the OMUTCD)</td>
<td>$7.50</td>
</tr>
<tr>
<td>Traffic Control in Work Zones (pocket guide)</td>
<td>$2.50</td>
</tr>
</tbody>
</table>

Place orders for these publications by telephone by calling 1-800-459-3778 or 614-466-3778 or by writing to:
Ohio Department of Transportation
Office of Contracts
1980 W. Broad St., 1st floor
Columbus, Ohio 43223

Make checks or money orders payable to the “Treasurer of the State of Ohio.”
Prices are subject to change without notification.

* Plus shipping and tax (based on quantities ordered)
Intentionally blank.
198 FIGURES INDEX

198-1 **ODOT Table of Organization**

*Figure 198-1* is a reproduction of the overall Table of Organization for ODOT that is posted on the ODOT web site.

198-2 **ODOT Districts - Locations and Addresses**

*Figure 198-2* presents a map of Ohio showing the ODOT Districts and contact information (addresses and phone numbers) for each of them.

198-3 **Alternative Purchasing Program for Local Agencies**

*Figure 198-3* presents a chart which visually depicts the process described in detail in *Section 120-6*.

198-4 **Administering Local Government Agency / Utility Force Account Work**

*Figure 198-4* presents a chart which visually depicts the process described in detail in *Section 150-3*.

198-5 **Sample Letter Requesting Alternate Bids**

*Figure 198-5* shows a sample letter from local authorities requesting alternate bids as referenced in *Section 120-7.2*.

198-6 **Sample Letter Stating Local Decision on Alternate Bids**

*Figure 198-6* shows a sample letter of acceptance or rejection by local authorities of the alternate bids as referenced in *Section 120-7.3*.
Figure 198-1. ODOT Table of Organization
Figure 198-2. ODOT District Locations and Addresses

<table>
<thead>
<tr>
<th>Dist.</th>
<th>Address</th>
<th>Phone No.</th>
<th>Centrex No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1885 N. McCullough St., Lima, OH 45801</td>
<td>419-222-9055</td>
<td>995-7901</td>
</tr>
<tr>
<td>2</td>
<td>317 East Poe Rd., Bowling Green, OH 43402-1330</td>
<td>419-353-8131</td>
<td>995-7902</td>
</tr>
<tr>
<td>3</td>
<td>906 N. Clark St., Ashland, OH 44805</td>
<td>800-276-4188</td>
<td>995-7903</td>
</tr>
<tr>
<td></td>
<td></td>
<td>419-281-0513</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>2088 S. Arlington Rd., Akron, OH 44306</td>
<td>800-603-1054</td>
<td>995-7904</td>
</tr>
<tr>
<td>5</td>
<td>9600 Jacksontown Rd. SE, Jacksontown, OH 43030</td>
<td>740-323-4400</td>
<td>995-7905</td>
</tr>
<tr>
<td>6</td>
<td>400 E. William St., Delaware, OH 43015</td>
<td>800-372-7714</td>
<td>995-7906</td>
</tr>
<tr>
<td></td>
<td></td>
<td>740-363-1251</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>1001 St. Mary’s Ave., Sidney, OH 45365</td>
<td>937-492-1141</td>
<td>995-7907</td>
</tr>
<tr>
<td>8</td>
<td>505 SR 741, Lebanon, OH 45036</td>
<td>800-831-2142</td>
<td>995-7908</td>
</tr>
<tr>
<td></td>
<td></td>
<td>513-932-3030</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>650 Eastern Ave., Chillicothe, OH 45601-0467</td>
<td>888-819-8501</td>
<td>995-7909</td>
</tr>
<tr>
<td></td>
<td></td>
<td>740-773-2691</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>338 Muskingum Dr., Marietta, OH 45750</td>
<td>740-373-7317</td>
<td>995-7910</td>
</tr>
<tr>
<td>12</td>
<td>5500 Transportation Blvd., Garfield Hts., OH 44125</td>
<td>866-737-8112</td>
<td>995-7912</td>
</tr>
<tr>
<td></td>
<td></td>
<td>216-581-2100</td>
<td></td>
</tr>
</tbody>
</table>
Figure 198-3. Alternative Purchasing Program for Local Agencies
(Page 1 of 3)
Figure 198-3 continued (Page 2 of 3)
Figure 198-3 continued (Page 3 of 3)
Figure 198-4. Local Government Agency / Utility Force Account Work

1. Submission made to the District.
2. Evaluate.
3. Draft Agreement and Send to Agency for Signature.
4. Send to FHWA for Approval, if required.
5. Work Performed.
6. Billings Submitted to District.
7. Reviewed by District.
8. Return copy of Executed Agreement and Formal Approval to Local Agency or Utility.
9. Send to Project Coordination for Director's Signature and Encumbrance No.
10. Submit to Business & Human Services Administrator for Payment.
Figure 198-5. Sample Letter Requesting Alternate Bids

Date: ____________

District Planning and Engineering Administrator
Ohio Department of Transportation
Street
City

Re: County – Route – Section

Dear ________________:

We request that alternate bids be incorporated into the subject plan for the following item(s):

1. ____________
2. ____________

This item(s) will be used at the following locations:

1. ____________
2. ____________

We further request that the alternate bids describe the following brand and model of equipment:

1. ____________
2. ____________

We make this request because…

At such time as bids have been taken, please contact (phone ____________) to advise us of the comparative prices. We understand that our decision concerning acceptance or rejection of the alternates must be made quickly and reported by telephone. We also understand that our letter confirming this decision and agreeing to pay any extra costs must be in your hands within 10 calendar days following opening of bids.

Signed
District Planning and Engineering Administrator  
Ohio Department of Transportation  
Street  
City  

Re: County – Route – Section  
Project ________  
Alternate Bids  

Dear _______________:  

We have been advised, by a telephone call from __________________ of your office, of the bid price received for the alternate items on this project.  

This letter confirms our recent telephone conversation concerning disposition of those alternate bids.  

We request that the award be based upon the alternate (Brand Name) bids for reference items ____-A, ____-A…____-A. We understand that this will increase our financial obligation to the project by $_______ and agree to pay this when invoiced.  

OR  

We request that the award be based upon the generic bids for reference items _____. _____. _____. and _____. This decision will not increase our project financial obligation.  

Signed
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200 GENERAL

200-1 Introduction

The information provided in this Part is intended to supplement the OMUTCD Part 2 by presenting ODOT policies, standards, guidelines, practices and procedures concerning the design, construction, operations and maintenance of various types of traffic control signing.

After some general discussion of the overall subject of signing in Chapter 200, this Part of the TEM is organized to generally address the various types of signs (i.e., Regulatory, Warning and Guide Signs) separately. Given the range of signs covered under the general heading of Guide Signs, that category has also been subdivided further, with separate Chapters on Route Signs, Conventional Road Destination and Distance Signs, General Information Signs, Motorist Services Signs, Rest Area Signs, and Freeway and Expressway Destination and Distance Signs. A Section for Miscellaneous Signs has also been provided.

Separate Chapters have been provided for information specifically related to Sign Designing (Chapter 211), Sign Lighting (Chapter 212), Materials and Hardware (Chapter 220), Sign Supports (Chapter 221), Design Information, Plan Preparation/Production, Plan Notes and Specifications (Chapters 240 through 243), Construction (Chapter 250) and Maintenance/Operations (Chapter 260).

The OMUTCD provides general information on the design of traffic control signs, including the basic concepts of shape and color. It also provides specific information on the application of standard signs. Information on the location of signs, including height, lateral offset and longitudinal placement, is included as well.

Since the OMUTCD applies to jurisdictions statewide, some of the requirements contained therein are general rather than specific in nature. This allows the respective jurisdictions, where appropriate, to develop their own standards and policies within the framework of the OMUTCD. For example, OMUTCD Section 2A.07 requires that traffic control signs be reflectorized to show the same shape and color both by day and night. As noted in Section 220-6, Type G, H or J reflective sheeting shall be used for all permanent new traffic control signs on ODOT-maintained highways. Other jurisdictions may elect to use different reflective materials for their traffic control signs.

200-2 Construction Projects

Chapter 140 addresses the general application of ODOT standards, specifications and standard construction drawings to construction projects and Chapter 250 provides additional construction-related information specific to traffic control signs.

200-3 Force Account (ODOT Operations) Work

Districts performing force account signing work must comply with the requirements in the OMUTCD and this Manual. It is recommended that the Districts follow the provisions in the applicable signing related SCDs and CMS sections as well.

It should be recognized, however, that the information in the CMS and SCDs does not necessarily provide the only method to achieve a given objective. For instance, SCD TC-41.20 provides details on the use of yielding posts that are typically used for flatsheet signs. If a District instead wanted to use a breakaway support, this departure from common practice would be acceptable provided the support system met breakaway requirements, was installed accordingly, and had sufficient capacity to support the sign load.
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201 REGULATORY SIGNS

201-1 General

Regulatory Signs are addressed in OMUTCD Chapter 2B. Although many Regulatory Sign designs are shown in the OMUTCD, additional Regulatory Sign designs are contained in the Sign Designs and Markings Manual (SDMM). OMUTCD Section 2B.01 states that Regulatory Signs contained in the SDMM are incorporated by reference into the OMUTCD, and have the same legal applicability as if they had been included in the OMUTCD. Therefore, a regulatory sign appearing in either the OMUTCD or SDMM is legally enforceable.

As noted in OMUTCD Section 2A.06, there may be circumstances where a jurisdiction determines that signing is needed, but related signing is not addressed in the current OMUTCD or SDMM. In this situation, the responsible jurisdiction may develop the needed signing, as long as the design conforms to the OMUTCD standards. For local jurisdictions, such as a municipality, County, or Township, legislation (ordinance, resolution) is necessary for the sign to be legally enforceable. For ODOT-maintained facilities, a different process is followed.

ODOT does not have the ability to enact legislation. Therefore, for regulatory situations on ODOT-maintained facilities where no sign design is contained in the OMUTCD or SDMM, it will be necessary to create a new Regulatory Sign. Districts wanting to create a new Regulatory Sign design should contact the Office of Traffic Engineering (OTE). OTE will work with the District to develop appropriate wording, assign a code number, create a sign design, and incorporate the design into the SDMM. A new Regulatory Sign may be installed in the field as soon as it is developed; however, it will only become legally enforceable by ORC Chapter 4511 once included in the SDMM, since by reference it then becomes part of the OMUTCD.

OMUTCD Table 2B-1 addresses Regulatory Sign sizes and contains “minimum” sign sizes for certain of these signs. These sizes, which are smaller than the conventional road sizes, should not be used on ODOT-maintained facilities.

The following Sections address Regulatory Signs not in the OMUTCD, or provide additional information about the intended use of signs that do appear in the OMUTCD. Figure 298-4a illustrates Regulatory Signs discussed in this Chapter which are not shown in the OMUTCD.

201-2 Prohibition of U-Turns at Median Crossovers

ORC Section 4511.35 permits indiscriminate use of median openings for the purpose of making U-turns. Experience has shown this to be an unsafe practice on high-speed, limited-access divided highways. It has been determined that U-turns may be prohibited at median openings on divided highways by authority granted under ORC Section 4511.10.

When a median opening is restricted to emergency or authorized vehicles only, the standard treatment consists of erecting the U-Turn Prohibition sign (R3-4) and the AUTHORIZED VEHICLES ONLY sign (R5-11) as shown in Figure 298-1 (also see OMUTCD Section 2B.39). This standard treatment should be used at all median crossovers on the Interstate system and at median crossovers on other divided highways where the District Deputy Director has determined that a median opening should be restricted to emergency and authorized use only.

201-3 STOP Signs

The STOP sign (R1-1) is one of the most important devices used to control traffic at intersections. Its purpose is to assign the right-of-way to drivers of vehicles so that they may proceed through an intersection in an orderly and safe manner. The use of STOP signs at highway-rail grade crossings is addressed in Section 801-2. The maintenance responsibilities of STOP and YIELD signs at County and Township road intersections with state highways is addressed in Section
STOP signs are commonly used upon the approaches to through roadways so that a driver may proceed along the highway for a considerable distance and be given the right-of-way at succeeding intersections. The principles contained herein should be used in determining which highway approach or approaches to an intersection should have STOP sign control. **OMUTCD Sections 2B.04, 2B.05 and 2B.06** provide additional information on the use of STOP signs.

**ORC Section 4511.41** defines the “Right Hand Rule” regarding the right-of-way at an intersection, **Section 4511.43** defines the obedience required to a STOP sign, and **Section 4511.65** defines the right-of-way at through highways. **Section 4511.65** also indicates that YIELDS signs (see Section 201-11) and traffic control signals can be used to control intersecting traffic on a through highway; however, this is less common on the rural state highway system.

Normally, the selection of the highway approach to be stopped should be made in accordance with the functional class of the highway. The classification of the various types of highways in order of priority for assignment of right-of-way is as follows: (1) Interstate, (2) Freeway, (3) Expressway, (4) Principal Arterial, (5) Minor Arterial, (6) Major Collector, (7) Minor Collector, and (8) Local Street or Road.

The highway with the lower functional class should normally be stopped. Generally, a lower-volume highway should be stopped for a higher-volume highway where the intersecting highways have the same functional classification.

The preceding principles may be modified when any of the following conditions exist at an intersection:

1. A higher class route approach may be stopped for a lower class route when the traffic volume on the lower class route is at least 25 percent greater than the traffic on the higher class route, or when unusual intersection geometrics exist.

2. The selection of the highway approaches to be stopped should include consideration of conflicting uncontrolled travel paths. For example, drivers who are making a left turn usually recognize that they are required by law to yield to oncoming traffic on the same roadway. But there are instances, such as where a State Route turns, where the drivers on the State Route may not expect to yield to a vehicle on an adjacent approach (see **Figure 298-2(A)**, **(B)** and **(C)**).

In the case illustrated in **Figure 298-2(A)**, STOP signs should normally be placed on the State Route approach with the lower volume and the opposing County Road. In all cases, STOP signs (and YIELD signs where applicable) shall be placed so there are no conflicting movements which have the right-of-way.

A driver approaching a Y-type intersection may not recognize that he will be executing a left-turn movement across the path of oncoming traffic (see **Figure 298-2(C)**). Whenever this condition exists, the selection of the highway approaches to be stopped shall be made so as to eliminate this conflict.

3. The location and type of traffic control at intersections upstream or downstream may influence the selection of STOP sign controlled approaches. For example, if drivers on a highway have the right-of-way at successive major intersections for a considerable distance it may be desirable to give them the right-of-way at the subject intersection rather than create an unexpected stop.

STOP signs shall not be used at intersections with traffic control signals.

STOP signs shall be used in conjunction with the flashing red indication of Intersection Control.
Beacons.

At an intersection, the higher classification street or highway should be used to determine the size of the STOP sign to be erected at that intersection.

A STOP sign shall be erected at the point where the vehicle is to stop or as near thereto as possible, and may be supplemented with a Stop Line and the word STOP on the pavement, as shown in the OMTCD Figure 2A-3. Except where unusual intersection geometrics exist, STOP signs should not be placed farther than 50 feet from the intersected roadway. Where there is a marked or unmarked crosswalk, the sign should be erected approximately 4 feet in advance of the crosswalk edge nearest to approaching traffic.

Dual Stop signs shall be installed on all rural and high-speed (>45 mph) Stop sign controlled U.S. and State Route intersection approaches in accordance with the ODOT Comprehensive Highway Safety Plan. (See Section 202-10 regarding the use of dual Stop Ahead signs on these approaches.)

Dual Stop signs shall be installed on all County and Township Stop sign controlled intersection approaches with U.S. and State Routes with eleven or more intersection angle crashes in a three-year period, in accordance with the ODOT Comprehensive Highway Safety Plan.

Stop signs shall be augmented with flashing beacons or flashing LEDs at Stop sign controlled intersection approaches with fourteen or more intersection angle crashes in a three-year period, in accordance with the ODOT Comprehensive Highway Safety Plan. If a District's review of the crashes shows this countermeasure would not reasonably have a positive effect on the noted crash pattern, the District shall document the reasons why they are not installing the flashing beacon or flashing LED signs.

An intersection angle crash analysis will be performed every other year in calendar years ending in even numbers by the Office of Systems Planning and Program Management. Locations meeting the eleven and fourteen crash thresholds will be identified in conjunction with the Highway Safety Program by July 1 and tracked in the District Safety and Congestion Work Plans. The biannually produced list will include new locations as well as those identified in previous years. The treatments discussed in the previous two paragraphs should remain until major reconstruction (e.g., elimination of sight restrictions, addition of turn lanes, realignment, signalization) is undertaken and the location is removed from the list.

201-4 No Turn on Red Signing

ORC Section 4511.13 indicates that unless a sign prohibiting such action is in place: vehicular traffic, after stopping, may cautiously make a right turn on a steady red signal; and that vehicular traffic, after stopping, may cautiously make a left turn on a steady red signal from a one-way street to a one-way street on which traffic moves to the left. It also authorizes local authorities by ordinance, or the Director of Transportation on state highways, to “prohibit a right or a left turn against a steady red signal at any intersection, which shall be effective when signs giving notice thereof are posted at the intersection.”

The District or any maintaining agency may prohibit or restrict turns against a steady red signal. The following factors should be considered in making the determination:

1. Sight distance from the stop position to approaching traffic is less than adequate for the right or left-turning driver to observe safe gaps.

2. Geometrics of the intersection are such that the path of the right or left-turning vehicle crosses rather than merges with the path of the vehicle which has a green indication.
3. Right or left-turning vehicles conflict with other traffic which has been given a green arrow indication.

4. Right or left-turning vehicles create a storage or capacity problem on the street onto which they are turning.

5. Right or left-turns are permitted from two or more lanes on an approach. (Consideration can be given to permitting turns against a steady red signal from the curb lane only.)

6. An intersection has five or more approaches.

7. An intersection is used by a substantial number of school children, elderly persons or other pedestrians where right or left-turning vehicles would be a hazard to the pedestrians.

8. An intersection is near a highway-rail grade crossing.

9. Other hazards or conflicts.

The District or maintaining agency should document reasons where turns against a steady red signal are prohibited.

201-5 Safety Belt Signing (R16-H1)

Safety belt signing is intended to remind motorists of the mandatory safety belt law, and to encourage safety belt use. The R16-H1 sign is used for this purpose (see OMUTCD Section 2B.66 and Figure 2B-32).

A sign should be used in rest areas at a point where traffic leaves the rest area to re-enter the highway. For freeway rest areas, the suggested location is at the first part of the freeway entrance ramp in a conspicuous location that does not interfere with other signs. For rest areas on other routes, the sign should be located in a conspicuous location that does not obstruct sight distance.

A sign should be erected near the State Line for traffic entering Ohio. It should be erected on all ODOT-maintained highways, unless a suitable location cannot be found, or the route is minor in nature with insignificant traffic volumes. Where the State Line location falls within a municipality, arrangements should be made with the municipality for erection of a sign.

A sign should also be erected on selected highways outside municipalities for traffic leaving the municipality. To limit the number of signs to a reasonable amount, consideration should be given to traffic volumes, the distance between municipalities, and the number of signs on a particular route.

The red, white and blue N-84 information sign, and black on white R16-H2 word message regulatory sign, are no longer used. Existing installations of these signs may remain in place until they have reached the end of their service life, at which time they should be replaced with an R16-H1 sign.

201-6 Speed Limit Signs

Standards for the design and use of Speed Limit signs are addressed in OMUTCD Chapter 2B. As noted in OMUTCD Section 2B.13, ORC Section 4511.21 establishes the statutory speed limits in Ohio, and “prescribes how those speed limits may be altered.”

TEM Chapter 1203 describes the processes by which altered speed limits are established and the forms that are used.
School Speed Limit signs, School Speed Limit Signs with Beacons, and school zones are discussed in OMQTCD Section 7B.10 and TEM Chapters 702 and 705.

ODOT guidelines for reducing the speed limit in certain types of temporary traffic control zones are described in Subsection 640-18.2.

Refer to Section 202-11 for information regarding the use of the Reduced Speed Limit Ahead (W3-5, W3-5a) signs.

201-7 Signing for Engine Brake Restrictions (R20-H1, R20-H2, R10-H20bP, R10-H20cP)

An engine brake is a device used on vehicles, principally large trucks, that changes the timing of the exhaust valves to slow the vehicle. The engine brake is used instead of, or in addition to, the friction brakes and produces an audible “popping” noise that is sometimes perceived as objectionable.

The slang term “Jake Brake” is sometimes used to refer to engine brakes in general. However, this term is a registered trademark of Jacobs Vehicle Systems, a major manufacturer of engine brakes. Since this term actually refers to all of Jacobs Vehicle Systems retarding products and is brand specific, it should not be construed as being equivalent to “engine brake,” and should not be used on highway signing.

The Ohio Office of the Attorney General has determined that, pursuant to ORC Sections 505.17(A) and 4513.221(E)(4), a Board of County Commissioners or Township Trustees may enact a regulation prohibiting the use of engine brakes on vehicles within the unincorporated area of the County or Township. This includes ODOT-maintained highways within the boundary of the County or Township, as well as County and Township Roads.

Section 4917 of the United States Code is part of the Noise Control Act of 1972, and sets maximum noise emissions for motor carriers engaged in interstate commerce. According to an opinion issued by the Ohio Office of the Attorney General, local regulations restricting the use of engine brakes to control noise for motor carriers engaged in interstate commerce “may be inconsistent with federal law, and thus preempted and unenforceable.” For this reason ODOT will not install NO ENGINE BRAKE signs (R16-H4) on the mainline and ramps of Interstate Routes.

The NO ENGINE BRAKE sign (R20-H1) shall be used where the use of engine brakes has been restricted by the proper resolution per the ORC. The R10-H20bP and R10-H20cP auxiliary plaques may be used to indicate specifics regarding when or where the restriction applies, and may be combined with the R20-H1 sign on a single panel. Sample legends for these plates are “6 PM - 6 AM” for the R10-H20bP and “NEXT ½ MILE” or “NEXT 500 FT” for the R20-H20cP. The END ENGINE BRAKE RESTRICTION sign (R20-H2) may be used to indicate the terminus of the restriction.

For a Township restriction, typically only one NO ENGINE BRAKE sign (R20-H1) in each direction of travel within the Township should be installed on a state highway. More than one sign in each direction of travel may be needed for a countywide restriction, based on the length of the route within the County. The signs should be placed at strategic locations where the use of engine brakes has been a problem, such as at the beginning of a downgrade or an approach to an intersection. Alternatively, signs may be placed near where the state highway enters the County or Township or where a state highway begins within a County or Township. Overuse of signing should be avoided.

When a County or Township has passed a resolution restricting the use of engine brakes pursuant to ORC Sections 505.17(A) and 4513.221(E)(4), ODOT will install signs on the rural state highway system indicating such a restriction. The County or Township is responsible for furnishing all signs to ODOT. The signs shall be fabricated in accordance with ODOT design
standards and material specifications. ODOT will supply the sign supports and necessary hardware.

<table>
<thead>
<tr>
<th>Code No.</th>
<th>Route Type</th>
<th>Size in inches (width x height)</th>
</tr>
</thead>
<tbody>
<tr>
<td>R20-H1, R20-H2</td>
<td>Conventional</td>
<td>24 x 30</td>
</tr>
<tr>
<td>R10-H20bP</td>
<td></td>
<td>24 x 8</td>
</tr>
<tr>
<td>R10-H20cP</td>
<td></td>
<td>24 x 18</td>
</tr>
<tr>
<td>R20-H1, R20-H2</td>
<td>Expressway</td>
<td>36 x 48</td>
</tr>
<tr>
<td>R10-H20bP</td>
<td></td>
<td>36 x 12</td>
</tr>
<tr>
<td>R10-H20cP</td>
<td></td>
<td>36 x 24</td>
</tr>
<tr>
<td>R20-H1, R20-H2</td>
<td>Freeway</td>
<td>48 x 60</td>
</tr>
<tr>
<td>R10-H20bP</td>
<td></td>
<td>48 x 16</td>
</tr>
<tr>
<td>R10-H20cP</td>
<td></td>
<td>48 x 30</td>
</tr>
</tbody>
</table>

201-8 Move Over or Slow Down Signs (R25-H1)

R25-H1 signs were installed at 75 locations on ODOT-maintained highways in 2000 at the request of the Ohio State Highway Patrol (OSHP) to publicize the provisions in ORC Section 4511.213. The sign legend was revised to reflect changes to ORC Section 4511.213 which became effective on April 1, 2009. The OSHP provided funding for initial sign fabrication, and the Districts provided the materials and labor for installation. However, no funding has been provided by OSHP to cover fabrication costs of signs needed for maintenance replacements. The Districts should order and install replacement signs as needed using established procedures. Existing signs with the old legend may remain in place until they have reached the end of their effective performance lives.

201-9 Truck Restrictions in Municipal Corporations

A municipal corporation may restrict truck traffic on State or U.S. Routes through the municipal corporation only by regulating weight limits on the route, and only with the approval of the Director of Transportation.
A municipal corporation can regulate the use of its streets and can restrict the type of vehicles that travel over those streets pursuant to ORC Section 4511.07. However, ORC Sections 4511.06 and 4513.33 restrict the use of that power for trucks traversing designated State or U.S. Routes. Thus, a municipal corporation may establish its own truck weight limits for streets and highways within its jurisdiction that differ from those established in ORC Chapter 5577 and must post signs notifying the traveling public. However, when such weight limits involve an ODOT-maintained highway, ORC 4513.33 requires the approval of the Director to alter them. Otherwise, the ordinance may conflict with ORC Sections 4511.06 and 4513.33 and be found ineffective.

201-10  Lane-Use Control Signs

OMUTCD Sections 2B.19 through 2B.22 address Lane-Use Control signs and show some of them. However, there are many more of these signs that have been designed and assigned code numbers than could practically be shown in the OMUTCD. For reference purposes, Table 297-1 provides a listing of them with their standard sizes and Figure 298-22 provides illustrations of them.

201-11  YIELD Signs (R1-2)

OMUTCD Sections 2B.04, 2B.08, 2B.09 and 2B.10 discuss YIELD signs. OMUTCD Section 3B.16 addresses Yield Lines. The maintenance responsibilities of STOP and YIELD signs at County and Township road intersections with state highways is addressed in Section 260-6.

A YIELD sign shall be erected at the point where the vehicle is to stop if necessary to yield the right-of-way. Except where unusual intersection geometrics exist, YIELD signs should not be placed further than 50 feet from the intersected roadway. Where there is a marked or unmarked crosswalk, the sign should be erected approximately 4 feet in advance of the crosswalk edge nearest to approaching traffic (see OMUTCD Figure 2A-3).

201-12  DO NOT ENTER Signs (R5-1)

OMUTCD Section 2B.37 discusses the DO NOT ENTER sign.

In accordance with OMUTCD Section 2B.10, when a DO NOT ENTER sign is mounted back-to-back with a STOP sign, the DO NOT ENTER sign should stay within the edges of the STOP sign. If necessary, the size of the STOP sign should be increased so that the DO NOT ENTER sign installed back-to-back with the STOP sign remains within the edges of the STOP sign.

201-13  KEEP RIGHT (LEFT) Signs (R4-7, R4-8)

OMUTCD Section 2B.32 discusses KEEP RIGHT (LEFT) signs.

On a median, the KEEP RIGHT (LEFT) sign should be mounted not more than 50 feet beyond the approach end of the island. To facilitate guidance of left-turning traffic entering from a cross street, the KEEP RIGHT (LEFT) sign may be erected at an angle of up to 45 degrees with the cross street.

201-14  Traffic Law Photo Monitoring Signs (R10-18)

Substitute House Bill Number 30, passed by the 127th General Assembly, took effect September 12, 2008. This law imposes certain responsibilities on local authorities who chose to use traffic law photo monitoring devices.

The duties of the local authority are as follows:
1. Before using a traffic law photo monitoring device, erect R10-18 signs on all highways that are not freeways that are part of the state highway system entering the local authority. The sign shall be erected inbound within 300 feet of the boundary. If a highway enters the jurisdiction multiple times, the local authority is only required to erect the sign where the highway first enters the jurisdiction.

2. After the initial installation of all the required R10-18 signs, at least 90 percent of these signs shall be in place and functional at all times.

3. The local authority shall annually document and, upon request, certify compliance with provision 2 of this Section.

4. At intersections where traffic law photo monitoring devices (red light cameras) are used, the yellow change interval shall exceed by 1 second the yellow change interval determined in accordance with Section 403-2.

No traffic law photo monitoring device shall be installed at any intersection or on any highway maintained by ODOT.
202 WARNING SIGNS

202-1 General

Warning Signs are addressed in OMUTCD Chapter 2C. As noted in OMUTCD Section 2A.06, there may be circumstances where a jurisdiction determines that signing is needed, but related signing is not addressed in the current OMUTCD text. In this situation, the jurisdiction may develop the needed signing, as long as the design conforms to the OMUTCD standards.

The following Sections address Warning Signs not in the OMUTCD, or provide additional information about the intended use of signs that do appear in the OMUTCD. Figures 298-4a and 4b illustrate Warning Signs discussed in this Chapter which are not shown in the OMUTCD.

202-2 Children at Play Signs

Signs intended to alert drivers that children may be present in an area, such as CHILDREN AT PLAY or WATCH FOR CHILDREN, have not been shown to have a discernable benefit to traffic safety but still remain popular with the public. No factual evidence has been presented to document the success of this type of signing in reducing pedestrian accidents, operating speeds or legal liability. Studies have shown that many types of signs attempting to warn of normal conditions in residential areas, or conditions that are not always present, have failed to achieve the desired safety benefits.

Children should not be encouraged to play in the roadway. If signs encourage parents and children to believe they have an added degree of protection, which the signs do not and cannot provide, this can result in a disservice. This type of signing has long been rejected since it is a direct and open suggestion that this behavior is acceptable.

For these reasons, ODOT does not provide CHILDREN AT PLAY or similar signing. This type of signing is not recommended for use on any roadway at any time.

202-3 HIDDEN DRIVE Signs

The use of this sign was discontinued on ODOT-maintained highways in 1970 when traffic observations and experience disclosed that drivers on the through roadway were ignoring the sign message. The signs had little or no effect in alerting drivers or in reducing their speed.

The erection of HIDDEN DRIVE signs could create a false sense of security for the driveway user. The driveway traffic should be fully aware of the hazard of entering the through roadway, and should not be misled into thinking that the through traffic will be prepared to yield or stop.

For these reasons, ODOT does not provide HIDDEN DRIVE or similar signing.


Some freeway and expressway interchanges have been built as “half-diamonds,” with the exit and same direction entrance ramps several miles apart. Since this is not the usual situation, it is not expected by drivers. Although trailblazing to the entrance ramp may be provided, the lack of direct reentry can be confusing and irritating and some through drivers would choose not to exit at such an interchange if they were given advance warning.

The black on yellow NO REENTRY _______BOUND sign (W13-H10P) has been developed for this situation. When this interchange configuration creates a problem on ODOT-maintained freeways and expressways, this sign should be mounted as a supplemental panel with one or more of the Guide Signs for the exit. For signs less than 12 feet in width, the two-line sign (W13-
H11P) is available. The sign width of the W13-H10P or W13-H11P may be increased to match the width of the Guide Sign.

Use of a black on orange version of this sign for construction situations is discussed in Section 605-6.3.

202-5 Narrow and One-Lane Bridges

On ODOT-maintained highways, narrow bridges shall be identified using the NARROW BRIDGE sign (W5-2) in accordance with OMUTCD Section 2C.20, and the ONE LANE BRIDGE sign (W5-3) shall be used at one-lane bridges in accordance with OMUTCD Section 2C.21.

A NO PASSING ZONE sign (W14-3) shall be erected in accordance with OMUTCD Section 2C.45; however, the W14-3 sign shall only be used where the No-Passing Zone and the narrow or one-lane bridge treatment begin at the same location.

Figure 398-2 illustrates the signing and markings guidelines for narrow and one-lane bridges. Additional information is also provided in Sections 302-6, 303-2 and 304-5.

202-6 Amish Buggy Signing Where Paved Shoulder Becomes Narrower (W11-H14a, W11-H14P)

In order to accommodate buggy traffic, paved shoulders are being provided along some ODOT-maintained highways in the vicinity of Amish communities. This allows the slow moving buggies to use the shoulder instead of the roadway.

A potential conflict exists where a paved shoulder ends and buggies enter the roadway. Motorists who are accustomed to seeing buggies on the shoulder may not be expecting to encounter them on the roadway. As shown in Figure 298-7, Warning Signs may be used to inform drivers that the shoulder is narrowing and to be prepared for buggies on the roadway ahead.

<table>
<thead>
<tr>
<th>Code No.</th>
<th>Route Type</th>
<th>Size in inches (width x height)</th>
</tr>
</thead>
<tbody>
<tr>
<td>W11-H14a</td>
<td>Conventional</td>
<td>36 x 36</td>
</tr>
<tr>
<td>W11-H14P</td>
<td></td>
<td>24 x 18</td>
</tr>
</tbody>
</table>
202-7 Low Clearance Signs

OMUTCD Section 2C.27 discusses Low Clearance signs and Ohio Revised Code Section 5577.05 establishes a maximum vehicle height of 13 feet-6 inches.

The Low Clearance sign (W12-2) shall be used to warn road users of clearances less than 14 feet-6 inches. The structure-mounted Low Clearance sign (W12-2a) shall be used for clearances of 13 feet-6 inches or less, and may be used for clearances greater than 13 feet-6 inches. The W12-2a sign should be centered over the approach lane(s) with the low vertical clearance. The W12-2 and the W12-2a should display the same clearance height. The vertical clearance shown should be the minimum clearance measured to the bottom of a chord not less than 10 feet in width over the approach lane(s).

The Side Low Clearance sign (W12-H3) is intended to show the vertical clearance directly above the face of the side rail or curb. This sign shall be used on the structure where the vertical clearance at the face of the side rail or curb is 13 feet-6 inches or less. This sign should be used as necessary on variable clearance structures where the side clearance is more than 13 feet-6 inches, but less than 14 feet-6 inches. When W12-H3 signs are used on a structure, the W12-2a sign should also be used even if the center clearance is more than 13 feet-6 inches.

Example applications of Low Clearance signs on low structures are shown in Figure 298-42.

202-8 Entrance Sign (W11-H13)

The Entrance sign (W11-H13) may be used to provide advance warning of driveways where there is poor sight distance or a fairly large volume of entering or exiting traffic. Where the driveway traffic is seasonal, the sign should be covered or removed during the period the entrance is not in common use.

Commonly used Entrance signs include TRUCK, PARK, SCHOOL, CHURCH, PLANT and HOSPITAL. Refer to Section 702-5 for additional information on the use of the SCHOOL ENTRANCE sign.

Although not addressed specifically in the 2005 OMUTCD, designs for a generic ENTRANCE (W11-H13) sign and the SCHOOL ENTRANCE (S3-H3) sign are provided in the Sign Design Manual.

202-9 Transition Signing

The OMUTCD describes various warning signs that can be used in highway transitions for a reduction in the number of lanes. Larger warning signs (W9-H4a, W9-H4b) can be used for added emphasis. For ground mounting of these signs, a size of 144" x 48" is recommended. For overhead mounting, a size of 192" x 60" is recommended.

Example transition signing is shown in Figures 298-43 and 298-44.
202-10 Stop Ahead Signs (W3-1)

OMUTCD Section 2C.36 discusses the Stop Ahead signs.

Dual Stop Ahead signs shall be installed on all rural and high-speed (>45 mph) Stop sign controlled US and State Route intersection approaches in accordance with the ODOT Comprehensive Highway Safety Plan. (See Section 201-3 regarding the use of dual Stop signs on these approaches.)

202-11 Reduced Speed Limit Ahead Signs (W3-5, W3-5a)

OMUTCD Section 2C.38 indicates that “a Reduced Speed Limit Ahead (W3-5, W3-5a) sign (see OMUTCD Figure 2C-7) should be used to inform road users of a reduced speed zone where the speed limit is being reduced by more than 10 mph, or where engineering judgment indicates the need for advance notice to comply with the posted speed limit ahead.” On ODOT-maintained highways, a Speed Reduction (W3-5 or W3-5a) sign should be installed whenever the speed limit is reduced by more than 10 miles per hour, whether it is the statutory speed limit or an authorized Speed Zone.

However, before installing the W3-5 or W3-5a in advance of a Speed Limit sign erected by others (at Corporation Limits) the speed limit should be confirmed. The Speed Reduction signs shall not be erected in advance of inappropriate Speed Limit signs (e.g., an unapproved Speed Zone or signs that do not reflect the correct statutory speed limit).

202-12 GROOVED PAVEMENT Sign (W8-15)

Longitudinal grooves in pavement surfaces, excluding diamond grinding, may cause lateral control problems for bicycles, motorcycles and other small vehicles. Without adequate warning, an operator may not have sufficient time to adjust the vehicle’s speed to safely negotiate the grooved pavement section.

A GROOVED PAVEMENT Sign (W8-15) shall be erected in advance of longitudinally grooved pavement sections.

A distance plaque may be used to supplement the sign.

202-13 GRATED BRIDGE DECK Sign (W5-H8)

Grated bridge decks may cause vehicle control problems for bicycles, motorcycles and small cars due to low traction on this type of bridge deck.

Grated bridge decks shall be marked with the GRATED BRIDGE DECK sign (W5-H8).

A distance plaque may be used to supplement the sign.

202-14 Object Markers and End-of-Roadway Markers

202-14.1 General

OMUTCD Chapter 2C establishes standards and guidelines for the design and use of object markers and end-of-roadway markers. Additional design and application information is provided herein. As noted in Section 341-5, for plan purposes object markers and end-of-roadway markers shall be treated as flatsheet signs.
202-14.2 Narrow and One-Lane Bridges

Type 3 object markers shall be used in accordance with MUTCD Sections 2C.65 to mark narrow and one-lane bridges. Figure 398-3 illustrates the signing and markings guidelines for narrow and one-lane bridges. Additional information is also provided in Sections 202-5, 302-6 and 304-5.

202-14.3 Delineation of Left-Turn Lanes in Medians

Delineation of left turn lanes may be accomplished by using various traffic control devices including delineators, signs, object markers and retroreflecterized paint on the curb and nose. Delineation is recommended for parallel and tapered left-turn lanes at intersections which are not illuminated. Section 304-6 addresses the use of delineators, Keep Right signs and object markers at these locations. Figures 398-4 and 398-5 illustrate delineation of left-turn lanes in medians.

202-14.4 Barrier Object Marker

A Barrier Object Marker is a special type of marker mounted on top of 32-inch Portable Barrier (PB). Barrier Object Markers may also be used on other temporary traffic barriers. See Section 605-19 for details.
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203 GUIDE SIGNS

203-1 General

Guide Signs on conventional roads are addressed generally in OMUTCD Chapter 2D, and Guide Signs on freeways and expressways are addressed generally in OMUTCD Chapter 2E. Additional specific information on General Information Signs, General Service Signs, Specific Service Signing (Logos), Tourist-Oriented Directional Signs (TODS), Changeable Message Signs, Recreational and Cultural Interest Signs, and Emergency Management Signing is provided in OMUTCD Chapters 2H, 2I, 2J, 2K, 2L, 2M and 2N, respectively.

Sizes for commonly used Guide Signs are shown in Tables 297-12. Additional guidance related to these signs is provided in Chapters 204 through 209 of this Manual. Various Guide Signs discussed in this Manual which are not shown in the OMUTCD are illustrated in Figures 298-5a through 5d, and 298-6a through 6b.

203-2 Minor Interchanges

OMUTCD Section 2E.51 allows for fewer Guide Signs at Minor Interchanges, and this is illustrated in OMUTCD Figures 2D-12 and 2E-40. However, as noted in the OMUTCD text there are no Minor Interchanges in Ohio. Generally, this type of Minor Interchange is seen only in the wide open areas of the western states.
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204 ROUTE SIGNS

204-1 General

OMUTCD Chapter 2D addresses route signs and route sign auxiliaries. The following Sections address route signs not in the OMUTCD, or provide additional information about the intended use of signs that do appear in the OMUTCD. Figures 298-5a and 5c illustrates route signs discussed in this Section which are not shown in the OMUTCD.

204-2 Ohio Byway Signing (M8-H3, M8-H3P)

As noted in OMUTCD Section 2D.56, certain roads have been designated by ODOT as Ohio Byways based on their archeological, cultural, historic, natural, recreational, or scenic qualities. The Ohio Byway program is administered by the Office of Local Assistance. A route must be approved by ODOT as an Ohio Byway before signs can be installed, and a route designated by ODOT as an Ohio Byway shall be signed.

Ohio Byways are not limited to ODOT-maintained highways, and may follow County, Township and municipal roads as well. ODOT is responsible for installing and maintaining Ohio Byway signs and auxiliary signs on ODOT-maintained highways, including state route extensions within municipalities. To assure uniformity of appearance, ODOT will provide signs to the local authority for use on local roads. The local authority is responsible for installing and maintaining the signs on local roads.

The Ohio Byway sign (M8-H3) is considered a route sign. Auxiliary signs used with the Ohio Byway sign shall have a white legend on a green background (e.g., M5-1, M6-1).

The Ohio Byway sign should be installed in accordance with OMUTCD Section 2D.56 and other OMUTCD standards for route signs.

The Ohio Byway supplemental sign (M8-H3P) may be used at the discretion of the sponsoring agency. If used, the signs shall be fabricated by the sponsoring agency and supplied to the appropriate jurisdictions for erection. The decision by the sponsoring agency to have M8-H3P signs installed does not necessitate their use with all M8-H3 signs along the route. The M8-H3P signs can be selectively utilized at key locations as determined by the sponsoring agency, with the concurrence of the responsible jurisdiction. Their use may be particularly beneficial where overlapping Ohio Byways diverge.

204-3 Business Routes (M1-2, M1-3, M4-3, D20-H1, D20-H2)

Ordinarily, when an ODOT-maintained highway bypasses the central business district (CBD) of a municipal corporation, standard Guide Signs and route marking for the routes which remain in the urban area will be adequate to guide drivers from the bypass route to the CBD and back. In cases where existing signing does not adequately perform this function, additional guidance may be provided by establishing an official Business Route.

A Business Route may be either a business loop or a business spur. A business loop is a route which begins at an ODOT-maintained interchange or intersection, traverses over adequate streets and highways to and through the CBD of the bypassed municipal corporation, and returns to the ODOT-maintained highway at another location. A business spur is a route which begins at an ODOT-maintained interchange or intersection, leads traffic into the CBD of the bypassed municipal corporation, and returns to the ODOT-maintained highway along the same route to the point where it began.
A Business Route may be established by the District where an ODOT-maintained highway has been constructed on a new alignment which bypasses the CBD of a municipality and no other ODOT-maintained highway provides a direct two-way connection between the bypass route and the CBD, or where the existing guide signing does not adequately direct the driver from the bypass route to the CBD and back to the bypass route. A business loop or spur from an ODOT-maintained highway may be routed over the existing State and U.S. Routes, County Roads, and municipal streets as applicable. The business loop or spur route should be clearly marked by appropriate signing.

Where portions of a proposed Business Route will follow County Roads or municipal streets (including state route extensions within the corporation limits), appropriate resolutions should be submitted from the County and/or municipality (see Forms 296-1 and 296-2).

Business Route signing should be installed in accordance with MUTCD standards. The Interstate Business Route Markers (M1-2, M1-3) should be used where appropriate. The BUSINESS auxiliary sign (M4-3) should be used with standard State or U.S. Route Markers and auxiliary signs. Supplemental Guide Signs or supplemental plaques may be used on freeway and expressway routes. On conventional roads, the D20-H1 and D20-H2 signs may be used.

Normally, ODOT will furnish and install the signing for the business route, and the local jurisdictions will be responsible for the future replacement and maintenance of the signing on their respective portions of the route.

![Business Route Sign](image1)

![Business Route Sign](image2)

204-4 Lake Erie Circle Tour Signing (M8-H1, M8-H2)

Due to their proximity to the Lake Erie shoreline or connecting waterways, the ODOT-maintained highways in Table 297-2 have been designated as the Lake Erie Circle Tour (LECT). ODOT is responsible for installing and maintaining LECT signs (M8-H1) and auxiliary markers on these routes, including state route extensions within municipalities.

The M8-H1 sign has a white legend on a green background, and is considered a route sign. Auxiliary signs used with the M8-H1 sign shall also have a white legend on a green background (e.g., M5-1, M6-1).

The M8-H1 sign should be installed in accordance with MUTCD standards for route signs. Signs should be installed in both directions along the established route. A sign should be installed at the beginning of the route near the State Lines. A sign and directional arrow should be placed before each turn in the route, and at each intersection where the route turns or changes direction. A sign should also be installed after each turn to confirm the routing. Additional signs should be installed at 5 to 10 mile intervals and at other key locations along the route. Signs may also be placed on major intersecting highways informing of the junction with the LECT route as appropriate. An LECT route sign may be installed in an assembly with other route signs.

To help establish a link between the Lake Erie Circle Tour and the overall Great Lakes Circle Tour (GLCT) system, GLCT route signs (M8-H2) should be erected near the State Lines. One sign should be placed on southbound I-75 near the Michigan State Line and another on...
westbound U.S. Route 20 near the Pennsylvania State Line.

Local communities may identify, promote and sign spur and loop routes from the LECT system. Proposals for such routes and the related signing must be reviewed jointly by representatives of the Ohio Departments of Development, Transportation and Natural Resources.

Sign placement criteria for approved spur and loop routes is the same as described for the LECT route signs; and the sign used is identical to the M8-H1 sign, except that the sign has a white legend on a brown background. Auxiliary signs shall also have a white legend on a brown background.

Markers for approved spur and loop routes should be furnished, installed and maintained by the agency having jurisdiction over the roadway, at the cost of the agency or group sponsoring the spur or loop route. When the approved spur or loop is on an ODOT-maintained highway, ODOT shall furnish, install and maintain the signs; however, all expenses shall be reimbursed per an agreement between ODOT and the route sponsor executed prior to sign placement.

204-5 Appalachian Highway Signing (M1-H11)

State Route 32 has been designated as the Appalachian Highway for its entire length across the State of Ohio. The Appalachian Highway supplemental plaque (M1-H11) should be installed above all State Route 32 confirming assemblies (above the cardinal direction plaque). The width of the M1-H11 plaque should match the width of the route sign. This plaque shall not be used with junction assemblies and directional assemblies on intersecting routes.

204-6 Municipal Street System Signing

Figure 298-38 is an example of route marking for municipal street systems. Section 260-4 provides information on the responsibilities regarding signing within municipalities.
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205 CONVENTIONAL ROAD DESTINATION AND DISTANCE SIGNS

205-1 General

Conventional Road Destination and Distance Signs are addressed in O MULTCD Sections 2D.36 through 2D.42. The following Sections address signs not in the O MULTCD, or provide additional information about the intended use of signs that do appear in the O MULTCD.

205-2 Conventional Road Destination Signs

OMUTCD Section 2D.05 indicates that “the lettering for names of places, streets, and highways on conventional road guide signs shall be a combination of lower-case letter with initial upper-case letter letters.” The optional use of all capital letters for conventional road destination signs was eliminated with the issuance of the 2012 O MULTCD. ODOT’s practice had been to use all capital letters on these Destination signs. However, in late 2005 it was decided that ODOT would start changing over to a practice of using upper and lower-case letters for these legends. It had also been decided that based on FHWA’s Interim Approval of Clearview Font, ODOT would begin using this new font for guide sign legends. The details of the transition to this new design practice are not all addressed at this time. Design information in this Chapter and in the Sign Designs and Markings Manual related to this information will be updated to address this change.

For many years, ODOT has used the 72 x 12 inch destination signs at intersections on conventional roads. Where more than one destination is shown, separate signs have been used for each destination with the signs mounted in an assembly on the same supports. This system has provided versatility and convenience for ODOT, while providing pertinent information to the motoring public. Keeping sign lengths at 72 inches by using various series letters has simplified installation, especially where right-of-way is limited or physical constraints make the installation of longer signs difficult.

Unless there is a preference to do otherwise, on ODOT-maintained conventional highways, the Districts should install destination signs as follows:

1. On two-lane conventional rural roads use the 72 x 12 inch D1-H1 and D1-H1a signs. For two or three destinations, use multiple assemblies of the 72 x 12 inch D1-H1 and D1-H1a signs.

2. On four or more lane conventional rural roads, use the 96 x 24 inch D1-H1 and D1-H1a signs. For two or three destinations, use multiple assemblies of the 96 x 24 inch D1-H1 and D1-H1a signs.

3. For urban applications, use the 48 x 8 inch D1-H1 and D1-H1a signs. For two or three destinations, use multiple assemblies of the 48 x 8 inch D1-H1 and D1-H1a signs.

4. For recreational destinations, use the D7-H1 and D7-H1a signs in the same manner as described for the D1-H1 and D1-H1a signs in items 1 through 3 above. When used in mixed multiple assemblies, position the white-on-green destination signs above the white-on-brown destination signs.

205-3 Signing for Traffic Generators at Intersections

205-3.1 General

OMUTCD Chapters 2D and 2M discuss the use of Guide Signs on conventional roads to provide guidance to traffic generators. In order to control the proliferation of such signing, each responsible jurisdiction is encouraged to establish a traffic generator policy in general agreement with the “official ODOT policy.” This Section establishes the ODOT criteria for determining when a destination qualifies as a traffic generator for which Guide Signs, typically

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containing the name of the generator, may be erected at intersections on ODOT-maintained conventional roads.

As used in this Section, "non-profit" also refers to facilities or organizations described as "not for profit."

205-3.2 Procedure for Reviewing Requests

For signing requests for traffic generators at intersections, the following procedures apply:

1. Signs may be erected at intersections on ODOT-maintained highways after a written request has been received from the operator of the generator (with all data necessary to determine eligibility) and an investigation by the District has confirmed the eligibility of the generator as defined by this standard.

2. Requests for generator signing which would be erected completely inside a municipality should be forwarded to the local authority for their consideration. Where part of the warranted signing for a generator will be within a municipality and part outside, the District shall request the municipality to furnish and erect the necessary signing within its corporation limits.

3. The erection of signs for eligible generators shall be in accordance with standards for sign type, height, lateral placement and location as specified in the OMUTCD. The number of destinations used in any one destination sign assembly should be in accordance with OMUTCD Section 2D.37. The legend size of generator signing should be consistent with the legend size of other existing destination signs in the vicinity.

4. Signs for eligible generators shall not be erected when the proposed signs would conflict with existing primary Guide Signs or other traffic control signs. Therefore, no commitment should be made to erect signs until an on-site inspection has been conducted at the proposed sign location in order to determine that sufficient space exists.

5. Signs erected for eligible generators should be placed on the nearest ODOT-maintained highway at its intersection with the road which leads to the generator. If the nearest ODOT-maintained highway is not used by the majority of the drivers traveling to the generator, the signs may be erected at the intersection of the ODOT-maintained highway which is used by the majority of the drivers traveling to the generator instead of the lesser used highway.

6. When the generator is located on an ODOT-maintained highway, a sign indicating the entrance to the generator should only be erected when the entrance to the generator is not conspicuously marked or readily visible.

7. ODOT shall not erect signs until necessary trailblazing signs off the state system have been erected by others.

8. Under exceptional circumstances, additional signs may be necessary to adequately sign for a traffic generator. Additional signs should be approved by the District Deputy Director based on an engineering study that documents the need.
9. Not all demands for generator signing can be accommodated. Therefore, the District should develop a priority system to determine which of the generators should get the limited space available. If signs for the generator requesting signing would result in too many signs or too many destinations on a sign, the District shall review the information and determine which generators would receive signing. To minimize future conflicts and removals of existing generator signs, consideration should be given to future expectations and priorities of signing at intersections before erecting signs.

205-3.3 Criteria and Eligible Generators

Signing for traffic generators may vary in color depending on the category of the generator. ODOT has established the following criteria in determining which generators will qualify for signing and what color will be used for the sign.

205-3.3.1 Signs with a Green Background

Signs for the following generators shall have a white legend on a green background:

1. Airport, Heliport, Ferry, Train Station and Bus Station.

   Signs may be erected for any public airport or ferry shown on the official Ohio Transportation map, or any public heliport, train station, or bus station which has regularly scheduled departures and/or arrivals.

   To warrant signing at a particular intersection, an airport should also be within 15 miles of the intersection. Optional guide (trailblazer) signing may also be provided along routes other than the primary route within a 10 mile radius of the airport for commercial airports, and within a 7.5 mile radius of other airports. Guide signing shall not be permitted for privately owned airports that are not open to the public.

2. College, University and Other Post High School Educational Institution.

   Signs may be erected when the institution is duly accredited, provides multiple associate, bachelors, masters, and/or doctorate degree programs of the traditional academic variety, and is within 5 miles of the intersection.


   A joint vocational school is a public school primarily intended for vocational training for high school juniors and seniors. Signs may be erected when the school is within 5 miles of the intersection.


   Signs may be erected when the school provides a traditional academic curriculum and has a substantial portion of the student enrollment comprised of individuals whose permanent residence is not considered to be local to the community in which the school is located. This includes college preparatory schools and military academies.

5. Major Military Installation.

   Signs may be erected when the military installation has at least 500 permanently assigned personnel or employees and the installation is within 5 miles of the intersection.
6. **Privately Owned Non-Profit Campground.**

   Signs may be erected when the privately owned non-profit campground is within 5 miles of the intersection. This includes scout, church, 4-H, youth, and YMCA/YWCA camps.

7. **Hospice Facility.**

   Signs may be erected when the hospice is licensed by the Ohio Department of Health, is within 5 miles of the intersection, and is a freestanding facility.

205-3.3.2 **Signs with a Blue Background**

   Signs for the following generators shall have a white legend on a blue background:

   1. **Law Enforcement Agency.**

      Signs may be erected when the law enforcement agency facility is within 5 miles of the intersection, and the agency headquarters approves or requests the installation.

   2. **General Service.**

      Signing for hospitals is addressed in Section 207-4, signing for generic general services (fuel, food, lodging and camping) is addressed in Section 207-5, and signing for tourist information centers is addressed in Section 207-6.

   3. **Tourist Oriented Directional Signing (TODS).**

      The TODS program is described in Section 207-3.

205-3.3.3 **Signs with a Brown Background**

   Permanent signs may be erected for the following generators provided: (1) the generator is a publicly owned or a privately owned non-profit facility; and (2) the generator has an annual attendance of 100,000 plus 10,000 per mile in urban areas, or 50,000 plus 5,000 per mile in rural areas, where the distance is measured from the generator to the intersection. In rural areas, where generators are less common and more space for generator signing is available, attendance requirements may be reduced by up to 60 percent by the District Deputy Director. Signs for these generators shall have a white legend on a brown background:

   1. **Miscellaneous Generator** - Arenas, coliseums, stadiums, auditoriums, convention halls, fairgrounds, parks (national, state, county, municipal, etc.), racetracks, casinos and zoos.

   2. **Recreation Area** - Recreation areas (e.g., beaches and lakes). Where recreational areas are established at a large lake, reservoir or forest and many recreational facilities are available, boundaries may be established for the purpose of informing oncoming traffic. On roadways entering the region, the D7-H3 sign may be erected at the boundary.

   3. **Tourist Attraction** - Aquariums, arboretums, botanical gardens, geological sites, historical sites, State memorials, restorations, monuments, museums, planetariums and other attractions of historic or cultural interest.
Also, permanent signs may be erected for privately-owned major tourist attractions (e.g., large amusement parks) where the traffic volumes are such as to warrant additional signing to facilitate an orderly flow of traffic to the facility. Signs for these generators shall have a white legend on a brown background.

### 205-3.4 Generators That Do Not Normally Warrant Signing

Except as covered in the previous paragraph, activities signed for under the Tourist Oriented Directional Signing (TODS) program do not qualify for generator signing under this Section.

Also, it has been determined that the following facilities do not normally qualify for signing under these provisions for traffic generators:

1. **Business** - Industrial parks, shopping centers, shopping malls, television stations, radio stations and theaters.

2. **Cemetery** - National, local, State, military, public and private.

3. **Community Facility** - Churches, civic centers, libraries and subdivisions.

4. **Educational** - Grade schools and high schools (except as provided in Section 205-3.3.1).

5. **Governmental** - Courthouses, disaster assistance facilities, civil defense facilities, driver’s license centers, jails, prisons, local government highway buildings, post offices, research facilities, experimental facilities.

6. **Medical** - County homes, fraternal homes, nursing homes, humane facilities (i.e., animal shelters), infirmaries, treatment centers, mental facilities, research facilities, retirement facilities, sanitariums, veteran facilities.

7. **Military** - Armories, arsenals, sites and detachments.

8. **Recreational** - Amusement parks, country clubs and golf courses.

### 205-3.5 Temporary Event Signing

Directional signing may be installed for temporary events. Temporary events include shows (e.g., boat, car, air, horse, RV), street fairs and festivals, reenactments, sports tournaments, concerts and other similar short-term activities that generate a significant amount of traffic from outside the immediate area of the event, but for which permanently installed signs would not be appropriate. The duration of these events would typically be several days or several successive weekends; however, some could be as short as a few hours. Temporary directional signs will assist the unfamiliar road user, and facilitate the orderly flow of traffic to the event.

Generally, for events expected to attract fewer than 1,000 visitors per day, or attracting visitors principally from the local area, directional signage would not be needed. For events attracting 1,000 or more visitors per day, with many from outside the local area, appropriately designed and installed directional signs would be beneficial.

Requests for directional signage to be placed on the rural state highway system under ODOT’s jurisdiction should be submitted by the sponsoring agency to the appropriate ODOT District Office at least 45 days prior to the event. The District Office should review the request, and on a case-by-case basis, determine what, if any, directional signage would be appropriate on the rural state highway system.
The sponsoring agency shall be responsible for the fabrication and installation of the signs on the rural state highway system, once the sign designs, locations and support arrangements have been approved by ODOT. The sponsoring agency shall obtain an ODOT right-of-way use permit prior to the installation of the signs. Alternatively, ODOT may install the approved signs furnished by the sponsoring agency on the rural state highway system, and bill the sponsoring agency for the costs incurred.

The sponsoring agency shall be responsible for the removal of the signs within 24 hours after the conclusion of the event. ODOT may remove signs not removed by the sponsoring agency within a timely manner, and bill the sponsoring agency for the costs incurred.

The directional signs are intended to provide guidance to road users looking for the event, and are not meant to entice others to attend. The signs shall conform to the requirements in the OMUTCD, and shall not contain any advertising. On conventional roads, a minimum upper case letter height of 4 inches is recommended. For major conventional roads, a minimum upper case letter height of 6 inches is recommended. The sign background should be brown or green, with a white legend. The legend should be as concise as possible while still conveying the necessary pertinent information to associate the sign with the event.

The signs may be installed on their own ground-embedded supports, may be attached to existing supports or utility poles, or may be mounted on portable supports. Signs installed in exposed locations (i.e., not protected by guardrail or concrete barrier), must be on crashworthy, ground-embedded or portable supports (except for signs attached to utility poles). Signs on portable supports shall have a minimum mounting height of 1 foot above the edge of pavement. The mounting height of other signs shall be in accordance with the OMUTCD.

If determined by ODOT to be appropriate, ODOT may allow the sponsoring agency to install portable changeable message signs on the rural state highway system, in accordance with the provisions of the OMUTCD.

205-4 Weigh Station Signing for Conventional Roads

Weigh Station signing for conventional roads is addressed in OMUTCD Section 2D.49 and Figure 2D-17. There are currently no weigh stations on ODOT-maintained two-lane conventional roads. Signing for weigh stations on ODOT-maintained major conventional roads should be the same as that used for freeways and expressways (see Section 209-4).

205-5 Street Name Signing for At-Grade Intersections on Conventional Roads

Street Name signs on conventional roads are normally installed by the agency having jurisdiction over the intersected street, although these may be installed by ODOT. The D3-H1 and D3-H1b signs are used for this purpose. Where it is desired to include the name of the maintaining agency on the sign, the D3-H6b and D3-H6c signs may be used.

Figures 298-31 and 298-32 illustrate examples of signing arrangements that may be used where it is desired to provide advance notice of intersections with important public roads.

For at-grade intersections on expressways and major conventional roads (see Section 209-6.2), refer to Section 209-6 and Figures 298-28 through 298-30.

205-6 Signing for Historical Markers on Conventional Roads

Guide signing may be used to alert road users to the presence of an historical marker along the roadway or on an intersected road. The D7-H8, D7-H8a and D7-H9 signs are used for this purpose.
To be eligible for guide signing, historical markers located along the roadway must be in an area with adequate sight distance for safe ingress and egress and a minimum of two parking spaces. Historical markers located on an intersected road should be within 1 mile of the intersection with the main highway, and have all necessary trailblazer signs installed by the responsible jurisdiction prior to the installation of signs along the main highway.

The D7-H8, D7-H8a and D7-H9 signs have a white legend on a brown background, with a standard size of 24 x 24 inches. Larger sizes may be used on multi-lane roads or where additional emphasis is desired. The D7-H8 and D7-H8a signs may be installed in an assembly with a white on brown M5 or M6 series auxiliary sign. Where an historical marker is associated with an Ohio Byway (see OMUTCD Section 2D.53 and TEM Section 204-2), the historical marker sign may be installed in an assembly below the Byway sign.

When signing is provided for an historical marker located along the roadway, a D7-H8 sign with appropriate distance should be used in advance of the site. This sign would typically be placed 500 feet in advance of the site on a two-lane road, and one-half mile in advance of the site on a multi-lane road. Other distances may be used as appropriate. On a two-lane road, an M5 or M6 series auxiliary sign may be used with the D7-H8 sign. On a multi-lane road, the D7-H8 sign should normally be augmented with an M5 or M6 series auxiliary sign. A D7-H9 sign may be used at the site where additional guidance is desired.

When signing is provided for an historical marker located on an intersecting road, a D7-H8a sign should be used in advance of the intersection. This sign would typically be placed 500 feet in advance of the intersection on a two-lane road, and one-half mile in advance of the intersection on a multi-lane road. Other distances may be used as appropriate. On a two-lane road, an M5 or M6 series auxiliary sign may be used with the D7-H8a sign. On a multi-lane road, the D7-H8a sign should normally be augmented with an M5 or M6 series auxiliary sign. At the intersection, a D7-H8 sign showing the appropriate distance to the site of the historical marker, with an M6 series auxiliary arrow sign mounted below, should be used.

*Figure 298-37* provides examples of the use of these signs.
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206 GENERAL INFORMATION SIGNS

206-1 General

General Information Signs are addressed in OMUTCD Chapter 2H. The following Sections address signs not in the OMUTCD, or provide additional information about the intended use of signs that do appear in the OMUTCD. Figures 298-5a through 5c illustrate Guide Signs that fall into the General Information Signs category discussed in this Chapter which are not shown in the OMUTCD.

206-2 Reserved for Future Information

This Section is reserved for future information.

206-3 Township Limit Signing (I-H2e)

ORC Section 503.061 requires ODOT to erect Township Limit signs on ODOT-maintained highways, other than freeways and expressways, located within the Township and outside the limits of an incorporated municipality, indicating the boundaries of the Township, when a resolution requesting signs has been adopted by the Township. The I-H2e sign is used for this purpose (see OMUTCD Section 2H.02 and Appendix C).

Although there is no legal requirement to erect signs on freeways and expressways, Districts may, at their discretion, erect I-H2e signs on these facilities for townships which have populations in excess of 5,000 outside of municipal corporation limits.

206-4 Signing for Unincorporated Communities (I-H2d)

The Unincorporated Community Name sign (I-H2d) shown in OMUTCD Appendix C may be erected on ODOT-maintained conventional roads in accordance with OMUTCD Section 2H.02. Requests should be referred to the local Board of County Commissioners to confirm the spelling and the boundaries of the community. Unincorporated communities which claim to be historically significant should furnish confirmation from the Ohio Historical Society or a local historical society.

A driver should be able to recognize a change from rural conditions. A community usually has a cluster of homes, schools, churches, businesses furnishing motorist services, stores, parking, pedestrians, or other land development. Signs should not be erected where the unincorporated community name is synonymous with that of a developer, contractor or real estate broker where the sign could be considered an advertisement.


206-5.1 General

Basic guidelines for Radio Information Signs are provided in OMUTCD Section 2I.09. The following additional guidelines and criteria have been developed for use of this signing on ODOT-maintained highways.

HAR signing may be authorized for systems installed by local jurisdictions or governmental agencies when the criteria set forth in the OMUTCD and this Section are met, and after receiving approval by the District, as outlined below.
The owner/operator of the HAR system will be responsible for the fabrication, erection and maintenance of the signs under an Agreement (and Occupancy Permit) with the Director of Transportation. With a written notice, the Director may require the owner/operator to remove signs that have not been properly installed or maintained.

206-5.2 Guidelines

For situations which cannot be addressed by other signing, the following guidelines have been established to support a determination for the use of signs to supplement HAR systems (also known as Traffic Advisory Systems and Radio-Traffic Information Systems) installed by local jurisdictions or governmental agencies on high-volume or high-speed roadways. However, these should not be considered the only justification for the erection of this signing.

1. Extraordinary circumstances in one or both of the following categories:
   a. Unusual road conditions, including extended construction or maintenance operations, detours, and management of traffic incidents.
   b. Traffic and parking advisories - information for traffic destined for specific events (e.g., World’s Fair) or major traffic generators (e.g., transportation terminals or stadiums).

2. As a component of a traffic management system.

206-5.3 Procedures for Approval, Installation and Removal

The following procedure shall be used for approval, installation and removal of an HAR system:

1. The owner/operator shall submit a written request to the District including, but not limited to, the following information:
   a. Map of the region showing transmitter location, broadcast frequency, area of coverage and route(s) on which signs are requested.
   b. A general description of message content, anticipated frequency of message repetition and message changes, and hours of transmission.
   c. Names of persons operating the HAR station and where it is located.
   d. Number of signs requested, including approximate location and legend for each sign.

2. The District reviews the information provided and makes a field check to determine if the system is eligible and if the signs and locations are appropriate.

3. If approved by the District, an Agreement is prepared (see Form 296-3 for a Sample Agreement) and returned to the owner for review and execution.
4. When the executed Agreement and a copy of the station’s **Federal Communications Commission (FCC)** license are returned to the **District** by the owner, the following package of information is then provided by the **District** to the owner:

   a. **Occupancy Permit Application** for work in the right-of-way.

   b. Sample plan sheets including design information, applicable **ODOT** specifications and **Standard Construction Drawings**.

   c. Specific sign locations determined by **District** review of requested sign locations.

5. Owner/operator submits **Occupancy Permit Application** and construction plans for installation of the signs to the **District**.

6. After approval of the construction plans by the **District** and issuance of the **Occupancy Permit**, the owner/operator has the signs installed. The completed installation shall be inspected and approved by the **District**.

7. The owner/operator shall immediately notify the **District** of any event or condition which may significantly affect its ability to perform in accordance with the provisions of its Agreement with **ODOT**.

8. Any modifications or alterations of the signing will require written approval of the **Director**.

9. As provided in the Agreement, the owner/operator will be responsible for removal of the signs and restoration of the area when the HAR system ceases to operate.

### 206-5.4 Operational Criteria

The following operational criteria shall apply:

1. Only traffic advisory or directional messages shall be broadcast over the radio station.

2. No message of a commercial or promotional nature may be broadcast at any time.

3. Messages concerning disruptions of normal traffic flow or road conditions due to highway construction or maintenance activities shall be broadcast when requested by **ODOT**.

4. The radio station shall be operated at all times in accordance with **FCC** rules and regulations.

5. The HAR system shall be operated on a permanent year-round basis, twenty-four hours a day unless otherwise approved by the **District**.

6. The location(s) of the broadcast receptions zone(s) shall not be altered subsequent to placement of the related signs.

### 206-5.5 Signing for HAR Systems

The following criteria shall apply when signing has been approved for an HAR system:

1. The design and placement of HAR signs shall be in accordance with standards in the **OMUTCD**. These signs usually have a white legend on a blue background; however, if used as work zone signs the standard colors shall be used (i.e., black legend with an orange background). The signs and their sizes are shown in the **Sign Designs and Markings Manual (SDMM)**.
2. Signing for an HAR zone normally consists of three signs in each direction of travel: the D12-H6 sign 1 mile in advance of the broadcast zone, the D12-H7 at the beginning of the broadcast zone and the D12-H9 at the end of the zone. Depending on the circumstances (e.g., length of zone and sign crowding in the area) it may be desirable to erect more than one of the D12-H7 signs in the broadcast zone and/or not use the D12-H9 sign.

3. Other legend elements such as AIRPORT or VISITORS instead of TRAFFIC may be warranted.

4. As noted in OMUTCD Section 2I.09, when circumstances warranting the signing are seasonal, the owner/operator shall remove or cover the signs when the HAR system is not in use.

5. When the HAR system is able to remotely provide incident information, the black on yellow TRAFFIC ALERT WHEN FLASHING (D12-H8P) supplemental panel shall be mounted below the D12-H7 sign at the beginning of the broadcast zone, with yellow flashing beacons mounted above. The beacons shall be activated when incident information is being broadcast.

206-6 **Carpool Signing (D12-2)**

As noted in OMUTCD Section 2I.11, the availability of rideshare opportunities is publicized using Carpool Information Signs. On ODOT-maintained highways the D12-2 sign is used. The local rideshare agency (LRA) is responsible for furnishing all signs to ODOT. The signs shall be fabricated in accordance with ODOT design standards and material specifications. ODOT will supply the sign supports and necessary hardware, and install the signs. The locations for the signs may be suggested by the local rideshare agency, but must be approved by ODOT prior to installation.

The **Districts** should maintain the signs. Replacement signs should be obtained from the LRA as needed.

206-7 **Signing for Countywide 9-1-1 Systems (D12-H14)**

206-7.1 **General**

ORC Section 4931.46 indicates that upon installation of a countywide 9-1-1 system, the **Board of County Commissioners** may direct the **County Engineer** to erect and maintain at the **County** boundaries on **County** Roads and **State** and Interstate Routes, signs indicating the availability of a countywide 9-1-1 system. Any sign erected by a **County** under this Section shall be erected in accordance with and meet the specifications established in **Section 206-7.2**. All expenses incurred in erecting and maintaining the signs shall be paid by the **County**.

For other signing dealing with 9-1-1 systems, see **OMUTCD Section 2I.09** and **TEM Section 207-7**.
206-7.2 Sign Details

**ORC Section 4931.46(B)(2)** requires the Director of Transportation to develop design specifications for signs giving notice of the availability of a countywide 9-1-1 system and establish standards for erection of the signs. Consequently, the D12-H14 sign was developed. The standard size for use on conventional roads is 36 x 24 inches, and on freeways and expressways the standard size is 60 x 36 inches. Type G, H or J reflective sheeting shall be used for the signs.

The signs shall be flatsheet material. **SCD TC-52.20** provides information about bolt hole spacing for flatsheet signs. The sign blank material, sign supports and mounting hardware shall conform to **CMS Item 730. SCD TC-41.20** provides post information.

206-7.3 Procedure

If a countywide 9-1-1 system exists and the Board of County Commissioners directs the County Engineer to erect signs on an ODOT-maintained highway, the County Engineer shall contact the local ODOT District Office in writing to obtain: (1) approval of the proposed sign locations, and (2) a permit to work within the State right-of-way. The request should include specific information about the proposed sign locations and a proposed traffic control plan.

Unless the District agrees to another arrangement, the County Engineer shall have the proposed sign locations marked by stake or paint to assist in District review; no paint marks shall be permitted on the pavement surface. The D12-H14 sign shall be placed for traffic entering the County at or near the location where the route crosses the County Line. It should be placed on the right side of the highway, except that when the existing County Line sign is in the median, the 9-1-1 sign(s) may also be placed in the median. Further, the D12-H14 sign is a separate installation and shall not be mounted with the County Line sign or any other signs. Existing signs shall not be moved to accommodate placement of the D12-H14 on ODOT-maintained highways.

The District shall field check each proposed site to assure the placement of the signs will be in accordance with **OMUTCD Sections 2A.18, 2A.19, and 2E.23**, which establish horizontal and vertical placement criteria, and **SCDs TC-42.10 and TC-42.20**. If the District concurs with the proposed location and the traffic control plan, the County Engineer may schedule erection of the sign once the permit is approved.

When the signs have been erected, the District should have the locations checked for compliance to ODOT standards. All discrepancies will be corrected by the County Engineer.

206-7.4 Maintenance

The County Engineer shall maintain these signs in good condition and shall advise the District of who should be contacted for repair or replacement of signs erected on ODOT-maintained highways. Damage reports received by ODOT concerning the signs shall be forwarded to the County Engineer’s office or a designated contact.

If the County should choose to discontinue the countywide 9-1-1 signing program, the County Engineer will notify the District in writing. The County Engineer will be responsible
for removing all D12-H14 signs and supports on the State right-of-way.

If D12-H14 signs erected on ODOT-maintained highways become a hazard or nuisance and the problem is not corrected by the County within a reasonable time, the District shall remove the signs and supports. The County shall be billed for the work and advised where the sign(s) and supports can be picked up.

206-8 Memorial Highway/Bridge Signing (D6-H5)

Any street/highway or bridge that is part of the State highway system may be officially assigned a distinctive name, commemorative of an historical event or personage or a commonly accepted and appropriate name, by which the highway or bridge is known. A list of named highways and bridges established by ORC Chapter 5533 is shown in Table 297-17. A list of named highways and bridges on the rural state highway system established by the Director of Transportation in accordance with ORC Section 5511.01 and local governments in accordance with ORC Section 5511.09 is shown in Table 297-18.

There are three processes by which ODOT-maintained highways and bridges can be memorialized or named. They are as follows:

1. The most frequently used process is by legislation. ORC Chapter 5533 contains numerous examples of action by the legislature to name or memorialize a highway or bridge.

2. Where the section of State highway is completely rural, ORC Section 5511.01 allows the Director, by administrative action, to assign a distinctive name to the highway. (We have, however, been advised that this does not include naming individual bridges.)

3. Local governments may request the naming of a highway or bridge that is part of the rural state highway system that lies within their boundaries. This requires unanimous agreement of the local governments in accordance with ORC Section 5511.09, and approval by the Director. Requests from local governments should be submitted to the District for approval. The decision on approval should be made by the District Deputy Director on behalf of the Director. The District shall notify OTE of such approvals.

For rural roads that are totally under the maintenance and operational authority of local governments, the Director has no involvement in the naming/memorializing process. ORC Sections 5541.04 and 5543.04 assign responsibility for naming/memorializing County and Township Roads to County officials.

Municipal corporations also do not require action by the Director to name/memorialize streets located totally within their boundary. ORC Section 723.01 grants broad authority for the control of streets within the municipal corporation to the municipality officials, and ORC Section 5511.09 addresses the authority of municipal officials to name highways and bridges on the state highway system within the municipal corporation without action of the Director.

Signing of memorial highways and bridges should be in accordance with OMUTCD Section 2M.10. Signs for memorial highways or bridges on the rural state highway system and Interstate highways within municipal corporation limits established by the legislature in accordance with ORC Chapter 5533 or by the Director in accordance with ORC Section 5511.01 should be furnished and installed by the District. Signs for memorial highways and bridges on the U.S. and State Routes inside municipal corporation limits established by the legislature in accordance with ORC Chapter 5533 shall not be installed by ODOT. ODOT may furnish the signs to the municipal corporation for a fee commensurate with the sign size and construction.

Signs for memorial highways and bridges on the rural state highway system established by local governments in accordance with ORC Section 5511.09 shall be furnished and installed by the
requesting agency at locations approved by the District.

The D6-H5 sign is used in rest areas, scenic overlooks and other off-highway locations, and on the mainline of conventional roads, freeways and expressways. For sign design details refer to the Sign Designs and Markings Manual (see Section 295-2).

206-9 TARGET ENFORCEMENT AREA Sign (D12-H15)

Every six months the Ohio State Highway Patrol (OSHP) produces a list of their high accident locations for each patrol post. These locations may be targeted for increased enforcement efforts.

ODOT has agreed to cooperate with the OSHP in posting signs indicating the target enforcement areas. The TARGET ENFORCEMENT AREA sign (D12-H15) is used for this purpose.

Each post will have one location to be marked with these signs. The size of the target enforcement area is determined by OSHP, and may consist of an intersection or section of highway. The location may change every six months.

A sign should be installed on each ODOT-maintained approach to the target enforcement area, including locations on ODOT-maintained highways inside Villages.

206-10 Signing for Over/Underpasses on Freeways and Expressways

Districts may, at their discretion, elect to provide signing on freeways and expressways to identify roads that pass over or under the mainline. For those Districts that decide to provide such signing, a D3-H1 sign may be ground mounted in advance of the structure. Other signing methods, such as the use of direct applied sheeting on the bridge beams, can be considered, if acceptable to the District.

Use of this signing is optional and can be selectively applied at over/underpasses in the District.

206-11 Drinking Water Protection Area Signs (I-H15)

In 1999, the Ohio Environmental Protection Agency (Ohio EPA) requested that signs be erected to designate those areas that have been scientifically determined to be contributing ground water to public drinking water systems serving populations of 500 or more persons. The I-H15 sign is used for this purpose.

The I-H15 sign is 36 x 24 inches and blue on white. The sign color was selected to distinguish this sign from other traffic control signs. The signs are intended to increase public awareness, and alert emergency response teams that they are entering a Drinking Water Protection Area. The clean-up of spills is handled differently in these areas.

The I-H15 sign includes a phone number. The statewide Ohio EPA emergency response phone
number is 1-800-282-9378. The public drinking water provider will decide what phone number to include on the sign. This can be the statewide emergency response number or a local emergency response number (including 9-1-1).

**ODOT** fabricates and erects I-H15 signs at locations where an **ODOT**-maintained highway crosses the five-year time of travel zone for aquifers serving populations of 500 or more persons. Specific locations for the signs are determined by the **Ohio EPA**. Signs for locations within municipal corporation limits should be provided and erected by the municipal corporation.

![DRINKING WATER PROTECTION AREA REPORT SPILLS 1-800-282-9378](I-H15)

**206-12 TOURISM INFO 1-800-BUCKEYE Sign (D7-H10P)**

The **TOURISM INFO 1-800-BUCKEYE** sign (D7-H10P) is intended for installation as a supplemental panel below Recreational and Cultural Interest Area signs to acquaint drivers with the toll-free tourist information telephone number. This sign should be installed on all Recreational and Cultural Interest Area signs on the Interstate system that do not have another supplemental panel.

![TOURISM INFO 1-800-BUCKEYE](D7-H10P)

**206-13 ROAD CONDITIONS 1-888-2-OH-ROAD Sign (D12-H10)- (Discontinued)**

The **ROAD CONDITIONS 1-888-2-OH-ROAD** sign (D12-H10) was first used in 1998 to acquaint drivers with the toll-free weather and highway construction telephone number. Effective March 1, 2009, the telephone number was deactivated. All the signs shall be removed.

![ROAD CONDITIONS 1-888-2-OH-ROAD](D12-H10) (Discontinued)

**206-14 Community Recognition Signing**

Periodically, communities desire signing for the purpose of recognizing a local achievement, such as a State high school championship athletic team or an award from a professional organization. This signing does not provide pertinent information to drivers to enable them to perform their driving task, nor does it meet the basic principles for traffic control devices outlined in the **OMUTCD**. To control proliferation of this type of signing along the rights-of-way of **ODOT**-maintained highways, the following guidelines should be used when determining whether a community that has requested such signing should receive it.

Under **Ohio** law, state route extensions within municipal corporations are the responsibility of the local authority. **ODOT** does not endorse installation of Community Recognition Signing on such extensions, nor does it accept any responsibility for such signs. However, **ODOT** generally does not question decisions made by local authorities regarding signs erected on such routes. Anyone requesting Community Recognition signing should be referred to the local authority. If the authority agrees to erect this signing inside the municipality, the requesting community is

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Revised April 20, 2012
responsible for obtaining the signing. In addition, any such signing should not be erected on Corporation Limit (I-H2a) or Unincorporated Community (I-H2d) signs. Furthermore, it is recommended that only one such sign be erected on a particular state route extension into a municipality.

Similarly, ODOT does not generally endorse installation of signing on ODOT-maintained highways recognizing a County’s achievement except when approved by the County Commissioners and the District office. When this occurs, such signing may be installed on County Line signs (I-H2f, I-H2g) by the District office after the sign’s design has received the approval of the District Deputy Director. Only one Community Recognition sign should be erected on any I-H2f or I-H2g sign.

The ODOT Sign Shop will normally not fabricate Community Recognition signs; the community should provide the sign.

These signs shall not be installed on Interstates or other freeways.

**206-15 Maintenance Marker Sign (D10-H8, D10-H8a)**

The Maintenance Marker sign (D10-H8) should be used on all non-Interstate ODOT-maintained highways. These signs give the distance in miles along the route, and should be installed in accordance with the mileages contained in the ODOT Straight Line Diagrams.

The signs may be single faced for mounting on both sides of the road. For mounting on one side of the road, the signs may be double faced or mounted back-to-back. Where physical restrictions prevent the installation of the D10-H8 sign at the even mile, the D10-H8a sign may be used with the D10-H8 sign indicating the distance in hundredths of a mile that the sign is located from the proper location. The use of a zero (0) marker indicating the beginning of a route at the County line or within a County is optional.

The D10-H8 signs should be mounted at a minimum height of 4 feet above the pavement edge.

**206-16 High Water Signing**

**206-16.1 General**

At times, high water may cover portions of highways. Advance warning of this condition allows road users to take appropriate action based on the conditions encountered. Appropriate Warning Signs should be erected in advance of affected highway sections as soon as practical after becoming aware of high water covering the highway.

In many cases, conditions change rapidly. Adjustments to High Water signing should be made as appropriate when warranted by changing conditions.

**206-16.2 HIGH WATER Sign (W8-H18a)**

The HIGH WATER sign (W8-H18a) may be used where high water temporarily covers the road. It should be erected as soon as practical after becoming aware that such a condition exists.

While traffic can still pass over the affected section of highway, the sign should be located in advance of the section in accordance with OMUTCD Table 2C-4. When the section becomes
impassible, an additional HIGH WATER sign may be placed at the point where traffic can select an alternate route.

HIGH WATER signs may be placed on temporary supports. On sections of highway where high water events occur often, hinged signs may be permanently mounted and displayed when needed. When the road is expected to be impassible for an extended length of time, other devices may be used to supplement the HIGH WATER signs. These include ROAD CLOSED signs, detour signs, barricades, cones and drums.

206-16.3 ROAD MAY FLOOD Sign (W8-18)

For locations where high water coverage occurs often, the ROAD MAY FLOOD sign (W8-18) may be permanently mounted to alert road users to the flooding potential. This sign should be located in advance of the affected section in accordance with ODOT Table 2C-4.

When high water is present, the HIGH WATER sign (W8-H18a) may be used to supplement the ROAD MAY FLOOD sign.

206-16.4 Depth Gauge Sign (W8-19)

The Depth Gauge Sign (W8-19) may be used as a permanent marker along a section where flooding is a frequent occurrence, in accordance with ODOT Section 2C.35.

When used, the signs should be erected on both sides of the road at intervals of 200 feet or less along the section subject to high water coverage. Two signs may be mounted back-to-back on one post. The signs should, where possible, be placed 2 feet-6 inches from the edge of the paved shoulder or from the edge of the pavement when no paved shoulder exists. All markers should be erected the same distance from the edge of the road in order that the driver may be able to estimate his position with respect to the edge of the traveled highway at times when the road is covered with water. Each marker shall be mounted so that its zero foot line is at the same elevation as the pavement or traveled roadway edge.

When high water is present, the HIGH WATER sign (W8-H18a) may be used to supplement the Depth Gauge Signs.

206-17 WATERSHED Signs (I-H3d)

The boundary between the Lake Erie watershed to the north and the Ohio River watershed to the south runs through six ODOT Districts, specifically Districts 1, 3, 4, 6, 7 and 12, and seventeen Ohio Counties, namely Mercer, Shelby, Auglaize, Allen, Hardin, Marion, Wyandot, Crawford, Richland, Ashland, Medina, Summit, Portage, Stark, Geauga, Trumbull and Ashtabula. To identify this significant watershed boundary, ODOT will install signs at (or as close as practical to) the locations shown in Table 297-14.

The Lake Erie and Ohio River watershed signs should be installed directly opposite each other at the locations specified in Table 297-14.

The Lake Erie and Ohio River watersheds can be subsequently subdivided into progressively smaller watersheds and sub-watersheds. However, ODOT will not install signs identifying any of these smaller watershed and sub-watershed boundaries. Signs will only be installed at the major boundary between the Lake Erie and Ohio River watersheds at the locations in Table 297-14.
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GENERAL SERVICE SIGNS

207-1 General

General Service signs are addressed in **OMUTCD Chapter 2I**. As noted in **Section 203-1**, information on Specific Service Signs (Logos), Tourist-Oriented Directional Signs (TODS), and Recreational and Cultural Interest Signs is provided in **OMUTCD Chapters 2J, 2K and 2M**, respectively. They are also addressed further herein. **Figures 298-5b and 298-5c** include illustrations of General Service type Guide Signs discussed in this Chapter which are not shown in the **OMUTCD**.

The following Sections address signs not in the **OMUTCD**, or provide additional information about the intended use of signs that do appear in the **OMUTCD**.

207-2 Logo (Specific Service) Sign Program

207-2.1 General

Logo (Specific Service) Signs are addressed in **OMUTCD Chapter 2J**. The Ohio Business Logo Sign Program established by **ODOT**, also known as the Specific Service Sign Program, permits eligible businesses which provide fuel, food, lodging, camping or attraction services to road users to have their Logo Sign Panels placed on Specific Service Signs. Mainline Logo Sign Panels are placed in advance of eligible interchanges, and directional Logo Sign Panels are placed along the exit ramps. The Logo Sign Program is operated by a private company (Program Manager) under contract with **ODOT**. **Table 297-15** provides a summary of the eligibility criteria for this program.

Documents that define the program adopted by **ODOT** are available upon request from the **Office of Traffic Engineering**. Generally, the document package contains the following: (1) Contract with Program Manager; (2) Program Administrative Rules and Regulations; (3) Signing Standards and Guidelines; (4) Ohio Revised Code Section 4511.101 and 5516.02; (5) Right-of-Way Permits Process; and (6) Remittance information.

Information regarding removal and temporary re-erection of Logo Signs due to construction activity is addressed in **Plan Note 242-7 (Section 242-7)**. Logo Signs issues that arise due to maintenance activities should be directed to the District’s Logo Program Coordinator.

207-2.2 District Procedures and Responsibilities

District procedures to be followed are contained in the documents referred to in **Section 207-2.1. District** responsibilities include, but are not necessarily limited to, the following:

1. Approve work plans for each interchange.

2. Approve relocation of existing signs to accommodate Specific Service Signs.

3. Provide written notice to the Program Manager to remove or relocate Specific Service Signs due to other necessary non-specific service signs or a highway improvement project.

4. Remove the danger when any Specific Service Sign, Logo Sign Panel or support becomes, or is in danger of becoming, a clear and present danger to the public, and the Program Manager is unavailable.

5. Notify the Program Manager of needed relocations or removal of Specific Service Signs.
207-2.3 Central Office Procedures and Responsibilities

Central Office procedures to be followed are also contained in the documents referenced in Section 207-2.1. Central Office responsibilities include, but are not necessarily limited to, the following:

1. Approve the Program Manager’s advertising agreement.

2. Approve the general plans for work zone traffic control.

3. Review and approve Logo Sign Panel designs, including alternative fuel legends or symbols.

4. Approve the form and content of consent legislation drafted and processed by the Program Manager.

207-3 TODS Program

207-3.1 General

Tourist-Oriented Directional Signs (TODS) are addressed in OMUTCD Chapter 2K. This Section describes the Ohio Tourist-Oriented Directional Signs (TODS) Program as established by ODOT. This program permits eligible tourist-oriented activities to be identified on directional signs established for the program. These signs are placed in advance of intersections on ODOT-maintained highways, but not at interchanges on freeways and expressways. The TODS Program is operated by a private company (Program Manager) under contract with ODOT. Table 297-16 provides a summary of the eligibility criteria for this program.

The following documents, available upon request from the Office of Traffic Engineering, define the TODS Program, including the procedures, standards and guidelines: (1) Contract with Program Manager; (2) Program Administrative Rules and Regulations; (3) Signing Standards and Guidelines; (4) ORC Sections 4511.102 to 4511.107; and (5) Right-of-Way Permits Process.

Information regarding removal and temporary re-erection of TODS due to construction activity is addressed in Plan Note 242-7 (Section 242-7). TODS issues that arise due to maintenance activities should be directed to the District’s TODS Program Coordinator.

207-3.2 District Responsibilities

The documents referenced in Section 207-3.1 outline the responsibilities assigned to the Districts. They include, but are not necessarily limited to, the following:

1. Approve advanced signing at an intersection.

2. Provide construction project information to the Program Manager.

3. Approve the work plan for each intersection.

4. Remove the danger when any TODS installation becomes, or is in danger of becoming, a clear and present danger to the public and the Program Manager is unavailable.

5. Notify the Program Manager of needed relocations or removal of TODS signing.

6. Determine which existing ODOT-maintained signs will continue to be maintained at each intersection prior to the Program Manager marketing the program at that intersection.
7. Determine where safety or operational features preclude sign installation.

207-3.3 Central Office Responsibilities

The documents referenced in Section 207-3.1 also outline Central Office responsibilities for this program. They include, but are not necessarily limited to, the following:

1. Extend, modify or terminate the contract as needed.
2. Approve the Program Manager’s advertising agreement.
3. Approve the general plans for the work zone traffic control.
4. Approve all forms, applications, agreements and other documents necessary to carry out the program.
5. Coordinate the review of proposed non-standard symbols and submit them to FHWA.
6. Cancel individual advertising agreements with reasonable cause.

207-4 Hospital and Emergency Medical Care Facility Signing (D9-2, D9-H2a, D9-H2b, D9-H13g, D9-H13h, D12-H17, D12-H17aP, D12-H17b)

207-4.1 General

Signing for hospitals and emergency medical care facilities is in the general service sign category. It is intended to provide directional information to a treatment facility for the unfamiliar motorist with a medical emergency. For this reason, the name of the facility is not normally used on the signs.

Signing for hospitals and emergency medical care facilities should be erected for treatment facilities that meet the requirements of Section 207-4.3. Signs may be erected by ODOT for the following types of routes:

1. Interstate Routes inside and outside of corporation limits.
2. Freeways and expressways outside of corporation limits.
3. Other National Highway System (NHS) routes (Section 130-5) outside of corporation limits.

207-4.2 Procedures for Reviewing Requests

In order to avoid a proliferation of signs for hospitals and emergency medical care facilities, not more than one treatment facility should be signed for at an interchange or intersection.

When two or more treatment facilities fulfill the requirements for signing, preference should be based on the hierarchy established in Section 207-4.3 and accessibility and distance from the interchange or intersection.

When U.S. and State routes enter municipalities, signing will normally not be erected by ODOT since the most appropriate interchange or intersection for signing will usually be within the corporation limits.

Signing will normally not be erected on NHS routes when the treatment facility is located adjacent to the highway.
ODOT will erect necessary trailblazing signs on ODOT-maintained routes outside the corporation limits. Local officials are responsible for furnishing, erecting, and maintaining necessary trailblazing signs on roads within their jurisdiction. The District shall not erect signs until necessary trailblazing signs have been erected by local authorities having jurisdiction over the roadway.

207-4.3 Criteria for Hospital and Emergency Medical Care Facility Signing

To qualify for signing, the treatment facility must provide emergency medical care twenty-four hours per day, 365 days per year. To qualify as a hospital, the facility must also provide hospital beds intended primarily for the care of inpatients (patients staying for twenty-four hours or longer). Emergency medical care facilities differ from hospitals in that they do not provide inpatient hospital beds.

The following hierarchy shall be used in determining the medical treatment facilities for which to provide signing.

1. Hospital with level 1 trauma center.
2. Hospital with level 2 trauma center.
3. Hospital with level 3 trauma center.
4. Hospital without trauma center designation, with physician on duty within the emergency department.
5. Hospital without trauma center designation, with registered nurse on duty within the emergency department with a physician in the hospital on call.
6. Hospital without trauma center designation, with registered nurse on duty within the emergency department with a physician on-call from his/her office or home.
7. Emergency medical care facility with physician on duty.
8. Emergency medical care facility with registered nurse on duty with a physician on call from his/her office or home.

The American College of Surgeons maintains a list of hospitals with trauma centers. This list can be accessed at [http://www.facs.org/trauma/verified.html](http://www.facs.org/trauma/verified.html).

The hospital or emergency medical care facility shall be located within 5 roadway miles of the interchange or intersection where signing is initiated.

207-4.4 Signing

Signing for hospitals and emergency medical care facilities should be in accordance with OMUTCD Chapter 2I.

For hospitals with trauma centers, the D9-H2a and D9-H2b signs should be used. The D9-H2a sign is intended for use as a panel on freeway and expressway D9-18 and D9-18b General Service Signs. It can also be appended to other Major Guide Signs. The D9-H2b sign, with supplemental arrow plate, is intended for use on conventional roads, freeway and expressway ramps, and for trailblazing.

For hospitals without trauma centers, the D9-2 sign should be used. This sign is intended for use as a panel on freeway and expressway D9-18 and D9-18b General Service Signs. It can also be appended to other Major Guide Signs. Alternatively, word message signs (D12-H17,
D12-H17b) may be installed, or the word message supplemental panel (D12-H17aP) may be appended to other Major Guide Signs, on freeways and expressways. The D9-2 sign, with supplemental arrow plate, is used on conventional roads, freeway and expressway ramps, and for trailblazing.

For emergency medical care facilities, the D9-H13g and D9-H13h signs should be used. (As per the requirements of OMUTCD Section 21.02, the D9-13 Emergency Medical Services symbol cannot be used without a supplemental message indicating the type of service provided.) The D9-H13g sign is intended for use as a panel on freeway and expressway D9-18 and D9-H18b General Service Signs. It can also be appended to other Major Guide Signs. The D9-H13h sign, with supplemental arrow plate, is intended for use on conventional roads, freeway and expressway ramps, and for trailblazing.

207-5 Generic General Service Signing

207-5.1 General

The TODS and Logo Programs discussed in Sections 207-2 and 207-3, respectively, address signing for various fuel, food, lodging and camping facilities. See those Sections for details of those programs.

This Section establishes guidelines and criteria for the use of generic General Service signing for fuel, food, lodging and camping. However, this standard does not apply to privately-owned, non-profit campgrounds which are addressed in Section 205-2.

For purposes of this discussion, the term “non-profit” also refers to facilities or organizations described as “not for profit.”

207-5.2 Guidelines

The following guidelines shall be used in determining when to use generic General Service signing:

1. Generic General Service signing should only be provided for facilities meeting the criteria established in Section 207-5.3.

2. Under the terms of Ohio’s TODS Program contract (Section 207-3), certain food, lodging and camping establishments may be eligible for TODS signing in advance of intersections on U.S. and State Routes. Fuel establishments are not eligible for this program.

New generic General Service signs for fuel, food, lodging and camping establishments that are not eligible for the TODS Program, are not normally warranted at intersections on U.S. and State Routes.

However, existing generic General Service signs for fuel, food, lodging and camping may remain in place until they have reached the end of their effective performance life, or until the facilities have been signed for under the TODS Program, if eligible.

3. Signing for fuel, food, lodging and camping at interchanges on freeways and expressways should be in accordance with the Specific Service Signing (Logo) Program described in Section 207-2. Generic General Service signing for fuel, food, lodging or camping at interchanges eligible for Logo signing is only warranted for a specific type of service when none of that type of service is signed for with Logo signing at that interchange and the criteria in Section 207-5.3 are met. Interchanges on the Interstate system not eligible for Logo signing would normally not be eligible for generic General Service signing for fuel, food, lodging and camping.
4. Generic General Service signs for fuel, food, lodging and camping are not normally warranted in urban areas.

5. Generic General Service signs for fuel, food, lodging and camping should only be erected where the road user can directly return to the highway and continue in the same direction of travel.

6. The erection of signs for general services shall be in accordance with standards for sign type, height, lateral placement and location specified in the OMUTCD Chapter 2A.

7. General Service signing shall not be erected when the proposed signs would conflict with existing primary Guide Signs or other traffic control devices. Therefore, no commitment should be made to erect signs until an on-site inspection has been conducted at the proposed sign location in order to determine that sufficient space exists.

8. ODOT shall not erect signs until necessary trailblazing signs off the State system have been erected by others.

207-5.3 Criteria

Specific criteria have been established for generic General Service signing, depending on the type of service:

1. Fuel - The facility shall:
   a. Be located within 5 miles of the highway for which signing is sought.
   b. Provide vehicle services to include fuel, oil and water.
   c. Be in continuous operation for at least sixteen hours a day, seven days a week, all weeks of the year.

2. Food - The facility shall:
   a. Be located within 5 miles of the highway for which signing is sought.
   b. Have all required licensing or approval.
   c. Be operated continuously to serve at least two meals per day, at least 6 days per week.

3. Lodging - The facility shall:
   a. Be located within 5 miles of the highway for which signing is sought.
   b. Have all required licensing or approval.
   c. Provide adequate sleeping accommodations.
   d. Provide modern sanitary facilities.

4. Camping - The facility shall:
   a. Be located within 15 miles of the highway for which signing is sought.
   b. Have all required licensing or approval.
   c. Provide adequate parking accommodations.
d. Provide sanitary facilities and drinking water.

5. Other Facilities

Signing for emergency medical treatment facilities is addressed in Section 207-4. Signing for law enforcement agencies is addressed in Sections 205-2 and 209-2. Signing for privately owned, non-profit campgrounds is addressed in Section 205-2.3. Signing for Tourist Information Centers is addressed in Section 207-6.

**207-6 Tourist Information Center Signing**

**207-6.1 General**

OMUTCD Section 21.08 establishes standard freeway and expressway signing for Tourist Information Centers. The following procedure and criteria shall be used in addressing requests for public and privately-owned Tourist Information Centers signing for freeways and expressways.

Signs should not be erected unless requested by the Tourist Information Center operator. Upon receipt of a request, the District's designee should visit the center to check for compliance with the following criteria. Signs shall not be erected unless the criteria noted in Section 207-6.2 are met and the District recommends signing for the Tourist Information Center.

If a local Tourist Information Center meets the criteria, except that the information available pertains only to the local area, signing may be provided at the discretion of the District. These centers shall be signed for as described herein, except that the sign legend should be revised to read “LOCAL TOURIST INFO CENTER.”

**207-6.2 Criteria for Signing**

When evaluating a request for Tourist Information Center signing on a freeway or expressway, the following criteria shall apply:

1. The Tourist Information Center shall be located either:
   a. Within a rest area on a freeway or expressway, or
   b. Within 1 mile of a freeway or expressway interchange.

2. The Tourist Information Center shall be open at least eight hours a day, seven days a week. If operated on a seasonal basis, TOURIST INFO signs shall be removed or covered during the off-season.

3. Unless approved by the District Deputy Director, the Tourist Information Center shall not be located within a building, or on the same property, as a building used for the primary purpose of selling services to the motoring public.

4. The center shall have an adequate number of free parking spaces for automobiles with and without trailers, campers and motor homes. If located within an urban area, a turnaround shall be available to accommodate trailers, campers and motor homes.

5. The center shall provide, or be located adjacent to, well-maintained public restroom facilities.
6. The center shall provide, or be located adjacent to, at least one public telephone.

7. A privately-owned center should be endorsed by local authorities and/or civic organizations.

8. Information available to tourists should include, but is not limited to, the following:
   a. Local Tourist Services - Hotels, motels, restaurants, churches, hospitals with twenty-four hour emergency services and camping facilities.
   b. Local and Regional Points of Interest - Cultural locations, historical sites and geographical landmarks
   c. Local and Regional Attractions - Recreation areas, amusement parks, festivals and fairs, concerts, outdoor dramas, State parks and national parks.

9. It is desirable, but not mandatory, that facilities for Tourist Information Centers located off of freeways and expressway include the following:
   a. Benches and picnic tables on the lawn,
   b. A feminine napkin vendor in the women's restroom, and
   c. Sanitary drinking water.

10. The Tourist Information Center may be either a manned or self-service facility.

207-6.3 Signing for Centers on Freeways and Expressways

In general, if the Tourist Information Center meets the criteria in Section 207-6.2 and is recommended for signing by the District, the center shall be signed in accordance with OMQC Section 21.08.

If the Tourist Information Center is located within a rest area the following shall apply:

1. If Rest Area signs are in place, a supplemental TOURIST INFO CENTER (D5-H7aP) or TOURIST INFO (D5-H7bP) panel should be attached above the Rest Area Advance sign (D5-H1) and above the Rest Area Exit Direction sign (D5-H2 or D5-H1a). The width of the supplemental panel (D5-H7aP or D5-H7bP) should not be wider than the existing signs. Alternatively, the Tourist Information symbol (D9-10) may be appended beneath the Rest Area Advance sign.

2. If the signing for the Tourist Information Center is to be erected as part of the initial Rest Area signing, one of the following signing methods may be used:
   a. Erect D5-H1 and D5-H2 (or D5-H1a) signs with the TOURIST INFO CENTER (D5-H7aP) or TOURIST INFO (D5-H7bP) supplemental panel; or
   b. Erect the REST AREA TOURIST INFO CENTER X MILES sign (D5-H7) and the REST AREA TOURIST INFO CENTER NEXT RIGHT (D5-H8a) sign; or
   c. Erect the REST AREA TOURIST INFO CENTER X MILES sign (D5-H7) and the REST AREA TOURIST INFO CENTER (with arrow) (D5-H8) sign.

3. The D5-H7 and D5-H8a (or D5-H8) signs may also be erected if the existing Rest Area signs are being replaced because of safety upgrading, sign damage or deterioration. Serviceable Rest Area signs should not be replaced with D5-H7 and D5-H8a (or D5-H8) signs solely for the purpose of adding the TOURIST INFO CENTER or TOURIST INFO legend.
4. The D5-H7 and D5-H8a (or D5-H8) signs shall not be erected for Tourist Information Centers which operate on a seasonal basis.

207-6.4 Signing for Centers Off of the Freeway or Expressway

For a Tourist Information Center located off the freeway or expressway, the following additional provisions shall apply:

1. If a General Services sign (D9-18, D9-18b) is in place for the interchange, a Tourist Information symbol (D9-10) should be added to the sign. If space is not available to add the symbol, a larger General Services sign may be installed.

2. If no General Services sign is in place at the interchange, the Tourist Information symbol (D9-10) may be appended to ground-mounted interchange Guide Signs. Alternatively, a Tourist Information Center word message sign (D5-H7c) may be erected.

3. Tourist Information symbol signs (D9-10) with appropriate Directional Arrow Auxiliary Signs should be erected:
   a. On multi-lane ramps, and
   b. At the end of a ramp when the Tourist Information Center is not within sight of the interchange.

4. Signs shall not be erected by ODOT for Tourist Information Centers located off the State right-of-way until the operator or appropriate local authorities have provided, at other than State expense, any additional signing necessary to direct tourists to the center.

5. ODOT shall not erect trailblazing signs on City streets, or County or Township roads.

207-7 Drug Enforcement Signs (D12-H22, D12-H23)

DRUG ACTIVITY IMPAIRED DRIVERS CALL #677 signs (D12-H22) and DRUG TRAFFICKERS GO TO PRISON CALL #677 signs (D12-H23) were installed by ODOT on ODOT-maintained highways in early 2012. These signs were installed at the request of the Ohio State Highway Patrol (OSHP), to publicize their #677 phone number. These signs replaced the NEED HELP 1-877-7-PATROL and EMERGENCY CALL 9-1-1 signs (D12-H11, D12-H12), which were initially installed in 1999. The 1-877-7-PATROL phone number is no longer in service.

OSHP provided funding for initial sign fabrication. The Districts provided the materials and labor for installation.

No funding has been provided by OSHP to cover fabrication costs of signs needed for maintenance replacements. The Districts should order and install replacement signs as needed using established procedures.

Signing for the EMERGENCY CALL XX (D12-4) sign is addressed in OMUTCD Section 21.09, and signing for the Countywide 9-1-1 Systems (D12-H14) is addressed in Section 206-7.
OMUTCD Chapter 2M provides information on Guide Signs used for recreational and cultural interest areas. On ODOT-maintained highways, the use of rectangular signs with a white legend and border on a brown background is preferred. The trapezoidal shape should not be used.
208 REST AREA SIGNS

208-1 General

The OMUTCD addresses signing for rest areas in Section 21.05. Additional signing has been developed over the years for use in ODOT rest areas. For the most part, these signs have been developed to address specific requests from the Department of Public Safety (ODPS) or the offices responsible for maintaining the facilities. The following Sections address additional signing approved for use in advance of, and within, rest areas. Figures 298-6a through 298-6c illustrate rest Area signs discussed herein that are not shown in the OMUTCD.

Mainline rest area signs for use on ODOT-maintained highways are shown in Figure 298-6a. Example applications of these signs are shown in Figures 298-39 through 298-41.

208-2 REST ROOMS CLOSED Sign (D5-H33)

The REST ROOMS CLOSED sign (D5-H33) shall be erected on conventional roads and on the mainline of freeways and expressways when rest rooms are closed for other than routine maintenance of short duration. This sign should be erected under the Advance Rest Area sign (D5-H1). On freeways and expressways, an additional sign may be erected under the Exit Direction Rest Area sign (D5-H1a or D5-H2).

If the Rest Area signs are supplemented with panels, the D5-H33 sign should be erected under the bottom panel. If the sign support has a breakaway connection, care shall be taken to assure that the D5-H33 sign does not interfere with the breakaway action.

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<tr>
<th>Code No.</th>
<th>Route Type</th>
<th>Size Inches</th>
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</thead>
<tbody>
<tr>
<td>D5-H33</td>
<td>Freeway &amp; Expressway</td>
<td>48 x 48</td>
</tr>
<tr>
<td>D5-H33</td>
<td>Conventional</td>
<td>24 x 24</td>
</tr>
</tbody>
</table>

208-3 SAFETY BREAK FREE COFFEE Sign (D5-H51P, D5-H52P)

The SAFETY BREAK FREE COFFEE signs (D5-H51P, D5-H52P) may be erected when authorized by the District Deputy Director. These signs shall not be easel-mounted, and should not be erected on separate supports. If the D5-H52P sign is used, extreme care shall be taken to assure that it does not interfere with the breakaway (or yielding) aspect of the supports and that the supports are of sufficient size to accommodate the extra signing area and wind loading.
208-4 NO FACILITIES Sign Panel (D5-H17)

The NO FACILITIES panel (D5-H17) may be used on freeways and expressways when a rest area is constructed with the rest room facilities to be added at a later date. This panel is erected below the Advance Rest Area sign (D5-H1). An additional panel may be erected below the Exit Direction Rest Area sign (D5-H1a or D5-H2).

<table>
<thead>
<tr>
<th>Code No.</th>
<th>Route Type</th>
<th>Size Inches</th>
</tr>
</thead>
<tbody>
<tr>
<td>D5-H51P</td>
<td>All</td>
<td>48 x 48</td>
</tr>
<tr>
<td>D5-H52P</td>
<td>Freeway &amp; Expressway</td>
<td>120 x 48</td>
</tr>
</tbody>
</table>

208-5 Other Rest Area Signs

Additional approved signs for use within the rest area are shown in Figure 298-6a. Color and size information is provided in the SDMM (see Section 295-2).

208-6 Report Drunk Drivers Sign (D12-H13)

The D12-H13 sign is intended to assist the Ohio Department of Public Safety’s campaign to encourage reporting of drunk drivers.

This sign should be erected in all ODOT rest areas. It should be erected on separate supports along the ramp exiting the rest area when possible, but may be erected elsewhere in the rest area if space is unavailable along the ramp.

<table>
<thead>
<tr>
<th>Code No.</th>
<th>Route Type</th>
<th>Size Inches</th>
</tr>
</thead>
<tbody>
<tr>
<td>D5-H17</td>
<td>Freeway &amp; Expressway</td>
<td>72 x 36</td>
</tr>
</tbody>
</table>

REPORT DRUNK DRIVERS
1-800-GRAB DUI
CELLULAR DIAL • DUI
FREE AIR TIME

D12-H13
48” x 30”
209  FREEWAY & EXPRESSWAY DISTANCE & DESTINATION SIGNS

209-1  General

Freeway and expressway Distance and Destination signs are addressed in OMEM Chapter 2E. Information regarding the design of freeway and expressway Guide Signs is provided in OMEM Sections 2E.01 through 2E.19 and Appendix C of the SDMM (see Section 295-2). This is discussed further in Section 211-3.

The following Sections address signs not in the OMEM, or provide additional information about the intended use of signs that do appear in the OMEM.

209-2  Signing for Generators at Interchanges on Freeways & Expressways

209-2.1  General

As noted in OMEM Section 2E.35, the following guidelines have been developed for determining when a destination qualifies as a traffic generator for which Guide Signs, typically containing the name of the generator, may be erected at interchanges on freeways and expressways.

209-2.2  Participation Within a Municipality

Within the corporation limits of a municipality, ODOT’s involvement with generator signing shall only occur in the following ways:

1. On Interstate Routes, in conformance with the provisions of SOP OPS-111, ODOT will furnish signing for eligible traffic generators. The municipality is responsible for acquiring necessary data and determining eligibility before requesting signs from ODOT.

2. At interchanges on other freeways and expressways, federal or State funding may participate in the costs of furnishing or installing generator signing as part of a highway improvement. The signing must meet the generator signing criteria established by local authorities which, in turn, must be in substantial agreement with the criteria contained herein (see OMEM Section 2E.35, and Chapter 2M).

209-2.3  Procedures for Reviewing Signing Requests

Signs may be erected at interchanges on freeways and expressways: (1) after a written request has been received from the operator of the generator (with all data necessary to determine eligibility) and an investigation by the District has confirmed the eligibility of the generator as defined by this standard; or (2) after receipt of a written request from local authorities for generator signs on an Interstate Route within a municipality where the requirements of Section 209-2.2 are satisfied.

The design and erection of signs for eligible generators shall be in accordance with standards for sign type, height, lateral placement and location as specified in the OMEM. The signs typically contain the name of the generator, and are typically classified as Supplemental Guide Signs. As noted in OMEM Section 2E.35, Supplemental Guide Signs may show one or two destinations not shown on the major Guide Signs. However, only one Supplemental Guide Sign should be used on each interchange approach.

Signs for eligible generators shall not be erected when the proposed signs would conflict with existing primary Guide Signs or other warranted signs. Therefore, no commitment should be made to erect signs until an on-site inspection has been conducted at the proposed sign location in order to determine that sufficient space exists.
Generator signs should normally not be erected at freeway-to-freeway interchanges.

Normally, the Supplemental Guide Sign for each direction of travel on the mainline should be at the same interchange. Where it would be more appropriate to erect the generator signs for each direction of travel at separate interchanges, this may be done. The operator of the generator may recommend an interchange for signing in each direction on the mainline. However, the final decision as to sign placement rests with ODOT. Within the corporate limits of a municipality, this determination of sign location shall be coordinated with local authorities.

Under exceptional circumstances, additional signs may be necessary at interchanges on other freeways and expressways to adequately sign for an eligible generator. Additional signs should be approved by the District Deputy Director based on an engineering study that documents the need.

Erection and maintenance of signs which trailblaze from the freeway or expressway interchange to the generator are the responsibility of ODOT on ODOT-maintained highways, and local officials for municipal, County and Township Roads. Generator signs on freeways and expressways shall not be erected until trailblazer signs are in place.

Not all demands for generator signing can be accommodated. Therefore, the District should develop a priority system to determine which of the generators should get the limited space available. If signs for the generator requesting signing would result in too many signs or too many destinations on a sign, the District shall review the information and determine which generators will receive signing. To minimize future conflicts and removals of existing generator signs, consideration should be given to future expectations and priorities of signing at interchanges before erecting signs.

209-2.4 Criteria and Eligible Generators

Signs for a traffic generator may be erected on a freeway or expressway when the generator meets the criteria specified in Table 297-4.

209-2.5 Traffic Generators that Do Not Normally Warrant Signing

Activities signed for under the Specific Service Signing (Logo) Program (Section 207-2) do not qualify for generator signing under this Section.

It has also been determined that the following traffic generators do not normally warrant signing:

1. Businesses - Factories, manufacturing facilities, industrial parks, shopping centers, shopping malls, television stations, radio stations and theaters.

2. Cemeteries - National, local, State, military, public and private.

3. Community Facilities - Churches, civic centers, recreational center, recreational complex, YMCA facilities, libraries, subdivisions and privately-owned historical facilities.

4. Educational - Grade schools and high schools, except as provided in Table 297-4.

5. Governmental - Courthouses, disaster assistance facilities, civil defense facilities, drivers license centers, jails, prisons, local government highway buildings, post offices, research facilities and experimental facilities.

6. Medical - County homes, fraternal homes, nursing homes, humane facilities (animal shelters), infirmaries, treatment centers, mental facilities, research facilities, retirement facilities, sanitariums and veteran facilities.
7. Military - Armories, arsenals, sites and detachments.

8. Recreational - Country clubs, golf courses, planetariums, fish hatcheries, game farms, 
game preserves, game refuges, arboretums and privately-owned campgrounds.

209-2.6 Temporary Event Signing

Directional signing may be installed on freeways and expressways for temporary events. 
Temporary events include shows (e.g., boat, car, air, horse, RV), street fairs and festivals, 
reenactments, sports tournaments, concerts and other similar short-term activities that 
generate a significant amount of traffic from outside the immediate area of the event, but for 
which permanently installed signs would not be appropriate. The duration of these events 
would typically be several days or several successive weekends; however, some could be as 
short as a few hours. Temporary directional signs will assist the unfamiliar road user with the 
selection of the appropriate exit from the freeway or expressway. These directional signs are 
tended to provide guidance to road users looking for the event, and are not meant to entice 
others to attend.

Generally, for events expected to attract fewer than 25,000 visitors per day, or attracting 
visitors principally from the local area, directional signage on the freeway or expressway 
would not be needed. For events attracting 25,000 or more visitors per day, with many from 
outside the local area, appropriately designed and installed directional signs would be 
beneficial.

Directional signing should only be considered for events located within 5 miles of the freeway 
or expressway interchange. This distance can be waived by the District Deputy Director. 
Signs should not be used at freeway to freeway (system) interchanges.

Requests for directional signage to be placed on the mainline and ramps of Interstate 
highways and other freeways and expressways under ODOT’s jurisdiction, should be 
submitted by the sponsoring agency to the appropriate ODOT District at least 45 days prior 
to the event. As a minimum, this request should include the proposed sign designs and 
locations. The District should review the request, and on a case-by-case basis, determine 
what, if any, directional signage would be appropriate on the mainline and ramps of Interstate 
highways and other freeways and expressways.

Once the sign designs, locations and support arrangements have been approved by ODOT, 
the sponsoring agency shall be responsible for the fabrication and installation of the signs on 
the mainline and ramps. The sponsoring agency shall obtain an ODOT right-of-way permit 
prior to the installation of the signs. Alternately, ODOT may install the approved signs 
furnished by the sponsoring agency and bill the sponsoring agency for the costs incurred.

The sponsoring agency shall be responsible for the removal of the signs within 24 hours after 
the conclusion of the event. ODOT may remove signs not removed by the sponsoring agency 
within a timely manner, and bill the sponsoring agency for the costs incurred.

The signs shall conform to the requirements in the OMUTCD, and shall not contain any 
advertising. On the freeway and expressway mainline, the minimum capital or upper case 
letter height should be 8 inches. On the freeway and expressway ramps, the minimum capital 
or upper case letter height should be 4 inches. The sign background color should be brown or 
green, with a white legend. The legend should be as concise as possible while still conveying 
the necessary pertinent information to associate the sign with the event.

The signs shall be installed on their own ground-embedded supports unless the District 
agrees that they may be attached to existing signs, sign supports, utility poles, or mounted on 
portable supports. Signs installed in exposed locations (i.e., not protected by guardrail or 
concrete barrier), must be on crashworthy (see OMUTCD Section 1A.13) ground-embedded
or portable supports (except for signs attached to utility poles). Signs on portable supports shall have a minimum mounting height of 1 foot above the edge of pavement. The mounting height of other signs shall be in accordance with the OMUTCD.

If determined by ODOT to be appropriate, ODOT may allow the sponsoring agency to install portable changeable message signs (PCMSs) on the freeway or expressway, in accordance with the provisions of the OMUTCD. The PCMSs shall be placed at locations approved by ODOT, and should be installed behind guardrail whenever possible.

Signs directing road users from the freeway or expressway to the event shall be in place prior to displaying sign messages on the freeway or expressway. Installed signs and PCMSs on the freeway and expressway shall remain covered or inactivated until such time as the necessary directional signing on the conventional and local street systems is in place.

### 209-2.7 Signing on Freeways and Expressways for Other Generators

Emergency Hospital signing is addressed in Section 207-4, signing for generic Motorist Services is addressed in Section 207-5, and signing for Tourist Information Centers is addressed in Section 207-6. Also, signing for the Logo Program is described in Section 207-2.

### 209-3 Control City Destinations for Ohio’s Interstate Highway System

Control cities are major destinations and population centers of national significance, located on or near the Interstate Highway System, that have been identified through a process established by AASHTO for use in guide signing. Each State is involved in the process, and the list is subject to change. The list of all control cities in the United States is in the AASHTO publication “List of Control Cities for Use in Guide Signs on Interstate Highways.”

Guide Sign directional and distance information shall be uniformly based on these control cities, instead of presenting a variety of short-range destinations at small mileage intervals that are of little value to the non-local, unfamiliar traveler. Consequently, the number of control cities should be kept to the minimum necessary to provide broad directional information, and they should be used as legends in the following situations:

1. Interchanges between freeways.
2. Separation points of overlapping freeways.
3. On directional signs on intersecting routes, to guide traffic entering the freeway.

In addition, OMUTCD Section 2E.12 addresses the use of control cities on Pull-Thru signs and Section 2E.39 addresses their use on the bottom line of Post-Interchange Distance (E7-H1) signs.

Control cities for loop, spur, outerbelt or innerbelt type facilities should be determined from the linear Interstate Routes to which they connect. Control cities identified for Ohio’s Interstate Highway System are listed in Table 297-5.

### 209-4 Weigh Station Signing for Freeways and Expressways

#### 209-4.1 General

Weigh Station Signing for freeways and expressways is addressed in OMUTCD Sections 2D.49 and 2E.54, and Figure 2D-17. On ODOT-maintained highways, the D8-H2, R13-H1 and R13-H2 signs shall be used (in addition to the D8-1 and D8-3).
The R13-H1 sign shall be located approximately 4,000 feet in advance of the gore. The R13-H2 sign shall be located approximately 3,200 feet in advance of the gore.

209-4.2 Exit Direction Sign (D8-H2)

As noted in OMUTCD Section 2E.54, on freeways and expressways this sign shall be erected at a minimum of 1500 feet in advance of the gore. The bottom line consists of a changeable message panel capable of displaying the words “OPEN” and “CLOSED.” The legend “CLOSED” shall be displayed when the station is closed and the legend “OPEN” shall be displayed when the station is open and shall be controlled from the scale house.

R13-H1 120 x 96
R13-H2 120 x 72
D8-H2 156 x 72

209-5 Interchange Exit Numbering (E1-H5P) and Reference Location Signs (D10-1 through D10-5, D10-H5a)

The OMUTCD discusses interchange exit numbering in Section 2E.31. Reference Location signs (including Enhanced Reference Location signs) are addressed in OMUTCD Sections 2H.05 and 2H.06.

The Enhanced Reference Location signs addressed in OMUTCD Section 2H.06 and Figure 2H-4 may be used on ODOT-maintained freeways, expressways and major conventional roads.

209-6 Street Name Signing for At-Grade Intersections on Expressways and Multi-Lane Conventional Roads

209-6.1 General

The OMUTCD discusses street name signing for at-grade intersections on expressways in Sections 2E.29.1 and 2E.29.2. This type of signing will also be appropriate at some intersections on multi-lane conventional roads. The type of signing to use on the mainline of expressways and multi-lane conventional roads at and in advance of intersecting public highways depends upon the characteristics of both roadways. Different signing arrangements may even be appropriate for adjacent intersections on a particular section of highway. Section 209-6 discusses the signing arrangements that are used for at-grade intersections on expressways and multi-lane conventional roads.

209-6.2 At-Grade Intersections on Expressways

For expressways where the primary access is by grade-separated interchange and at-grade intersections with public roads with few or no commercial and/or private driveways, the signing arrangements shown in Figures 298-28 and 298-29 would typically be used for at-grade intersections. Figure 298-28 applies to a numbered intersecting route and Figure 298-29 applies to an unnumbered intersecting route.
The major Guide Signs are designed as level 2. Supplemental Guide Signs, if used, would be designed as level 3. Signing levels are discussed in the SDMM Appendix C (see Section 295-2).

209-6.3 At-Grade Intersections on Multi-Lane Conventional Roads

A multi-lane conventional road is a divided or undivided highway with two or more through lanes in one or both directions where the primary access is by grade-separated interchanges and at-grade intersections with public roads, with numerous secondary access points with commercial and/or private driveways. Multi-lane conventional roads may or may not have partial control of access. Although they may sometimes meet the definition of an expressway, they function more as arterial streets due to the amount of development that can be directly accessed via commercial and/or private driveways.

On multi-lane conventional roads, for at-grade intersections with important public roads, the signing arrangement shown in Figure 298-30 would typically be used. The arrangements shown in Figures 298-28 and 298-29 may be considered where additional advance notice of intersections having significant amounts of cross traffic is desired.

209-6.4 Minor At-Grade Intersections on Expressways and Multi-Lane Conventional Roads

The use of advance signing may not be necessary at some at-grade intersections with relatively minor public roads located in the vicinity of numerous commercial and/or private driveways. Examples include dead end streets, or streets that serve only a few residential properties, where the amount of turning traffic may be less than at adjacent driveways. In these cases, the use of advance signing may provide minimal benefit and could interfere with the effectiveness of advance signing for more important at-grade intersections or grade-separated interchanges.

209-7 Signs for Option Lanes

An option lane exit is any multi-lane exit where the total number of through and exiting lanes exceeds the number of approach lanes. An option lane is that lane from which traffic has a choice of either continuing on the through roadway or exiting without changing lanes. Option lanes are always accompanied by a lane drop (see OMTCD Sections 2E.20 and 2E.23 and Figures 2E-4 through 2E-12).

Roadway geometrics of option lane exits are often further complicated by a bifurcation beyond the mainline gore immediately beyond the mainline exit (2000 feet or less) which may also contain option and/or drop lanes.

The directional signing for an option lane exit must convey to the approaching driver: (1) a warning of the lane drop; (2) the existence of the option lane; and (3) adequate advance notice of a bifurcation beyond the mainline gore and lane drops.

Chapter 2E of the 2012 OMTCD, includes expanded information regarding guide signing used for option lanes, and introduces the Arrow-per-Lane Guide Signs. It also prohibits or discourages many guide signing practices that are commonly used in Ohio. The following are of particular concern:

Section 2E.20, paragraph 02, requires the use of Arrow-per-Lane or Diagrammatic signs for multi-lane exits or splits that have an option lane.

Section 2E.19, paragraph 05, and Section 2E.23, paragraph 06 prohibit the use of a single down arrow over an option lane if that lane also serves another destination.

Section 2E.19, paragraph 06 prohibits the use of two down arrows on adjacent signs pointing to the same lane.
Section 2E.21, paragraph 07 (H) prohibits any indication of ramp splits beyond the mainline exit on the Arrow-per-Lane sign.

These requirements may not present any particular problems when used at isolated locations. However, problems may arise in cases where a mainline exit from an option lane is followed shortly thereafter by a ramp split, especially where the ramp split also contains an option lane, or where interchanges are closely spaced. Both of these situations are prevalent on Ohio freeways.

OMUTCD Figures 2E-4, 2E-5 and 2E-6 provide examples regarding the use of Arrow-per-Lane signs for multi-lane exits and splits that have an option lane, but do not have a subsequent ramp split. Figure 2E-34 provides examples of guide signing for ramp splits beyond the mainline exit, but where there is no mainline option lane or ramp option lane. There are no examples in the OMUTCD showing guide signing arrangements for multi-lane exits with an option lane followed by a ramp split. There are also no examples for multi-lane exits with an option lane for closely spaced interchanges.

For major highway reconstruction, efforts should be made to follow the OMUTCD to the greatest extent practical. This includes working with the highway design team to develop highway entrance and exit ramp configurations and interchange spacings that will be conducive to the application of the signing design principals in the OMUTCD.

The use of two down arrows on adjacent signs pointing to the same lane should be avoided on major highway reconstruction. This signing method can work effectively when done properly. However, past experience has shown that oftentimes the down arrows are placed on the signs at inappropriate angles, or the signs are improperly positioned on the overhead support, such that the intended information is poorly conveyed to the motorist. The continued use of slanting down arrows on adjacent signs pointing to the same lane can be continued at existing interchanges. When performing sign upgradings, consideration should be given to using other appropriate signing arrangements.

Besides the figures included in the OMUTCD, Figures 298-33 through 298-36, and 298-45 through 298-47 should be referred to when designing interchange guide signing.

For an optional lane exit with a secondary exit less than 2000 feet beyond the primary exit, the route and destination messages pertaining to the secondary exit should be included in the legend on the primary exit Guide Signs. Where traffic volumes exiting at the primary exit are well below the 1200 to 1300 vehicles per hour capacity of one lane, the optional lane may be eliminated by using transverse pavement markings; and the signing used may be as shown in Figure 298-34. As additional capacity is needed, the transverse pavement markings may be removed. No change in signing may be necessary (Figure 298-35). Where a major split occurs at a secondary exit, the typical signing shown in Figure 298-36 should be used.
210 MISCELLANEOUS SIGNS

210-1 General

This Chapter addresses miscellaneous signs not in the OMUTCD.

210-2 Reserved for Future Information

210-3 Decorative Signs in State Right-of-Way

Districts may, at their discretion, elect to allow local communities to erect decorative signs within the rights-of-way under ODOT jurisdiction. For those Districts that decide to allow such signing, the following criteria shall apply:

1. Four sets of detailed plans showing the sign face, post(s), lettering, colors, location, etc. shall be submitted to the District with a permit application in the community’s name for review and comment.

2. The sign is to be erected on a maximum 4 x 4 inch wooden post(s).

3. The sign face is to be no greater than 32 square feet

4. Neutral colors shall be used on the sign.

5. The sign shall be located a minimum of 40 feet from the edge of the paved shoulder unless located behind guardrail. Additionally, the sign should be located outside interchange roadways, including ramps.

6. The sign is to be installed and maintained by the Permit Holder. A minimum radius of 20 feet around the sign is to be maintained (grass mowed) by the Permit Holder.

7. Posts shall be direct buried. They cannot be encased in concrete.

8. No electricity shall be installed for the sign.

9. No advertising is permitted on the sign or supports, including acknowledgment or sponsorship.

10. The sign must be officially authorized by local ordinance or resolution.
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211 SIGN DESIGNING

211-1 General

OMUTCD Section 2A.06 briefly addresses sign designs, and additional general design information is provided in each OMUTCD signing chapter. General information is also provided in the Sign Designs and Markings Manual (SDMM) Introduction and Appendix B (see Section 295-2). Additional information is provided in the following Sections, and detailed information used for the design and fabrication of traffic control signs is contained in the SDMM.

For many positive contrast signs (white legend on dark background) the SDMM allows the use of either the Standard Highway Alphabet or Clearview font. ODOT has decided to use Clearview font for all signs on ODOT-maintained highways where its use is allowed in the SDMM.

The FHWA counterpart to the SDMM is the Standard Highway Signs and Markings (SHS) book (see Section 193-15).

211-2 Standard Signs

Generally, the designs for standard Regulatory and Warning Signs, as well as various Guide Signs where the design is basically set, are prepared by OTE and published in the SDMM. Section 205-2 provides some additional information on Conventional Road Destination Signs. Clearview font shall be used for positive contrast legends on Conventional Road Guide Signs when permitted in the Sign Designs and Markings Manual (SDMM). The standard symbols used in these signs are provided in SDMM Appendix A, and design information is provided in SDMM Appendices B and D. The symbols, arrows, alphabet information and design standards used are based on those established by FHWA.

211-3 Designable Guide Signs

As noted in Section 209-1, OMUTCD Sections 2E.01 through 2E.19 and SDMM Appendix C provide information regarding the design of freeway and expressway Guide Signs. Clearview font shall be used for positive contrast legends on freeway and expressway Guide Signs.

211-4 Sign Design Computer Program

A computerized sign design package (design and fabrication/production software) is currently in use in the Office of Traffic Engineering (OTE) and the Districts. Purchase and maintenance of the program, called SignCAD, is coordinated by OTE. The Clearview fonts must be purchased separately, since they are not included in the SignCAD software.

The program includes a library of ODOT standard signs, maintained through a maintenance agreement OTE has with the supplier.

OTE can assist the Districts in designing directional Guide Signs for construction project or force account installation purposes, as well as special Regulatory and Warning Signs that may become necessary.

SignCAD training is available from the OTE Traffic Control Section.
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212 SIGN LIGHTING

212-1 General

OMUTCD Section 2E.06 indicates that overhead sign installations should be illuminated unless an engineering study shows that retroreflectorization alone will perform effectively, providing effective and reasonably uniform illumination of the sign face and message. The following Sections, as well as Sections 240-7, 241-4, 242-2, 250-8, 260-7 and 1103-6.8, provide additional information about sign lighting.

212-2 Sign Lighting for Overhead Guide Signs

Research has shown that sign lighting is not necessary for overhead Guide Signs when Type H or J reflective sheeting is used for the reflective legends. Section 220-6 requires that Type H or J sheeting be used for the reflective legends (including shields, arrows and symbols) on overhead extrusheet signs on ODOT-maintained highways. Therefore, for new installations on ODOT-maintained highways, sign lighting should not be used, and as noted in Section 260-7, mercury vapor sign lighting shall not be used.

For existing installations, sign lighting may remain; however, as noted in Section 260-7, mercury vapor sign lighting shall not be maintained. As existing signs are upgraded with legends of Type H or J reflective sheeting, the existing sign lighting should be removed. Removal shall include, as a minimum, the physical removal of the luminaires and luminaire support assemblies.

212-3 Sign Lighting for Other Traffic Signs

Sign lighting is not necessary for other overhead and ground-mounted traffic signs. This includes overhead lane-use control signs and ground-mounted PREPARE TO STOP WHEN FLASHING signs.
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220 MATERIALS AND HARDWARE

220-1 General

Refer to the ODOT Construction and Materials Specifications and Supplemental Specifications (CMS) for details regarding signing materials. Chapter 241 lists the related CMS references and Chapters 240 and 250 address additional design and construction information related to signing materials and hardware.

220-2 Patented or Proprietary Materials, Specifications or Processes

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

220-3 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.

220-4 Sign Reflectivity

Traffic control signs utilize reflective sheeting materials containing optical elements designed to return a large portion of the incident light back towards the source. At night, this property, known as retroreflectivity, redirects incident light from a vehicle’s headlights back toward the vehicle’s occupants. This allows traffic control signs to remain visible after dark.

The retroreflective properties of traffic control signs degrade over time, due principally to exposure to ultraviolet radiation from the sun and environmental contaminants. Signs that may appear satisfactory during the day may have insufficient retroreflectivity to be visible at night.

The ODOT systematic sign replacement program (see Section 260-5) provides for traffic control signs to be replaced on a regularly scheduled basis to assure that they have adequate levels of retroreflectivity. Therefore, periodic night inspections of signs should not be necessary. Districts wanting to conduct night sign inspections may do so at their own discretion. A recommended procedure is described in Section 220-5.

220-5 Sign Reflectivity Inspections

Sign reflectivity can be checked at night using one of the Visual Nighttime Inspection procedures described in OMUTCD Section 2A.08. Additional information about these methods is contained in the 2007 Edition of FHWA’s “Maintaining Traffic Sign Retroreflectivity” and the FHWA web site. However, the ODOT systematic sign replacement program (see Section 260-5) should preclude the need to conduct periodic reflectivity checks, provided the replacement intervals are followed.

The formation of dew or frost on the face of a sign will negatively impact the sign’s retroreflective properties. When performing night inspections, evaluators should be aware of this potential condition. Night inspections should only be conducted when atmospheric conditions do not allow the formation of dew or frost on the sign face.

Retroreflectivity can also be measured with a retroreflectometer. However, this is a time consuming and labor intensive method, as it requires that multiple measurements be physically taken with the meter at each sign.
220-6 Use of Reflective Sheeting for Permanent Traffic Control Signs

For flatsheet and ground-mounted extrusheet signs, Type G, H or J reflective sheeting shall be used for the background and reflective legends. For overhead extrusheet signs, Type G, H or J reflective sheeting shall be used for the background, and Type H or J reflective sheeting shall be used for the reflective legends, shields, arrows and symbols (including the hazardous cargo plate, airport symbol, and borders). Type G reflective sheeting shall not be used for legends, shields, arrows and symbols on overhead extrusheet signs.

Existing signs made with Type F reflective sheeting may remain in the field until they have reached the end of their sign service life. New Type F signs shall not be installed. Any remaining stocks of Type F signs should be disposed of by the District.

Existing signs with legends of demountable embossed copy may remain in the field until they have reached the end of their sign service life. New signs with demountable embossed copy shall not be installed. Any remaining stocks of signs with legends of demountable embossed copy should be disposed of by the District.

220-7 Use of Fluorescent Yellow-Green Sheeting

The OMUTCD requires the use of fluorescent yellow-green sheeting for school warning signs, including the “SCHOOL” portion of the School Speed Limit sign and including any supplemental plaques used in association with these warning signs, and allows for the optional use of fluorescent yellow-green sheeting for pedestrian, bicycle, and playground Warning Signs. It also states that the mixing of standard yellow and fluorescent yellow-green signs within a zone or area should be avoided.

For ODOT-maintained highways, the following signs will normally be fabricated with fluorescent yellow-green reflective sheeting: School Advance Warning (S1-1), School Bus Stop Ahead (S3-1), SCHOOL BUS TURN AHEAD (S3-2), SCHOOL ENTRANCE (S3-H3), SCHOOL (S4-3P), yellow portions of School Speed Limit (S5-H1), In-Street Pedestrian Crossing (R1-6, R1-6b), and Overhead Pedestrian Crossing (R1-9), Bicycle (W11-1), Pedestrian (W11-2), Handicapped (W11-9), Bicycle/Pedestrian (W11-15), TRAIL CROSSING (W11-15a), Playground (W15-1), and SAFETY ZONE (W15-H2). The process ODOT will follow to transition to fluorescent yellow-green sheeting is described in this Section.

Existing yellow signs of the above code numbers may remain in the field until the signs have reached the end of their effective performance life, except that when upgrading a sign within a zone or area to fluorescent yellow-green, all yellow signs of the above code numbers within the zone or area should be replaced with fluorescent yellow-green signs. Yellow signs that have been removed prior to the end of their effective performance life may be returned to District stocks for use in maintenance activities.

Signs of the above code numbers will be provided from the ODOT Sign Shop in fluorescent yellow-green, unless specified otherwise by the District. The intent is to convert the above signs to fluorescent yellow-green as existing signs are upgraded.

Supplemental sign plaques, such as Advisory Speed (W13-1P), SHARE THE ROAD (W16-1P), Distance (W16-2P, W16-2aP, W16-3P, W16-3aP), Supplemental Arrows (W16-5P, W16-6P, W16-7P) and AHEAD (W16-9P) should be ordered to match the color of the primary sign.
220-8 Production and Purchasing of Signs and Related Materials

220-8.1 General

In accordance with ORC Section 5147.07, the Office of Traffic Engineering (OTE) operates a sign production facility and is responsible for the manufacture and coordination for procurement of all signs and related items required for use by ODOT. Actual sign production is accomplished by the Central Office Sign Shop located in Columbus.

Except for normal field maintenance of Guide Signs or in extreme emergencies, Districts should not fabricate, repaint or re-stencil any sign for use on ODOT-maintained highways.

Temporary non-standard signing, if used, should be replaced by standard signs as soon as possible.

220-8.2 Sign Shop Orders

All orders for signs, markers and any other materials or equipment to be supplied or manufactured by the Sign Shop shall be submitted to the Sign Shop through the automated Smart Sign Ordering System (SSOS). All necessary information shall be provided.

Orders for designable extrusheet signs should be accompanied by a SignCAD file so that the District can be assured that the Sign Shop will provide what they are expecting. If there are questions associated with this requirement, call the Sign Shop for assistance.

Excluding warehouse orders, standard sign orders shall be submitted in advance with as much lead time as possible, to afford the Sign Shop sufficient time to integrate fabrication into regular production schedules. “Rush” orders shall be kept to a minimum.

In extreme situations, when circumstances dictate urgent need, orders may be made by telephone. The Sign Shop may be called directly when an emergency situation arises. However, a confirming Sign Shop Order via SSOS must be submitted following any telephone order.

220-8.3 Delivery

The Sign Shop will strive to complete, and have ready for pick-up or delivery, all orders for flatsheet signs within 30 days after receipt of order (ARO), and all extrusheet sign orders within 45 days ARO. The only exception to the preceding timeline is warehouse signs, which can be accessed on a daily basis. The primary delivery of flatsheet signs to the Districts will be the pony system. Each District should provide an adequately sized vehicle for the transporting of signs from the Sign Shop – full-sized vans or trucks ideally with bed covers to provide all weather transportation. The Sign Shop will deliver flatsheet signs when necessary and will routinely deliver all extrusheet signs.

220-8.4 Special Projects

The Sign Shop will accept special requests from various ODOT offices and other State agencies; however, all special requests must have prior approval from the Sign Shop Administrator. Regular highway sign production work will have priority in the scheduling of work through the Sign Shop.

220-8.5 Sign Costs

On July 1, 2000 the Sign Shop’s operating budget was decentralized to the Districts. This funding measure now requires the Districts to designate a portion of their operating budget for the acquisition of traffic signs used in District sign maintenance activities. Billable sign
costs that are passed on to the **Districts** are for materials only. Labor, benefits and overhead are excluded.

### 220-9 Salvaging Sign Material

The **Sign Shop** does not reclaim, recycle or reuse salvaged flatsheet aluminum sign blanks or extrusheet sign panels. This has not been found to be cost-effective for **ODOT** operations. Used sign blanks and extrusheet panels should be disposed of by the **Districts**. Preferably, the used material should be sold to local area scrap aluminum dealers. These types of transactions will be in accordance with **ODOT’s Purchasing Guidelines, Procedures and General Terms and Conditions** as set forth by the **Office of Contracts**. Profits from the aluminum scrap sales can supplement the **District’s** operating budget.

### 220-10 Use of Fluorescent Yellow Sheeting

**OMUTCD Section 2A.10 and Table 2A-5** specifies the use of yellow as the background color of certain sign types. Reflective sheeting materials are currently available in two version of yellow – nonfluorescent yellow and fluorescent yellow. Either of these versions of yellow meets the **OMUTCD** requirement. Due to the improved appearance of signs made with fluorescent yellow sheeting over those made with nonfluorescent yellow sheeting, especially in overcast and twilight conditions, it has been decided that for **ODOT**-maintained highways, yellow signs will be made with fluorescent yellow sheeting.

All yellow signs, yellow portions of multi-colored signs, and yellow sign post reflectors, except for signs and portions of signs required to be fabricated with fluorescent yellow-green reflective sheeting (see Section 220-7), shall be fabricated with fluorescent yellow sheeting.

Existing nonfluorescent yellow signs may remain in the field until they have reached the end of their sign service life. After December 31, 2009, remaining stocks of nonfluorescent yellow signs should be disposed of; however, until December 31, 2009, existing stocks of new nonfluorescent yellow signs may continue to be installed.
221 SIGN SUPPORTS

221-1 General

In addition to the guidelines provided in this Chapter, Chapters 240 and 250 provide design and construction information on the selection and use of standard sign supports. Overhead sign supports are also addressed in SCDs TC-7.65 through TC-22.20, and ground-mounted sign supports are covered in SCDs TC-41.10 through TC-42.20. Design charts are included herein as Figures 298-12 through 298-18 to facilitate selection of the proper support for the proposed sign area.

All sign supports used in exposed locations must meet the breakaway requirements of the National Cooperative Highway Research Program (NCHRP) Report 350. Sign supports detailed in the Traffic SCDs meet these requirements when installed as specified.

FHWA maintains a list of approved sign supports and breakaway connections that have passed crash testing requirements and are acceptable for use in exposed locations. Sign supports used in exposed locations on ODOT-maintained highways must be approved for use by FHWA, and must be installed in accordance with the conditions of their approval.

221-2 Splicing of U-Channel Posts

The splicing of U-channel drive posts can be accomplished with steel or aluminum bolts. When the connection is made with steel bolts, the drive posts are considered as acting as a one piece post. When using aluminum bolts, the connection would be expected to come open upon impact.

With steel bolts, the connection between the stub post and upper post should be made with a minimum of two 5/16 inch bolts with a minimum center-to-center spacing of 4 inches. No restrictions to stub height are imposed when using steel bolts for the connection. To reduce the possibility of vehicle snagging, the upper post should be attached behind the stub post when splicing posts of the same weight per unit length. When splicing a no. 2 U-channel upper post to a no. 3 U-channel stub post, the no. 2 post should be attached in front of the no. 3 post to achieve a sound structural connection.

Stub height should be limited to 4 inches above the ground when using aluminum bolts for the connection.

221-3 Overhead Sign Support Inspection

Inspection of overhead sign supports on construction projects is addressed in Sections 250-4 and 250-5.

Bridge-mounted overhead sign supports and overhead sign supports with bridge-mounted foundations should be inspected annually, preferably at the time of, and included with, the annual bridge inspection. All other overhead sign supports should be inspected at a maximum five-year interval. New overhead sign supports should be inspected at the time of construction.

A statewide uniform practice for the periodic inspection of the structural components of existing ODOT-maintained overhead sign supports is also necessary to assure their structural integrity. All overhead sign supports, including but not limited to cantilever, butterfly, box truss, monotube, span wire, semi-overhead and bridge-mounted supports, should be periodically inspected. The inspections should be conducted in a systematic and organized manner that will be efficient and minimize the possibility of any item being overlooked. The use of an inspection form is recommended. A sample form (Form 296-4), has been provided which may be used as is or modified by the District as desired.
Supports should be visually inspected from the ground. Binoculars should be used as an aid for visual inspections. Use of a bucket truck or other means is not necessary on a routine basis, but may be used to more closely examine a defect that has been detected from the ground. Anchor bolts should be tested for structural integrity by sounding with a hammer. Non-destructive testing procedures, such as dye penetrant, ultrasonics and magnetic particle, are not necessary on a routine basis, but can be used to define the extent of a defect that has been detected by visual means. Written documentation of all inspections should be kept.

Items to be inspected should include, but not be limited to, foundation concrete, soil around the foundation, anchor bolts and nuts, structural members, structural connections, sign attachment assemblies and structural components of the sign lighting.

Deficiencies to be inspected for should include, but not be limited to, cracks in the concrete, soil erosion, non-bearing leveling nuts, loose anchor nuts, bent or distorted structural members, cracked welds, missing or loose hardware, and corrosion.

Appropriate corrective action, in accordance with sound engineering practices, should be taken to correct detected deficiencies. Repairs should be made within a reasonable time frame, commensurate with the extent of the deficiencies found. Temporary remedial actions, up to and including complete removal of the structure, may be appropriate until permanent repairs can be accomplished. Written documentation of corrective actions should be kept.

Overhead sign support inspection training is available from the OTE Traffic Control Section.

221-4 Erecting Highway Signs On or Near Utility Poles

Highway signs should normally be mounted on supports installed by ODOT. These installations should, whenever practical, be placed a minimum of 4 feet from utility poles.

However, ORC Section 5515.04 authorizes ODOT to attach signs to utility poles along the public highway. Permission of the pole owner is not required. Therefore, districts may, at their discretion, use any suitably located utility pole as a support for a highway sign.

221-5 Solid Wood Posts

Solid wood posts have been crash tested and are approved for use as sign supports. Approved post sizes are 4 x 4, 4 x 6, 6 x 6 and 6 x 8 inch (nominal dimensions); however, they must be installed as per the details in Figure 298-26 to meet breakaway requirements.

For the two larger post sizes (6 x 6 and 6 x 8 inch), only one post is permitted in a 7 foot path. This means that a minimum of 7 feet clear distance must be maintained between the two posts. For the two smaller post sizes (4 x 4 and 4 x 6 inch), two posts are permitted in a 7 foot path.

More than two posts can be used for a sign. However, no more than two of the smaller posts (4 x 4 and 4 x 6 inch) or one of the larger posts (6 x 6 and 6 x 8 inch) is permitted within any 7 foot width. For instance, if three 4 x 6 inch posts are used for a sign, a minimum clear distance of 7 feet shall be maintained between the outermost posts. If three 6 x 8 inch posts are used, a minimum clear distance of 7 feet shall be maintained between the left and center post, and between the center and right post. Please note that these are clear distances, not center-to-center distances.

The three larger post sizes must have holes drilled perpendicular to the roadway centerline at 4 inches and 18 inches above the ground line after installation. The hole size is dependent upon the post size, and is shown in Figure 298-26. The 4 x 4 inch post does not require any drilled holes.
Grade 2 Southern Yellow Pine was used in the crash tests. The FHWA approval letter notes that:

Southern Yellow Pine is a relatively strong softwood; therefore, most other softwoods and some hardwoods will be acceptable for use as breakaway signposts. Care should be taken in specifying wood for posts to ensure that the strength does not significantly exceed that of the Grade 2 Southern Yellow Pine.

The wood used should be pressure treated with CCA (chromated-copper-arsenate) preservative. Retention should be a minimum of 0.40 lbs/ft², with 0.60 lbs/ft² preferable.

Flat sheet signs can be attached directly to the wood posts with lag screws. For extrusheet signs, sections of U-channel drive post of the same height as the sign can be attached to the wood posts with lag screws. The extrusheet sign can then be installed using standard sign clips.

Additional information regarding wood sign posts is contained in Figure 298-26. This includes the recommended wind pressures, minimum embedment depths and maximum allowable moment per post. The wind pressures are based on a 60 mile per hour sustained wind speed.

A design chart for solid wood posts is provided in Figure 298-27.

**221-6 Sign Post Reflectorization**

OMUTCD Section 2A.21 discusses the use of sign post reflectorization.

Sign posts shall be reflectorized with Type G, H or J reflective sheeting as shown on Standard Construction Drawing (SCD) TC-41.30, in accordance with the ODOT Comprehensive Highway Safety Plan. It has been determined that the most cost effective method to accomplish sign post reflectorization is by applying the reflective sheeting to strips of flat sheet aluminum, and then bolting these strips to the sign post. Other mounting arrangements may be used. The reflective strips should have a nominal width of 3 inches, and a length as described in SCD TC-41.30.

Red sign post reflectors shall be installed with all post-mounted STOP (R1-1), YIELD (R1-2), DO NOT ENTER (R5-1) and WRONG WAY (R5-1a) signs.

Yellow sign post reflectors shall be installed with all post-mounted One-Direction Large Arrow (W1-6), Two-Direction Large Arrow (W1-7), Chevron Alignment (W1-8), and Stop Ahead (W3-1) signs. As noted in Section 220-10, ODOT is transitioning to the use of fluorescent yellow sheeting for yellow signs on ODOT-maintained highways. Although it is preferable that nonfluorescent yellow sign post reflectors be used with nonfluorescent yellow signs, and fluorescent yellow sign post reflectors be used with fluorescent yellow signs, the intermixing of these versions of yellow in the same assembly is acceptable.

The use of sign post reflectors on other Regulatory and Warning Signs is optional. In accordance with OMUTCD Section 2A-21, the color of the sign post reflector shall match the background color of the sign. In the case of the yellow color, either version of yellow (nonfluorescent and fluorescent), whether used exclusively or intermixed in an installation, is considered as fulfilling the OMUTCD requirement that the sign post reflector match the background color of the sign.
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This Chapter has been reserved to address, as needed, planning and programming information related to traffic control signs.
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240 DESIGN INFORMATION

240-1 General

The L&D Manual Volumes One and Three and Chapter 140 provide general background regarding design information for ODOT projects, including the three-stage review process typically used for traffic control plans. Additional design information has been provided in this Chapter, including checklists for Stage 2 and 3 submittals (see Section 240-8). See Chapter 241 for additional information specifically related to plan preparation. Plan Notes are addressed in Chapter 242, and Chapter 243 provides a listing of related CMS Items.

240-2 Signs and Sign Attachments

240-2.1 General

Except as noted in this Section, furnishing and erecting permanent signs on construction projects shall be the responsibility of the contractor.

The freeway and expressway State Line sign (E8-H1) and the Ohio Byway sign (M8-H3) shall normally be furnished by ODOT for erection by the contractor. For these signs the bid item “Signs Erected, by Type” shall be used.

240-2.2 Sign Attachments

The standard drawings and specifications provide several methods of attaching signs to supports, depending on the circumstances. The summary below lists the applicable bid items with reference to standards and specifications:

1. Sign Attachment Assembly: Used to attach extrusheet signs to overhead sign supports (SCD TC-22.20). This consists of a sign bracket, U-bolts and hardware. They are furnished with new overhead sign supports. The bid item is only necessary if the support is an existing installation. The bid item is “Sign Attachment Assembly” (CMS Item 630.06(E)).

2. Sign Backing Assembly: Used to provide the necessary posts and hardware to attach a supplemental sign or exit number plaque to the main Guide Sign or to provide the back bracing for a grouping of flat sheet signs in an assembly (SCD TC-42.10). They are furnished with the “sign” bid item. The bid item is only necessary for reerected signs. The bid item is “Sign Backing Assembly” (CMS 630.14).

3. Sign Hanger Assembly: Used to attach signs to span wire and mast arm signal supports (SCD TC-41.41). The item includes all necessary hardware to attach one individual sign. The bid items are “Sign Hanger Assembly, Span Wire” and “Sign Hanger Assembly, Mast Arm.”

“Sign Hanger Assembly, Span Wire” is furnished with new SCD TC-17.10 span wire sign supports.

4. Sign Support Assembly: Used for the attachment of flat sheet type signs to bridge parapets or miscellaneous poles (SCD TC-41.40). The bid items are “Sign Support Assembly, Pole Mounted” and “Sign Support Assembly, Bridge Mounted” (CMS 630.06(E) and 630.14).
240-2.3 Overhead Lighted Signs

When overhead lighted signs are part of the traffic control plans the following criteria shall be used concerning their inclusion in the plans:

1. On the base plans, the sign height shown shall be the effective sign height. This is the height from the Sign Designs and Markings Manual, Appendix C (Section 295-2). It does not include the glare shield.

2. In the subsummary, the actual sign height shall be used. The actual sign height is the effective sign height plus the glare shield height of 6 inches. The quantity of "Signs, Extrusheet" paid for in the plans is the length times the actual sign height.

3. In the elevation views, the overall sign height is to be used. This height is the effective sign height plus 12 inches (luminaire support tube of 6 inches plus glare shield height of 6 inches).

240-3 Overhead Sign Clearance After Pavement Overlay

As noted in OMUTCD Section 2A.18, overhead-mounted signs shall provide a vertical clearance of not less than 17 feet to the sign, light fixture or sign bridge over the entire width of the pavement and shoulders except where the structure on which the overhead signs are to be mounted or other structures along the roadway near the sign structure have a lesser vertical clearance. If the vertical clearance of other structures along the roadway near the sign structure is less than 16 feet, the vertical clearance to an overhead sign structure or support may be as low as 1 foot higher than the vertical clearance of the other structures in order to improve the visibility of the overhead signs. Most actual sign installations were in excess of 17 feet when first erected.

As a result of the build-up of pavement due to various types of pavement overlays, this minimum may be violated. When a roadway surface increment of more than 6 inches is to be added, or when the total of all resurfacing courses will become more than 10 inches, the clearances of overhead signs shall be checked and appropriate corrections made.

The Stage 2 submission will identify the clearance each sign would have if it were not raised, the future clearance of adjacent bridges, and recommendations regarding signs to be raised, including the distance to be raised and the method. The following steps should be taken:

1. Determine or obtain clearance requirements for major structures on the section of roadway.

   a. New construction or major reconstruction

      | Type                        | Clearance |
      |------------------------------|-----------|
      | Interstate, Priority and Rural | 16 to 17 feet |
      | Interstate, Urban non-priority | 15 to 17 feet |
      | Other Freeway, Expressway or Arterial | 15 to 16.5 feet |
      | Collectors                   | 14.5 to 15 feet |
      | Locals                       | 14.5 to 15 feet |

   b. Resurfacing, minor rehabilitation

      | Type                        | Clearance |
      |------------------------------|-----------|
      | Interstate, Priority and Rural | 16 feet |
      | Interstate, Urban non-priority | 14 feet |
      | Other Freeway, Expressway or Arterial | 14 feet |
      | Collectors                   | 14 feet |
      | Locals                       | 14 feet |

2. For new supports, provide sign clearance based on new structure clearance plus 1 foot.
3. For existing supports, establish the desired sign clearance criteria as either 1 foot more than the clearance for major structures which will be provided on the section, or as 1 foot more than the clearance prescribed for major rehabilitated structures plus an allowance for any resurfacing anticipated in the next 15 years, whichever is greater.

Determine the individual sign clearances expected when the project is completed, and compare them to the desired sign clearance above. If the sign clearance will be greater than or within 3 inches of the desired sign clearance, no action is required at that time. If the sign clearance will be greater than 3 inches below desired sign clearance, the sign clearance should be increased.

4. If grading can be accomplished around the existing foundation to avoid standing water around the anchor bolts, it may be possible to simply raise the signs on the supports to obtain 1 foot of extra clearance. If raising the sign results in the sign being an unsupported distance of more than 4 feet above the centerline of the top support chord, intermediate sign brackets will be required. Also, if the existing sign support is at its maximum capacity prior to raising the sign, the support will have to be evaluated in detail to determine if this is feasible.

5. If grading around the existing foundation can be accomplished, another possibility might involve design of a "pole extension" which would engage the anchor bolts of the existing foundation and connect to the support base plates with new bolts. These would have stub shafts to provide a variable amount of rise to the support. This should not be done if the present foundation design is marginal.

6. If the system cannot be properly graded or the sign cannot be raised on the support for other reasons, the foundation top can be raised using a system of barrel nuts and anchor bolt extension studs, repouring the top of the foundation and re-erecting the sign support.

When a sign is raised on an existing support, a new item of work must be described in a note to cover raising each sign.

If the support must be raised, items of work and notes may be needed for:
- Removing the support with sign.
- Modifying the foundation or inserting the pole extension(s).
- Re-erecting the sign and support.
- Replacing any electrical power cable between the disconnect switch and the pullbox.
- Re-connecting the ground wire.

240-4 Overhead Sign Supports

240-4.1 General

Overhead sign supports and foundations shall be included in the contract plans. All overhead sign support foundations shall be electrically grounded.

If an overhead sign support exceeding ODOT’s design charts is required in a plan, the consultant shall be responsible for determining the support and foundation size required. Details similar to those shown on ODOT Standard Construction Drawings shall be included in the plans. As part of the Stage 3 submission, the consultant shall submit detailed structural calculations showing the adequacy of the proposed design including foundation.

When determining the sign area for design, use only the sign area exposed to the wind. For back-to-back signs, add the total square footage for both signs and subtract the square footage where the signs overlap.

240-4.2 Location

The exact location (by station to the nearest 1 foot) of the overhead supports should be
determined according to the following criteria:

1. Refer to standard placement drawings (see Figures 298-8 through 298-11).

2. The preferred location for overhead sign supports is in the middle one-third of the design spacing for conventional roadway lighting units.

3. When the desired location criteria for a sign support does not place the support within the preferred area, the following minimum separation between overhead sign installations and lighting units should be maintained:

<table>
<thead>
<tr>
<th>Mounting Height for Lighting</th>
<th>Minimum Separation</th>
</tr>
</thead>
<tbody>
<tr>
<td>32.5 feet</td>
<td>40 feet</td>
</tr>
<tr>
<td>40 feet</td>
<td>60 feet</td>
</tr>
<tr>
<td>50 feet</td>
<td>90 feet</td>
</tr>
</tbody>
</table>

If the lighting unit or the sign support locations cannot be adjusted to maintain the above minimum separation, the lighting unit may be placed immediately in advance of the sign support when a 40 foot or 50 foot mounting height is used for the lighting. However, this position cannot be used effectively when the mounting height is 32.5 feet, and consideration should be given, particularly for complete or intermediate lighting design, to an adjustment of the mounting height for several light pole units in the general vicinity of the sign support.

At intersections, it is preferable to combine lighting units with overhead sign and/or traffic signal supports, when practical to do so, in consideration of current safety criteria, and in order to minimize the cost or clutter effect of a number of separate support poles.

4. Supports should be shown at 90 degrees to the roadway centerline in the plan view, or with the angle shown on the plan if not 90 degrees.

5. For medians 30 feet or less in width, the sign support should be centered in the median.

6. Every effort should be made to locate overhead sign supports off of bridge structures. The following is the order of preference for location.
   a. Off of the bridge structure
   b. Mounted directly to the pier
   c. Over top of a pier
   d. On the bridge mid-span. This location should be avoided if at all possible.

7. Minimum lateral clearances shall be as per Section 600 of the L&D Manual Volume One.

240-4.3 Design of Cantilever Sign Supports

Cantilever supports are addressed in SCDs TC-12.30 and TC-16.21. Standard practice for choosing a specific design for cantilever type overhead supports is as follows:

1. For supports in SCD TC-12.30:
   a. Determine the sign area. Include glare shield, luminaire support tube and Exit Number Panel, if applicable. For design purposes, use the total sign area, or a minimum of 120 square feet for mainline signs, or a minimum of 80 square feet for lead-in signs, whichever is larger.
b. Determine the lateral location of the sign over the pavement (use Figure 298-9 and item g below).

c. Determine the lateral location of the support pole centerline with respect to the pavement.

d. Determine the distance from the centerline of the sign to the center of the pole.

e. Choose an adequate design from the design chart for the SCD TC-12.30 supports (Figure 298-12).

f. Compare the standard arm length with the nominal length required for the sign location originally determined.

g. Adjust the lateral sign location (normal tolerance is within ±2 feet of the desired location) to enable use of an arm length in whole foot increments, using the standard length if possible.

h. Determine the required elevation of the top of the foundation to provide proper clearance to the sign. Clearance shall be determined using the highest elevation of the pavement or shoulder under the sign. For design, use overall sign height, or 10 feet on mainline or 8 feet on lead-in signs, whichever is larger.

2. For supports in SCD TC-16.21:

a. Determine the approximate arm length as the horizontal distance from the pole flange plates to the outer edge of the most remote sign.

b. Calculate the area moment design factor "K" by multiplying each sign area (in square feet) by the distance (in feet) from its centerline to the pole centerline and add the products.

\[ K = A_1 b_1 + A_2 b_2 + A_3 b_3 \]

c. Select the design number from the following Table. Choose a design number that provides both an adequate design factor and maximum arm length that meets or exceeds the actual arm length.
<table>
<thead>
<tr>
<th>Design Factor “K”</th>
<th>Design No.</th>
<th>Max. Arm Length (feet)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1081</td>
<td>5</td>
<td>24</td>
</tr>
<tr>
<td>1033.5</td>
<td>6</td>
<td>27</td>
</tr>
<tr>
<td>1091.5</td>
<td>7</td>
<td>30</td>
</tr>
<tr>
<td>1300</td>
<td>8</td>
<td>33</td>
</tr>
<tr>
<td>1597.5</td>
<td>9</td>
<td>36</td>
</tr>
<tr>
<td>1925</td>
<td>10</td>
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<td>12</td>
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</tr>
<tr>
<td>3042</td>
<td>13</td>
<td>60</td>
</tr>
<tr>
<td>3666</td>
<td>14</td>
<td>72</td>
</tr>
</tbody>
</table>

d. A given design number may have an adequate design factor “K” but have a maximum arm length that is too short for the intended application. If the arm length cannot be adjusted as explained below, the proper design will be controlled by the arm length. Do not exceed the maximum arm length for any design number.

The arm length may be adjusted by carefully choosing the proper lateral pole location and sign placement. The most remote sign on the arm may be positioned 2 feet short of being centered over its applicable lane. Minimum pole offsets are given in Section 600 of the L&D Manual Volume One.

e. The design pole length and attachment point may be increased 1 foot if necessary to provide adequate vertical clearance.

*Figure 298-20* provides an example of a table used in plans to present design information for this support.

### 240-4.4 Design of Center-Mount Sign Supports

Center-mount supports are addressed in SCDs TC-9.10 and TC 9.30.

The SCD TC-9.10 support is intended for use with Guide Sign installations, generally in urban areas, where the sign is not over the roadway and reduced vertical clearance is required for visibility (typically 10 feet minimum).

For either support, the sign is normally centered on the pole laterally, but may be eccentrically located if necessary. The design number selected must accommodate within its maximum allowable area, and maximum arm length L, the actual area and sign length.

Plan details shall show the actual lateral arm position and sign bracket locations. Sign brackets shall be spaced to avoid the arm attachment plate.

### 240-4.5 Design of Span Sign Supports

Span sign supports are addressed in SCDs TC-7.65, TC-15.115 and TC-17.10. Standard practice for choosing a specific design for the span type overhead support is as follows:

1. For supports in SCD TC-17.10:
   a. Determine the total sign area.
b. Determine the lateral location of the strain poles with respect to the pavement.

c. Determine the length of the span.

d. Choose an adequate design from the SCD TC-17.10 design chart *(Figure 298-18)*.

e. Calculate the wire sag as 5 percent of the span length.

f. Calculate the elevation of the attachment point of the top wire by adding to the critical pavement elevation the clearance, height of the sign, and the sag.

g. Determine the elevation of the top of the foundation.

h. Determine pole lengths by subtracting the foundation elevation from the attachment elevation and selecting a value, to the nearest whole foot, that will result in attachment at a point from 12 to 24 inches below the pole top.

i. Special design calculations must be made in the following circumstances:

   i. Sign areas or span lengths exceeding the limits of the design chart.

   ii. Required pole heights that exceed the standard (a higher design number with an adequate pole height may be selected if practical).

   iii. Special conditions, such as a large difference in the two pole lengths or an installation requiring attachment points at unequal elevations.

j. *Figure 298-21* provides an example of a table used to present design information for span-wire sign supports in the plans.

2. For supports in SCDs TC-7.65 and TC-15.115:

   a. Determine the total sign area. Include glare shields, luminaire support tubes and Exit Number plaques, if applicable. For design, use the total sign area, or 120 square feet per lane spanned for mainline signs, or 80 square feet per lane spanned for lead-in signs, whichever is larger.

   b. Determine the lateral location of support end frame centerlines with respect to the pavement.

   c. Determine the length of span. The span length shall be in whole foot increments unless structures or other physical restrictions require special lengths.

   d. Choose an adequate design from the design chart for overhead support trusses *(Figure 298-13)*.

   e. Determine the required elevations of the top of the end frame foundations and end frame lengths to provide proper clearance of the signs. Clearance shall be determined using the highest pavement or shoulder elevation under the span to the bottom of the largest sign (or critical sign) on the span. For design, use overall sign heights, or 10 feet on mainline, or 8 feet on lead-in signs, whichever is larger.

240-4.6 Vertical Clearance and Modification of Designs

Overhead-mounted signs shall provide a vertical clearance of not less than 17 feet, except where lesser clearance are allowed (see *Section 240-3*).
To obtain required vertical clearance and maintain a minimum of exposed concrete foundation, pole or end frame lengths may be varied from the standard lengths shown on the SCDs. Lengths may be shortened as necessary, but increased a maximum of 2 feet over standard length. For increases over 2 feet a special design will be necessary.

### 240-4.7 Elevation Views

Elevation views, in the direction of traffic viewing the sign faces, shall be prepared to a scale of 1”= 5’ showing the following for each sign support:

1. Total span or arm lengths for horizontal support members, to the nearest 1 foot, unless physical conditions dictate greater precision.

2. Pavement elevations at the highest critical pavement or shoulder point, e.g., outside edges of the pavement and the crown, to the nearest 0.1 foot.

3. Pavement and shoulder widths to the nearest 1 inch.

4. Concrete foundation elevations at the top and bottom, to the nearest 0.1 foot, if foundation dimensions are not as shown on the SCDs, or when steep roadside slopes or roadway superelevation would make foundation elevations difficult to determine.

5. Ground line elevation at the foundations to the nearest 0.1 foot. The amount of exposed concrete should be restricted to a range from 0.1 foot minimum to 0.3 foot maximum.

6. Guardrail placement dimensions, laterally from the centerline of the sign support pole or end frame to the face of guardrail, to the nearest 1 inch.

7. Minimum design vertical sign clearance and actual sign clearance to the nearest 0.01 foot. Signs (including glare shield and luminaires) shall be centered vertically on the span or arms. Exit Number plaques are excluded from this positioning.

8. Horizontal sign placement, with sign dimensions and spacing continuous across the span or arm supports to horizontal limits of the support to the nearest 1 inch.

   All signs carrying lane arrows shall be placed so that lane arrows are centered over the lanes, with a maximum 2 feet offset from lane arrow to lane centerline where required.

9. Overall sign height, including glare shield and luminaire support tubes.

10. Sign bracket spacing for the center-mount supports (SCDs TC-9.10 and TC-9.30), otherwise only if it varies from that shown on the SCDs.

   Intermediate sign brackets shall be provided whenever the sign (excluding Exit Number plaque) extends more than 4 feet above or below the attachment point.

11. Station location, sign reference number, and design number of the support.

12. Sign bracket lengths if different from overall sign height.

### 240-4.8 Concrete Barrier Median Foundations

Concrete Barrier Median Foundations for overhead sign support foundations are addressed in SCD TC-21.50. With this treatment, the median is widened maintaining typical wall slope configuration. A 10-foot length of the special median section is provided at each sign support location, and for a typical median section with a 6 to 12 inch top width, a 40 foot taper transition is provided on either side of the 10-foot foundation section.
The transition section of the median barrier shall be shown on the roadway plans with a reference note to that portion of the traffic control plans showing the details.

Even if roadway lighting circuits are located in the median, electrical sign service, if used, should remain on the right end frame or support (looking at signs), with crossover conduit provided from the median to a pull box located 10 feet beyond the sign support in the direction of travel. Conduit, cable, pull boxes and connector kits shall be included in the roadway lighting quantities.

Payment for the 10-foot foundation section of barrier median shall be included in Item 630 “Rigid Overhead Sign Support Foundation.” Sealing of the 10-foot foundation section of barrier median, if required, shall be paid for under Item 512.

The transition sections shall be included in the regular roadway quantities for the barrier median. Details of the transition section are shown on SCD RM-4.4.

240-4.9 Overpass Structure-Mounted Sign Supports

The following information should be included in the plans for structure-mounted sign supports (see SCDs TC-18.24 and TC-18.26):

1. Elevation view with the following:
   a. Lateral location of the sign with respect to the edge of the pavement.
   b. Bracket spacing, if different from that shown on the SCD.
   c. Minimum design and actual vertical clearance from the critical pavement elevation or, for a roadside location, from the ground line.

2. Adjacent to the elevation view, a cross-section view of the bridge parapet and sign attachment showing the frame height.

3. When the bridge is being designed concurrently with the signing plan, the designer shall consider these support loads and incorporate them into the bridge design. If the bridge is existing, the designer shall contact the Office of Structural Engineering to make sure that they have no objections to the use of this type of support.

240-5 Ground-Mounted Sign Supports

240-5.1 General

Ground-mounted sign supports included in the contract plans shall be yielding posts, structural beams or structural pipe supports.

240-5.2 Yielding Sign Supports

Yielding posts are addressed in SCD TC-41.20 and the design of these posts shall be in accordance with design charts in Figures 298-14 and 298-15. They are designated:

No. 2 Post
No. 3 Post
No. 4 Post (all except single post Type S installations shall be used only behind guardrail or concrete barrier)
No. 6 Post (shall be used only behind guardrail or concrete barrier)
240-5.3 Structural Beam Sign Supports

Structural beam sign support installations are addressed in SCD TC-41.10 and Figure 298-19.

The beam supports are designated S4 x 7.7, W6 x 9, W8 x 18, W10 x 12, W10 x 22, and W12 x 30, and the design charts in Figures 298-16 and 298-17 shall be used to determine which beam to use.

When structural beams are used, breakaway accessories shall be provided if the sign cannot be placed behind an adequate length of guardrail or concrete barrier (see Section 240-6). Signs requiring beams larger than W8 x 18, with a clear distance between supports of less than 7 feet, shall be protected by guardrail in accordance with Section 240-6.3. Also, beam support installations subject to multidirectional impacts at intersections should use only the S4 x 7.7 beams (or require the use of the alternate breakaway design described in Note 8 of SCD TC-41.10).

240-5.4 “One Way” Sign Supports

The “One Way” Sign Support shown in SCD TC-41.50 shall be used when it is necessary to mount two or more signs at 90 degrees to each other on the same post.

240-5.5 Breakaway Connections

When the breakaway connections shown in SCD TC-41.10 are used, there shall be one each required as pay item for each beam installed (i.e., a sign requiring three beams will have three breakaway connections).

240-5.6 Lateral Offset and Vertical Clearance

Lateral offset and vertical clearance details for signs are addressed in SCDs TC-42.10 and TC-42.20.

A 30 foot offset from the edge of pavement should be provided on all mainline freeway or expressway Guide Signs unless adequately protected by guardrail or concrete barrier installed for other purposes or have breakaway connections. Minimum clearances above the pavement are shown on SCD TC-42.10.

Signs supports shall not be placed in drainage ditches. The sign locations should be adjusted laterally or longitudinally to avoid ditches.

240-5.7 Elevation Views

Elevation views, in the direction of traffic viewing the sign faces, shall be prepared to a scale of 1”= 5’ for all Guide Signs mounted on beam supports. Elevation views are not required for structural pipe supports. The elevation views shall typically contain the following:

1. Edge of pavement, shoulder and break point elevations.
2. Size, placement, support size, length and elevations at the ground line at each leg.
3. Existing and proposed guardrail, fence and related devices.
4. Foundation elevations and depth.
5. Station, placement right (Rt) or left (Lt), and sign support number.
Regulatory, Warning and Route Signs shall be installed in conformance with SCD TC-42.20. If placement is different than shown in the SCD, typical placement details should be shown on the plans.

240-5.8 Street Name Sign Supports

Street Name signs are typically erected and maintained by local authorities, but they may be included in contract plans (see SCD TC-41.40).

240-5.9 Structural Pipe Supports

Structural pipe support installations are addressed in SCD TC-41.15.

240-6 Guardrail Protection For Signs

240-6.1 General

An effort should be made to locate signs behind proposed lengths of standard guardrail or concrete barrier used for other purposes. Be sure to recheck sign distance to the exit when so doing. Distance should be correct to the nearest one-quarter mile. No independent guardrail shall be provided for beam supports except as described below or in Section 240-5.3.

If the sign cannot be relocated, standard guardrail may be extended up to 100 feet to provide the required protection in advance of the sign, as described in Section 240-6.3.

240-6.2 New Overhead Installations

Guardrail protection is required for all overhead sign installations not protected by concrete barrier or located outside the clear zone on highways where the operating speed is anticipated to be 50 miles per hour or more. Where independent guardrail is required, a total of 112.5 feet should be provided. This measurement does not include the anchor assembly at each end. See SCDs GR-5.1, GR-5.2 and GR-5.3 for further details. The standard offset is 6.5 feet from the face of the guardrail to the centerline of the support.

In median locations, guardrail protection will be required on the opposite roadway if the sign support is less than 30 feet from the pavement edge. For details refer to SCD GR-6.1 (treat similar to a bridge pier).

240-6.3 Ground-Mounted Installations

Beam supports located behind roadway guardrail require the following minimum advance protection (assumes that the near-edge of the sign is typically offset 4 feet from the face of the guardrail):

<table>
<thead>
<tr>
<th>Sign Width</th>
<th>Advance Guardrail</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 15 feet</td>
<td>100 feet</td>
</tr>
<tr>
<td>16 to 19 feet</td>
<td>125 feet</td>
</tr>
<tr>
<td>20 to 24 feet</td>
<td>150 feet</td>
</tr>
<tr>
<td>≥ 25 feet</td>
<td>175 feet</td>
</tr>
</tbody>
</table>

These measurements do not include the anchor assembly.
240-6.4 Existing Overhead Installations

At existing overhead sign supports with less than 6.5 feet, but more than 4 feet, of clearance from the face of the guardrail to the centerline of the support, additional posts shall be added to obtain one-quarter panel spacing. The reduced spacing shall start 12.5 feet upstream of the support and continue to just downstream of the support. At supports with 4 feet or less clearance, Type D concrete barrier shall be used.

240-7 Sign Lighting

240-7.1 General

Sign lighting is typically not used. Current guidelines governing lighting of signs are contained in Chapter 212. This Section addresses design details for sign lighting and related information needed in plans.

Luminaires are normally mounted at the bottom of the sign; however, in specifically justified cases, top mounting may be required (OTE will supply details to be included in plans).

All overhead-mounted signs that will have sign lighting shall include a glare shield as specified in CMS Item 630.04. It should be noted that the top 6-inch portion of the glare shield shown in PIS 203121 (Sign Lighting Details) is an extension of the sign and is not notched. The remaining 6-inch portion of the glare shield is part of the structural member of the sign lighting support system.

240-7.2 Sign Service

Details for sign service are shown on SCDs TC-32.10 and TC-32.11. As described in CMS Item 631.04, Sign Service includes all cable and equipment to make the connection between the disconnect switch and a source, which is a pull box or the point of an overhead drop.

As noted in Section 1103-6.7, electrical services will normally be provided for overhead signs as an integral part of highway lighting circuits. This will be accomplished by providing a pull box located 10 feet beyond the sign support in the direction of traffic. The total ballast wattage for each installation shall be shown on the highway lighting plans.

Where highway lighting circuits do not exist, or are impractical to use for sign lighting, separate independent circuits may be used. Highway lighting circuits may be extended beyond the last unit to service a lighted sign to the extent that the cost does not exceed separate service if power is available. If the sign is not near an area with highway lighting, which was provided as a part of the facility, the sign lighting may be fed from a separate independent source arranged with the local power company. See Section 240-7.7 for further details regarding getting electrical power from a local power company for lighted signs.

Photoelectric control of sign lighting shall be provided by one of the following, in order of preference: 1) within highway lighting circuit controls, or 2) on sign supports or independent service poles when uncontrolled independent circuits are required.

If one or more sign installation is to be provided with separate underground electrical service, the plans shall include the necessary service in conformance with the guidelines in Part 11 (Highway Lighting).

If the source is uncontrolled, the payment item “631 Photoelectric Control” shall be included for each sign service.
240-7.3 Ground Rods

All overhead sign installations shall be grounded at each foundation. Overhead sign supports shown in SCDs TC-18.24 and TC-18.26 will always require a ground rod. All other overhead sign supports will require an item for ground rods unless mounted on a bridge parapet, where grounding is included in the item for the structure grounding system. Sign supports shown in SCD TC-17.10 will require a ground rod for each strain pole. Grounding details are shown on SCDs TC-32.10 and TC-32.11.

240-7.4 Disconnect Switch with Enclosure, Type X

This item shall be required for all new lighted installations. Existing overhead sign supports will usually be equipped with a switch and enclosure.

The bid item “Switch Enclosure Mounting Bracket Assembly” is required for all new lighted installations.

240-7.5 Ballasts

Each mercury vapor luminaire requires a separate ballast. The typical location is within the luminaire (integral) or in a weatherproof housing attached to or beside the luminaire (contiguous).

The bid item is “Ballast, By Type.” An example of “By Type” is CMRI-100-480, where 100 indicates the lamp wattage and 480 indicates the operating voltage.

Any reuse of ballast items will require special Plan Notes and details relating to the specific situations and circumstances.

240-7.6 Luminaires

This item is required for all lighted sign installations. The bid item “Luminaire, Type with ____-watt Lamp” will provide new equipment.

If existing fixtures can be reused the bid item “Removal of Luminaire and Reerection” should be included in the plans.

The bid item for “Luminaire Support Assembly” will be required for all new lighted installations.

240-7.7 Electrical Power Provided by the Power Company

When it has been determined that the most appropriate power source for sign lighting is the local power company, it is reasonable to use a different ballast/luminaire combination which matches an existing supply voltage already available from the power company in the area. Normally this will be 120/240 single phase using three-wire service; however, this should be confirmed with the power company.

Design development in such a situation should include:

1. A check with the power company to determine the most advantageous location for the service pole or other facility, which will separate their work from the contractor’s:

   a. If a meter will be used, it should be placed and oriented to allow easy reading by power company personnel without the need of stopping on mainline or high-speed ramp areas.
b. Meters, disconnect switches and photocells should be reasonably sheltered from casual vandalism.

c. A service pole should be readily accessible for maintenance.

d. If the contractor will install underground service to the sign, a disconnect switch should protect the circuit before it goes underground.

e. If the power company will install overhead cable to our pole, it should be routed down the outside of the pole in separate conduit and into the (meter if used and on to the) disconnect switch.

f. If the power company offers either metered or unmetered service, the designer should check with the maintaining agency to determine their preference.

2. A photocell should normally be provided at each sign support.

3. The submittal of detailed plans to the power company should clearly request written response to the following:

   a. That the extent of the contractor's proposed work shown in the plans to make power connections will be sufficient to establish the needed electrical service, and no added work by the contractor, ODOT or the local maintaining agency, such as providing or installing conductors, conduit, trench, service disconnect equipment transformers, etc., will be needed to complete the service later.

   b. Will the power company require any payment by the contractor, ODOT or the local agency to establish or continue the power service shown in the plans? Examples of such costs might include: underground or overhead hook-up charges, conduit, trench, conductors, poles, transformers, etc. Also, if such charges will be made by the contractor, an itemized estimate should be provided which will be in sufficient detail to satisfy ODOT and FHWA requirements.

   c. Are any proposed features in conflict with the company's underground or overhead facilities? (Conflict with underground utility facilities is covered by the requirements of ORC Section 153.64).

   d. Will any proposed features require that the power company rearrange their existing facilities to allow the contractor to proceed? Examples might include rearrangement of electrical service wires (or telephone or coaxial cable) on a pole to allow proper clearances to attach a signal messenger or signal interconnect cable to the pole. Also, if such work will be needed, an itemized estimate of any costs which will be charged to the contractor, ODOT or the local agency should be requested.

240-8 **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. Base plan drawn at a scale of 1 inch equals 200 feet or 1 inch equals 100 feet continuous for the entire project. A second base plan drawn at a minimum scale of 1 inch equals 50 feet for all interchanged crossroads and mainline intersections, and for other critical at-grade intersections in urban areas. Show all proposed roadways and connections to existing construction.

   On some projects, particularly in urban areas, it may be more efficient to show the entire project on one plan drawn at a scale of 1 inch equals 50 feet or 1 inch equals 20 feet.
b. Location of pavement edges, number of lanes, lane widths if other than 12 feet, speed change lanes, transitions, raised medians and all structures.

c. Location of existing signing; and existing sign legends at each location.

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

e. Location of proposed signing.

f. Proposed sign legends at each location.

g. Level of signing proposed, ground mounted or overhead.

h. Size of signs.

i. Sign code numbers.

j. Legend for symbols used.

k. Guardrail locations.

l. SignCad files on CD showing detailed designs for all designable guide signs, with positive contrast legends of Clearview font.

2. Stage 3 Plan Requirements:

a. General Notes.

b. Estimated quantities.

c. Special details.

d. Elevation views.

240-9  Rectangular Rapid Flashing Beacon (RRFB) Sign Assembly

As noted in Section 405-3, FHWA has issued an Interim Approval (IA-11) for use of this device.

The duration of a predetermined period of operation of a Rectangular Rapid Flashing Beacon (RRFB) following each actuation should be based on the OMUTCD procedures for timing of pedestrian clearance times for pedestrian signals.

Plan Note 242-8 (see Section 242-8) should be included on all projects where RRFBs are being installed.
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241 PLAN PREPARATION / PRODUCTION

241-1 General

The L&D Manual Volume Three and Chapter 140 describe general ODOT plan preparation and production guidelines and standards. Chapter 240 provides additional design detail information, including a discussion of Stage 2 and 3 plan submissions (Section 240-8). Plan Notes are addressed in Chapter 242, and Chapter 243 provides a listing of related ODOT CMS sections. The following Sections provide additional information regarding how signing items are shown in plans.

241-2 Signs

Proposed sign legends shall be shown at each sign location. Also, the supplemental design information should include a comment or indication as to whether signs on adjoining projects under construction, or open to traffic, should be revised to fit traffic pattern changes resulting from the proposed project.

241-3 Signal and Sign Supports

Section 440-7 addresses Stage 2 and 3 plan submissions for traffic signal items, and Section 441-2 describes location requirements for both signal and sign supports that apply to Stage 2 plans.

241-4 Power Service

Service for sign lighting is usually through the power service provided for traffic signals or highway lighting. See Sections 240-7.7, 441-3 and 441-8 for information on handling power service details in the plans.

241-5 Quantities

In the General Summary, all quantities should be shown in whole units of measurement.

241-6 Bid Item Descriptions

Bid item descriptions are required to exactly match the descriptions published in the "Item Master."

When the standard bid item description is inappropriate, the words "As Per Plan" shall be added to the description, and a note shall be provided to describe the deviation from the standard specifications and/or details. See Chapter 242 for examples of Plan Notes.

241-7 Sign Support, Detail Design Requirements

Instructions for designing sign supports are included in Chapter 240 and the related SCDs. Figures 298-19 and 298-20 provide examples of tables for presenting signal support information in the plans for support types described in SCDs TC-16.21 and TC-17.10.

Use of the sample tables is recommended as a means of uniformly presenting support information to the contractor or support manufacturer. The support designer should note that the orientation angles consist of:

- A field angle that establishes the angular relationship between a line perpendicular to the
project centerline and a pole feature (handhold or mast arm) which serves as an index; and

- Angles for all pole appurtenances that are measured from this index pole feature.

241-8 **Object Markers and End-of-Roadway Markers**

For plan purposes, object markers and end-of-roadway markers shall be considered flatsheet signs.
242 PLAN NOTES

242-1 General

Typical Plan Notes related to signing items 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 CMS, both the note and the bid item will be “As Per Plan.” Where there are design instructions pertaining to a specific note, they are listed herein at the end of each note. These notes may be modified to further define the conditions of a project or maintaining agency.

In keeping with the traditional format of Plan Notes, the format used in the following Sections varies slightly from that used elsewhere in the TEM, e.g., the terms “Contractor” and “Engineer” are capitalized, and references to publications are not shown in bold font.

Also, at this time the Plan Note number that has been used in the past is shown in parentheses at the beginning of the title for the note.

See Sections 442-10 and 442-11 for Plan Notes related to combination signal and sign supports.

242-2 (625-B) Power Supply for Sign Lighting

Electric power shall be obtained from the _________________ at the location indicated on the plans. Power supplied shall be ___ volts.

Designer Note: This note should be included on projects with lighted signs when separate service is required for one or more signs which cannot be integrated with the highway lighting circuits. The name and address of the power company and voltage to be supplied shall be specified in the appropriate blanks.

242-3 (630-A) 630 Overhead Sign Support Modification, by Type

Overhead sign supports shall be modified as shown in the plans. The modification shall consist of (see examples below):

1. The insertion of a new box truss section of ___ feet.
2. The replacement of an existing arm with a new arm of ___ feet.
3. The replacement of an existing end frame with a new end frame.
4. The replacement of the existing pole with a new pole of ___ feet.
5. The relocation of an existing end frame.

Payment will be at the contract unit price for the modification of the overhead sign support, including all necessary material, parts, equipment and labor, using the designation: 630 Each - Overhead Sign Support Modifications, By Type.

Designer Note: This note should be included on projects which require the modification of overhead sign supports. The note should be edited as required to specify the modification needed and to fill in the blank. When example 1 is used, it is typically used in combination with 3 or 5.

The following is a bid Item example: Overhead Sign Support Modification, Type TC-7.65, Design 6, New Box Truss Section ___ feet.
242-4 (630-B) Reference Location Signs

The location of Reference Location signs on the plans are approximate and a more precise location will be provided by the Department. The Contractor shall notify the Engineer at least 30 days in advance of the planned date of Reference Location sign installation. The Engineer will contact the Office of Technical Services which will locate the longitudinal position of Reference Location signs by means of a paint mark on the pavement edge. Alternate marks will not be provided on divided highways and the Contractor shall set Reference Location signs for the opposite roadway across from the provided mark. Delineators whose normal position falls within 50 feet of a Reference Location sign shall be omitted.

Designer Note: This note should be included on all projects where Reference Location signs are being installed.

242-5 (630-C) 630 Modification of Barrier Wall Assembly

Barrier Wall Assembly SCD TC-21.41 provides a 3 inch high clearance below the bottom of the steel wall plates for the drainage of water away from the sign support foundation and for ventilation.

Asphalt concrete shall be placed and compacted around the sign support foundation so that no water will be trapped in this area when all project work is completed.

If the resurfacing of the shoulders reduces the clearance to less than 2 inches the following shall be done:

1. Remove the steel wall plates;

2. Remove, by sawing, cutting or grinding, enough material from the bottom of the steel wall plates and the center bulkhead to provide a 3-inch clearance from the finished asphalt;

3. Paint the cut edges and any damaged galvanized areas with two coats of zinc-rich paint; and

4. Reinstall the steel wall plates in their proper positions, using new bolts, nuts and washers.

Payment will be at the contract unit price for each Item 630 "Modification of Barrier Wall Assembly" including all necessary material, parts, equipment and labor at each foundation.

Designer Note: This note shall be included on resurfacing projects with this type of existing barrier wall assemblies.

242-6 630 Sign, Extrusheet Guide

The designable extrusheet guide signs shown in this plan were designed using the FHWA Standard Highway Alphabets. The Contractor shall use Clearview fonts for these signs as required in Section 630.04 of the Construction and Material Specifications. Do not revise overall sign sizes from what is shown in the plans. The edge space between the border and the text may be reduced from what is normally acceptable to achieve the sign widths shown. If this results in crowding of the border, a slight reduction in inter-letter and inter-word spacing may be used.

Designer Note: Plans sold under the 2008 Construction and Material Specifications require the use of Clearview font for the positive contrast legends on guide signs. In June, 2009, the SignCAD software was updated to allow signs to be laid out in Clearview font. Prior to this time, the SignCAD software was unable to lay out signs in Clearview font.
For projects containing designable Guide Signs, the signs should be laid out with Clearview fonts using the updated SignCAD software. For projects that are already under development, where it is impractical to redesign the signs with Clearview font, the signs may be laid out with the FHWA Standard Highway Alphabet.

Designable Guide Signs laid out using SignCAD with the FHWA Standard Highway Alphabet will have the same vertical height as signs laid out with Clearview font, but will usually be slightly narrower. This note should be used in plans where the designable freeway and expressway Guide Signs were designed using the FHWA Standard Highway Alphabet.

The Clearview and the FHWA Standard Highway Alphabets are available in the Sign Designs and Markings Manual (SDMM), available on the web at: http://www.dot.state.oh.us/Divisions/Operations/Traffic/publications2/SDMM/Pages/default.aspx. The Clearview and FHWA Standard Highway Alphabets for freeway and expressway designable Guide Signs are in SDMM Appendix C. Other information about standard alphabets for traffic control signs is in SDMM Appendix D.

242-7 630. Specific Service and Tourist-Oriented Directional Signs Removal and Reinstallation

In the event that this project necessitates the removal of any Specific Service (Logo) signs and/or Tourist-Oriented Directional Signs (TODS) that are not specifically described in other items of work, the Contractor shall carefully remove such signs. Removed Logo signs and TODS shall be immediately re-erected on approved temporary supports in the same general vicinity along the roadway to be viewed by the motoring public. Unless the original supports will be reused, the Contractor shall remove and dispose of the supports and foundations in accordance with Item 630.12. The Contractor shall notify Ohio Logos, Inc. at (800) 860-5646 at least 60 days prior to project completion to alert them that one or more Logo signs and/or TODS are on temporary supports. Ohio Logos, Inc. will make arrangements to have the signs installed on permanent supports at the completion of the project.

This item of work includes removal and temporary re-erection of Logo signs and TODS, furnishing and installation of temporary supports, removal and disposal of the original supports and foundations, and providing notification to Ohio Logos, Inc. This work will be included in the lump sum payment for Item 614, Maintaining Traffic.

Designer Note: This note should be included on all projects sold under the 2010 Construction and Material Specifications. This note is intended to supersede the requirements in CMS Item 630.09.

242-8 630 Signing Misc.: Solar Powered Rectangular Rapid Flashing Beacon (RRFB) Sign Assembly

This work shall consist of furnishing and installing a solar powered Rectangular Rapid Flashing Beacon (RRFB) sign assembly. The flashing unit shall be 2-sided LED, solar powered and pedestrian activated. Multiple units shall be wirelessly controlled and synchronized. The unit shall be compliant with the most current Ohio Manual of Uniform Traffic Control Devices (OMUTCD).

General Requirements –

Each RRFB shall consist of two rapidly and alternately flashing rectangular yellow indications having LED array based pulsing light sources.

Each RRFB shall be a complete assembly, consisting of but not limited to, signage, sign mounting hardware, indications and electrical components (wiring, solid-state circuit boards, etc.).
Functional Requirements –

Each RRFB shall utilize solar power.

Each RRFB shall be activated by ADA compliant pushbuttons.

The RRFB shall be normally dark, shall initiate operation only upon pedestrian actuation, and shall cease operation after a predetermined time limit (based on OMUTCD procedures).

Each remote RRFB shall be wirelessly activated.

When activated, the RRFB unit indications shall flash in a rapidly alternating “wig-wag” flashing sequence (left light on, then right light on).

All RRFB light indications shall be wirelessly synchronized (all lights will turn on within 120 msec and remain synchronized throughout the duration of the flashing cycle).

Each of the RRFB’s indications shall flash at 70 to 80 flashes per minute.

The unit shall be low current/high output including automatic dimming capabilities for day and night visibility.

The unit shall be capable of running up to 30 days without sunlight.

Materials –

Furnish a complete assembly, consisting of but not limited to, signage, sign mounting hardware, indications, and electrical components (wiring, solid-state circuit boards, etc.). The RRFB assembly includes the following items:

1. RRFB Indications
   a. Each RRFB indication lens shall be a minimum size of approximately 5" wide x 2" high.
   b. The RRFB indications shall be aligned horizontally, with the longer dimension of the indication horizontal. There shall be two indications on the front and two indications on the back.
   c. Each RRFB shall be supplied with all required hardware to install assembly. All exposed hardware shall be anti-vandal.
   d. Each RRFB shall be located between the bottom of the crossing warning sign and the top of the supplemental downward diagonal arrow plaque.
   e. The light intensity of the yellow indications shall meet the minimum specifications of Society of Automotive Engineers (SAE) standard J595 (Directional Flashing Optical Warning Devices for Authorized Emergency, Maintenance, and Service Vehicles) dated January, 2005.
   f. A small confirmation light directed at and visible to pedestrians in the crosswalk shall be installed integral to the RRFB or pushbutton to give confirmation that the RRFB is in operation.

2. Signs
   a. All sign assemblies shall use anti-vandal fasteners to mount components to sign and sign to fixture.
b. Pedestrian pushbuttons signs shall be provided and include the legend "PUSH BUTTON TO TURN ON WARNING LIGHTS". Signs should be mounted adjacent to or integral with each pedestrian pushbutton.

c. Two sets of signs shall be required per unit for view from each approach.

3. Control Circuit

a. When activated, the two yellow indications in each RRFB shall flash in a rapidly alternating "wig-wag" flashing sequence (left light on, then right light on).

b. The control circuit shall have the capability of independently flashing up to two independent outputs. The LED light outputs and flash pattern shall be completely programmable.

c. As a specific exception to the 2003 MUTCD Section 4K.01 requirements for the flash rate of beacons, RRFBs shall use a much faster flash rate. Each of the two yellow indications of an RRFB shall have 70 to 80 periods of flashing per minute and shall have alternating, but approximately equal, periods of flashing light emissions and dark operation. During each of its 70 to 80 flashing periods per minute, the yellow indications on the left side of the RRFB shall emit two slow pulses of light after which and the yellow indications on the right side of the RRFB shall emit four rapid pulses of light followed by a long pulse.

d. The flash rate of each individual yellow indication, as applied over the full on-off sequence of a flashing period of the indication, shall not be between 5 and 30 flashes per second, to avoid frequencies that might cause seizures.

e. The control circuit shall be sealed watertight to eliminate dirt contamination and allow for safe handling in all weather conditions.

f. The LEDs shall be sealed against dust and moisture intrusion as per the requirements of NEMA Standard 250-1991 for Type 4 enclosure and to protect all internal LED and electrical components.

4. Battery and Solar Panels

a. Battery unit shall be a 12VDC, 40 Ah minimum, sealed GEL or AGM lead acid battery. Batteries shall have a written two year full replacement warranty.

b. The solar panel shall provide a minimum of 55 watts peak total output.

c. The solar panel shall be mounted to an aluminum plate and bracket at an angle of 45 degrees- 60 degrees to provide maximum output.

d. All fasteners used shall be anti-vandal.

5. Wireless Radio

a. Radio control shall operate on a 900 MHz frequency hopping spread spectrum network, Wi-Fi or approved equal.

b. Radio shall integrate communication of RRFB control circuit to activate sign from pushbutton input.

c. The radio shall be synchronized so all of the remote RRFB light indications will turn on within 120 msec of each other and remain synchronized through-out the duration of the
flashing cycle.

d. Radio systems shall operate from: 3Vdc to 15Vdc.

6. Pushbutton

a. The pushbutton shall be capable of continuous operation over a temperature range of
-30 degrees F to +165 degrees F.

b. Pushbutton shall be ADA compliant.

7. Pedestal Shaft and Base - Mount on a standard 4.5-inch OD aluminum pedestal pole with
breakaway base. A 14 foot pole shall be provided and field adjusted to maintain the proper
sign mounting heights, unless specified otherwise in the plans. Pole and base
manufacturer shall be listed on ODOT’s Qualified Products List.

Construction –

The RRFB shall be assembled and constructed by the Contractor as shown and specified on
the plans.

Warranty –

Warranty shall be two years from the date of final acceptance.

Measurement –

The Department will measure the item complete in place, including all materials, testing, labor
and software for a fully functional unit.

Payment –

Payment will be at the contract unit price per each for Item 630 “Signing Misc.: Solar
Powered Rectangular Rapid Flashing Beacon (RRFB) Sign Assembly”.

Designer Note: This note should be included on all projects where Rectangular Rapid
Flashing Beacons are being installed.

243 SPECIFICATIONS

ODOT specifications for furnishing and installing signing materials and hardware are contained in
the following CMS sections:

630 and 730 Traffic Signs and Sign Supports, and Traffic Sign and Support Material
631 and 731 Sign Lighting and Electrical Signs, and Sign Lighting and Electrical Signs Material

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

Supplement 1049 covers the prequalification procedure for reflective sign sheeting. Supplement
1075 defines the load deflection test procedures for U-channel sign posts. Supplement 1092
defines the certification procedure for sign fabricators. Supplement 1093 defines the certification
procedure for sign support fabricators.
250 CONSTRUCTION

250-1 General

This information is intended to serve as a guide for construction personnel where the contractor furnishes and installs traffic control devices and appurtenances. However, it may also be useful for maintenance personnel performing the same functions. Inspection procedures for various types of traffic control devices are outlined, mainly in the form of checklists to assist project personnel in performing their duties. This information points out the various important features of each device and references the applicable specification or standard drawing. Illustrations are used for easy recognition of the device or feature being discussed.

250-2 Sign Service

Sign service shall comply with SCDs TC-32.10 and TC-32.11 and the plans. Additional information is provided in Section 240-7.2 and CMS Item 631.04. Basically, sign service consists of cable and equipment to provide a complete electrical service from either an underground source or an overhead direct drop to a separately furnished disconnect switch with enclosure. The equipment could include a weatherhead, a conduit riser with necessary fittings, attachment clamps and cable.

A thorough review of the plans should be made to determine the specific requirements of the maintaining agency for sign service.

When required, an electric meter base will be furnished by the applicable utility and installed by the contractor as part of the sign service work.

The sign service shall terminate at the meter base, if used; otherwise termination shall be at the switch enclosure. Sign service may be by:

1. Direct drop by means of a weatherhead and conduit riser routed to the switch enclosure;
2. Underground conduit and the pole interior to the enclosure; or
3. Underground and structure-attached conduit to the enclosure (for overpass-mounted signs).

The conduit riser shall comply with CMS Item 725 and the plans, and the weatherhead shall be threaded aluminum or galvanized ferrous metal (CMS Item 732.16).

The disconnect switch shall be a single-throw safety switch meeting the voltage and capacity requirements of the plans. The enclosure shall be a NEMA Type 4 ICS 1-110.15 with sufficient volume to accommodate an internal transformer when specified. The enclosure shall contain a solid neutral bar.

A ground wire shall be used as shown on SCDs TC-32.10 and TC-32.11 leading to a ground rod installed in accordance with Section 240-7.3.

250-3 Foundations

250-3.1 Staking

Sign support foundations shall be located so that the sign face is at a right angle to the roadway lanes served, unless the plans specify otherwise. An example of an exception is the W1-6 Large Arrow sign (black arrow on yellow background) which is located as shown in Figure 298-24.

Foundations should be staked by the contractor in accordance with the locations shown on the plans.
The stakeout locations should be checked for:

1. The presence of obstructions which could restrict proper visibility of the sign from the point where road users are expected to read the sign. Curved roadway locations should especially be checked.

2. Obvious conflicts with overhead power lines or other utilities. There should be available a proper safe clearance from overhead lines for construction operations, in compliance with the National Electric Safety Code and any local codes.

3. Possible conflict with underground facilities.

With the concurrence of the project engineer, foundation locations may be adjusted when necessary to overcome difficulties such as those shown in Figure 298-24 and discussed herein. However, such adjustments should not violate minimum clearance dimensions shown in the OCHTD and on SCDs TC-42.10 and TC-42.20.

250-3.2 Excavation

Foundations shall be placed only in undisturbed soil or compacted embankment, and excavation shall be by an earth auger of the specified diameter to the specified depth. See Figure 298-25 for a diagram of a foundation excavation.

If a minor cave-in should occur, the contractor may continue excavation using an increased diameter; or by sleeving, casing or other method approved by the project engineer. The contractor shall remove all extraneous material from the excavation before concrete placement.

When subsurface obstructions are encountered, permission may be granted by the project engineer to replace the excavated material and relocate the foundation.

When bedrock is encountered, that portion of the specified foundation depth within the bedrock may be reduced as much as fifty percent.

250-3.3 Placement

Anchor bolts and conduit ell(s) shall be of the correct size and furnished with the support. At least one 2 inch minimum conduit ell shall be furnished and capped if unused. Anchor bolts, conduit ell(s) and EMT (Electric Metallic Tubing) shall be oriented in the foundation according to the plans, conduit runs and ground rod location. All anchor bolts shall be provided with standard steel hex nuts, leveling nuts, and plain washers. The nuts shall be capable of developing the full strength of the anchor bolts.

Reinforcing bars, tie loops and tie bars shall be of the correct size and arranged with the anchor bolts into cages according to the applicable SCD TC-21.10 or TC-21.20. A special foundation design will be required when soil with a load bearing capacity of less than 2,000 pounds per square foot is encountered.

Anchor bolts shall be vertical with their ends projecting the correct distance above the foundation surface in compliance with the plans. When the distance the anchor bolts project above the foundation surface is not specified, a rule of thumb is four times the bolt diameter. The anchor bolts shall be tied to the cage tie bars according to standard details.

The rebar cage shall to be supported 3 to 4 inches above the bottom of the excavation by a piece of concrete block or similar material. The cage shall be positioned with a clearance of 3 inches from the excavation wall by similar blocking so that after concrete placement a full thickness cover is assured.
A template and/or frame shall be used to rigidly hold the anchor bolts and conduit ell(s) in the specified pattern during concrete placement. A form shall be oriented according to the plans to shape the foundation into a square, from the surface or grade shown to a nominal 6 inches below the ground line. The template and form may be combined. Gaps of 6 inches or less between the foundation and adjacent paved surfaces shall be eliminated by increasing the formed foundation.

Water encountered in the foundation excavation shall be pumped out before concrete placement. If this is not feasible, concrete should be placed by the tremi-tube method.

Concrete conforming to CMS Item 499 and CMS Item 511 shall be placed and vibrated to eliminate voids. Care should be exercised during vibrating to avoid disturbing the anchor bolts, conduit ell(s) and reinforcing cage.

Forms may be removed as soon as the concrete has hardened sufficiently so as not to be susceptible to damage (CMS Item 511.16).

Minor earth caving external to the hole which may have occurred during excavation using sleeving or casing should be corrected after concrete placement by backfilling and tamping in accordance with CMS Item 203.

Joint filler complying with CMS Item 705.03 shall be placed between the formed foundation and adjacent paved surfaces.

Supports and poles may be erected, signs installed, and span wire load applied, only after the concrete has aged sufficiently to be in compliance with Section 250-3.4.

### 250-3.4 Curing and Loading

Curing and loading of concrete for traffic control devices shall comply with CMS Item 511.17. Concrete for foundations of sign supports shall be cured, have bracing removed and be loaded only when the concrete has achieved the age shown below:

<table>
<thead>
<tr>
<th>Age of Concrete in Days</th>
<th>Without Beam Test</th>
<th>With Beam Test **</th>
</tr>
</thead>
<tbody>
<tr>
<td>Curing</td>
<td>7</td>
<td>5</td>
</tr>
<tr>
<td>Removing Bracing</td>
<td>7</td>
<td>3</td>
</tr>
<tr>
<td>Loading*</td>
<td>14</td>
<td>7</td>
</tr>
</tbody>
</table>

* No load shall be applied or other work done that will damage new concrete or interfere with its curing.
** Beam test specimens shall be poured from the same batch, immediately before, during or after foundation pour. Specimen configuration shall be to ODOT requirements. Specimens when tested shall have at least an average modulus of rupture for two tests of not less than 650 pounds per square inch.

### 250-4 Overhead Supports in General

#### 250-4.1 General

Various general aspects of overhead sign supports are addressed in this Section. Table 297-7 provides an overall summary of the structure types, allowable sign area on each, and the span or arm length.
250-4.2 Pole and Support Inspection

This inspection checklist covers the general features of strain poles, mast arm type signal supports, and overhead sign supports. Features pertaining only to specific pole or support types will be found in the Sections of this Manual covering exclusively those poles or supports.

1. When poles and supports of the combination type are specified, they shall provide extra length as necessary for a highway lighting function and a welded-on bracket arm plate(s) complying with SCD HL-10.12 or HL-10.11, for attachment of a separately furnished luminaire arm.

2. Supports may be of an alternate design utilizing all non-tapered tubing structural members.

3. Poles and supports should be inspected when received if possible, but certainly prior to erection.

4. General dimensions should be checked first, including pole length, base diameter, top diameter, and wall thickness. Similar mast arm dimensions should also be checked. Wall thickness is most easily measured with calipers at the end. Caps on poles may have to be removed.

5. Orientations of the various appurtenances should be checked against the plan’s orientation diagram if such is available; otherwise, orientations may be determined from certified shop drawings and the intersection drawing.

6. Base plate dimensions should be checked including thickness, bolt circle diameter and bolt hole size. Base plates may be plate or cast steel according to CMS Item 730.04.

7. A handhole with ground lug is to be furnished, with a cover plate complying with CMS Item 730.05 and a stainless steel chain complying with CMS Item 730.10.

8. A pole cap conforming to CMS Item 730.06 shall be furnished and in place before final inspection.

9. An arm cap conforming to CMS Item 730.07 shall be furnished for chords or mast arms.

10. All strain poles and overhead sign and signal support foundations shall be grounded (even if no power is available).

11. Welding shall be inspected in accordance with Section 250-4.3.

12. Galvanizing shall be inspected in accordance with Section 250-4.4.

13. Supports are to include sign brackets, U-bolts and clamps.

14. The correct number and size of anchor bolts and conduit ells shall be furnished for placement in the foundation.

15. Anchor bolt diameter and length shall be in accordance with the plans and SCD TC-21.10 or TC-21.20. Anchor bolt ends may have an L-bend or be fitted with a tapped steel plate. Threaded ends shall not be damaged and shall be galvanized at least 2 inches beyond the threads. The galvanizing should be in good condition, and absent or damaged galvanizing should be repaired by the application of two coats of zinc-rich paint. Galvanizing thickness should permit the turning of nuts by a wrench without difficulty. Loose rust on anchor bolts should be removed.
16. All anchor bolts shall be provided with standard steel hex nuts, leveling nuts and plain washers. The nuts shall be able to develop the full strength of the anchor bolts.

250-4.3 Inspection of Welds

All welds of supports shall be inspected visually as soon as possible following support delivery. Welds should be inspected for flaws and imperfections under good lighting conditions using a magnifying glass as necessary. Evidence of any of the following faults or other imperfections such as warping and misalignment may be cause for rejection of the support. The following features of welds should be checked:

1. A check should be made for the actual presence of all welds called for by the certified shop drawings and standard drawings.

2. Welds on tapered tubes, pipes or structural shapes shall be continuous around the joint. Welds requiring terminations shall be of the correct length.

3. Welds shall not exhibit cracks or discontinuities in base metal or weld material and shall not show evidence of porosity, showing up as pitting or pinholes. The galvanizing layer may cover such flaws, but their existence should be checked.

4. Welds shall be full cross section without excessive concavity or convexity. Required weld terminations shall be filled to full section without depressions or craters.

5. There should be no evidence of undercut, a condition where a shallow groove is melted into the base metal adjacent to a weld and left unfilled by weld metal.

6. Base plates shall be welded to two ply poles with AWS prequalified welds in conformance with CMS Item 730.04.

7. Arm attachment plates shall be welded inside and outside with fillet or full penetration welds. Each fillet weld shall be equal to the wall thickness of the respective tubing.

250-4.4 Inspection of Galvanizing

The galvanizing cover of supports shall be inspected visually as soon as possible following delivery. The galvanizing should be inspected externally and internally for flaws and imperfections in daylight or strong artificial light. In accordance with CMS Item 513.26, supports shall be loaded, transported, unloaded, stored and erected in a manner avoiding damage to any feature including the galvanizing. Supports stored in the field should be kept off the ground to prevent the galvanizing from contacting water which may result in a premature oxidation condition. The galvanizing should have the appearance of a uniform application. Supports should be checked for assurance that the following flaws or...
imperfections do not exist:

1. Loose or bare spots in the galvanizing where improper preparation has prevented metal adherence in the molten zinc bath. Poles should be rejected if the point of a penknife can flake off the galvanizing layer.

2. General overall roughness, a symptom of overpickling or of excess zinc bath temperature and/or immersion time.

3. Pimples, due to entrapped bath scum particles.

4. Blisters, due to hydrogen gas absorbed during pickling and coming out at the time of galvanizing.

5. Flux inclusions, picked up from the top of the bath when dipping and burnt-on during immersion.

6. Ash, usually in course lumps picked up from the top of the bath.

7. Patches of dull gray coating, due to the slow cooling of heavier cross sections of supports after immersion.

8. Excess zinc lumps or runs, due to delayed molten metal run-off from surface discontinuities such as joints, seams or holes.

9. Rust stains, due to the weeping of impurities from the pickling process at seams and folds.

Excessive galvanizing faults and imperfections combined with general poor workmanship may be cause for rejection of the support. Gross imperfections may lead to the suspicion of inadequate protective cover which may require inspection with a magnetic instrument. Items 1 through 6 may be cause for rejection. Items 7 through 9, if extreme, may also be cause for rejection, because of poor appearance even if the protection of the support is not affected.

After erection, supports should be given a final inspection for any damage to the galvanizing due to improper handling in the erection process. Damage due to slings, etc., which is more serious than superficial brightening is to be repaired by the contractor with the application of two coats of zinc-rich paint.

250-4.5 Weight of Supports

*Tables 297-8a through 297-8f* provide information on the weight of various overhead sign supports. For all structures, the weight of the pipe support has been given where pipe has been frequently used in place of tapered tubes. In general, the tapered tube support will be lighter than the pipe support. The support numbers listed may be preceded by I-129, 815, 844 or other designation instead of TC.

For estimating purposes, a 10 x 10 foot extrusheet sign (excluding the sign lighting) weighs approximately 250 pounds.

250-4.6 Assembly and Erection Procedure

Erection procedures pertaining to specific pole or support types will be found in the Sections of this Manual devoted exclusively to those poles or supports. In general the following assembly and erection procedure applies:

1. To minimize erection time and the hazard to workers and road users where traffic is maintained, supports should be erected with mast arms attached, and horizontal sign
support members (over the roadway) should be prewired for lighted signs or other traffic control devices. See the notes in the plan for traffic maintenance requirements when span-type sign support members are erected.

2. Support components shall be assembled with their threaded fasteners tightened in accordance with CMS Item 630.06. Fasteners 1/2 inch or greater shall have anaerobic adhesive applied to the threads in accordance with the manufacturer’s recommendations. Nuts shall be tightened by the “turn of the nut” method.

3. The “turn of the nut” method shall be in accordance with CMS Item 513.20. Nuts shall be made snug tight by the effort of a person using an ordinary spud wrench followed by an additional 1/12 to 1/6 turn.

4. Leveling nuts shall be placed on the anchor bolts, initially clearing the foundation surface by at least 1/4 inch and forming a horizontal plane.

5. Poles or supports shall be raised into position with equipment of adequate lifting capacity and used in a manner to prevent damage to attached appurtenances (signs, brackets, luminaires, etc.) and to the galvanizing. The weight of poles or supports is given in Section 250-4.5 for the use of the contractor in the erection procedure.

6. With the pole or support’s base plate resting on the leveling nuts, the plain washers and anchor nuts shall be placed on the anchor bolts, the support plumbed in a vertical position or raked as required, and anchor nuts given a preliminary tightening.

7. After any necessary leveling nut adjustments are made, to assure that the supports are essentially vertical after attachment of signs, sign lighting equipment or signals, the anchor nuts shall have anaerobic adhesive applied and be final tightened in accordance with the instructions for assembling fasteners given in paragraphs 2 and 3 of this Section.

8. Anchor nuts shall not be covered with bolt covers or a cover base regardless of support location (CMS Item 630.06 B).

9. Poles or supports which are prewired before erection should be checked to determine if the erection procedure has disturbed the wiring. Wire for lighted signs should be supported by looping wire over the J-hook in the vertical support member (CMS Item 631.05). Cable supported by cable support assemblies should be checked to determine if the sling is over the J-hook and if the adjustment is proper to eliminate strain on the cable jacket.
250-5  **Overhead Sign Supports By Type**

250-5.1  General

*Section 250-4.6* addressed general assembly and erection guidelines for strain poles and supports. The following Sections provide additional information specific to various types of supports. For the most part the information is provided in a checklist format.

250-5.2  Span Wire Support

Span Wire sign supports shall comply with SCD TC-17.10 and the plans. These sign supports consist of strain poles, messenger wire with accessories and sign hangers. Strain pole size shall be as specified.

1. Strain poles shall be inspected in accordance with *Section 450-6.1* and general features of the poles shall be inspected in accordance with *Section 250-4.2*. Welds shall be inspected according to *Section 250-4.3* and the galvanizing shall be inspected according to *Section 250-4.4*.

2. Erection shall be in accordance with the general procedure given in *Section 250-4.6* except as hereafter noted.

   a. For the initial rake of strain poles see *Section 450-6.1*.

   b. The upper messenger wire shall be assembled with its accessories according to the standard drawing. Preformed guy grips are not permitted because wind loads on the signs can cause failure of the grips. Alternate methods of attaching messenger wire to strain poles may be used:

      i. Span wire clamp with clevis, anchor shackle and thimbles on the messenger wire, or

      ii. Messenger wire wrapped twice around the strain pole and secured with a 3-bolt clamp of the proper size.

   c. The upper messenger wire shall be fitted with its signs, furnished under other items of work, and the vertical clearance to sign bottoms adjusted within clearance limits over the roadway. The sag of the upper messenger wire shall be between 4 and 5 percent.

   d. It is essential that the lower messenger wire have more slack than the upper wire. The sag should be approximately 3 inches greater than the upper wire. This sag adjustment shall be made before the sign hangers are attached to the lower wire.

   e. Sign hangers shall be clamped snugly to the lower wire by U or J bolts. In the case of back-to-back signs, the lower messenger wire running in between the sign hangers, is clamped between bolted spacers that are slightly thinner than the messenger wire (see SCD TC-17.10).

250-5.3  Single Arm Support

1. Single arm supports shall comply with certified shop drawings, SCD TC-16.21 and the plans.

2. General features of the support shall be inspected in accordance with *Section 250-4.2*. Welds shall be inspected according to *Section 250-4.3* and the galvanizing shall be inspected according to *Section 250-4.4*.
3. For arms of two telescoping pieces, a 15-inch overlap is required. The overlapped arms shall be secured with a stainless or galvanized steel hex head through-bolt with nut.

4. Arm caps shall cover at least fifty percent of the end area (CMS Item 730.07).

5. A minimum of two brackets shall be provided for each sign, each attached to the arm by steel clamps with carriage bolts. The clamps should be able to be tightened in a manner to firmly grasp the arm so as to prevent sign rotation.

6. If signs are lighted, disconnect switch enclosure mounting brackets may be required on the support.

7. Erection shall be in accordance with the general procedure given in Section 250-4.5, except as hereafter noted.
   a. The contractor may choose to attach the signs and any sign lighting items before erection.
   b. Signs are installed at the same elevation. For this purpose, adjustment is provided by two pairs of slotted holes in the sign bracket for attachment of the arm clamp.
   c. Contact between galvanized clamp flanges and aluminum sign brackets shall be prevented by the use of chloroprene gaskets.
   d. Initial rake shall be adjusted so that under the load of signs, the pole will assume an essentially vertical position and the arm rise will be within the limits specified on the standard drawing, i.e., 3 inches minimum, 12 inches maximum.

250-5.4 Cantilever Support

1. Cantilever supports shall comply with certified shop drawings, SCD TC-12.30 and the plans.

2. General features of the support shall be inspected in accordance with Section 250-4.2. Welds shall be inspected according to Section 250-4.3 and the galvanizing shall be inspected according to Section 250-4.4.

3. Supports with arm lengths 18 feet and over shall have truss members. Truss members may be angles or pipe.

4. Erection shall be in accordance with the general procedure given in Section 250-4.5, except as hereafter noted.
   a. The contractor may choose to attach the sign(s) and any sign lighting items before erection.
   b. Signs are centered vertically on the chords.

250-5.5 Center-Mount Support

1. Center-mount supports shall comply with certified shop drawings, SCD TC-9.30 and the plans.

2. General features of the support shall be inspected in accordance with Section 250-4.2. Welds shall be inspected according to Section 250-4.3 and the galvanizing shall be
inspected according to Section 250-4.4.

3. Sign clearance above the roadway shall be a minimum of 17 feet.

4. Arms may be either square or round tube. The arm attachment design shall be in accordance with standard details for either square arms or round arms with separate cradle.

5. Erection shall be in accordance with the general procedure given in Section 250-4.6, except as hereafter noted.
   a. Signs are centered vertically on the arms.
   b. Signs may be mounted laterally on the support in an eccentric position. However, a minimum of 2 feet of sign length shall remain to one side of the pole centerline.
   c. The contractor may choose to attach the sign and any sign lighting items before erection.

250-5.6 Semi-Overhead Support

1. Semi-overhead supports shall comply with certified shop drawings, SCD TC-9.10 and the plans.

2. General features of the support shall be inspected in accordance with Section 250-4.2. Welds shall be inspected according to Section 250-4.3 and the galvanizing shall be inspected according to Section 250-4.4.

3. Sign clearance above the ground shall be at least 10 feet unless a lower height is approved by the project engineer to provide sign visibility through preceding overpass structure(s).

4. Arms may be either square or round tube. The arm attachment design shall be in accordance with standard details for either square arms or round arms with separate cradle.

5. Erection shall be in accordance with the general procedure given in Section 250-4.6, except as hereafter noted.
   a. Signs are centered vertically on the arms.
   b. Signs may be mounted laterally on the support in an eccentric position. However, a minimum of 2 feet of sign length shall remain to one side of the pole centerline.
   c. The edge of the sign shall be back at least 2 feet from the edge of the curb.
   d. The contractor may choose to attach the sign and any sign lighting items before erection.

250-5.7 Span Truss Support

1. End frames for span truss supports shall comply with certified shop drawings, the plans, and SCD TC-7.65 for aluminum trusses and SCD TC-15.115 for steel trusses.

2. General features of end frames shall be inspected in accordance with Section 250-4.2.
Welds shall be inspected according to Section 250-4.3 and the galvanizing shall be inspected according to Section 250-4.4.

3. Handholes shall be oriented on the end frame downstream vertical member on the side away from the direction of traffic.

4. The size of truss members shall be in accordance with standard details. Truss member joints may be of two different designs.

5. An angle shall be furnished and welded onto the end frame, near the top, to support the lower chords of the span box. Stainless steel U-bolts shall be used with aluminum trusses and galvanized steel U-bolts with steel trusses.

6. End frame vertical members shall be furnished with steel clamps and a separate tee or angle (alternate) for supporting the upper chords of the span box. Stainless steel U-bolts shall be used with aluminum trusses and galvanized steel U-bolts with steel trusses.

7. When using an aluminum truss, the following shall apply:
   a. Aluminum trusses shall comply with certified shop drawings, SCD TC-7.65 and the plans.
   b. Welds shall be inspected according to Section 250-4.3.
   c. End caps shall be on each end of chords. The top front end caps shall be tapped for wiring.
   d. Span length shall be in accordance with shop drawings and plans.
   e. Span box camber shall be in accordance with standard details.
   f. Flanges between span box sections may be cast or fabricated with forged flanges as an alternate.
   g. Flange attachment hardware shall be stainless steel bolts and nuts.
   h. Supports shall be furnished with necessary sign brackets, U-bolts, luminaire support arms, bracing rods and other necessary structural members.

8. When using a steel truss, the following shall apply:
   a. Steel trusses shall comply with certified shop drawings, SCD TC-15.115 and the plans.
   b. Steel truss checking instructions are the same as those for aluminum trusses, except:
      The galvanizing shall be inspected according to Section 250-4.4.
      Flanges between span box sections shall be forged.
      Flange attachment hardware shall be galvanized steel bolts and nuts.

9. See the notes in the plan for traffic maintenance requirements when span type sign support members are erected.

10. The base plates of end frames shall be placed on anchor bolt leveling nuts, plain washers and anchor nuts placed, the frames plumbed into a vertical position in both longitudinal and lateral directions, and nuts made tight in accordance with Section 250-4.6.
11. Truss camber shall be correct. The various truss sections shall be assembled in the arrangement and sequence shown on the shop drawing.

12. Trusses may be assembled into a total span while lying on blocks with wedges. Flanges on truss section ends may be aligned by driving in the wedges as necessary. All flange bolts are then assembled and made tight.

13. Two cranes may be necessary when lifting very long trusses or the heavier steel trusses. For reference, truss weights are given in Section 250-4.5.

14. Care should be taken in the attachment of slings. Trusses should be lifted at positions of a quarter to a third of the total span. Slings should be attached to the top chords and the horizontal diagonals.

15. Trusses may be easily overstressed by poor handling, and care should be taken when moving assembled trusses for temporary storage, during transportation to the erection location, and in the erection procedure.

16. Trusses shall not be erected unless at least one sign will be in place within eight hours, or the trusses are fitted within the same period with damping devices approved by the project engineer (CMS Item 630.06 B).

17. Attachment of the box truss to the end frames shall be by four U-bolts. Aluminum trusses shall be attached by 5/8 inch stainless steel bolts according to SCD TC-7.65 and steel trusses shall be attached by 3/4 inch galvanized steel bolts according to SCD TC-15.115.

18. The contractor may choose to attach the sign(s) and any sign lighting items before erection.

19. Signs are centered vertically on the chords (not considering the height of Exit Number plaques).

250-5.8 Overpass Structure-Mounted Support

1. Overpass structure-mounted supports shall comply with the plans and SCD TC-18.24 for flush-type supports and SCD TC-18.26 for skewed-type supports.

2. Overpass structure-mounted supports include sign brackets and two different kinds of steel Z-bars which are fastened to bridge concrete. For steel beam bridge mounting, aluminum angles at the bottom are to extend between sign brackets and short steel angles bolted to the bridge steel. For overpass structures essentially perpendicular to the roadway underneath, sign brackets are flush mounted to Z-bars for direct sign viewing. For overpass structures skewed to the roadway underneath, a wedge-shaped box structure is inserted between the sign brackets and Z-bars to provide for direct sign viewing.
3. The number of sign brackets will vary according to the bracket spacing as required by SCD TC-22.20. Bracket details are also shown on the standard drawing.

4. The number of aluminum frames in skewed supports shall equal the number of sign brackets. Frame details shall be in accordance with standard details and are to include two angles placed diagonally.

5. Front upper and lower members of skewed supports shall be aluminum angles with a length equal to the sign length.

6. The skewed support structure shall be internally braced by two aluminum angles extending diagonally and horizontally through the interior.

7. For bridge clearance above a roadway of less than 17 feet, the sign clearance above the bottom of the bridge shall be 3 inches minimum without, or 15 inches minimum with, sign lighting fixtures on the lower edge of the sign.

8. Supports shall be mounted on the overpass structure so the sign is horizontal regardless of bridge slope (CMS Item 630.06 D).

9. Expansion double wedge steel anchor bolts shall be used to fasten the support’s Z-bars to the overpass structure concrete parapet. Intended locations of anchor bolts are to be approved by the project engineer before any field drilling. Z-bars “A” are used at the top, and Z-bars “B” at the bottom, of parapet concrete.

10. For a steel beam bridge mounting, aluminum angles at the bottom shall be fastened to short galvanized steel angles bolted to the bridge steel.

11. Chloroprene gaskets shall be used to prevent contact between aluminum sign brackets or support frames and steel Z-bars or bolted-on angles.

12. If the sign extends more than 4 feet above or below the attaching Z-bars, intermediate sign brackets shall be provided.

13. For precast beam bridges, aluminum angles at the bottom shall be fastened to short steel
angles and two expansion double wedge steel anchor bolts shall be used.

14. After sign erection, the sturdiness of the support to bridge attachment should be checked.

250-6  **Ground-Mounted Sign Supports**

250-6.1  **General**

*Section 250-6* provides additional information, generally in the form of checklists, about various ground-mounted supports. *Chapter 221* addressed general guidelines about sign supports and *Section 240-5* provides additional design information about ground-mounted supports.

250-6.2  **Posts**

1. Ground-mounted sign supports of the post type shall be U-channels or square posts of the number specified and as shown on SCD TC-41.20.

2. Post lengths appearing on the plans are approximate and the contractor is responsible for determining the exact length of required posts before cutting to length (CMS Item 630.06A1).

3. No. 4 U-channel posts consist of two No. 2 posts bolted back-to-back. No. 6 U-channel posts consist of two No. 3 posts bolted back-to-back. Back-to-back posts are assembled using 5/16 inch steel bolts, lockwashers and nuts on 4 inch centers below the ground line and 16 inch centers above the ground line. No. 4 and No. 6 U-channel posts shall not be installed in exposed locations.

4. Posts should have a line of paint 48 inches from the end which will be in the earth. The mark when driven to a distance of 6 inches above the ground indicates a post driven to the proper depth.

5. If it is necessary to cut posts to correct length in the field, the cut end should be covered with two coats of zinc-rich paint and the cut end driven in the earth or embedded when required (except for back-to-back posts).

6. Posts shall yield when hit and shall be driven to a depth of 42 inches. Posts are typically not to be embedded in concrete, unless specified in the plans or ordered by the project engineer to overcome problems such as adverse soil conditions or generally prevalent bedrock close to the surface. The driven depth has been established to assure best yielding characteristics. Deeper depths are not beneficial in this regard.

7. Caution shall be used when driving posts in areas of buried cable.

8. Posts shall not be driven in drainage ditches.

9. Posts shall be installed vertically and at right angles to the edge of pavement, except for signs not intended for this orientation, such as Parking, One-Direction Large Arrow, and Chevron Alignment signs. Another exception may be STOP signs located at intersections with curved approaches. In this situation, STOP signs should be placed perpendicular to a line from the viewing point where they are normally recognized and stopping action would begin.

10. Posts shall be driven without bending, distortion or end mutilation. Mutilation may be prevented by the use of a driving cap. Posts should be checked to see if the paint mark is 6 inches out of the ground after driving.

11. Posts located in paved areas shall be driven through a hole provided by sleeving or core...
drilling. After driving, the hole shall be patched with asphaltic concrete or approved bituminous material in accordance with SCD TC-42.20.

12. At locations where posts cannot be driven, the post may be moved at no additional cost to ODOT, when approved by the project engineer.

13. Typical vertical and horizontal clearances of signs are shown on SCDs TC-42.10 and TC-42.20.

250-6.3 “One Way” Sign Supports

Square posts which are capable of supporting signs at right angles to other signs on the post are used as “one-way” sign supports, based on the most common application. This is shown on SCD TC-41.50.

250-6.4 Standard Beams

1. Ground-mounted sign supports of the non-breakaway beam type shall be rolled steel, wide flange sections of the size and weight specified (from the list on SCD TC-41.10). Non-breakaway beams shall be protected by guardrail or concrete barrier installed for another purpose. Inspection of beams of the breakaway type is addressed in Section 250-6.5.

2. Beam lengths appearing on the plans are approximate and the contractor is responsible for determining the exact length of required beams before fabrication (CMS Item 630.06 A).

3. Galvanizing shall be inspected in accordance with Section 250-4.4.

4. Beams shall be embedded in a concrete foundation in accordance with SCD TC-41.10.

5. Beams shall be raised into position with equipment of adequate lifting capacity and in such a manner as to prevent damage to the galvanizing. The beams shall be braced in a plumb and square position until the concrete has cured. The age of the concrete before it is considered cured and before signs are permitted to be erected is to be in accordance with Section 250-3.4.

250-6.5 Breakaway Beams and Connections

1. Ground-mounted sign supports of the breakaway beam type shall be rolled steel, wide flange sections of the size and weight specified (from the list on SCD TC-41.10).

2. Beam lengths appearing on the plans are approximate and the contractor is responsible for determining the exact length of required beams before fabrication (CMS Item 630.06 A).

3. Beams shall use a slip base design; however, alternate designs of breakaway connections are permitted.

4. Base plates shall be fabricated to standard details and welded-on with a bead equal to the beam flange and web thickness respectively, but not less than 1/4 inch.

5. Welding shall be inspected in accordance with Section 250-4.3.

6. Galvanizing of beams shall be inspected in accordance with Section 250-4.4.

7. All portions of beams should be shop assembled, in accordance with SCD TC-41.10.
8. The beam upper portions shall be joined by the bolts attaching the fuse and hinge plates (see the Section B-B detail on SCD TC-41.10). The plates shall be fabricated to standard details with the fuse plate having notched holes at the bottom and the hinge plate having unnotched holes. The steel hex head bolts, with washers under both head and nut, shall be tensioned in the shop to the final specified value. For S4x7.7 beams only, malleable iron beveled washers are used under bolt head and nuts.

9. The beam lower portions should be joined by steel hex head bolts inserted with their nuts uppermost. A galvanized bolt retainer plate shall be sandwiched between the base plates. Flat washers shall be used under both bolt head and nut as well as under the bolt retainer plate. Bolts shall be snug tightened for delivery to the site with final torquing to be done after erection.

10. Base plate skewed notches should point toward the roadway along the path of a typical vehicle collision. The skewed notches of both base plates should match.

11. For beams located in medians, the base plates should be welded-on upside down as compared with those of beams located on the right side of the roadway, so the base plate skewed notches will point toward each roadway along the path of vehicle collision from either direction of traffic.

12. For beams located in medians, fuse plates shall be used on both sides of the beam.

13. For beams located on the right side of the roadway, fuse plates shall be on the side of the beam facing traffic.
14. For the alternate design, special foot brackets shall be bolted to the upper beam portion, and four couplings incorporating a breakable reduced section are connected between the foot brackets and threaded anchor inserts embedded in the foundation. The couplings permit use of the design in medians where collision can occur in either direction of traffic.

15. The alternate design uses four hinge/fuse plates incorporating a thinned section and bolted where the beam is cut through just under the sign. The pair of plates on the impact side of the beam sever upon impact and a pair on the opposite side bend to allow the beam to swing upward out of the path of the impacting vehicle.

16. Beams should be erected in a single unit because they are easier to plum, square and brace when the entire assembly is raised and set in concrete.

17. Beams shall be erected in accordance with the procedure given for non-breakaway beams in Section 250-6.4.

18. A sloping concrete foundation top surface is required on the high ground side to prevent a water pooling pocket and permit drainage as per SCD TC-41.10. For the alternate design, the foundation top shall be level in the area of the breakable couplings.

19. When a supplemental panel is required below an extrusheet sign, the panel is fastened by sign backing assemblies to the parent sign. The panel shall be separated from the sign by the width of the fuse plate plus 1 inch. This is to permit unhindered hinge plate bending in the event of a vehicle collision.

20. After the foundation concrete is cured, base plate nuts shall be loosened in turn and re-tightened with a torque wrench in a systematic manner to the specified maximum torque shown in the table on SCD TC-41.10, also shown in Table 297-9. Torque wrenches used should be calibrated daily.

21. At least four weeks following the erection of signs on breakaway beams, the breakaway feature shall be inspected by the contractor for evidence of shifting or loose fasteners.

22. All loose fasteners shall be re-torqued to specified values. Base plate fasteners shall be
loosened and re-torqued even if no shifting or looseness is detected. Re-torqued nuts at this time shall have anaerobic adhesive applied.

250-7 Signs

250-7.1 General

Signs should be inspected when received on the job site if possible, but certainly prior to erection. The signs should be inspected for conformance with the plans, certified shop drawings, catalog cuts and material specifications.

Flat sheet signs are typically of aluminum sheet cut into geometric shapes of the size specified. Dimensions and thickness are to be as shown on SCDs TC-52.10 and TC-52.20. Bolt holes are to be drilled or punched (CMS Item 630.04).

Extrusheet signs are fabricated of aluminum sheet and extrusions, joined by spot welding and assembled by bolts (SCD TC-51.11). As an alternative, panels extruded in a single operation may be used (SCD TC-51.12). Extruded panels and spot welded panels shall not be used in the same sign. There shall be no appreciable deviation from flatness on the face of an assembled sign. Regardless of panel construction, the term “extrusheet” is used when referring to these signs.

Overlay signs are of aluminum flat sheet of the thickness specified and used to cover the legend of extrusheet signs. Signs with overlays should be checked for any loose rivets holding the overlay sign.

All signs shall be retroreflectORIZED by being covered with the appropriate grade of sheeting. The sheeting shall be of the correct color, firmly attached and free of tears, wrinkles, blisters or blemishes.

Sign legend shall be in accordance with the plans, certified shop drawings and the O MUTCD. The type of copy on extrusheet signs shall be as shown on the certified shop drawings. Available types of copy are listed in Table 297-6.

Extrusheet signs shall also be identified by information in a detachable form on the back (see CMS Item 630.04).

250-7.2 Sign Storage

Signs shall be suitably protected and identified for shipment and storage. Extrusheet signs shall be kept rigid by backbracing or crating and the sign face covered with protective material. The backbracing shall extend sufficiently below the lower edge of the sign to keep the sign off the ground.

Extrusheet and flat sheet signs shall be stored in a vertical position.

Signs must be stored in such a manner that the packaging paper or cardboard material does not get wet. If the packaging material or slip sheeting should become wet, the paper should be removed immediately from contact with sign faces to prevent damage to reflective
sheeting on the faces.

In the case of signs furnished by ODOT for erection by the contractor, the contractor shall be responsible for the storage and care of the signs after their transfer (CMS Item 630.08).

250-7.3 Sign Copy

Table 297-6 provides information about the sign copy used, type, material used, design features, etc.

250-7.4 Sign Identification Decals

All signs shall be identified on the reverse side by decals of Type F white reflective sheeting (CMS Item 730.18) with silk screened numerals. Information shall be coded by silk screened or punched-out numerals before decal application and shall include: sheeting manufacturer and year of sign fabrication. At the time of erection, month and year of erection shall be scratched out by the contractor. This procedure is described in CMS Item 630.04, which also contains an illustration of the decal. Decals for overlay signs may be on the front surface.

The following codes shall be used on the decals to identify the manufacturer of the sheeting.

<table>
<thead>
<tr>
<th>Decimal Code</th>
<th>Manufacturer</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Avery Dennison</td>
</tr>
<tr>
<td>1</td>
<td>Minnesota Mining and Manufacturing Company (3M)</td>
</tr>
<tr>
<td>2</td>
<td>Sakai Trading-New York, Inc.</td>
</tr>
<tr>
<td>3</td>
<td>Nippon Carbide Industries (USA)</td>
</tr>
<tr>
<td>4</td>
<td>Morgan Adhesives Company</td>
</tr>
<tr>
<td>5</td>
<td>American Decal and Manufacturing Company</td>
</tr>
<tr>
<td>6</td>
<td>Stimsonite Corporation</td>
</tr>
<tr>
<td>7</td>
<td>Reflexite North America</td>
</tr>
<tr>
<td>8</td>
<td>Oracal USA, Inc.</td>
</tr>
</tbody>
</table>

250-7.5 Sign Erection

250-7.5.1 General

Section 250-7.5 provides information on erection of the signs. Assembly and erection of various types of overhead sign supports are addressed in Sections 250-4 and 250-5 and ground-mounted supports are addressed in Section 250-6.

250-7.5.2 Ground-Mounted Flat Sheet Signs

When erecting ground-mounted flat sheet signs the following provisions apply:

1. Typical vertical and lateral clearances of ground-mounted flat sheet signs are shown on SCD TC-42.20.

2. Flat sheet signs shall be fastened to posts by 5/16 inch hex head steel bolts with a 3/8 inch ID x 1 1/4 inch OD wide washer under the bolt head and using a lockwasher and hex nut. For U-channel posts, at each bolt a bearing plate shall be used behind the sign to reinforce the sign, as indicated on SCD TC-41.20. The hardware and bearing plates are furnished with the signs.

3. Posts supporting groupings of flat sheet signs in multiple arrangements will require the use of sign backing assemblies made up of bolted together short sections of posts. Sign backing assemblies are furnished with the signs unless separately itemized.

4. Flat sheet signs mounted so as to be read by road users using bridges shall be
erected on special steel posts in accordance with SCD TC-41.40.

5. Street Name signs shall be erected on square supports in accordance with SCD TC-41.40, unless specified otherwise in the plans.

250-7.5.3  Ground-Mounted Extrusheet Signs

When erecting ground-mounted extrusheet signs the following provisions apply:

1. Typical vertical and lateral clearances of ground-mounted extrusheet signs are shown on SCD TC-42.10.

2. Mounting clips and other attachment hardware shall conform to SCD TC-51.11.

3. Supplemental panels erected below ground-mounted extrusheet signs mounted on non-breakaway beams shall be fastened directly to the beams. The panel shall be separated from the parent sign by 1 inch to conform to SCD TC-42.10. When the panel is too short to reach between the beams, the panel may be fastened to the parent sign by sign backing assemblies.

4. Supplemental panels erected below ground-mounted extrusheet signs mounted on breakaway beams shall be fastened to the parent sign by sign backing assemblies. The panel shall be separated from the parent sign by the width of the fuse plate plus 1 inch.

5. Exit Number plaques erected above extrusheet signs shall be attached by sign backing assemblies furnished with the Exit Number plaque.

6. The signs should be checked after erection to verify that the beams extend to the top of the signs and that the signs are horizontal and the clearances satisfactory.

250-7.5.4  Overhead Signs

When erecting overhead signs the following provisions apply:

1. The clearance above the roadway for the bottom of overhead signs shall be a minimum of 17 feet, or as shown on the plans.

2. Overhead signs shall be vertical or horizontal regardless of the sag of supporting messenger wire, mast arm rise, chord camber or overpass slope.

3. Signs erected on span wire supports shall be attached in accordance with SCD TC-17.10.

4. Signs erected on single arm supports (SCD TC-16.21) shall be installed so their bottom edge is at the same elevation. Sufficient adjustment for this purpose is provided by the two pair of slotted holes in the sign brackets for the attachment of the arm clamps. The clamps shall be tightened sufficiently to prevent sign rotation about the arm.

5. Signs mounted on semi-overhead supports (SCD TC-9.10) shall be erected so that their edge clearance from the curb line is at least 2 feet.

6. Extrusheet signs over 8 feet in height may be delivered in two pieces for assembly in the field (CMS Item 630.08).

7. Extrusheet signs erected on supports with two arms shall be centered vertically.
8. Mounting clips and other attachment hardware for extrusheet signs shall conform to SCD TC-51.11.

9. Signs mounted on center-mount supports (SCD TC-9.30) may be mounted laterally on the support in an eccentric position when required by the plans. However, a minimum of 2 feet of sign length shall remain to one side or the other of the vertical member centerline.

10. Overlay signs erected in the field over existing extrusheet signs shall be attached by blind rivets at spacings as required in CMS Item 630.04.

11. Flat sheet signs used in connection with signals supported by span wire shall be fastened to the messenger wire by special attachments in accordance with SCD TC-41.41.

12. Flat sheet signs used in connection with signals supported in a swinging condition on mast arm supports shall be fastened to the arm by a special attachment in accordance with SCD TC-41.41.

13. Exit Number plaques erected above Guide Signs shall be attached by sign backing assemblies furnished with the Exit Number plaque.

14. Extrusheet signs shall be attached to rigid overhead supports using sign brackets in accordance with SCD TC-22.20. Signs extending more than 4 feet above or below an attachment point require the use of intermediate sign brackets.

250-7.6 Sign Inspection

After sign erection, the contractor shall inspect all signs under both day and night conditions. Any necessary adjustments in lateral position or orientation to correct visibility deficiencies shall be made to the satisfaction of the project engineer (CMS Item 630.13).

Overhead Guide Signs should typically be centered over the lane(s) to which they apply. Down arrows on the signs should normally be centered over the proper lane as viewed by the road user. The maximum displacement of a down arrow from the center of a lane should not be more than 2 feet.

Overhead Guide Signs situated on curved roadways and incorporating down arrows may have the arrow(s) adjusted within the sign and/or the entire sign moved laterally so the arrows when seen from a typical viewing distance on the curve will appear to be over the proper lane(s).

Night conditions inspection is to assure that each sign has visible and uniform retroreflectivity. Any signs not having proper retroreflectivity should be noted and cleaned or replaced by the contractor.

250-8 Sign Lighting

250-8.1 General

Sign lighting is not necessary for overhead Guide Signs when Type H or J reflective sheeting is used for the reflective legends. Therefore, for new installations, sign lighting will normally not be used.

Guidelines and design information on sign lighting are addressed in Chapter 212 and Section 240-7. Section 250-8 provides additional information about what to look for when installing sign lighting.
1. Check certified shop drawings, catalog cuts, etc. for luminaires, ballasts, switches and enclosures.

2. Luminaires shall consist of a housing containing a reflector, lamp socket, wiring and a door containing a glass lens or refractor, meeting the following requirements:
   a. The housing shall be adequately reinforced cast aluminum with a natural finish or painted gray.
   b. The reflector shall be highly reflective aluminum.
   c. The lamp socket shall be a porcelain shrouded mogul screw with lamp grips and a large center spring providing firm contact with a lamp base.
   d. The door shall be an aluminum frame either cast with a natural finish or a formed extrusion with an anodized finish. The door shall be hinged securely to the housing and provided with a spring loaded latch. Hinges shall be stainless steel and designed so that unintentional door separation is impossible. Latches shall be stainless steel and shall not require tools for opening.
   e. A flexible readily removable gasket shall be attached to the housing or door so a waterproof seal is formed when the door is closed and the gasket compressed. The glass lens shall be mounted within the door and sealed with elastic cement or a gasket. The glass lens shall be borosilicate or equivalent, able to withstand hail or the thermal shock of freezing rain.
   f. Drainage weepholes shall be provided in the housing or door depending upon the luminaire’s bottom or top position on a sign.

3. Lamp sizes shall be as specified. Ballast types shall match the specified lamp wattage.

4. Sign lighting shall be controlled by a disconnect switch within an enclosure. The switch shall be a two-pole minimum, single throw, fused safety disconnect type rated at 600 volts and 30 amperes (CMS Item 631.06). The fuse size shall be as specified. A solid neutral bar shall be provided.

5. The enclosure shall be weatherproof and lockable, complying with NEMA standard Type 4 ICS 1-110.15. Enclosure size shall be as specified (See SCD TC-32.10).

6. Each enclosure shall be furnished with at least one padlock, and each padlock shall have a corrosion resistant body and a corrosion proof steel shackle. All padlocks for a project shall be keyed alike from an appropriate master key number obtained by the contractor from the maintaining agency.

7. Sign service to the enclosure shall be in accordance with the plans. Service wiring cable size shall be as specified, single conductor rated at 600 volts and not less than Number 4 AWG (CMS Item 631.04). Sign service underground from a pull box to a foundation-mounted support, or to a support mounted on a concrete median barrier, is shown on SCD TC-32.10. Sign service from a direct drop is shown on SCD TC-32.11.
8. Sign wiring from the disconnect to the luminaires shall be the size specified, single conductor rated at 600 volts and not less than Number 10 AWG (CMS Item 631.05). The wiring shall be fully protected within enclosures, support interiors, junction boxes, rigid or flexible conduit and luminaire housings. Wiring shall be continuous from the disconnect switch to a junction box mounted on the sign support or overpass structure. The junction box shall permit disconnection of wiring when a sign and its lighting equipment is removed as a unit. A junction box shall be installed for each sign. Wiring shall be continuous from the junction box to the first luminaire on a sign and continuous between additional luminaires on the sign.

9. Luminaire ballast shall be located within the luminaire (integral) or in a weatherproof housing attached to or beside the luminaire (contiguous). Wiring to the ballast shall be continuous with permitted disconnection at the sign support junction box (see paragraph 8).

10. The wiring routing for wired signs shall be as shown on PIS 203121.

11. Luminaire supports complying with PIS 203121 are specified for new installations. Support arms are of welded tubular design incorporating an attachment flange and a luminaire support plate. The arms are bolted to a continuous rectangular galvanized steel tube forming the lower portion of the sign’s glare shield. The face of the rectangular tube shall be covered with non-reflective sheeting complying with CMS Item 730.20 so as to match the color of the glare shield sheeting. Support arms shall not be mounted upside-down or in any other manner than that permitted by the SCD.

12. Luminaires shall be adjusted to a proper aiming angle according to the manufacturer’s instructions and inspected at night to determine if they are providing uniform illumination to the sign face.

250-8.2 Sign Lighting Inspection and Testing

1. In accordance with CMS Item 631.11, sign lighting and electrical signs shall meet the requirements of the following tests as required by CMS Item 625.19 and performed by the contractor:

   a. Ground rod resistance to ground (see Section 450-11.2).

   b. Cable insulation (Megger Test) test (see Section 450-11.5).

   c. Ten-day performance test (see Section 450-11.7).

      During the ten-day performance test, failure of lamps, ballasts and transformers may be corrected by replacement of the faulty component but will not require restart of the entire test period.

2. The contractor should perform a circuit test on all sign lighting cable and wire conductors to determine if there are any short circuits, cross circuits or other improper connections. Circuit testing may be done in accordance with Section 450-11.4.

3. The test results shall be reported to the project engineer in the test information required by CMS Item 625.19. The test results should be documented.

4. During the ten-day performance test, a night inspection shall be performed by the contractor and final adjustments made to sign lateral positions and the aiming angle of luminaires to the satisfaction of the project engineer (CMS Item 631.11). The adjustments are to eliminate excessive brightness and glare and to obtain optimum sign face reflected brightness, uniformity of illumination, visibility and legibility.
5. Following successful completion of a ten-day performance test and after there has been a partial or final acceptance of the project, the contractor should turn over to the project engineer all manuals, diagrams, instructions, guarantees and related material. The project engineer should transfer the material to the maintaining agency. For ODOT-maintained signs, the material should be given to the appropriate ODOT District Office.

6. After the project has been accepted by ODOT, the project engineer should immediately notify the maintaining agency that as of a certain exact time and date, the agency is responsible for the maintenance.
260 MAINTENANCE / OPERATIONS

260-1 General

Signing is an essential part of the traffic control system on our highways. The consequences of poor maintenance practices are a reduction in safety to road users and an unnecessarily large exposure to liability claims. District Roadway Services personnel and sign maintenance contractors are required to repair, replace and install signs as needed.

The OMUTCD and earlier Chapters of Part 2 of this Manual address basic signing standards and guidelines. This Chapter provides additional information regarding ODOT maintenance and operations functions related to signing. For example, Section 260-5 describes the Systematic Sign Replacement Program established to help assure adequate visibility of permanent traffic control signs on ODOT-maintained highways. It is important that ODOT personnel responsible for installation and maintenance of traffic control signs be familiar with these resources.

Although primarily intended as a guide for construction personnel, the information in Chapter 250 should also be helpful for maintenance personnel performing the same functions. That Chapter includes information about various important features of the devices, references applicable specifications and standard drawings, and provides illustrations for easy recognition of the devices or features being discussed.

260-2 Responsibilities

In general, the Districts shall do the work necessary to maintain the signing on the state highway system and the Office of Traffic Engineering (OTE) shall:

1. Staff and maintain a central Sign Shop.
2. Assist Districts in maintaining reasonable stock levels of materials and hardware required for new installations and maintenance through the management of annual term contracts.
3. Assist the Districts, through procedure manuals, training programs, inspections and other methods, in providing quality maintenance of traffic control features used on the state highway system.

260-3 Maintenance on Interstate Routes Within Municipalities

ODOT SOP OPS-111, Maintenance of Interstate Highways through Cities and Villages, addresses maintenance of highway signs and sign supports on Interstate routes within the boundaries of Cities and Villages.

260-4 Maintenance on Non-Interstate State Highways Within Municipalities

260-4.1 General

ORC Sections 5511.01 and 5511.02 contain provisions pertaining to ODOT's responsibility for the maintenance of signs on highways on the state highway system within municipal corporations. ORC Section 5511.01 contains the following statement: “The director may erect state highway route markers and other signs directing traffic as the director thinks proper upon those portions of the state highway system lying within municipal corporations, and the consent of the municipal corporations to that erection and marking shall not be necessary.” Section 5511.02 contains the following: “The director of transportation may lay out, establish, acquire, open, construct, improve, maintain, regulate, vacate, or abandon ‘limited access highways' or 'freeways' in the same manner in which the director may lay out, establish, acquire, open, construct, improve, maintain, regulate, vacate, or abandon
highways.”

Section 204-3 addresses maintenance of highway signs and sign supports on business routes and Section 221-3 addresses the inspection and maintenance of overhead sign supports. Also, Sections 205-2 and 209-2 address ODOT’s involvement with traffic generator signs located within a municipality.

260-4.2 Limits and Responsibilities in Cities and Villages

Arrangements other than those described herein are permissible provided they are agreed upon in writing and are acceptable to all involved parties and ODOT’s responsibility does not exceed the parameters set forth herein.

1. ODOT will bear the cost and:
   
   a. Furnish, install, maintain and repair all signs used in route sign assemblies and signs containing route shields (except for enhanced reference location signs) on conventional roads, and on the mainline and interchange ramps of freeways and expressways;
   
   b. Furnish, install, maintain and repair all freeway and expressway entrance ramp approach signs located within ODOT right-of-way on intersecting highways and streets not on the state highway system, as prescribed in the OMUTCD;
   
   c. Furnish all signs used in trailblazer assemblies considered necessary, as agreed upon by ODOT and municipal officials, to provide additional directional guidance to the conventional road, freeway or expressway; and
   
   d. Furnish, install, maintain and repair all sign supports containing one or more signs that are maintained by ODOT, except for supports which have a primary purpose other than for displaying signs, such as, but not limited to, utility, signal and lighting poles.

2. The City or Village shall:
   
   a. Furnish, install, maintain and repair all destination signs and other signs not maintained by ODOT on conventional roads, and on the mainline and interchange ramps of freeways and expressways;
   
   b. Furnish, install, maintain and repair all signs not maintained by ODOT on intersecting highways and streets not on the state highway system;
   
   c. Install, maintain and repair all signs used in trailblazer assemblies considered necessary as agreed upon (see item 1(c) above);
   
   d. Furnish, install, maintain and repair all sign supports not containing any signs maintained by ODOT;
   
   e. Furnish and install all necessary modifications required to assure structural integrity of sign supports maintained by ODOT when increasing loading on the supports due to the upgrading or addition of City or Village-maintained signs (written approval shall be obtained from ODOT prior to making any modifications to ODOT-maintained sign supports);
   
   f. Furnish, install, maintain and repair all sign lighting on ODOT and City or Village-maintained signs; and
g. Provide electrical energy for the operation of sign lighting on ODOT and City or Village-maintained signs, except where power to ODOT-maintained signs is supplied through highway lighting circuits.

260-4.3 Additional Services for Villages

For Villages which have requested additional services from ODOT under the provisions of ORC Section 5521.01, and have on file with ODOT an executed M&R 689, the following shall also apply:

1. ODOT will, in addition to the limits specified in this Section, bear the cost and furnish, install, maintain and repair all:

   a. Regulatory and Warning Signs within the right-of-way of conventional roads and on the mainline and interchange ramps of freeways and expressways;

   b. STOP and YIELD signs on intersecting highways and streets at the intersection with the state highway; and

   c. School Signs with Beacons and related appurtenances located within the State highway right-of-way.

2. Regulatory and Warning Signs previously installed by the Village will be maintained and repaired only when justified, designed and installed in conformance with the OMUTCD and the ORC. For example, non-warranted STOP signs will not be maintained.

260-5 Systematic Sign Replacement Program

Highway signs utilize white or colored reflective sheeting materials containing optical elements designed to return a large portion of incident light back towards the source. At night, this property, known as retroreflectivity, redirects incident light from a vehicle’s headlights back toward the vehicle’s occupants. Retroreflectivity allows highway signs to remain visible after dark.

The color and retroreflective properties of highway signs degrade over time, due primarily to exposure to ultraviolet light and environmental contaminants. Sign color will fade, and retroreflectivity will be reduced, over time. The purpose of this standard is to assure adequate sign appearance and visibility by establishing a statewide uniform practice for the systematic replacement of permanent traffic control signs on ODOT-maintained highways.

All new permanent traffic control signs are required to be reflectorized with Type G, H or J reflective sheeting (see Section 220-6). It is expected that signs fabricated with Type G, H or J reflective sheeting will have a sign service life of fifteen years. Sign service life is the period of time that a sign has an adequate appearance, proper color retention and contrast, and sufficient retroreflectivity to effectively convey its message both day and night. Signs made with Type F reflective sheeting shall not be used on ODOT-maintained highways.

OMUTCD Section 2A.08 requires that ODOT adopt an assessment or management method that is designed to maintain sign retroreflectivity at or above the minimum levels in OMUTCD Table 2A-3. ODOT’s Systematic Sign Replacement Program, begun in 2001 and as described herein, conforms to the Blanket Replacement method in OMUTCD Section 2A.08.

Each District shall develop and implement a program to provide for the systematic replacement of permanent traffic control signs on a fifteen year cycle. This should be done on a route by route basis, with signs on the entire length of a route within a District or County, or on a segment of a route within a District or County, scheduled for replacement on a fifteen year cycle.

The District should make preparations well in advance to provide sufficient time to assure signs are replaced within the recommended time interval. Sign replacements may be by contract or
force account, or a combination of the two.

All signs on a route or route segment should be replaced at the same time. Signs that have been installed within two years of the scheduled replacement may remain in place. Type G, H or J signs that are removed that have sufficient remaining service life may be returned to District stocks to be used in maintenance activities (e.g., knockdown replacements).

The District may elect to delay sign replacements on a route segment for up to two years to allow the sign replacement to be combined with other scheduled work for that section of highway, provided the District verifies that the signs have sufficient retroreflectivity to effectively convey their messages both day and night, and are at or above minimum reflectivity levels established by FHWA.

260-6 Maintenance of STOP and YIELD Signs at County and Township Road Intersections

260-6.1 General

ODOT has a general duty to maintain State Routes pursuant to ORC Sections 5501.01(C), 5501.31 and 5511.01. Therefore, although they face the cross or side road, since the vast majority of STOP and YIELD signs at intersections of local roads with state highways are on ODOT right-of-way, ODOT has traditionally accepted the responsibility for them.

The Districts should include these signs in their Systematic Sign Replacement Program efforts (see Section 260-5).

If officials from a County or Township encounter a STOP or YIELD sign at the intersection of a road under their jurisdiction with a state highway that they believe needs to be replaced, this should be brought to the attention of the appropriate ODOT District. If the District agrees that a particular sign needs to be replaced, the District should proceed to schedule the work. If the District does not agree that a particular sign needs to be replaced, then the County or Township may, at their discretion, replace the sign at the County or Township’s expense.

260-6.2 Limits of Maintenance and Responsibilities

Arrangements other than those described herein are permissible, provided they are agreed upon in writing and are acceptable to all involved parties and ODOT’s responsibility does not exceed the parameters set forth herein.

ODOT will bear the cost and:

1. Furnish, install, maintain and repair all STOP and YIELD signs at the intersection of County and Township roads with rural state highways. No distinction will be made as to whether or not the sign is actually located within the limits of ODOT’s right-of-way.

2. Furnish, install, maintain and repair all sign supports used with a STOP or YIELD sign at the intersection of County and Township roads with rural state highways.

The County or Township shall furnish and install all STOP and YIELD signs, and related supports, at the intersections of County or Township roads with rural state highways that they believe are in need of replacement, but which the appropriate ODOT District does not agree need to be replaced.
260-7 **Maintenance of Sign Lighting**

Because of the January 1, 2008 federal government mandate that mercury vapor luminaires and ballasts no longer be manufactured or imported, these parts have become increasingly difficult to obtain.

For this reason, **ODOT** will no longer maintain existing sign lighting. Luminaires and ballasts should be allowed to fail in place.

When the sign lighting is no longer operational, the **District** may, at its discretion, remove the luminaires and/or luminaire support assemblies. Glare shields should not be removed.
Intentionally blank.
295  REFERENCE RESOURCES

295-1  General

Various reference resources that may be useful have been noted in Chapters 193 and 194.

The following document is hereby incorporated into the TEM by reference.

295-2  Sign Designs and Markings Manual

295-2.1  General

The Sign Designs and Markings Manual (SDMM) is intended to provide Standard Sign Designs for the signs depicted in the OMUTCD and the TEM, as well as some additional signs that are not currently addressed in either of these manuals. General guidelines for the design of other signs are also provided. As noted in Section 195-3, the SDMM is referenced in the OMUTCD and is used to assure uniformity in the design of standard traffic signs in Ohio.

The information covered includes element sizes, horizontal and vertical arrangements, spacing rules and charts which simplify procedures and minimize time and effort in the design and layout of Guide Signs. Symbols and arrows used for traffic control signs are contained in Appendix A of the SDMM; design information is provided in Appendix B; the freeway and expressway guide sign design method is in Appendix C; letter size and spacing information are in Appendix D. The spacing criteria and element sizes contained in Appendix D are based on criteria established by FHWA in combination with criteria from sign legend manufacturers.

The standard pavement markings alphabet and symbols have also been incorporated into the SDMM, as Appendix F.

Although the SDMM is physically a separate publication, it is also considered part of the TEM, i.e., Section 295-2. Cross-referencing is provided as appropriate within the text of this Manual to related additional detail information currently in the SDMM.

295-2.2  Format and Design Details

Standard Sign Designs intended to be included in the SDMM shall be drawn showing the sign layout to scale. The sheet shall be sized to 8.5 x 11. The Sign Design should also include a color graphic version of the sign. This graphic representation shall be shown so as to clearly represent the sign whether the design is printed using a color or a black and white printer. English dimensions in inches should be used in the sign layout. The dimensions shall be indicated either on the sign, when only one size is available, or in a table shown below the sign layout for drawings when more than one size is available. Dimension arrowheads shall use a filled arrowhead design.

Proposed drawings should include in the file a scaled, color layout of the sign which can be used to create graphic images in other formats, for use in other publications. This is in addition to the sheet to be used in the SDMM. The file name for a Sign Design shall indicate the sign name/number designation and the date the drawing was created; and shall be submitted to the OTE Standards Section for review and processing.

The seed file for a Standard Sign Design is trafsdm_v8.dgn (I:\tr\trstd\seed). All Standard Sign Designs begin by copying this file and then renaming it for the appropriate drawing. The seed file includes a table which can be removed or modified as needed for the sign design. The phrase “All dimensions shown in inches” shall be shown on the sheet.
Font 30, line weight 0, 0.14 size shall be used overall, with the exceptions of the page header title and the title block sign code designation which shall use Font 30, line weight 0, 0.17 size. If notes are used in the design, they should be typed in an Arial true type font using 0.14 height size.

Levels used for a sign design are SH_Border for the cutline and title block, ST_Details for the sign (both the layout and the smaller graphic design), and ST_Text for dimensions and text.
296-1 Business Route Resolution for a County

Form 296-1 is a sample Resolution which can be used in establishing a Business Route for a County (see Section 204-3).

296-2 Business Route Resolution for a Municipality

Form 296-2 is a sample Resolution for establishing a Business Route within a municipality (see Section 204-3).

296-3 HAR Installation and Maintenance Agreement

Form 296-3 is a sample HAR Agreement as described in Section 206-5.

296-4 Overhead Sign Support Inspection

Form 296-4 is a sample form that can be used for inspection of overhead sign supports (Section 221-3).

296-5 Sign Ordering Form

Form 296-5 is a copy of the form used for ordering signs and signing materials (Section 220-8.2).
Form 296-1.  Request for Business Route Signs on a County Road

Resolution Number ______

Requesting the Ohio Department of Transportation
to Erect Business Route Signs on a County Road

WHEREAS, state route ______ has been relocated so as to bypass the Corporation of ______________________, and,

WHEREAS, the ownership of the old and previously marked section of state route ______ from ______ to ______ except that part of the previously marked road which lies inside the Corporation of ______________________ as shown in the attached map, has been transferred from the Ohio Department of Transportation to the County of ______________________, and,

WHEREAS, the ______________________ County Commissioners believe that it is in the best interest of the citizens of ______________________ County and the public in general that motorists be provided with appropriate direction to and from the business district of the Corporation of ______________________,

NOW, THEREFORE, be it resolved by the Commissioners of the County of ______________________, State of Ohio, that

SECTION 1: The Ohio Department of Transportation be requested, and consent is hereby given, to erect appropriate signs at appropriate places and intervals designating route ______ as previously described, as a business route.

SECTION 2: The County of ______________________ shall be responsible for the future replacement and maintenance of the business route signs, and the pavement, berms, traffic signals and all parts of said road, and furthermore, the County agrees to maintain all traffic control devices in accordance with the standards as set forth in the Ohio Manual of Uniform Traffic Control Devices (OMUTCD). It is also understood that all traffic control devices on the above section of road and any of its parts will be subject to inspection by ODOT personnel and failure of the County to maintain the marking system in accordance with the OMUTCD shall be cause for ODOT to rescind approval of the business route and order the removal of the business route signs.

SECTION 3: The County of ______________________ recognizes its responsibility for the section of road described above and it understands and agrees that the posting of this section of road as a business route will not remove the responsibility of any part of it from __________________ County. Specifically, the County will in no manner be relieved or discharged from any claim or claims of any nature arising from, or growing out of, the maintenance of said section of road and the County shall save the State of Ohio harmless from any and all such claims.

SECTION 4: This resolution shall be in full force and effect from and after its passage, legal publication and earliest period allowed by law.

Passed this ______ day of __________________, ________.

Commissioners Voting

______________________________ ______
______________________________ ______
______________________________ ______

ATTEST:

____________________________________
Clerk of the Board
Form 296-2. Request for Business Route Signs within a Corporation

Resolution Number ______

Requesting the Ohio Department of Transportation
to Erect Business Route Signs within a Corporation

WHEREAS, state route ______ has been relocated so as to bypass the Corporation of __________________, and,

WHEREAS, the streets as described below, which were previously marked as a section of this state route:

______________________________________________________________________________________
______________________________________________________________________________________
______________________________________________________________________________________

have been abandoned by the Ohio Department of Transportation as a part of the state highway system, and

WHEREAS, it is believed that it is in the best interest of the citizens of the Corporation of __________________ and the public in general that motorists be provided with appropriate direction to and from the business district of the Corporation of ________________________.

NOW, THEREFORE, be it resolved by ________________________________

-sectional number--

SECTION 1: The Ohio Department of Transportation be requested, and consent is hereby given, to erect appropriate signs at appropriate places and intervals designating route ______ as previously described, as a business route.

SECTION 2: The Corporation of ______________________ shall be responsible for the future replacement and maintenance of the business route signs, and the pavement, berms, traffic signals and all parts of said road, and furthermore, the Corporation agrees to maintain all traffic control devices in accordance with the standards as set forth in the Ohio Manual of Uniform Traffic Control Devices (OMUTCD). It is also understood that all traffic control devices on the above section of road and any of its parts will be subject to inspection by ODOT personnel and failure of the Corporation to maintain the marking system in accordance with the OMUTCD shall be cause for ODOT to rescind approval of the business route and order the removal of the business route signs.

SECTION 3: The Corporation of ______________________ recognizes its responsibility for the streets described above and it understands and agrees that the posting of this section of road as a business route will not remove the responsibility of any part of it from the Corporation of ______________________. Specifically, the Corporation will in no manner be relieved or discharged from any claim or claims of any nature arising from, or growing out of, the maintenance of said streets and the Corporation shall save the State of Ohio harmless from any and all such claims.

SECTION 4: This resolution shall be in full force and effect from and after its passage, legal publication and earliest period allowed by law.

Passed this ______ day of __________________, ______

Corporation of ______________________ Voting

____________________________________
____________________________________

ATTEST:

____________________________________
Clerk of the Board
**Form 296-3. HAR Installation and Maintenance Agreement**

**AGREEMENT NO. ____**

This Agreement is made and entered into by and between the Ohio Department of Transportation ("ODOT") and the ______________________________, hereafter referred to as the "owner."

In consideration of the mutual covenants, promises and warranties set forth herein, ODOT and the owner agree as follows:

SECTION 1: DEFINITIONS

The following words and items shall have the following meanings:

1.1 **AGREEMENT**: This Agreement, which is herein identified as Agreement No. ____.

1.2 **APPLICATION**: The written request by the owner.

1.3 **DIRECTOR**: The Director of ODOT.


1.5 **PERMIT**: An Occupancy Permit issued to owner by ODOT.


1.7 **PROJECT**: The project of fabricating, erecting and maintaining Highway Advisory Radio signs in accordance with the procedures.

1.8 **HIGHWAY ADVISORY RADIO SYSTEM**: A specific information radio transmission system.


SECTION 2: PURPOSE OF AGREEMENT

2.1 The purpose of this Agreement is to set forth the covenants, rights, duties, obligations and warranties of the parties with respect to the installation, maintenance, and operation of a Highway Advisory Radio System and the installation and maintenance of associated sign(s) located on Route ____ at or about exit number _____ at mile marker _____ in _________ County.

SECTION 3: SCOPE OF THE PROJECT

3.1 The owner, entirely at its own expense, shall design, construct, and maintain a Highway Advisory Radio System and associated signs as described in this Agreement and in the following documents hereby incorporated by reference:

1. The application.
2. The procedures.
3. ODOT Standard Operating Procedure PH-P-403.
5. ODOT Standard Construction Drawings.
6. ODOT Construction and Material Specifications.
8. Approved construction plans for installation of signs.

3.2 The resolution of any conflict among these documents shall be made by the Director upon written request of the owner.
SECTION 4: PROJECT RESTRICTIONS

4.1 The owner agrees to operate a Highway Advisory Radio System transmitter and associated signs in the following manner.

a. Only traffic advisory or directional messages shall be broadcast over the radio station.

b. No message of a commercial or promotional nature may be broadcast at any time.

c. Messages concerning disruptions of normal traffic flow or road conditions due to highway construction or maintenance activities shall be broadcast when requested by the Ohio Department of Transportation.

d. The Highway Advisory Radio System shall be operated at all times in accordance with applicable Federal Communications Commission Rules and Regulations.

e. The Highway Advisory Radio System shall be operated on a permanent year-round basis 24 hours a day unless otherwise approved by the Director.

f. The location(s) of the broadcast reception zone(s), as described in this Agreement, shall not be altered subsequent to placement of the signs referred to herein.

g. The owner shall immediately notify the Ohio Department of Transportation of any event or condition which may significantly affect its ability to perform in accordance with the provisions of this Agreement.

SECTION 5: PERIOD OF PERFORMANCE

5.1 The term of this Agreement shall commence upon the execution thereof by the Director.

5.2 This Agreement shall terminate when one of the following events occurs:

a. The owner no longer operates the Highway Advisory Radio System; or

b. ODOT's operational needs require removal of all Highway Advisory Radio System signs and/or equipment from the Right of Way;

c. At the discretion of the Director.

5.3 In the event that paragraph 5.2b or 5.2c occurs, ODOT shall provide the owner with reasonable written notice of termination sufficient to allow the owner to find an alternate site, if any.

SECTION 6: PERFORMANCE BOND AND PAYMENT BOND REQUIREMENTS:

6.1 The owner hereby agrees to post a performance bond prior to commencement of the Project and subject to ODOT's approval in an amount equal to the greater of twenty-five percent of the estimated cost of the initial Project construction cost or Five Thousand Dollars ($5,000), conditioned upon the owner's promise to perform in accordance with SECTION 8, Removal and Restoration, of this Agreement.

6.2 The owner further agrees to post a payment bond prior to the commencement of the Project and subject to ODOT's approval in an amount equal to the greater of one hundred percent of the initial project construction cost or Twenty-Five Thousand Dollars ($25,000.00) for the payment of any contractor or subcontractor for labor performed or materials furnished in connection with the Project.

6.3 If the owner or its contractor or subcontractor does not commence work within the time required, or does not carry the same forward with responsible progress, or is improperly performing the work, or has abandoned or fails to prosecute the work in an acceptable manner or fails or refuses to complete this Agreement, ODOT shall so notify the owner in writing and the owner and its contractors shall immediately cease work on the Project. ODOT shall forthwith give written notice, by certified mail, to the sureties on the bonds of the owner's contractor of such action. If, within ten days after the receipt of such notice, such sureties notify ODOT in writing of their intention to enter upon and complete the work covered by such contract, the sureties shall be permitted to do so. The sureties shall commence work within thirty days after receipt of permission from ODOT.

6.4 In the event said sureties do not undertake their legal and contractual obligations, ODOT may take any action it deems suitable in order to complete the Project or terminate the Project in accordance with Section 13, Default and Termination.

6.5 The owner shall include the terms found in 6.1 through 6.4 above in any and all contracts it enters into with contractors or subcontractors who actually perform work on the Project and shall provide ODOT with a copy of any such contract(s) and/or subcontract(s).

SECTION 7: PERMIT REQUIREMENTS

7.1 Except in emergencies, the owner shall obtain a Permit prior to each occasion that the owner intends to
perform any scheduled installation, maintenance, repair and/or removal operations within the State highway right-of-way at or near the location of the Highway Advisory Radio signs described in this Agreement.

7.2 An emergency is defined as: (Add definition)

SECTION 8: MAINTENANCE OF HIGHWAY ADVISORY RADIO SIGNS

8.1 The owner shall provide maintenance of the Highway Advisory Radio signs at no cost to ODOT and in accordance with the specifications and standards defined by ODOT. This will include relocating or removing any Highway Advisory Radio signs which ODOT deems it necessary for any reason to relocate or remove.

8.2 If, in the opinion of ODOT, the Highway Advisory Radio System or associated signs malfunction, cease to function or cause damage or any threat of damage to State property or if the Highway Advisory Radio signs become, in the opinion of ODOT, unsightly, badly faded or in a state of dilapidation, the owner shall, at its own cost, immediately repair any damage or remove any threat of damage, cure any malfunction or make any needed repairs after written notice from ODOT.

8.3 If the owner fails to remedy the defects as noted by ODOT and ODOT repairs, or causes to be repaired, any Highway Advisory Radio sign, the owner shall reimburse ODOT for all expenses incurred as a result of the owner’s failure to provide a remedy in accordance with this Section.

8.4 ODOT reserves the right to claim and recover by process of law such sums or otherwise receive satisfaction as may be sufficient to correct any and all errors or make good any and all defects in the performance, workmanship and/or materials involved pursuant to this Agreement.

SECTION 9: REMOVAL AND RESTORATION

9.1 The owner hereby agrees that it shall assume the entire cost of removing signs, sign supports, and foundations for Highway Advisory Radio signs and SHALL restore the area upon termination of this Agreement.

SECTION 10: RELEASE AND INDEMNIFICATION

10.1 The owner covenants and agrees to indemnify and hold ODOT, the State, and its agents harmless against any loss, claim, cause of action, damages, liability (including without limitation, strict absolute liability in tort or by statute imposed), charge, cost or expense (including, without limitation, counsel fees to the extent permitted by law) caused by the owner’s negligent, willful, or wanton actions or inactions, including such actions or the failures to act of any contractors or subcontractors or other employee hired by owner in connection with this Agreement.

10.2 No claim, cause of action or request of any kind shall be made by the owner against ODOT or the State for any compensation for damage to the Highway Advisory Radio System and related signs resulting from the performance of ODOT highway maintenance or construction activities.

10.3 In no event shall the owner or any of its employees, agents, contractors or subcontractors, be considered agents or employees of ODOT or the State. The owner agrees that none of its employees, agents, contractors or subcontractors will hold themselves out as, or claim to be, agents, officers or employees of ODOT or the State and will not, by reason of any relationship with ODOT or the State make any claim, demand or application to or for any right or privilege applicable to an agent, officer or employee of ODOT or the State including, but not limited to, rights and privileges concerning workmen’s compensation benefits, social security coverage or retirement membership, credit or any other terms, conditions, or privileges of employment.

10.4 The obligation of the owner to indemnify and hold ODOT and the State harmless shall not be limited or reduced in any way by reason of any insurance coverage or lack thereof.

SECTION 11: COMPLIANCE WITH FEDERAL, STATE AND LOCAL REQUIREMENTS

11.1 The owner shall fully comply with all federal, State and local laws, rules, executive orders, and other legal requirements as they apply to the performance of this Agreement.

(April 20, 2012)  
October 23, 2002  
2-149
SECTION 12: NO ADDITIONAL WAIVER IMPLIED

12.1 If any term, provision or condition contained in this Agreement is breached by either the owner or ODOT and thereafter such breach is waived by the other party, such waiver shall be limited to the particular breach so waived and shall not be deemed to waive any other breach hereunder.

12.2 No remedy herein conferred upon or reserved by ODOT is intended to be exclusive of any other available remedy, but each and every such remedy shall be cumulative and shall be in addition to every other remedy given under this Agreement or now or hereafter existing at law or in equity.

12.3 No delay or omission to exercise any right or option accruing to ODOT upon any default by the owner shall impair any such right or option or shall be construed to be a waiver thereof, but any such right or option may be exercised from time to time as often as may be deemed expedient by ODOT.

SECTION 13: DEFAULT AND TERMINATION

13.1 If the owner or its Contractor or Subcontractor does not commence work within the time required, or does not carry the same forward with responsible programs, or is improperly performing the work, or has abandoned or fails to prosecute the work in an acceptable manner, or fails to maintain signing in an acceptable manner, or fails or refuses to complete this Agreement, the Director may terminate this Agreement upon giving the owner 10 days written notice.

13.2 Neglect or failure of the owner to comply with any of the terms, provisions or conditions of this Agreement or failure of any representations made to ODOT in connection with this Agreement by the owner to be true may be an event of default, provided that if by reason of force majeure the owner is unable in whole or in part to carry out its covenants contained herein, the owner shall not be deemed in default during the continuance of such inability.

13.3 The term force majeure as used herein shall mean, without limitation: Acts of God, strikes, lockouts or other industrial disturbances; acts of public enemies, order of any kind of government of the United States or of the State or of any of their political subdivisions or any of their departments, agencies, or officials, or any civil or military authority; epidemics; landslides; lightning; earthquake; fire; hurricanes; storms; floods; washouts; droughts; restraint of government and people; civil disturbances; explosions; partial or entire failure of utilities; or any other cause not reasonably in the control of the owner. The owner shall, however, remedy with all reasonable effort each cause preventing it from carrying out its covenants contained herein.

13.4 If notified by ODOT in writing that it is in violation of any of the terms, conditions, or provisions of this Agreement, and a default has occurred, the owner shall have thirty (30) days from the date of such notification to remedy the default or, if the remedy will take in excess of thirty (30) days to complete, the owner shall have thirty (30) days to satisfactorily commence a remedy of the causes preventing its compliance and curing the default situation. Expiration of the thirty days and failure by the owner to remedy, or to satisfactorily commence the remedy of, the default whether payment of funds has been fully or partially made, shall result in ODOT, at its discretion, declining to make any further payments to the owner, or termination of this Agreement by ODOT. If this Agreement is terminated, the owner shall repay to ODOT all of the federal funds disbursed to it under this Agreement pursuant to Article XVII of this Agreement.

13.5 The owner, upon receiving a notice of termination from ODOT for default, shall cease work on the terminated activities covered under this Agreement. If so requested by ODOT, the owner shall assign to ODOT all its rights, title, and interest to any contracts it has with any Consultants or Contractors. Otherwise, the owner shall terminate all Contracts and other Agreements it has entered into relating to such covered activities, take all necessary and appropriate steps to limit disbursements and minimize any remaining costs. At the request of ODOT, the owner may be required to furnish a report describing the status of Project activities as of the date of its receipt of notice of termination, including results accomplished and other matters as ODOT may require.

13.6 No remedy herein conferred upon or reserved by ODOT is intended to be exclusive of any other available remedy, but each and every such remedy shall be cumulative and shall be in addition to every other remedy given under this Agreement or now or hereafter existing at law or in equity. No delay or omission to exercise any right or option accruing to ODOT upon any default by the owner shall impair any such right or option or shall be construed to be a waiver thereof, but any such right or option may be exercised from time to time and as often as may be deemed expedient by ODOT.
SECTION 14: SETTLEMENT OF THIRD PARTY AGREEMENT DISPUTES OR BREACHES

14.1 The owner shall avail itself of all legal and equitable remedies under any third party contract which relates to the Project and shall notify ODOT of any current or prospective litigation pertaining to any such third party contract.

SECTION 15: CHANGE IN CONDITIONS OF LAW AFFECTING PERFORMANCE

15.1 The owner shall immediately notify ODOT of any other event, which may significantly affect its ability to perform in accordance with the provisions of this Agreement.

SECTION 16: SEVERABILITY

16.1 If any provision of this Agreement is held to be invalid or unenforceable by a Court of competent jurisdiction, such holding shall not affect the validity or enforceability of the remainder of this Agreement. All provisions of this Agreement shall be deemed severable.

SECTION 17: SUCCESSORS IN INTEREST

17.1 All the obligations incurred by the owner under this Agreement shall pass to and be binding upon any successors, heirs, contractors, subcontractors and assigns of the owner and such successors, heirs, assigns, contractors, subcontractors shall be bound to the terms, conditions, restrictions, specifications and covenants of this Agreement.

17.2 The owner shall not assign, transfer, convey or subcontract, in whole or in part, or otherwise dispose of this Agreement without the express prior written consent of ODOT, and such written consent shall not release the owner from any of the obligations of this Agreement.

SECTION 18: EXCLUSIVE AGREEMENT

18.1 This Agreement, when fully executed by the parties, constitutes the entire Agreement between the parties and shall supersede all other communications, representations or agreements, either oral or written, with respect to the subject matter in this Agreement unless a modification to this Agreement is executed in writing by the parties.

SECTION 19: CAPTION

19.1 The section captions in this Agreement, are used for the convenience of reference only and in no way define, limit or describe the scope or intent of this Agreement or any part hereof and shall not be considered in any construction hereof.

SECTION 20: DRUG-FREE WORK PLACE

20.1 The owner agrees to comply with all applicable State and federal law regarding a drug-free work place. The owner shall make a good faith effort to ensure that its employees will not purchase, transfer, use, or possess illegal drugs, or abuse prescription drugs in any way.

SECTION 21: EQUAL EMPLOYMENT OPPORTUNITY

21.1 In carrying out this Agreement, the owner shall not discriminate against any employee or applicant for employment because of race, religion, color, sex, national origin, ancestry, age, or disability as that term is defined in the Americans with Disabilities Act. The owner shall ensure that applicants are hired and that employees are treated during employment without regard to their race, religion, color, sex, national origin, ancestry, age, or disability. Such action shall include, but not be limited to the following: employment, upgrading, demotion, or transfer; recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training including apprenticeship.

21.2 The owner agrees to post in conspicuous places available to employees and applicants for employment, notices setting forth the provisions of this nondiscrimination clause, and in all solicitations or advertisements for employees placed by it, state that all qualified applicants shall receive consideration for employment without regard to race, religion, color, sex, national origin, ancestry, age, or disability. The owner shall incorporate this nondiscrimination requirement within all of its Contracts for any of the work on the Project (other than Subcontracts for standard commercial supplies or raw materials) and shall require all of its Contractors to incorporate such requirements in all Subcontracts for any part of such Project work.
21.3 The owner agrees to ensure that minority business enterprises, as such are defined in 49 CFR Part 23, will have the maximum opportunity to participate in the performance of contracts and subcontracts financed in whole or in part with federal funds provided in conjunction with this Agreement.

SECTION 22: GOVERNING LAWS

22.1 This Agreement and any claims arising out of this Agreement shall be governed by the laws of the State of Ohio. Any provision of this Agreement prohibited by the law of Ohio shall be deemed void and of no effect. Any litigation arising out of or relating in any way to this Agreement or the performance thereunder shall be brought only in the courts of Ohio, and the owner hereby irrevocably consents to such jurisdiction. To the extent that ODOT is a party to any litigation arising out of or relating in any way to this Agreement or the performance thereunder, such an action shall be brought only in a court of competent jurisdiction in Franklin County, Ohio.

SECTION 23: NOTICE

23.1 Notice under this Agreement shall be directed as follows:

IF TO THE OWNER     IF TO ODOT:

___________________________  __________________________
___________________________  __________________________
___________________________  __________________________

SECTION 24: ASSIGNMENT

24.1 Neither this Agreement nor any rights, duties, or obligations described herein shall be assigned by either party hereto without the prior express written consent of the other party.

SECTION 25: SIGNATURES

25.1 Any person executing this Contract in a representative capacity hereby warrants that he/she has been duly authorized by his/her principal to execute this Contract on such principal's behalf.

IN WITNESS HEREOF, the parties hereto have executed this Agreement by their duly authorized officers on the day, month and year set forth below.

STATE OF OHIO
DEPARTMENT OF TRANSPORTATION

BY: ____________________________
    [typed Director's Name],
    Director

DATE: __________________________

______________________________

(OWNER)

BY: ____________________________

Print Name: __________________________

Title: __________________________

DATE: __________________________
Form 296-4. Overhead Sign Support Inspection

Support Information

Support Identifier: ___________________ Date: _______________________________
Route: ____________________________ Direction: ____________________________
C - R - S: __________________________ Mile Marker: _________________________

Design No.: ________________________ Bridge Mtd Foundation? ____Yes ____No
Support Type: ____Cantilever ____Box Truss ____Bridge Mtd ____Skewed Bridge Mtd
____Span Wire ____Monotube ____Butterfly ____Semi-Overhead
____Other: ___________________________________________________

Foundation

____Concrete Condition _____Soil Condition ____Anchor Bolts/Nuts
Comments: __________________________________________________________________
_________________________________________________________________

End Frame/Pole

____Structural Members ____Structural Connections
____Damage? _____Yes _____No _____Pitting? _____Yes _____No
____Surface Rust: ____Minimal ____Moderate ____Severe
Comments: __________________________________________________________________
_________________________________________________________________

Cantilever/Span

____Structural Members ____Structural Connections
____Sign Attachments ____Attachments to End Frame/Pole
____Damage? _____Yes _____No _____Pitting? _____Yes _____No
____Surface Rust: ____Minimal ____Moderate ____Severe
Comments: __________________________________________________________________
_________________________________________________________________

Structural Components of Sign Lighting

Type: ____Fluorescent ____Mercury Vapor TC-31.21 (New Design)
____Mercury Vapor TC-31.20 (Old Design) ____Repair Brkt? ____Yes ____No
Comments: __________________________________________________________________
_________________________________________________________________

Inspected by: ____________________________ Date: ____________________________
Form 296-5. Sign Order Form

**SIGN SHOP ORDER**

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<th>DISTRICT REQUEST NUMBER</th>
<th>Enter Request Number Here</th>
<th>RUSH</th>
<th>Date Needed</th>
<th>[Enter Date Needed]</th>
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</thead>
</table>

Material Types: Plastic, Plywood, Extrusion, Overlay, Decal

Order Types: Material Only, Special, Confirming, ODRN, Warehouse

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<th>Sign Code</th>
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<th>Sign Height</th>
<th>Sq Ft Per Sign</th>
<th>Total Sq Ft</th>
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Prepared By: [Name]

District: [District]

Order Prepared By: [Name]

Dates: [Order Date]

Return To: [Return Completed Order To]

Supplemental Sign Design Sheet(s) Attached: [Number of sheets Attached]

Traffic Engineering Manual

200 SIGNS October 23, 2002 (April 20, 2012)
297  TABLES INDEX

297-1 Sizes for Lane-Use Control Signs

As noted in Section 201-10, Table 297-1 provides a listing of the various Lane-Use Control Signs with their sizes. Figure 298-22 also provides a visual representation of these signs.

297-2 Lake Erie Circle Tour Routes

Section 204-4 describes signing provided for the Lake Erie Circle Tour Routes. Table 297-2 lists the routes involved.

297-3 Ramp Identification Code System

As noted in Section 210-2, Table 297-3 lists the codes used on the D10-H6 signs to identify interchange ramps.

297-4 Criteria for Signing for Traffic Generators on Freeways and Expressways

As noted in Section 209-2, Table 297-4 describes the criteria used when reviewing freeway and expressway signing requests for traffic generators.

297-5 Control City Destinations for Ohio’s Interstate Highway System

As noted in Section 209-3, Table 297-5 lists the control cities used on Ohio’s Interstate Routes for major destination references.

297-6 Sign Copy

As noted in Section 250-7.3, Table 297-6 provides information about the various kinds of sign copy.

297-7 Types of Overhead Sign Supports

As noted in Section 250-4.1, Table 297-7 provides a summary of information about the various types of overhead sign supports.

297-8a Weight of Overhead Supports - Truss

Table 297-8a provides information about the weight of truss sign supports (see Section 250-4.5).

297-8b Weight of Overhead Supports - Semi-Overhead & Center Mount

Table 297-8b provides information about the weight of semi-overhead and center-mount sign supports (see Section 250-4.5).

297-8c Weight of Overhead Supports - Butterfly

Table 297-8c provides information about the weight of butterfly sign supports (see Section 250-4.5).

297-8d Weight of Overhead Supports - Single Arm

Table 297-8d provides information about the weight of single arm overhead sign supports (see Section 250-4.5).
297-8e  Weight of Overhead Supports - Cantilever

*Table 297-8e* provides information about the weight of cantilever sign supports (*see Section 250-4.5*).

297-8f  Weight of Overhead Supports - Structure-Mounted

*Table 297-8f* provides information about the weight of overpass structure-mounted sign supports (*see Section 250-4.5*).

297-9  Bolt Size and Maximum Torque for Beam Supports

As noted in *Section 250-6.5, Table 297-9* provides information about the bolt sizes and maximum torque allowed for beam type supports.

297-10  Bolt Tension

As noted in *Section 250-4.6, Table 297-10* provides information from the *Society of Automotive Engineers Handbook* about the tensioning for bolts used with beam supports.

297-11  Sign Lighting Lamps and Ballast

As noted in *Section 250-8.1, Table 297-11* provides information about types of lamps and ballasts used for sign lighting.

297-12  Guide Sign Sizes - English

As noted in *Section 203-1, Table 297-12* shows sizes in English units for commonly used Guide Signs.

297-13  Guide Sign Sizes - Metric

As noted in *Section 203-1, Table 297-13* shows sizes in metric units for commonly used Guide Signs.

297-14  Watershed Sign Locations

As noted in *Section 206-17, ODOT* will install Watershed signs at (or as close as practical to) the locations shown in *Table 297-14*.

297-15  Specific Service (Logo) Signing Program Eligibility Criteria

*Table 297-15* summarizes the eligibility criteria for the Logo Signing Program described in *Section 207-2*.

297-16  TODS Signing Program Eligibility Criteria

*Table 297-16* summarizes the eligibility criteria for the TODS Signing Program described in *Section 207-3*.

297-17  Memorial Highways and Bridges Established in ORC Chapter 5533

*Table 297-17* provides a list of memorial highways and bridges established in *ORC Chapter 5533, see Section 207-3*. 
297-18 Memorial Highways and Bridges Established by ORC Sections 5511.01 and 5511.09

Table 297-18 provides a list of memorial highways and bridges established by ORC Sections 5511.01 and 5511.09, see Section 207-3.
Intentionally blank.
Table 297-1. Sizes of Lane-Use Control Signs

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<td>R3-5R</td>
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<td>R3-6R</td>
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### Table 297-2.  Lake Erie Circle Tour Routes

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Table 297-3. Ramp Identification Code System

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<tr>
<th>Letter Code</th>
<th>Mainline Direction of Travel</th>
<th>Ramp Type*</th>
<th>Ramp Usage</th>
</tr>
</thead>
<tbody>
<tr>
<td>H</td>
<td>NB, EB</td>
<td>Diamond</td>
<td>Exit</td>
</tr>
<tr>
<td>J</td>
<td>NB, EB</td>
<td>Diamond</td>
<td>Entrance</td>
</tr>
<tr>
<td>K</td>
<td>NB, EB</td>
<td>Loop</td>
<td>Exit</td>
</tr>
<tr>
<td>L</td>
<td>NB, EB</td>
<td>Loop</td>
<td>Entrance</td>
</tr>
<tr>
<td>M</td>
<td>SB, WB</td>
<td>Diamond</td>
<td>Exit</td>
</tr>
<tr>
<td>P</td>
<td>SB, WB</td>
<td>Diamond</td>
<td>Entrance</td>
</tr>
<tr>
<td>Q</td>
<td>SB, WB</td>
<td>Loop</td>
<td>Exit</td>
</tr>
<tr>
<td>R</td>
<td>SB, WB</td>
<td>Loop</td>
<td>Entrance</td>
</tr>
<tr>
<td>T</td>
<td>NB, EB</td>
<td>Irregular</td>
<td>Exit</td>
</tr>
<tr>
<td>U</td>
<td>NB, EB</td>
<td>Irregular</td>
<td>Entrance</td>
</tr>
<tr>
<td>V</td>
<td>SB, WB</td>
<td>Irregular</td>
<td>Exit</td>
</tr>
<tr>
<td>X</td>
<td>SB, WB</td>
<td>Irregular</td>
<td>Entrance</td>
</tr>
<tr>
<td>Y</td>
<td>NB, EB</td>
<td></td>
<td>Collector - Distributor</td>
</tr>
<tr>
<td>Z</td>
<td>SB, WB</td>
<td></td>
<td>Collector - Distributor</td>
</tr>
</tbody>
</table>

* A loop ramp is defined as any ramp which replaces a left turn movement.

Mainline direction of travel refers to the straight line mileage system. NB and EB are the directions of increasing log miles.

The letters N, O, S and W are not used in ramp coding. The letters A, B, C, D, E, F, G and I are used to designate extra exit and entrance ramps in some interchange configurations.
Table 297-4. Signing for Traffic Generators on Freeways & Expressways

<table>
<thead>
<tr>
<th>Type of Generator</th>
<th>Sign Type and Background Color</th>
<th>Criteria</th>
<th>Metropolitan Area over 100,000</th>
<th>Urbanized or Metropolitan Area under 100,000</th>
<th>Rural Area</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Airport*, Ferry, Heliport, Bus Station, Train Station</td>
<td>Supplemental Guide Sign – green</td>
<td>Type</td>
<td></td>
<td></td>
<td></td>
<td>* Maximum distance from interchange may be extended to 15 miles for each category for commercial airports.</td>
</tr>
<tr>
<td>College, University, Post High School Educational Institute</td>
<td>Supplemental Guide Sign – green</td>
<td>Curriculum</td>
<td>Must be duly accredited. Must offer at least two years instruction and offer at least an Associate Degree.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Joint Vocational School</td>
<td>Supplemental Guide Sign – green</td>
<td>Annual adult enrollment</td>
<td>11,000</td>
<td>8,000</td>
<td>5,000</td>
<td>Total adult attendance for all courses in a year</td>
</tr>
<tr>
<td>Boarding School</td>
<td>Supplemental Guide Sign – green</td>
<td>Curriculum/residency</td>
<td>Must provide a traditional academic curriculum and have a substantial portion of their student enrollment comprised of individuals whose permanent residence is not considered to be local to the community in which the school is situated. This includes college preparatory schools and military academies.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Major Military Installation</td>
<td>Supplemental Guide Sign – green</td>
<td>Number of employees or permanently assigned personnel</td>
<td>5,000</td>
<td>5,000</td>
<td>5,000</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Maximum distance from interchange</td>
<td>3 miles</td>
<td>4 miles</td>
<td>5 miles</td>
<td></td>
</tr>
</tbody>
</table>
Table 297-4. Signing for Traffic Generators on Freeways & Expressways (continued)

<table>
<thead>
<tr>
<th>Type of Generator</th>
<th>Sign Type and Background Color</th>
<th>Criteria</th>
<th>Metropolitan Area over 100,000</th>
<th>Urbanized or Metropolitan Area under 100,000</th>
<th>Rural Area</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amusement Park, Arena, Auditorium, Convention Hall, Dam, Historical Site, Museum, Stadium, Zoo</td>
<td>Supplemental Guide Sign – brown</td>
<td>Annual attendance</td>
<td>200,000 plus 20,000 per mile of distance from interchange</td>
<td>100,000 plus 10,000 per mile of distance from interchange</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Maximum distance from interchange</td>
<td>10 miles</td>
<td>10 miles</td>
<td>10 miles</td>
<td></td>
</tr>
<tr>
<td>Recreation Area</td>
<td>Supplemental Guide Sign – brown</td>
<td>Annual attendance</td>
<td>200,000 plus 20,000 per mile of distance from interchange</td>
<td>100,000 plus 10,000 per mile of distance from interchange</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Maximum distance from interchange</td>
<td>10 miles</td>
<td>10 miles</td>
<td>15 miles</td>
<td></td>
</tr>
<tr>
<td>Fairground, Racetrack, Casino</td>
<td>Supplemental Guide Sign – brown</td>
<td>Annual attendance for permanent signs</td>
<td>200,000</td>
<td>200,000</td>
<td>200,000</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Event attendance for temporary signs</td>
<td>20,000 plus 2,000 per mile of distance from interchange</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Maximum distance from interchange</td>
<td>10 miles</td>
<td>10 miles</td>
<td>15 miles</td>
<td></td>
</tr>
<tr>
<td>Law Enforcement Agency (State, County, Muni. Police)</td>
<td>D12-H16 blue</td>
<td>Maximum distance from interchange</td>
<td>1 mile</td>
<td>1 mile</td>
<td>2 miles</td>
<td></td>
</tr>
<tr>
<td>Toll Highway, Toll Bridge</td>
<td>Supplemental Guide Sign – green</td>
<td>Location</td>
<td>Direct access from exit and a part of the state highway system.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Central Business District (downtown)</td>
<td>Supplemental Guide Sign – green</td>
<td>Population</td>
<td>City of 300,000 or more population and no direct access to the downtown area.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Table 297-5. Control City Destinations for Ohio's Interstate System

<table>
<thead>
<tr>
<th>Interstate Route</th>
<th>Control City</th>
</tr>
</thead>
<tbody>
<tr>
<td>I-70</td>
<td>Indianapolis - Dayton - Columbus - Wheeling</td>
</tr>
<tr>
<td>I-71</td>
<td>Louisville - Cincinnati - Columbus - Cleveland</td>
</tr>
<tr>
<td>I-74</td>
<td>Indianapolis - Cincinnati</td>
</tr>
<tr>
<td>I-75</td>
<td>Lexington - Cincinnati - Dayton - Toledo - Detroit</td>
</tr>
<tr>
<td>I-76</td>
<td>Akron - Youngstown - Pittsburgh</td>
</tr>
<tr>
<td>I-77 NB</td>
<td>Charleston - Marietta - Cleveland</td>
</tr>
<tr>
<td>I-77 SB</td>
<td>Cleveland - Akron - Canton - Marietta - Charleston</td>
</tr>
<tr>
<td>I-80</td>
<td>Chicago - Toledo - Youngstown - New York City</td>
</tr>
<tr>
<td>I-90</td>
<td>Chicago - Toledo - Cleveland - Erie</td>
</tr>
</tbody>
</table>

### Table 297-6. Sign Copy

<table>
<thead>
<tr>
<th>Direct Applied</th>
<th>Material</th>
<th>Attachment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reflective copy and shields* on overhead Guide Signs</td>
<td>Type H or J reflective sheeting</td>
<td>Adhesive backing</td>
</tr>
<tr>
<td>Reflective copy and shields* on ground-mounted Guide Signs</td>
<td>Type G, H or J reflective sheeting</td>
<td>Adhesive backing</td>
</tr>
<tr>
<td>Nonreflective copy</td>
<td>Nonreflective black sheeting</td>
<td>Adhesive backing</td>
</tr>
</tbody>
</table>

* Interstate, U.S., State, County, Township, Ohio Turnpike, Hazardous Cargo
Table 297-7. Types of Overhead Sign Supports

<table>
<thead>
<tr>
<th>Support Type</th>
<th>Allowable Sign Area, Sq. Ft.</th>
<th>Span or Arm Length, Ft.</th>
<th>Configuration</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>TC-17.10 Span Wire</td>
<td>10 to 132</td>
<td>20 to 90</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TC-16.20 Single Arm</td>
<td>23 to 45</td>
<td></td>
<td>Arm 23 to 45</td>
<td></td>
</tr>
<tr>
<td>TC-12.30 Cantilever</td>
<td>Up to 300 (Depending on Arm Length)</td>
<td>Arm 16 to 30</td>
<td></td>
<td>Alternate Version - Made of Untapered Tubes.</td>
</tr>
<tr>
<td>TC-9.10 Semi-Overhead</td>
<td>Up to 150</td>
<td></td>
<td></td>
<td>Sign may be eccentric to pole.</td>
</tr>
<tr>
<td>TC-9.30 Center Mount</td>
<td>Up to 250</td>
<td></td>
<td></td>
<td>Sign may be eccentric to pole.</td>
</tr>
<tr>
<td>Support Type</td>
<td>Allowable Sign Area, Sq. Ft.</td>
<td>Span or Arm Length, Ft.</td>
<td>Configuration</td>
<td>Notes</td>
</tr>
<tr>
<td>------------------------------------</td>
<td>-----------------------------</td>
<td>-------------------------</td>
<td>---------------</td>
<td>------------------------------------------------------------------------</td>
</tr>
</tbody>
</table>
| TC-7.65 Aluminum Truss (Steel End Frames) | Design 6 Up to 600; Design 8 Up to 650 | Design 6 40 to 75; Design 8 40 to 120 |                           | Design 6 ~ 3' sq. box
Design 8 ~ 5' box                                                        |
| TC-15.115 Steel Truss (Steel End Frames) | Up to 1150                   | 40 to 150                |                           | 5' square box                                                          |
| Combination Sign Support            | According to Sign Support    | According to Sign Support |                           | May be used to add a highway lighting function to 16.20, 12.30, 9.10 and 9.30 |
| TC-18.24 Structure Mounted          |                             |                         |                           | Flush Mounting. Aluminum Brackets                                     |
| TC-18.26 Skewed Structure           |                             |                         |                           | Aluminum Structure                                                     |
Table 297-8a. Weight of Overhead Supports – Truss

<table>
<thead>
<tr>
<th>Sign Support Type</th>
<th>Span, Ft.</th>
<th>Wt./Ft.</th>
<th>Total Wt. of Truss, lbs.</th>
<th>Configuration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Truss – end frames weigh from 1400 to 1800 pounds each.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7.2</td>
<td>Des. 1</td>
<td>70</td>
<td>15.4</td>
<td>1150</td>
</tr>
<tr>
<td></td>
<td>Des. 2</td>
<td>85</td>
<td>16.2</td>
<td>1375</td>
</tr>
<tr>
<td></td>
<td>Des. 3</td>
<td>105</td>
<td>21.4</td>
<td>2250</td>
</tr>
<tr>
<td>7.3</td>
<td>Des. 1</td>
<td>55</td>
<td>16.8</td>
<td>925</td>
</tr>
<tr>
<td></td>
<td>Des. 2</td>
<td>80</td>
<td>21.3</td>
<td>1700</td>
</tr>
<tr>
<td></td>
<td>Des. 3</td>
<td>90</td>
<td>21.1</td>
<td>1900</td>
</tr>
<tr>
<td></td>
<td>Des. 4</td>
<td>105</td>
<td>21.4</td>
<td>2250</td>
</tr>
<tr>
<td>7.4</td>
<td>Des. 1</td>
<td>75</td>
<td>21.3</td>
<td>1600</td>
</tr>
<tr>
<td></td>
<td>Des. 2</td>
<td>85</td>
<td>21.2</td>
<td>1800</td>
</tr>
<tr>
<td></td>
<td>Des. 3</td>
<td>90</td>
<td>32.5</td>
<td>2925</td>
</tr>
<tr>
<td></td>
<td>Des. 4</td>
<td>110</td>
<td>32.7</td>
<td>3600</td>
</tr>
<tr>
<td>7.5</td>
<td>Des. 1</td>
<td>70</td>
<td>21.4</td>
<td>1500</td>
</tr>
<tr>
<td></td>
<td>Des. 2</td>
<td>80</td>
<td>21.3</td>
<td>1700</td>
</tr>
<tr>
<td></td>
<td>Des. 3</td>
<td>86</td>
<td>32.6</td>
<td>2800</td>
</tr>
<tr>
<td></td>
<td>Des. 4</td>
<td>110</td>
<td>32.7</td>
<td>3600</td>
</tr>
<tr>
<td>7.6</td>
<td>Des. 1</td>
<td>65</td>
<td>21.5</td>
<td>1400</td>
</tr>
<tr>
<td></td>
<td>Des. 2</td>
<td>75</td>
<td>21.3</td>
<td>1600</td>
</tr>
<tr>
<td></td>
<td>Des. 3</td>
<td>80</td>
<td>31.1</td>
<td>2650</td>
</tr>
<tr>
<td></td>
<td>Des. 4</td>
<td>110</td>
<td>32.7</td>
<td>3600</td>
</tr>
<tr>
<td>Sign Support Type</td>
<td>Span, Ft.</td>
<td>Wt./Ft.</td>
<td>Total Wt. of Truss, lbs.</td>
<td>Configuration</td>
</tr>
<tr>
<td>-------------------</td>
<td>----------</td>
<td>---------</td>
<td>-------------------------</td>
<td>---------------</td>
</tr>
<tr>
<td>TC-7.65</td>
<td>Des. 6</td>
<td>55</td>
<td>21.8</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1200</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Des. 6</td>
<td>75</td>
<td>22.7</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1700</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Des. 8</td>
<td>75</td>
<td>29.0</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2175</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Des. 8</td>
<td>120</td>
<td>30.0</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>3600</td>
<td></td>
</tr>
<tr>
<td>Steel Truss – end frames weigh from 1600 to 2000 pounds each.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15.8</td>
<td></td>
<td>100</td>
<td>87.0</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>8700</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>140</td>
<td>87.2</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>12200</td>
<td></td>
</tr>
<tr>
<td>TC-15.115</td>
<td>100</td>
<td>85</td>
<td>8500</td>
<td></td>
</tr>
<tr>
<td></td>
<td>140</td>
<td>84.3</td>
<td>11800</td>
<td></td>
</tr>
<tr>
<td>Span Truss – each pole weighs 775 pounds.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13.2</td>
<td>Des. 1</td>
<td>50</td>
<td>1275</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Des. 2</td>
<td>60</td>
<td>1500</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Des. 3</td>
<td>70</td>
<td>1800</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Des. 4</td>
<td>80</td>
<td>2150</td>
<td></td>
</tr>
<tr>
<td>Flat Truss – each pole weighs 1550 pounds.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14.5</td>
<td>Des. 1</td>
<td>50</td>
<td>2250</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Des. 2</td>
<td>60</td>
<td>2700</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Des. 3</td>
<td>70</td>
<td>3200</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Des. 4</td>
<td>80</td>
<td>2600</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Des. 5</td>
<td>90</td>
<td>4050</td>
<td></td>
</tr>
</tbody>
</table>
Table 297-8b. Weight of Overhead Supports - Semi-Overhead & Center Mount

<table>
<thead>
<tr>
<th>Sign Support Type</th>
<th>Total Wt. of Support, lbs.</th>
<th>Configuration</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Semi-Overhead</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TC-9.10</td>
<td>Des. 1 650</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Des. 2 900</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Des. 3 1300</td>
<td></td>
</tr>
<tr>
<td><strong>Center Mount</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9.12</td>
<td>Des. 1 800</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Des. 2 1100</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Des. 3 1300</td>
<td></td>
</tr>
<tr>
<td>9.24</td>
<td>Des. 1 1350</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Des. 2 1550</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Des. 3 1775</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Des. 4 2300</td>
<td></td>
</tr>
<tr>
<td>TC-9.30</td>
<td>Des. 1 975</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Des. 2 1525</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Des. 3 2350</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Des. 4 4200</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Des. 5 4500</td>
<td></td>
</tr>
</tbody>
</table>
Table 297-8c. Weight of Overhead Supports - Butterfly

<table>
<thead>
<tr>
<th>Sign Support Type</th>
<th>Total Wt. of One Set of Arms, lbs.</th>
<th>Total Wt. of Two Sets of Arms, lbs.</th>
<th>Configuration</th>
</tr>
</thead>
<tbody>
<tr>
<td>10.48</td>
<td>Des. 1 1825</td>
<td>2150</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Des. 2 1975</td>
<td>2500</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Des. 3 2325</td>
<td>2800</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Des. 4 2450</td>
<td>3000</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Des. 5 3925</td>
<td>5000</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Des. 6 3650</td>
<td>4400</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Des. 7 4125</td>
<td>5400</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Des. 8 5050</td>
<td>6700</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Des. 9 5750</td>
<td>8000</td>
<td></td>
</tr>
</tbody>
</table>
Table 297-8d.  Weight of Overhead Supports - Single Arm

<table>
<thead>
<tr>
<th>Sign Support Type</th>
<th>Arm Length, Ft.</th>
<th>Total Wt. of Support, lbs.</th>
<th>Configuration</th>
</tr>
</thead>
<tbody>
<tr>
<td>16.10</td>
<td>Des. 1</td>
<td>38</td>
<td>2000</td>
</tr>
<tr>
<td></td>
<td>Des. 2</td>
<td>28</td>
<td>925</td>
</tr>
<tr>
<td></td>
<td>Des. 3</td>
<td>36</td>
<td>2350</td>
</tr>
<tr>
<td></td>
<td>Des. 4</td>
<td>42</td>
<td>2500</td>
</tr>
<tr>
<td></td>
<td>Des. 5</td>
<td>38</td>
<td>2050</td>
</tr>
<tr>
<td></td>
<td>Des. 6</td>
<td>28</td>
<td>1250</td>
</tr>
<tr>
<td></td>
<td>Des. 7</td>
<td>28</td>
<td>1800</td>
</tr>
<tr>
<td>TC-16,20</td>
<td>Des. 1</td>
<td>23</td>
<td>800</td>
</tr>
<tr>
<td></td>
<td>Des. 2</td>
<td>31</td>
<td>1000</td>
</tr>
<tr>
<td></td>
<td>Des. 3</td>
<td>35</td>
<td>1200</td>
</tr>
<tr>
<td></td>
<td>Des. 4</td>
<td>43</td>
<td>1900</td>
</tr>
<tr>
<td></td>
<td>Des. 5</td>
<td>24</td>
<td>1150</td>
</tr>
<tr>
<td></td>
<td>Des. 6</td>
<td>27</td>
<td>1200</td>
</tr>
<tr>
<td></td>
<td>Des. 7</td>
<td>30</td>
<td>1250</td>
</tr>
<tr>
<td></td>
<td>Des. 8</td>
<td>33</td>
<td>1350</td>
</tr>
<tr>
<td></td>
<td>Des. 9</td>
<td>36</td>
<td>1800</td>
</tr>
<tr>
<td></td>
<td>Des. 10</td>
<td>39</td>
<td>2000</td>
</tr>
<tr>
<td></td>
<td>Des. 11</td>
<td>42</td>
<td>2050</td>
</tr>
<tr>
<td></td>
<td>Des. 12</td>
<td>45</td>
<td>2300</td>
</tr>
<tr>
<td>Sign Support Type</td>
<td>Total Wt. of Support, lbs.</td>
<td>Configuration</td>
<td></td>
</tr>
<tr>
<td>-------------------</td>
<td>---------------------------</td>
<td>---------------</td>
<td></td>
</tr>
<tr>
<td>12.24</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Des. 1</td>
<td>1300</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Des. 2</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Des. 3</td>
<td>1750</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Des. 4</td>
<td>2100</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Des. 5</td>
<td>3300</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Des. 6</td>
<td>3650</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Des. 7</td>
<td>4000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Des. 8</td>
<td>5500</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12.30</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Des. 1</td>
<td>1825</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Des. 2</td>
<td>2450</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Des. 3</td>
<td>2125</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Des. 4</td>
<td>2875</td>
<td></td>
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</tr>
<tr>
<td>Des. 5</td>
<td>3300</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Des. 6</td>
<td>4000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Des. 7</td>
<td>4350</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Des. 8</td>
<td>4650</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Des. 9</td>
<td>5275</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Des. 10</td>
<td>7000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Des. 11</td>
<td>6600</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Des. 12</td>
<td>8400</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Table 297-8f. Weight of Overhead Supports - Structure Mounted

<table>
<thead>
<tr>
<th>Sign Support Type</th>
<th>Total Wt. of Support, lbs.</th>
<th>Configuration</th>
</tr>
</thead>
<tbody>
<tr>
<td>TC-18.24</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Almost all the weight is</td>
<td></td>
</tr>
<tr>
<td></td>
<td>involved in the sign;</td>
<td></td>
</tr>
<tr>
<td></td>
<td>approximately 400 lbs.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>for a support with 10 x 10</td>
<td></td>
</tr>
<tr>
<td></td>
<td>foot extrusheet sign,</td>
<td></td>
</tr>
<tr>
<td></td>
<td>including lights.</td>
<td></td>
</tr>
<tr>
<td>TC-18.26</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Des. 1</td>
<td>150</td>
<td></td>
</tr>
<tr>
<td>Des. 2</td>
<td>200</td>
<td></td>
</tr>
<tr>
<td>Des. 3</td>
<td>325</td>
<td></td>
</tr>
<tr>
<td>Des. 4</td>
<td>600</td>
<td></td>
</tr>
<tr>
<td>Des. 5</td>
<td>175</td>
<td></td>
</tr>
<tr>
<td>Des. 6</td>
<td>225</td>
<td></td>
</tr>
<tr>
<td>Des. 7</td>
<td>400</td>
<td></td>
</tr>
<tr>
<td>Des. 8</td>
<td>175</td>
<td></td>
</tr>
<tr>
<td>Des. 9</td>
<td>300</td>
<td></td>
</tr>
<tr>
<td>Des. 10</td>
<td>325</td>
<td></td>
</tr>
</tbody>
</table>
### Table 297-9. Bolt Size and Maximum Torque for Beams

<table>
<thead>
<tr>
<th>Beam Type</th>
<th>Size</th>
<th>Bolt Size</th>
<th>Maximum Torque</th>
</tr>
</thead>
<tbody>
<tr>
<td>S4 x 7.7</td>
<td>4 x 2 5/8</td>
<td>1/2</td>
<td>200</td>
</tr>
<tr>
<td>W6 x 9</td>
<td>5 7/8 x 4</td>
<td>1/2</td>
<td>200</td>
</tr>
<tr>
<td>W10 x 12</td>
<td>9 7/8 x 4</td>
<td>3/4</td>
<td>750</td>
</tr>
<tr>
<td>W8 x 18</td>
<td>8 1/8 x 5 1/4</td>
<td>3/4</td>
<td>750</td>
</tr>
<tr>
<td>W10 x 22</td>
<td>10 1/8 x 5 3/4</td>
<td>1</td>
<td>1325</td>
</tr>
<tr>
<td>W12 x 30</td>
<td>12 3/8 x 6 1/2</td>
<td>1</td>
<td>1325</td>
</tr>
</tbody>
</table>

### Table 297-10. Bolt Tension

<table>
<thead>
<tr>
<th>Bolt Size</th>
<th>80% Proof Load</th>
<th>Proof Load</th>
</tr>
</thead>
<tbody>
<tr>
<td>inches</td>
<td>lbs.</td>
<td>lbs.</td>
</tr>
<tr>
<td>1/2</td>
<td>9,700</td>
<td>12,100</td>
</tr>
<tr>
<td>5/8</td>
<td>15,400</td>
<td>19,200</td>
</tr>
<tr>
<td>3/4</td>
<td>21,900</td>
<td>28,400</td>
</tr>
<tr>
<td>7/8</td>
<td>31,400</td>
<td>39,300</td>
</tr>
<tr>
<td>1</td>
<td>41,200</td>
<td>51,500</td>
</tr>
<tr>
<td>1 1/8</td>
<td>45,200</td>
<td>56,500</td>
</tr>
<tr>
<td>1 1/4</td>
<td>57,400</td>
<td>71,700</td>
</tr>
<tr>
<td>1 3/8</td>
<td>68,400</td>
<td>85,500</td>
</tr>
<tr>
<td>1 1/2</td>
<td>83,100</td>
<td>104,000</td>
</tr>
</tbody>
</table>

### Table 297-11. Sign Lighting Lamps and Ballast

<table>
<thead>
<tr>
<th>Lamp Watts</th>
<th>ANSI Lamp Code</th>
<th>Ballast Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
<td>H38HT - 100</td>
<td>CMRI-100-(a)</td>
</tr>
<tr>
<td>175</td>
<td>H39KB - 175</td>
<td>CMRI-175-(a)</td>
</tr>
<tr>
<td>250</td>
<td>H37KB - 250</td>
<td>CMRI-250-(a)</td>
</tr>
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</table>

Where (a) = Operating Voltage
Table 297-12. Guide Sign Sizes - English

<table>
<thead>
<tr>
<th>Sign Code</th>
<th>Sign</th>
<th>Comments</th>
<th>Sign Size in Inches (width x height)</th>
</tr>
</thead>
<tbody>
<tr>
<td>M1-1</td>
<td>Turnpike</td>
<td>24 x 24</td>
<td>(1,120)</td>
</tr>
<tr>
<td>M1-2</td>
<td>Loop</td>
<td>24 x 24</td>
<td>(1,120)</td>
</tr>
<tr>
<td>M1-3</td>
<td>Interstate</td>
<td>24 x 24</td>
<td>(1,120)</td>
</tr>
<tr>
<td>M1-4</td>
<td>Interstate</td>
<td>24 x 24</td>
<td>(1,120)</td>
</tr>
<tr>
<td>M1-5</td>
<td>Spur (US, State)</td>
<td>24 x 24</td>
<td>(1,120)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>JCT</th>
<th>Auxiliary</th>
<th>21 x 15</th>
<th>(960)</th>
<th>30 x 24</th>
</tr>
</thead>
<tbody>
<tr>
<td>M2-1</td>
<td>Combination</td>
<td>21 x 15</td>
<td>(960)</td>
<td>30 x 24</td>
</tr>
<tr>
<td>M2-2a</td>
<td>Route</td>
<td>21 x 15</td>
<td>(960)</td>
<td>30 x 24</td>
</tr>
<tr>
<td>M2-3</td>
<td>Combination</td>
<td>21 x 15</td>
<td>(960)</td>
<td>30 x 24</td>
</tr>
<tr>
<td>M2-4</td>
<td>Directional</td>
<td>21 x 15</td>
<td>(960)</td>
<td>30 x 24</td>
</tr>
<tr>
<td>M2-5</td>
<td>Combination</td>
<td>21 x 15</td>
<td>(960)</td>
<td>30 x 24</td>
</tr>
<tr>
<td>M2-6</td>
<td>Route</td>
<td>21 x 15</td>
<td>(960)</td>
<td>30 x 24</td>
</tr>
<tr>
<td>M2-7</td>
<td>Multi-directional</td>
<td>21 x 15</td>
<td>(960)</td>
<td>30 x 24</td>
</tr>
<tr>
<td>Sign Combination</td>
<td>Route Multi-Directional</td>
<td>Sign Code</td>
<td>Comments</td>
<td></td>
</tr>
<tr>
<td>------------------</td>
<td>-------------------------</td>
<td>-----------</td>
<td>----------</td>
<td></td>
</tr>
<tr>
<td>Wind Message</td>
<td>M3-2</td>
<td>M4-1</td>
<td>108 x 48</td>
<td></td>
</tr>
<tr>
<td>Auxiliary (except CT)</td>
<td>M3-3</td>
<td>M4-1a</td>
<td>24 x 12</td>
<td></td>
</tr>
<tr>
<td>Advance Turn and Directional Arrow Auxiliary</td>
<td>M3-4</td>
<td>M4-2</td>
<td>21 x 15</td>
<td></td>
</tr>
<tr>
<td>Destination (to dest)</td>
<td>M3-5</td>
<td>M4-3</td>
<td>21 x 15</td>
<td></td>
</tr>
<tr>
<td></td>
<td>M3-6</td>
<td>M4-4</td>
<td>21 x 15</td>
<td></td>
</tr>
<tr>
<td></td>
<td>M3-7</td>
<td>M4-5</td>
<td>21 x 15</td>
<td></td>
</tr>
<tr>
<td></td>
<td>M3-8</td>
<td>M4-6</td>
<td>21 x 15</td>
<td></td>
</tr>
<tr>
<td></td>
<td>M3-9</td>
<td>M4-7</td>
<td>21 x 15</td>
<td></td>
</tr>
<tr>
<td></td>
<td>M4-1</td>
<td>M5-1</td>
<td>108 x 48</td>
<td></td>
</tr>
<tr>
<td></td>
<td>M4-2</td>
<td>M5-2</td>
<td>24 x 12</td>
<td></td>
</tr>
<tr>
<td></td>
<td>M4-3</td>
<td>M5-3</td>
<td>24 x 12</td>
<td></td>
</tr>
<tr>
<td></td>
<td>M4-4</td>
<td>M5-4</td>
<td>24 x 12</td>
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<tr>
<td></td>
<td>M4-5</td>
<td>M5-5</td>
<td>24 x 12</td>
<td></td>
</tr>
<tr>
<td></td>
<td>M4-6</td>
<td>M5-6</td>
<td>24 x 12</td>
<td></td>
</tr>
<tr>
<td></td>
<td>M4-7</td>
<td>M5-7</td>
<td>24 x 12</td>
<td></td>
</tr>
<tr>
<td></td>
<td>M5-1</td>
<td>M6-1</td>
<td>108 x 48</td>
<td></td>
</tr>
<tr>
<td></td>
<td>M5-2</td>
<td>M6-2</td>
<td>24 x 12</td>
<td></td>
</tr>
<tr>
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<td>M5-3</td>
<td>M6-3</td>
<td>24 x 12</td>
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</tr>
<tr>
<td></td>
<td>M5-4</td>
<td>M6-4</td>
<td>24 x 12</td>
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<td>M6-5</td>
<td>24 x 12</td>
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<td>M5-6</td>
<td>M6-6</td>
<td>24 x 12</td>
<td></td>
</tr>
<tr>
<td></td>
<td>M5-7</td>
<td>M6-7</td>
<td>24 x 12</td>
<td></td>
</tr>
<tr>
<td></td>
<td>D1-H1</td>
<td>D1-H1a</td>
<td>72 x 12</td>
<td></td>
</tr>
<tr>
<td></td>
<td>D1-H2</td>
<td>D1-H2</td>
<td>72 x 12</td>
<td></td>
</tr>
<tr>
<td></td>
<td>D1-H3</td>
<td>D1-H3</td>
<td>72 x 12</td>
<td></td>
</tr>
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<td>D1-H4</td>
<td>D1-H4</td>
<td>72 x 12</td>
<td></td>
</tr>
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<td>D1-H5</td>
<td>D1-H5</td>
<td>72 x 12</td>
<td></td>
</tr>
<tr>
<td></td>
<td>D1-H6</td>
<td>D1-H6</td>
<td>72 x 12</td>
<td></td>
</tr>
<tr>
<td></td>
<td>D1-H7</td>
<td>D1-H7</td>
<td>72 x 12</td>
<td></td>
</tr>
</tbody>
</table>

Table 297-12. Guide Sign Sizes - English (Continued)
Table 297-12. Guide Sign Sizes - English (Continued)

<table>
<thead>
<tr>
<th>Sign Code</th>
<th>Sign Size (width x height)</th>
<th>Sign Size in inches (width x height)</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>D3-H1.5</td>
<td>-</td>
<td>- var x 36</td>
<td></td>
</tr>
<tr>
<td>D3-H1.6</td>
<td>-</td>
<td>- var x 48</td>
<td></td>
</tr>
<tr>
<td>D3-H1.7a</td>
<td>-</td>
<td>- var x 72</td>
<td></td>
</tr>
<tr>
<td>D3-H2</td>
<td>-</td>
<td>- var x 72</td>
<td></td>
</tr>
<tr>
<td>D3-H3</td>
<td>-</td>
<td>- var x 108</td>
<td></td>
</tr>
<tr>
<td>D3-H4</td>
<td>-</td>
<td>- var x 24</td>
<td></td>
</tr>
<tr>
<td>D3-H4a</td>
<td>-</td>
<td>- var x 72</td>
<td></td>
</tr>
<tr>
<td>D3-H4b</td>
<td>-</td>
<td>- var x 72</td>
<td></td>
</tr>
<tr>
<td>D3-H4c</td>
<td>-</td>
<td>- var x 72</td>
<td></td>
</tr>
<tr>
<td>D3-H5</td>
<td>-</td>
<td>- var x 72</td>
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</tr>
<tr>
<td>D3-H5a</td>
<td>-</td>
<td>- var x 72</td>
<td></td>
</tr>
<tr>
<td>D3-H5b</td>
<td>-</td>
<td>- var x 72</td>
<td></td>
</tr>
<tr>
<td>D3-H5c</td>
<td>-</td>
<td>- var x 72</td>
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</tr>
</tbody>
</table>

These signs may be used as alternatives to the D3-H1 and D3-H1b signs at the intersection.
Table 297-12. Guide Sign Sizes - English (Continued)

<table>
<thead>
<tr>
<th>Sign Code</th>
<th>Sign Description</th>
<th>Width (inches)</th>
<th>Height (inches)</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>D5-H1</td>
<td>REST AREA</td>
<td>72 x 36</td>
<td>120 x 60</td>
<td>Refer to Figures 298-39, 298-40 and 298-41</td>
</tr>
<tr>
<td>D5-H2</td>
<td>REST AREA (with angled arrow)</td>
<td>72 x 36</td>
<td>120 x 60</td>
<td>Refer to Figure 298-39</td>
</tr>
<tr>
<td>D5-H2a</td>
<td>REST AREA (with angled arrow)</td>
<td>72 x 36</td>
<td>72 x 72</td>
<td>Refer to Figure 298-39</td>
</tr>
<tr>
<td>D5-H5</td>
<td>REST AREA (with horizontal arrow)</td>
<td>42 x 48</td>
<td>42 x 48</td>
<td>Refer to Figure 298-39</td>
</tr>
<tr>
<td>D5-H7</td>
<td>TOURIST INFO CENTER</td>
<td>108 x 48</td>
<td>144 x 72</td>
<td>Alternate legend: OHIO WELCOME CENTER</td>
</tr>
<tr>
<td>D5-H7a</td>
<td>TOURIST INFO CENTER</td>
<td>108 x 48</td>
<td>108 x 24</td>
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<tr>
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Table 297-12. Guide Sign Sizes - English (Continued)

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<th>Sign Description</th>
<th>Comments</th>
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<tbody>
<tr>
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<td>City limits and</td>
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<tr>
<td></td>
<td>urban area</td>
<td></td>
</tr>
<tr>
<td>DS-H8</td>
<td>Town limit</td>
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<tr>
<td>DS-H9-P</td>
<td>State line</td>
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</tr>
<tr>
<td>DS-H1-P</td>
<td>River or lake</td>
<td></td>
</tr>
<tr>
<td>DS-H1-P</td>
<td>City limit</td>
<td></td>
</tr>
<tr>
<td>DS-H5-P</td>
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</tr>
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<td>County line</td>
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<td>Town limit</td>
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<td>Other location</td>
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<td>Expressway</td>
<td></td>
</tr>
<tr>
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<td>Interstate</td>
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<td>Local road</td>
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<tr>
<td>DS-H5-P</td>
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</tr>
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</tr>
<tr>
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<td>Pipeline</td>
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<td>Pipeline</td>
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<tr>
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<td>DS-H5-P</td>
<td>Pipeline</td>
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<td>DS-H5-P</td>
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<tr>
<td>DS-H5-P</td>
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<td>DS-H5-P</td>
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<td>DS-H5-P</td>
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<td>DS-H5-P</td>
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<td>DS-H5-P</td>
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<td>DS-H5-P</td>
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<td>DS-H5-P</td>
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<td>DS-H5-P</td>
<td>Railroad</td>
<td></td>
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<tr>
<td>DS-H5-P</td>
<td>Pipeline</td>
<td></td>
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<tr>
<td>DS-H5-P</td>
<td>Airport</td>
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<td>DS-H5-P</td>
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### Table 297-12. Guide Sign Sizes - English (Continued)

<table>
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<th>Sign Code</th>
<th>Sign Type</th>
<th>Size (Width x Height)</th>
<th>Comments</th>
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<tbody>
<tr>
<td>D7H3a</td>
<td>Entering Region</td>
<td>48 x 8</td>
<td>var x 60</td>
</tr>
<tr>
<td>D7H41a</td>
<td>Recreational Destination</td>
<td>72 x 12 (1 line)</td>
<td>var x 24</td>
</tr>
<tr>
<td>D7H41a</td>
<td>Recreational Destination</td>
<td>48 x 16 (2 lines)</td>
<td>var x 24</td>
</tr>
<tr>
<td>D7H41a</td>
<td>Recreational Destination</td>
<td>96 x 24 (2 lines)</td>
<td>var x 24</td>
</tr>
<tr>
<td>D7H41a</td>
<td>Recreational Destination</td>
<td>96 x 36 (2 lines)</td>
<td>var x 48</td>
</tr>
<tr>
<td>D7H41a</td>
<td>Recreational Destination</td>
<td>96 x 72 (2 lines)</td>
<td>var x 72</td>
</tr>
<tr>
<td>D7H41a</td>
<td>Recreational Destination</td>
<td>96 x 108 (2 lines)</td>
<td>var x 108</td>
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</table>

For signs 120 inches wide and greater, use the 120 x 120 size. For narrower signs, use the 84 x 12 size.
Table 297-12. Guide Sign Sizes - English (Continued)

<table>
<thead>
<tr>
<th>Sign Code</th>
<th>Sign Size in Inches (Width x Height)</th>
<th>Comments</th>
<th>Sign SIZE</th>
<th>Width</th>
<th>Height</th>
<th>var</th>
<th>36</th>
<th>24</th>
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<tbody>
<tr>
<td>Welcome to Ohio</td>
<td>Urban Single Lane Conv. Road (35 mph or less)</td>
<td>var 36</td>
<td>48x24</td>
<td>24x18</td>
<td>60x30</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corporation LIMIT</td>
<td>Urban Single Lane Conv. Road (35 mph or less)</td>
<td>var 36</td>
<td>48x24</td>
<td>24x18</td>
<td>60x30</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ENTER CORP</td>
<td>Urban Single Lane Conv. Road (35 mph or less)</td>
<td>var 36</td>
<td>48x24</td>
<td>24x18</td>
<td>60x30</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LEAVE CORP</td>
<td>Urban Single Lane Conv. Road (35 mph or less)</td>
<td>var 36</td>
<td>48x24</td>
<td>24x18</td>
<td>60x30</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unincorporated Community LIMIT</td>
<td>Urban Single Lane Conv. Road (35 mph or less)</td>
<td>var 36</td>
<td>48x24</td>
<td>24x18</td>
<td>60x30</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ENTER (county)</td>
<td>Urban Single Lane Conv. Road (35 mph or less)</td>
<td>var 36</td>
<td>48x24</td>
<td>24x18</td>
<td>60x30</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LEAVE (county)</td>
<td>Urban Single Lane Conv. Road (35 mph or less)</td>
<td>var 36</td>
<td>48x24</td>
<td>24x18</td>
<td>60x30</td>
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<td></td>
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</tr>
<tr>
<td>ENTERING</td>
<td>Urban Single Lane Conv. Road (35 mph or less)</td>
<td>var 36</td>
<td>48x24</td>
<td>24x18</td>
<td>60x30</td>
<td></td>
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<td></td>
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<tr>
<td>Geographical Feature</td>
<td>Urban Single Lane Conv. Road (35 mph or less)</td>
<td>var 36</td>
<td>48x24</td>
<td>24x18</td>
<td>60x30</td>
<td></td>
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</tr>
<tr>
<td>(e.g. Stream Name)</td>
<td>Urban Single Lane Conv. Road (35 mph or less)</td>
<td>var 36</td>
<td>48x24</td>
<td>24x18</td>
<td>60x30</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Airport Name</td>
<td>Urban Single Lane Conv. Road (35 mph or less)</td>
<td>var 36</td>
<td>48x24</td>
<td>24x18</td>
<td>60x30</td>
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<td></td>
<td></td>
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<tr>
<td>Exit (number)</td>
<td>Urban Single Lane Conv. Road (35 mph or less)</td>
<td>var 36</td>
<td>48x24</td>
<td>24x18</td>
<td>60x30</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EXIT</td>
<td>Urban Single Lane Conv. Road (35 mph or less)</td>
<td>var 36</td>
<td>48x24</td>
<td>24x18</td>
<td>60x30</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EXIT</td>
<td>Urban Single Lane Conv. Road (35 mph or less)</td>
<td>var 36</td>
<td>48x24</td>
<td>24x18</td>
<td>60x30</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EXIT</td>
<td>Urban Single Lane Conv. Road (35 mph or less)</td>
<td>var 36</td>
<td>48x24</td>
<td>24x18</td>
<td>60x30</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EXIT</td>
<td>Urban Single Lane Conv. Road (35 mph or less)</td>
<td>var 36</td>
<td>48x24</td>
<td>24x18</td>
<td>60x30</td>
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</table>
Table 297-12. Guide Sign Sizes - English (Continued)

<table>
<thead>
<tr>
<th>Sign Code</th>
<th>NEXT EXIT XX MILES (two lines)</th>
<th>EXIT (with angled arrow, for unnumbered exits)</th>
<th>EXIT (with exit number and angled arrow)</th>
<th>Narrow Exit Gore</th>
<th>Community NEXT XX EXITS</th>
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<tr>
<td>E2-H1aP</td>
<td>84 x 36</td>
<td>72 x 60</td>
<td>48 x 84</td>
<td>var x 60</td>
<td>var x 60</td>
</tr>
<tr>
<td>E5-H1</td>
<td>84 x 36</td>
<td>72 x 60</td>
<td>var x 60</td>
<td>var x 60</td>
<td>var x 60</td>
</tr>
<tr>
<td>E5-H1a</td>
<td>84 x 36</td>
<td>72 x 60</td>
<td>var x 60</td>
<td>var x 60</td>
<td>var x 60</td>
</tr>
<tr>
<td>E5-H1c</td>
<td>84 x 36</td>
<td>72 x 60</td>
<td>var x 60</td>
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<td>72 x 60</td>
<td>var x 60</td>
<td>var x 60</td>
<td>var x 60</td>
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</tbody>
</table>

Sign Size in inches (width x height):
- Urban Single Lane Conv Road (25 mph or less)
- Urban Multi Lane Conv Road (25 mph or less)
- Multi Way Lane Conv Road (25 mph or less)
- Expressway Multi Lane Conv Road
- Expressway Lane Conv Road (25 mph or less)
- Expressway Ramp Approach
- Expressway Exit Ramp
- Freeway Ramp

Comments:
- For use with guide signs 84 to 132 inches wide
Table 297-13

Reserved for Future Information
Table 297-14. Watershed Sign Locations

<table>
<thead>
<tr>
<th>Dist</th>
<th>County</th>
<th>Route</th>
<th>Direction</th>
<th>Section</th>
<th>Sign Legend</th>
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<tbody>
<tr>
<td>3</td>
<td>Medina</td>
<td>I-71</td>
<td>North</td>
<td>12.11</td>
<td>Entering Lake Erie Watershed</td>
</tr>
<tr>
<td>3</td>
<td>Medina</td>
<td>I-71</td>
<td>South</td>
<td>12.11</td>
<td>Entering Ohio River Watershed</td>
</tr>
<tr>
<td>4</td>
<td>Ashtabula</td>
<td>SR 11</td>
<td>North</td>
<td>5.74</td>
<td>Entering Lake Erie Watershed</td>
</tr>
<tr>
<td>4</td>
<td>Ashtabula</td>
<td>SR 11</td>
<td>South</td>
<td>5.74</td>
<td>Entering Ohio River Watershed</td>
</tr>
<tr>
<td>4</td>
<td>Portage</td>
<td>I-76</td>
<td>West</td>
<td>10.73</td>
<td>Entering Lake Erie Watershed</td>
</tr>
<tr>
<td>4</td>
<td>Portage</td>
<td>I-76</td>
<td>East</td>
<td>10.73</td>
<td>Entering Ohio River Watershed</td>
</tr>
<tr>
<td>4</td>
<td>Summit</td>
<td>I-76</td>
<td>East</td>
<td>10.02</td>
<td>Entering Lake Erie Watershed</td>
</tr>
<tr>
<td>4</td>
<td>Summit</td>
<td>I-76</td>
<td>West</td>
<td>10.02</td>
<td>Entering Ohio River Watershed</td>
</tr>
<tr>
<td>4</td>
<td>Summit</td>
<td>I-77</td>
<td>North</td>
<td>22.95</td>
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<td>4</td>
<td>Summit</td>
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<td>6</td>
<td>Marion</td>
<td>US 23</td>
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<td>Marion</td>
<td>US 23</td>
<td>South</td>
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<tr>
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<td>Auglaize</td>
<td>I-75</td>
<td>South</td>
<td>0.06</td>
<td>Entering Ohio River Watershed</td>
</tr>
</tbody>
</table>
## Table 297-15. Specific Service (Logo) Signing Program Eligibility Criteria

<table>
<thead>
<tr>
<th></th>
<th>Fuel</th>
<th>Food</th>
<th>Lodging</th>
<th>Camping</th>
<th>Attraction **</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Maximum Number of Logos per Direction</strong></td>
<td>12</td>
<td>12</td>
<td>12</td>
<td>12</td>
<td>12</td>
</tr>
<tr>
<td><strong>Maximum Distance of Service</strong></td>
<td>3 miles</td>
<td>3 miles</td>
<td>3 miles</td>
<td>3 miles*</td>
<td>3 miles – urban 15 miles - rural</td>
</tr>
<tr>
<td><strong>Minimum Period of Operation</strong></td>
<td>Continuous operation 16 hours per day, 7 days per week; 360 days per year.</td>
<td>Continuous operation 12 hours per day, 360 days per year (if space is available on the sign, the business may be closed one day per week).</td>
<td>Continuous operation 24 hours per day, 7 days per week.</td>
<td>Continuous operation 24 hours per day, 7 days per week (seasonal operation is allowed).</td>
<td>Open for a minimum of 40 hours a week, 5 days per week, one of which must be either a Saturday or Sunday, except for an arena, stadium, convention center, or not-for-profit attraction.</td>
</tr>
<tr>
<td><strong>Required Service to be Provided &amp; Other Requirements</strong></td>
<td><strong>Possess:</strong> Licensing by all appropriate authorities. &lt;br&gt;<strong>Provide:</strong> Vehicle services including gas, vehicle fuel, diesel and/or alternative fuel; Restroom facilities; Public telephone; Drinking water.</td>
<td><strong>Possess:</strong> Licensing by all appropriate authorities; Seating capacity for sit-down, eat-in service with a minimum seating for 24 guests. &lt;br&gt;<strong>Provide:</strong> Restroom facilities; Public telephone; Drinking water.</td>
<td><strong>Possess:</strong> Licensing by all appropriate authorities. &lt;br&gt;<strong>Provide:</strong> A minimum of 8 rooms available with sleeping and bathroom accommodations; Public telephone.</td>
<td><strong>Possess:</strong> Licensing by all appropriate authorities; Valid permits from all appropriate health departments. &lt;br&gt;<strong>Provide:</strong> A minimum of 50 camping sites; Restroom and shower (hot and cold water). Janitorial service must be provided daily for toilet and shower facilities, refuse disposal and modern sanitary facilities; Public drinking water; Public telephone;</td>
<td><strong>Possess:</strong> Have regional significance. &lt;br&gt;<strong>Provide:</strong> Adequate parking; Public restroom facilities; Drinking water.</td>
</tr>
</tbody>
</table>

* This distance may be extended under certain circumstances as outlined in the ODOT Business Eligibility Rule 5501-2-6-05.

** Attraction means an arena, stadium, amusement park, historical society, historical district, museum, scenic attraction, natural attraction, convention center, zoo, aquarium, shopping center (minimum area 400,000 square feet) winery or a privately owned recreation area.
### Table 297-16. TODS Signing Program Eligibility Criteria

<table>
<thead>
<tr>
<th>Activities</th>
<th>Cultural</th>
<th>Historical</th>
<th>Educational</th>
<th>Recreational</th>
<th>Commercial</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drama</td>
<td>Historic Areas</td>
<td>Museums</td>
<td>Arenas</td>
<td>Antiques</td>
<td></td>
</tr>
<tr>
<td>Theaters</td>
<td>Caves</td>
<td>Tours</td>
<td>Lake/Beach</td>
<td>Crafts</td>
<td></td>
</tr>
<tr>
<td>Galleries</td>
<td>Memorials</td>
<td>Colleges</td>
<td>Parks</td>
<td>Malls</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Reservations</td>
<td>Universities</td>
<td>Camping</td>
<td>Winery</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Mansions</td>
<td>Vo-Tech</td>
<td>Golf</td>
<td>Farm Markets</td>
<td></td>
</tr>
<tr>
<td>Maximum # of</td>
<td>12</td>
<td>12</td>
<td>12</td>
<td>12</td>
<td>12</td>
</tr>
<tr>
<td>Activities per</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Direction / Intersection</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>General Eligibility</td>
<td>Must derive a major portion of its income or motorists during the normal business season from motorists not residing in the immediate area (within 10 miles of the tourist-oriented activity).</td>
<td></td>
<td></td>
<td>Is not eligible to participate in the Logo Signing Program.</td>
<td></td>
</tr>
<tr>
<td>Criteria</td>
<td>Hours of operation: 8 hours per day; and 5 days per week (one of which must be a Saturday or Sunday).</td>
<td></td>
<td></td>
<td>Maximum distance of service from the signed intersection is 10 miles.</td>
<td></td>
</tr>
</tbody>
</table>
## Table 297-17. Memorial Highways and Bridges Established by ORC Chapter 5533

<table>
<thead>
<tr>
<th>ORC Section</th>
<th>Name</th>
<th>Effective Date</th>
<th>Route</th>
<th>Beginning and Ending Points*</th>
<th>Action Required</th>
<th>Districts Affected</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>5533.01</td>
<td>None specified</td>
<td>09-28-1973</td>
<td>various</td>
<td>All state and federal highways at points crossed by Morgan’s raiders in 1863</td>
<td>May erect suitable markers</td>
<td>5, 8, 9, 10, 11</td>
<td>Must be coordinated with the Ohio state archaeological and historical society</td>
</tr>
<tr>
<td>5533.02</td>
<td>Atlantic and Pacific Highway</td>
<td>10-01-1953</td>
<td>SR7</td>
<td>Cincinnati to Gallipolis except Rome Township in Lawrence County</td>
<td>No action required</td>
<td>8, 9, 10</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>SR509</td>
<td>Within Rome Township in Lawrence County</td>
<td>No action required</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>5533.03</td>
<td>Grand Army of the Republic Highway</td>
<td>09-28-1973</td>
<td>US6</td>
<td>Entire length in Ohio</td>
<td>May erect suitable markers</td>
<td>2, 3, 4, 12</td>
<td></td>
</tr>
<tr>
<td>5533.04</td>
<td>General McPherson Highway</td>
<td>09-28-1973</td>
<td>US20</td>
<td>Entire length in Ohio</td>
<td>May erect suitable markers</td>
<td>2, 3, 4, 12</td>
<td></td>
</tr>
<tr>
<td>5533.05</td>
<td>United Spanish War Veterans Memorial Highway</td>
<td>09-28-1973</td>
<td>US23</td>
<td>Entire length in Ohio</td>
<td>May erect suitable markers</td>
<td>1, 2, 6, 9</td>
<td></td>
</tr>
<tr>
<td>5533.06</td>
<td>Scioto Trail</td>
<td>09-28-1973</td>
<td>US23</td>
<td>Scioto County thru Wyandot County</td>
<td>May erect suitable markers</td>
<td>1, 6, 9</td>
<td></td>
</tr>
<tr>
<td>5533.07</td>
<td>Branch Rickey Memorial Highway</td>
<td>10-06-2009</td>
<td>US23</td>
<td>Franklin/Delaware County line to Delaware Corp Limit</td>
<td>May erect suitable markers</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>5533.08</td>
<td>Thirty-Seventh Division Memorial Highway</td>
<td>09-28-1973</td>
<td>SR3</td>
<td>Entire length</td>
<td>May erect suitable markers</td>
<td>3, 5, 6, 8, 11, 12</td>
<td></td>
</tr>
<tr>
<td>5533.09</td>
<td>Forty-Second Rainbow Division Memorial Highway</td>
<td>09-28-1973</td>
<td>US42</td>
<td>Entire length in Ohio</td>
<td>May erect suitable markers</td>
<td>3, 6, 7, 8, 12</td>
<td>ORC indicates SR42</td>
</tr>
<tr>
<td>5533.091</td>
<td>Eighty-Third Division Memorial Highway</td>
<td>09-28-1973</td>
<td>US21</td>
<td>Washington County thru Cuyahoga County</td>
<td>May erect suitable markers</td>
<td>3, 4, 5, 10, 11, 12</td>
<td>US21 does not exist</td>
</tr>
<tr>
<td>5533.092</td>
<td>Military Order of the Purple Heart Memorial Highway</td>
<td>03-15-2001</td>
<td>I-76</td>
<td>I-71 to I-80</td>
<td>May erect suitable markers</td>
<td>3, 4</td>
<td></td>
</tr>
<tr>
<td>5533.093</td>
<td>Purple Heart Trail</td>
<td>03-24-2008</td>
<td>I-70</td>
<td>Entire length in Ohio</td>
<td>May erect suitable markers</td>
<td>5, 6, 7, 8, 11</td>
<td></td>
</tr>
<tr>
<td>5533.093</td>
<td>Purple Heart Trail</td>
<td>03-24-2008</td>
<td>I-71</td>
<td>Entire length in Ohio</td>
<td>May erect suitable markers</td>
<td>3, 6, 8, 12</td>
<td></td>
</tr>
<tr>
<td>5533.092</td>
<td>Peter J. Delucia Memorial Bridge</td>
<td>04-06-2009</td>
<td>I-76</td>
<td>Lake Milton bridge</td>
<td>May erect suitable markers</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>5533.093</td>
<td>Corporal Jason J. Hernandez Memorial Highway</td>
<td>05-31-2010</td>
<td>SR43</td>
<td>Ethan Avenue to Kennedy Road, Portage County</td>
<td>May erect suitable markers</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>5533.10</td>
<td>George Washington Highway</td>
<td>09-28-1973</td>
<td>US50</td>
<td>Entire length in Ohio</td>
<td>Shall erect black on white 12” x 18” enamel markers</td>
<td>8, 9, 10</td>
<td></td>
</tr>
<tr>
<td>ORC Section</td>
<td>Name</td>
<td>Effective Date</td>
<td>Route</td>
<td>Beginning and Ending Points*</td>
<td>Action Required</td>
<td>Districts Affected</td>
<td>Comments</td>
</tr>
<tr>
<td>-------------</td>
<td>-----------------------------------------------------</td>
<td>----------------</td>
<td>-------</td>
<td>-------------------------------</td>
<td>--------------------------------------</td>
<td>--------------------</td>
<td>----------</td>
</tr>
<tr>
<td>5533.101</td>
<td>LCPL Nicholas B. Erdy Memorial Highway</td>
<td>04-06-2009</td>
<td>US50</td>
<td>MM 13 to SR133 in Clermont County</td>
<td>May erect suitable markers</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>5533.11</td>
<td>General Duncan McArthur Highway</td>
<td>09-28-1973</td>
<td>SR28</td>
<td>Entire length</td>
<td>Shall erect black on white enamel markers</td>
<td>8, 9</td>
<td></td>
</tr>
<tr>
<td>5533.12</td>
<td>Sherman-Sheridan-Stanton-Custer Highway</td>
<td>09-28-1973</td>
<td>US22</td>
<td>Entire length in Ohio</td>
<td>Shall erect suitable markers</td>
<td>5, 6, 8, 11</td>
<td></td>
</tr>
<tr>
<td>5533.13</td>
<td>Governor Thomas Kirker Highway</td>
<td>09-28-1973</td>
<td>SR136</td>
<td>Entire length</td>
<td>Shall erect suitable markers</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>5533.14</td>
<td>Wright Brothers Memorial Highway</td>
<td>09-28-1973</td>
<td>SR4</td>
<td>Entire length</td>
<td>Shall erect black on white enamel markers</td>
<td>2, 3, 6, 7, 8</td>
<td></td>
</tr>
<tr>
<td>5533.15</td>
<td>Governor Robert Lucas Highway</td>
<td>09-28-1973</td>
<td>SR124</td>
<td>Entire length</td>
<td>Shall erect suitable markers</td>
<td>8, 9, 10</td>
<td></td>
</tr>
<tr>
<td>5533.16</td>
<td>Johnny Appleseed Highway</td>
<td>09-28-1973</td>
<td>US68</td>
<td>SR31 to Toledo</td>
<td>May erect suitable markers</td>
<td>1, 2</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>SR31 US68 to US36</td>
<td>May erect suitable markers</td>
<td>1, 6</td>
<td></td>
</tr>
<tr>
<td>5533.17</td>
<td>Gold Star Mothers' Memorial Highway</td>
<td>11-02-1959</td>
<td>SR82</td>
<td>Entire length</td>
<td>No action required</td>
<td>3, 4, 12</td>
<td></td>
</tr>
<tr>
<td>5533.18</td>
<td>Thomas A. Edison Memorial Bridge</td>
<td>09-28-1973</td>
<td>SR2</td>
<td>Sandusky Bay bridge</td>
<td>Shall erect suitable markers</td>
<td>2, 3</td>
<td></td>
</tr>
<tr>
<td>5533.19</td>
<td>Tom Jenkins Memorial Highway</td>
<td>09-28-1973</td>
<td>US52</td>
<td>Within Lawrence County</td>
<td>Shall erect suitable markers</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Old Zane Trace Memorial Highway</td>
<td>09-28-1973</td>
<td>SR41</td>
<td>US52 to US50 (west junction)</td>
<td>Shall erect suitable markers</td>
<td>9</td>
<td>ORC indicates SR50 instead of US50</td>
</tr>
<tr>
<td>5533.21</td>
<td>Jeremiah Morrow Bridge</td>
<td>09-28-1973</td>
<td>I-71</td>
<td>Little Miami River bridge</td>
<td>Shall erect suitable markers</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>5533.23</td>
<td>Simon Kenton Trace Highway</td>
<td>09-28-1973</td>
<td>SR72</td>
<td>Entire length</td>
<td>May erect suitable markers</td>
<td>7, 8, 9</td>
<td></td>
</tr>
<tr>
<td>5533.24</td>
<td>American Legion Memorial Highway</td>
<td>09-28-1973</td>
<td>I-75</td>
<td>Entire length in Ohio</td>
<td>May erect suitable markers</td>
<td>1, 2, 7, 8</td>
<td></td>
</tr>
<tr>
<td>5533.241</td>
<td>Pearl Harbor Memorial Highway</td>
<td>03-05-2004</td>
<td>I-75</td>
<td>Entire length in Ohio</td>
<td>May erect suitable markers</td>
<td>1, 2, 7, 8</td>
<td></td>
</tr>
<tr>
<td>5533.25</td>
<td>Donald H. Rolf Circle Freeway</td>
<td>07-26-1982</td>
<td>I-275</td>
<td>Entire length in Ohio</td>
<td>Shall erect suitable markers</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>5533.251</td>
<td>S. Sgt. Matt Maupin Veteran's Memorial Highway</td>
<td>04-06-2009</td>
<td>I-275</td>
<td>Within Clermont County</td>
<td>May erect suitable markers</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>5533.26</td>
<td>James A. Rhodes Appalachian Highway</td>
<td>09-28-1973</td>
<td>SR32</td>
<td>Entire length</td>
<td>Shall erect suitable markers</td>
<td>8, 9, 10</td>
<td></td>
</tr>
<tr>
<td>ORC Section</td>
<td>Name</td>
<td>Effective Date</td>
<td>Route</td>
<td>Beginning and Ending Points*</td>
<td>Action Required</td>
<td>Districts Affected</td>
<td>Comments</td>
</tr>
<tr>
<td>-------------</td>
<td>-------------------------------------------</td>
<td>----------------</td>
<td>-------</td>
<td>------------------------------</td>
<td>-----------------</td>
<td>-------------------</td>
<td>----------</td>
</tr>
<tr>
<td>5533.27</td>
<td>Great Seal Memorial Highway</td>
<td>09-28-1973</td>
<td>US23</td>
<td>SR159 to SR104</td>
<td>Shall erect suitable markers</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>US35</td>
<td>Scioto River bridge northwest of Chillicothe to the Scioto River bridge southeast of Chillicothe</td>
<td>Shall erect suitable markers</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>5533.28</td>
<td>Lake to River Highway</td>
<td>09-28-1973</td>
<td>SR11</td>
<td>Entire length</td>
<td>Shall erect suitable markers</td>
<td>4, 11</td>
<td></td>
</tr>
<tr>
<td>5533.281</td>
<td>Marine Private Henry Kalinowski Memorial Highway</td>
<td>04-06-2009</td>
<td>SR11</td>
<td>Within Ashtabula County</td>
<td>May erect suitable markers</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>5533.29</td>
<td>General Thaddeus Kosciusko Memorial Highway</td>
<td>09-28-1973</td>
<td>SR257</td>
<td>Prospect Corp Limit to US33</td>
<td>May erect suitable markers</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>5533.30</td>
<td>Veterans of Foreign Wars Memorial Highway</td>
<td>05-07-1976</td>
<td>I-70</td>
<td>Entire length in Ohio</td>
<td>May erect suitable markers</td>
<td>5, 6, 7, 8, 11</td>
<td></td>
</tr>
<tr>
<td>5533.31</td>
<td>Christopher Columbus Highway</td>
<td>09-16-1977</td>
<td>I-80</td>
<td>Entire length in Ohio</td>
<td>May erect suitable markers</td>
<td>2, 3, 4, 12</td>
<td></td>
</tr>
<tr>
<td>5533.32</td>
<td>Disabled American Veterans’ Highway</td>
<td>09-08-1977</td>
<td>I-71</td>
<td>Entire length in Ohio</td>
<td>May erect suitable markers</td>
<td>3, 6, 8, 12</td>
<td></td>
</tr>
<tr>
<td>5533.33</td>
<td>Trooper James R. Gross Memorial Highway</td>
<td>05-14-2002</td>
<td>I-71</td>
<td>MM 189 to MM 191</td>
<td>May erect suitable markers</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>5533.331</td>
<td>Deputy Brandy Winfield Memorial Highway</td>
<td>09-28-2006</td>
<td>SR423</td>
<td>Bethlehem Road to Marion-Cardington Road in Marion County</td>
<td>May erect suitable markers</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>5533.332</td>
<td>Corporal Brad D. Squires Memorial Highway</td>
<td>04-06-2009</td>
<td>I-71</td>
<td>Within Middleburg Heights</td>
<td>May erect suitable markers</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>5533.333</td>
<td>Sgt. Jeremy Murray Memorial Highway</td>
<td>05-31-2010</td>
<td>SR44</td>
<td>County Road 18 in Rootstown to Waterloo Road in Randolph</td>
<td>May erect suitable markers</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>5533.334</td>
<td>Lance Corporal Thomas O. Keeling Memorial Highway</td>
<td>05-31-2010</td>
<td>I-71</td>
<td>Within Strongsville</td>
<td>May erect suitable markers</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>5533.335</td>
<td>Lance Corporal David Raymond Baker Memorial Highway</td>
<td>05-31-2010</td>
<td>SR2</td>
<td>SR44 to Painesville exit</td>
<td>May erect suitable markers</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>5533.34</td>
<td>Melvin E. Newlin Memorial Highway</td>
<td>03-15-2002</td>
<td>SR7</td>
<td>Jefferson/Columbiana County line to East Liverpool west Corp Limit</td>
<td>May erect suitable markers</td>
<td>11</td>
<td></td>
</tr>
<tr>
<td>5533.35</td>
<td>Amvets Highway</td>
<td>08-04-1978</td>
<td>I-90</td>
<td>Ohio Turnpike to Pennsylvania State line</td>
<td>May erect suitable markers</td>
<td>3, 4, 12</td>
<td></td>
</tr>
<tr>
<td>5533.351</td>
<td>The Ohio Veterans Memorial Bridge</td>
<td>04-06-2009</td>
<td>US20</td>
<td>Conneaut Creek bridge in Conneaut</td>
<td>May erect suitable markers</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Duplicate of ORC Section 5533.78</td>
<td></td>
</tr>
<tr>
<td>5533.352</td>
<td>Cpl. Joshua Harmon Memorial Highway</td>
<td>04-06-2009</td>
<td>I-90</td>
<td>Within Willoughby Hills in Lake County</td>
<td>May erect suitable markers</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>ORC Section</td>
<td>Name</td>
<td>Effective Date</td>
<td>Route</td>
<td>Beginning and Ending Points*</td>
<td>Action Required</td>
<td>Districts Affected</td>
<td>Comments</td>
</tr>
<tr>
<td>-------------</td>
<td>------</td>
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<tr>
<td>5533.354</td>
<td>LCPL Danny Scherry Memorial Highway</td>
<td>04-06-2009</td>
<td>I-90</td>
<td>Within Rocky River in Cuyahoga County</td>
<td>May erect suitable markers</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>5533.36</td>
<td>Lou Groza Highway</td>
<td>12-23-1986</td>
<td>SR7</td>
<td>Within Belmont County and in Martins Ferry</td>
<td>May erect suitable markers</td>
<td>11</td>
<td></td>
</tr>
<tr>
<td>5533.37</td>
<td>Vietnam Veterans’ of America Highway</td>
<td>06-13-1996</td>
<td>I-77</td>
<td>Entire length in Ohio</td>
<td>Shall erect at least two suitable markers</td>
<td>4, 5, 10, 11, 12</td>
<td></td>
</tr>
<tr>
<td>5533.371</td>
<td>Pfc. Ralph Dias Memorial Highway</td>
<td>04-06-2009</td>
<td>SR344</td>
<td>Leetonia west Corp Limit to SR11</td>
<td>May erect suitable markers</td>
<td>11</td>
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<tr>
<td>5533.372</td>
<td>Staff Sgt. Matthew J. Kuglics Memorial Highway</td>
<td>05-31-2010</td>
<td>I-77</td>
<td>MM 116 to MM 118</td>
<td>May erect suitable markers</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>5533.38</td>
<td>Edward J. Parish Highway</td>
<td>09-16-1998</td>
<td>SR125</td>
<td>Within Clermont County</td>
<td>May erect suitable markers</td>
<td>8</td>
<td></td>
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<tr>
<td>5533.39</td>
<td>Walter ‘Smoky’ Alston Memorial Highway</td>
<td>11-22-1999</td>
<td>SR177</td>
<td>Within Darountain Corp Limits</td>
<td>May erect suitable markers</td>
<td>8</td>
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<tr>
<td>5533.40</td>
<td>William ‘Hopalong Cassidy’ Boyd Memorial Highway</td>
<td>11-02-1999</td>
<td>SR800</td>
<td>Within Hendrysburg Corp Limits</td>
<td>May erect suitable markers</td>
<td>11</td>
<td></td>
</tr>
<tr>
<td>5533.41</td>
<td>General Walter Churchill Highway</td>
<td>11-02-1999</td>
<td>US23</td>
<td>I-475 to Michigan State line</td>
<td>May erect suitable markers</td>
<td>2</td>
<td></td>
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<tr>
<td>5533.42</td>
<td>William J. Brown Memorial Highway</td>
<td>08-29-2000</td>
<td>US250</td>
<td>Within Harrison County</td>
<td>May erect suitable markers</td>
<td>11</td>
<td></td>
</tr>
<tr>
<td>5533.43</td>
<td>McClernon-Skyway Memorial Drive</td>
<td>09-22-1989</td>
<td>SR844</td>
<td>I-675 to Wright-Patterson AFB</td>
<td>May erect suitable markers</td>
<td>8</td>
<td>ORC indicates SR444A instead of SR844</td>
</tr>
<tr>
<td>5533.44</td>
<td>Rosa Parks Highway</td>
<td>09-13-1989</td>
<td>I-475</td>
<td>Entire length</td>
<td>May erect suitable markers</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>5533.45</td>
<td>Art Bowers Memorial Highway</td>
<td>05-31-1990</td>
<td>US72</td>
<td>SR7 to Jefferson County Road 22A</td>
<td>May erect suitable markers</td>
<td>11</td>
<td></td>
</tr>
<tr>
<td>5533.46</td>
<td>U.S. Grant Memorial Highway</td>
<td>04-22-1997</td>
<td>US52</td>
<td>Entire length in Ohio</td>
<td>Shall use appropriate discretion with regards to signs</td>
<td>8, 9</td>
<td></td>
</tr>
<tr>
<td>5533.47</td>
<td>Catholic War Veterans of U.S.A. Highway</td>
<td>12-18-1997</td>
<td>I-280</td>
<td>Between Oregon and Toledo</td>
<td>May erect suitable markers</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>5533.48</td>
<td>Cliff Skeen Memorial Highway</td>
<td>09-16-1998</td>
<td>US224</td>
<td>SR241 to SR91</td>
<td>May erect suitable markers</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>5533.49</td>
<td>Simon Kenton Memorial Highway</td>
<td>06-01-1998</td>
<td>US68</td>
<td>North edge of the Simon Kenton Memorial Bridge over the Ohio River to the Kenton north Corp Limit</td>
<td>May erect suitable markers</td>
<td>1, 7, 8, 9</td>
<td></td>
</tr>
<tr>
<td>5533.491</td>
<td>Ron Burton Memorial Highway</td>
<td>10-13-2004</td>
<td>US68</td>
<td>Within Springfield Township, Clark County to Springfield north Corp Limit</td>
<td>May erect suitable markers</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>5533.50</td>
<td>John Kalaman and Robert O’Toole Memorial Highway</td>
<td>09-16-1998</td>
<td>I-675</td>
<td>Entire length</td>
<td>May erect suitable markers</td>
<td>7, 8</td>
<td></td>
</tr>
<tr>
<td>ORC Section</td>
<td>Name</td>
<td>Effective Date</td>
<td>Route</td>
<td>Beginning and Ending Points*</td>
<td>Action Required</td>
<td>Districts Affected</td>
<td>Comments</td>
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<tr>
<td>5533.51</td>
<td>William Green Memorial Highway</td>
<td>11-02-1999</td>
<td>US36</td>
<td>Coshocton corp limit to Coshocton/Tuscarawas County line</td>
<td>May erect suitable markers</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>5533.52</td>
<td>Korean War Veterans’ Memorial Highway</td>
<td>10-24-2002</td>
<td>US36</td>
<td>Coshocton/Tuscarawas County line to I-77</td>
<td>May erect suitable markers</td>
<td>11</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>US36</td>
<td>Champaign/Miami County line to Indiana State line</td>
<td>May erect suitable markers</td>
<td>7</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>I-280</td>
<td>I-80 to the Wood/Lucas County line</td>
<td>May erect suitable markers</td>
<td>2</td>
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<td></td>
<td></td>
<td></td>
<td>SR8</td>
<td>Within Summit County</td>
<td>May erect suitable markers</td>
<td>4</td>
<td></td>
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<td></td>
<td></td>
<td>05-31-2010</td>
<td>I-680</td>
<td>Within Mahoning County</td>
<td>May erect suitable markers</td>
<td>4</td>
<td></td>
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<tr>
<td>5533.53</td>
<td>Annie Oakley Memorial Pike</td>
<td>08-29-2000</td>
<td>US127</td>
<td>Within Darke County</td>
<td>May erect suitable markers</td>
<td>7</td>
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<tr>
<td>5533.531</td>
<td>Earle Baltes Highway</td>
<td>09-29-2007</td>
<td>SR118</td>
<td>St. Henry south Corp Limit to SR47</td>
<td>May erect suitable markers</td>
<td>7</td>
<td></td>
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<tr>
<td>5533.54</td>
<td>A.G. Lancione Memorial Highway</td>
<td>02-13-2001</td>
<td>SR7</td>
<td>MM 14.7 to MM 17.8</td>
<td>May erect suitable markers</td>
<td>11</td>
<td></td>
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<tr>
<td>5533.55</td>
<td>Reverend Dr. Sam Wells, Jr., Memorial Viaduct</td>
<td>06-18-2002</td>
<td>US20</td>
<td>Ashtabula River viaduct in Ashtabula and Ashtabula Township</td>
<td>May erect suitable markers</td>
<td>4</td>
<td></td>
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<tr>
<td>5533.56</td>
<td>Freedom Memorial Highway</td>
<td>07-05-1982</td>
<td>SR444</td>
<td>SR4 to I-675</td>
<td>May erect suitable markers with names of hostages and servicemen killed in rescue attempt</td>
<td>7,8</td>
<td></td>
</tr>
<tr>
<td>5533.57</td>
<td>Judge Kenneth B. Ater Bridge</td>
<td>06-18-2002</td>
<td>SR7</td>
<td>Paddy Creek bridge near Proctorville</td>
<td>May erect suitable markers</td>
<td>9</td>
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<tr>
<td>5533.58</td>
<td>Governor James A. Rhodes Memorial Highway</td>
<td>03-19-2003</td>
<td>SR72</td>
<td>I-70 to Clark/Champaign County line</td>
<td>May erect suitable markers</td>
<td>7</td>
<td></td>
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<tr>
<td>5533.59</td>
<td>Bill Mazeroski Highway</td>
<td>03-24-2003</td>
<td>SR7</td>
<td>Rush Run Road in Jefferson County to Jefferson/Belmont County line</td>
<td>May erect suitable markers</td>
<td>11</td>
<td></td>
</tr>
<tr>
<td>5533.60</td>
<td>Joseph Guy LaPointe, Jr. Memorial Parkway</td>
<td>04-07-2003</td>
<td>SR49</td>
<td>Within Trotwood and Clayton corp limits</td>
<td>May erect suitable markers</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>5533.601</td>
<td>Lance Cpl. Kevin S. Smith Memorial Highway</td>
<td>04-06-2009</td>
<td>SR334</td>
<td>Within Clark County</td>
<td>May erect suitable markers</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>5533.604</td>
<td>Sergeant Jeremy D. Barnett Memorial Highway</td>
<td>04-06-2009</td>
<td>SR800</td>
<td>Within Mineral City in Tuscarawas County</td>
<td>May erect suitable markers</td>
<td>11</td>
<td></td>
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<tr>
<td>5533.605</td>
<td>Cpl. Samuel F. Pearson Memorial Highway</td>
<td>04-06-2009</td>
<td>SR66</td>
<td>Shelby/Miami County line to Washington Avenue in Piqua</td>
<td>May erect suitable markers</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>5533.606</td>
<td>Major Rocco Barnes Memorial Highway</td>
<td>05-31-2010</td>
<td>SR10</td>
<td>Within North Olmstead corp limit</td>
<td>May erect suitable markers</td>
<td>12</td>
<td></td>
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<tr>
<td>ORC Section</td>
<td>Name</td>
<td>Effective Date</td>
<td>Route</td>
<td>Beginning and Ending Points*</td>
<td>Action Required</td>
<td>Districts Affected</td>
<td>Comments</td>
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<tr>
<td>5533.607</td>
<td>Navy Hospitalman Richard “Doc” Powell Memorial Highway</td>
<td>05-31-2010</td>
<td>I-680</td>
<td>SR711 to SR11</td>
<td>May erect suitable markers</td>
<td>4</td>
<td></td>
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<tr>
<td>5533.61</td>
<td>Martin Luther King, Jr. Boulevard</td>
<td>09-24-1986</td>
<td>US42</td>
<td>Xenia Corp Limit to Cedarville Corp Limit</td>
<td>May erect suitable markers</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>5533.62</td>
<td>U.S.A.F. Pararescue Memorial Parkway</td>
<td>05-18-2005</td>
<td>SR48</td>
<td>Entire length</td>
<td>May erect suitable markers</td>
<td>7, 8</td>
<td></td>
</tr>
<tr>
<td>5533.621</td>
<td>Captain Seth Mitchell Memorial Highway</td>
<td>05-31-2010</td>
<td>SR48</td>
<td>Within Loveland Corp Limit</td>
<td>May erect suitable markers</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>5533.63</td>
<td>Marine Corps League Memorial Highway</td>
<td>11-12-1997</td>
<td>US33</td>
<td>Willshire to West Virginia State line</td>
<td>May erect suitable markers</td>
<td>1, 5, 6, 7, 10</td>
<td></td>
</tr>
<tr>
<td>5533.631</td>
<td>Edward K. Core, Jr. Memorial Highway</td>
<td>08-10-2000</td>
<td>US33</td>
<td>Union/Logan County line to Logan County Road 57</td>
<td>Shall erect suitable markers</td>
<td>7</td>
<td>Expires 08-10-2009. Remove signs and give to family.</td>
</tr>
<tr>
<td>5533.632</td>
<td>Brian Montgomery Memorial Highway</td>
<td>09-29-2007</td>
<td>SR2</td>
<td>Within Willoughby Corp Limit</td>
<td>May erect suitable markers</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>5533.633</td>
<td>Sergeant Bryan W. Large Memorial Highway</td>
<td>04-06-2009</td>
<td>SR59 north</td>
<td>Kent Road exit to border of Cuyahoga Falls and Silver Lake</td>
<td>May erect suitable markers</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>5533.634</td>
<td>Sergeant Justin T. Walsh Memorial Highway</td>
<td>04-06-2009</td>
<td>SR59 south</td>
<td>Border of Cuyahoga Falls and Silver Lake to SR8 entrance ramp</td>
<td>May erect suitable markers</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>5533.635</td>
<td>Corporal Jeffrey A. Boskovitch Memorial Highway</td>
<td>04-06-2009</td>
<td>SR3</td>
<td>West Sprague Road to SR82 in North Royalton</td>
<td>May erect suitable markers</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>5533.64</td>
<td>Thomas A. Van Meter Memorial Highway</td>
<td>11-03-1999</td>
<td>SR60</td>
<td>Within Ashland County</td>
<td>May erect suitable markers</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>5533.642</td>
<td>Robert E. Netzley Highway</td>
<td>04-07-2003</td>
<td>SR571</td>
<td>Within Miami County</td>
<td>May erect suitable markers with private contributions only</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>5533.644</td>
<td>Senator William Bowen Memorial Highway</td>
<td>05-31-2010</td>
<td>US42</td>
<td>Within Cincinnati Corp Limit</td>
<td>May erect suitable markers</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>5533.65</td>
<td>Wayne Embry Way</td>
<td>09-01-2000</td>
<td>US40</td>
<td>SR235 to Gordon Road, Bethel Township, Clark County</td>
<td>May erect suitable markers</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>5533.66</td>
<td>Jackie Mayer Miss America Highway</td>
<td>08-29-2002</td>
<td>SR2</td>
<td>Thomas A. Edison Memorial Bridge approach thru Erie County</td>
<td>May erect suitable markers</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>5533.67</td>
<td>Troy Lee James Highway</td>
<td>03-19-2003</td>
<td>I-490</td>
<td>I-71 to I-77</td>
<td>May erect suitable markers</td>
<td>12</td>
<td></td>
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<tr>
<td>ORC Section</td>
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<td>5533.68</td>
<td>Trooper Frank G. Vazquez Memorial Highway</td>
<td>04-07-2003</td>
<td>I-270</td>
<td>I-70 to Georgesville Road</td>
<td>May erect suitable markers</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>5533.681</td>
<td>Trooper Wendy G. Everett Memorial Highway</td>
<td>04-06-2009</td>
<td>I-270</td>
<td>MM 1 to MM 3</td>
<td>May erect suitable markers</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>5533.682</td>
<td>Patrolman Jerry R. Neff Memorial Highway</td>
<td>04-06-2009</td>
<td>US62</td>
<td>MM 1 to MM 2 in Franklin County</td>
<td>May erect suitable markers</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>5533.683</td>
<td>Trooper Jody S. Dye Memorial Highway</td>
<td>04-06-2009</td>
<td>I-270</td>
<td>MM 45 to MM 47</td>
<td>May erect suitable markers</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>5533.684</td>
<td>Deputy Lawrence Barnes Memorial Highway</td>
<td>04-06-2009</td>
<td>US50</td>
<td>North Fork Creek bridge in the community of Slate Mills in Ross County</td>
<td>May erect suitable markers</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>5533.685</td>
<td>Officer Brett Markwood Memorial Highway</td>
<td>05-31-2010</td>
<td>US22</td>
<td>US33 to Memorial Drive in Fairfield County</td>
<td>May erect suitable markers</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>5533.69</td>
<td>Governor William Bebb Bicentennial Roadway</td>
<td>03-05-2004</td>
<td>SR126</td>
<td>Community of Venice in Butler County to Indiana State line</td>
<td>May erect suitable markers</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>5533.70</td>
<td>Governor James M. Cox Bicentennial Roadway</td>
<td>03-05-2004</td>
<td>SR744</td>
<td>Somerville to SR122</td>
<td>May erect suitable markers</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>5533.71</td>
<td>Governor James E. Campbell Bicentennial Roadway</td>
<td>03-05-2004</td>
<td>SR4</td>
<td>High Street in Hamilton to Central Avenue in Middletown</td>
<td>May erect suitable markers</td>
<td>8</td>
<td></td>
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<tr>
<td>5533.72</td>
<td>Governor Andrew L. Harris Bicentennial Roadway</td>
<td>03-05-2004</td>
<td>US127</td>
<td>Seven Mile to US35</td>
<td>May erect suitable markers</td>
<td>8</td>
<td></td>
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<tr>
<td>5533.73</td>
<td>William R. Foster Bridge</td>
<td>03-05-2004</td>
<td>SR129</td>
<td>Maud-Hughes Road bridge over Gregory Creek, Butler County, MM 23.18</td>
<td>May erect suitable markers</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>5533.74</td>
<td>Butler County Veterans Highway</td>
<td>10-13-2004</td>
<td>SR129</td>
<td>I-75 to Indiana State line</td>
<td>May erect suitable markers</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>5533.75</td>
<td>Deputy Ethan Collins Memorial Highway</td>
<td>03-29-2007</td>
<td>SR188</td>
<td>Within Fairfield County</td>
<td>May erect suitable markers</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>5533.751</td>
<td>Patrolman George Brentar Memorial Highway</td>
<td>04-06-2009</td>
<td>I-90</td>
<td>Within Euclid in Cuyahoga County</td>
<td>May erect suitable markers</td>
<td>12</td>
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<td>5533.76</td>
<td>Pfc. David C. Armstrong Memorial Highway</td>
<td>04-06-2009</td>
<td>US30</td>
<td>SR598 to SR61</td>
<td>May erect suitable markers</td>
<td>8</td>
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<tr>
<td>5533.761</td>
<td>Lance Corporal Daniel McVicker Memorial Highway</td>
<td>04-06-2009</td>
<td>US62</td>
<td>Alliance west Corp Limit to Highland Memorial Park Cemetery in Beloit</td>
<td>May erect suitable markers</td>
<td>4, 11</td>
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</tr>
<tr>
<td>ORC Section</td>
<td>Name</td>
<td>Effective Date</td>
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<tr>
<td>5533.77</td>
<td>Staff Sgt. Kendall H. Ivy II Memorial Highway</td>
<td>04-06-2009</td>
<td>US30</td>
<td>SR602 to SR598</td>
<td>May erect suitable markers</td>
<td>3</td>
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<tr>
<td>5533.771</td>
<td>Deputy Chad Edwards Memorial Highway</td>
<td>04-06-2009</td>
<td>SR37</td>
<td>Southernmost point in Lancaster to Fairfield/Licking County line</td>
<td>May erect suitable markers</td>
<td>5</td>
<td></td>
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<tr>
<td>5533.772</td>
<td>Sgt. Marco Miller Memorial Interchange</td>
<td>04-06-2009</td>
<td>US422 SR82</td>
<td>Interchange of US422 and SR82</td>
<td>May erect suitable markers</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>5533.773</td>
<td>SrA Kenneth P. Hauprich, Jr., Memorial Highway</td>
<td>04-06-2009</td>
<td>SR72</td>
<td>New Silvercreek Township Cemetery past the Greenview schools through Jamestown</td>
<td>May erect suitable markers</td>
<td>8</td>
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<tr>
<td>5533.774</td>
<td>Tuskegee Airmen Memorial Highway</td>
<td>04-06-2009</td>
<td>SR104</td>
<td>US23 to Lockbourne Road</td>
<td>May erect suitable markers</td>
<td>6</td>
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<tr>
<td>5533.775</td>
<td>Colonel Wilbur Blount, M.D., Memorial Highway</td>
<td>04-06-2009</td>
<td>I-670</td>
<td>4th Street to International Gateway at Port Columbus</td>
<td>May erect suitable markers</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>5533.78</td>
<td>The Ohio Veterans Memorial Bridge</td>
<td>04-06-2009</td>
<td>US20</td>
<td>Conneaut Creek bridge in Conneaut</td>
<td>May erect suitable markers</td>
<td>4</td>
<td>Duplicate of ORC Section 5533.351</td>
</tr>
<tr>
<td>5533.785</td>
<td>Sgt. Sean Landrus Memorial Highway</td>
<td>05-31-2010</td>
<td>SR528</td>
<td>US322 to Lake County line</td>
<td>May erect suitable markers</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>5533.79</td>
<td>Heritage Parkway</td>
<td>10-13-2004</td>
<td>SR4</td>
<td>I-70 to Springfield west Corp Limit</td>
<td>May erect suitable markers</td>
<td>7</td>
<td></td>
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<tr>
<td>5533.80</td>
<td>Crile-Lower Memorial Highway</td>
<td>10-13-2004</td>
<td>SR93</td>
<td>Within Coshocton County</td>
<td>May erect suitable markers</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>5533.81</td>
<td>Veterans' Glass City Skyway</td>
<td>05-18-2005</td>
<td>I-280</td>
<td>Maumee River bridge in Lucas County</td>
<td>May erect suitable markers</td>
<td>2</td>
<td></td>
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<tr>
<td>5533.811</td>
<td>Henry County Veterans Bridge</td>
<td>09-12-2008</td>
<td>SR108</td>
<td>Maumee River bridge in Napoleon</td>
<td>May erect suitable markers</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>5533.82</td>
<td>Kenneth Jutte-John Garman Memorial Highway</td>
<td>05-18-2005</td>
<td>SR66</td>
<td>SR119 to SR274</td>
<td>May erect suitable markers</td>
<td>7</td>
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<tr>
<td>5533.83</td>
<td>Bob Evans Highway</td>
<td>05-18-2005</td>
<td>US35</td>
<td>Within Gallia County</td>
<td>May erect suitable markers</td>
<td>10</td>
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<tr>
<td>5533.84</td>
<td>Nehemia and Permelia Atwood Memorial Highway</td>
<td>05-18-2005</td>
<td>SR588</td>
<td>Rio Grande to Jackson Pike in Rodney</td>
<td>May erect suitable markers</td>
<td>10</td>
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<tr>
<td>5533.85</td>
<td>Charles E. Holzer Highway</td>
<td>05-18-2005</td>
<td>SR160</td>
<td>Within Gallia County</td>
<td>May erect suitable markers</td>
<td>10</td>
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<tr>
<td>5533.86</td>
<td>Ohio Army National Guard 216th Engineering Battalion Memorial Highway</td>
<td>05-18-2005</td>
<td>SR756</td>
<td>Entire length</td>
<td>May erect suitable markers</td>
<td>8, 9</td>
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<tr>
<td>5533.87</td>
<td>Veterans' Memorial Highway</td>
<td>05-18-2005</td>
<td>SR209</td>
<td>Wheeling Avenue in Cambridge to Exit 178</td>
<td>May erect suitable markers</td>
<td>5</td>
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<tr>
<td>5533.871</td>
<td>Major James W. Reed Memorial Highway</td>
<td>08-22-2008</td>
<td>SR660</td>
<td>Within Guernsey County</td>
<td>May erect suitable markers</td>
<td>5</td>
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<tr>
<td>ORC Section</td>
<td>Name</td>
<td>Effective Date</td>
<td>Route</td>
<td>Beginning and Ending Points*</td>
<td>Action Required</td>
<td>Districts Affected</td>
<td>Comments</td>
</tr>
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<td>-------------</td>
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<td>5533.872</td>
<td>Guernsey County Veterans – Flags of Honor Memorial Highway</td>
<td>05-31-2010</td>
<td>SR313</td>
<td>Fritter Road to first intersection with SR83 (West Road)</td>
<td>May erect suitable markers</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>5533.88</td>
<td>Defiance County Veterans Memorial Highway</td>
<td>05-18-2005</td>
<td>US24</td>
<td>Within Defiance County</td>
<td>May erect suitable markers with private contributions only</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>5533.881</td>
<td>Ashland County Veterans’ Memorial Highway</td>
<td>05-31-2010</td>
<td>US250</td>
<td>Cottage Street to US42 in Ashland County</td>
<td>May erect suitable markers</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>5533.89</td>
<td>Bill Hing Memorial Highway</td>
<td>05-18-2005</td>
<td>US250</td>
<td>I-77 thru Ulrichsville</td>
<td>May erect suitable markers</td>
<td>11</td>
<td></td>
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<tr>
<td>5533.90</td>
<td>Lawrence E. Hughes Memorial Highway</td>
<td>05-18-2005</td>
<td>SR315</td>
<td>King Avenue overpass to Franklin/Delaware County line</td>
<td>May erect suitable markers</td>
<td>6</td>
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<tr>
<td>5533.91</td>
<td>LCpl Andy Nowacki Memorial Highway</td>
<td>09-29-2007</td>
<td>SR44</td>
<td>SR2 to Headlands Beach State Park</td>
<td>May erect suitable markers</td>
<td>12</td>
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<tr>
<td>5533.92</td>
<td>Carl B. Stokes Memorial Highway</td>
<td>04-06-2009</td>
<td>SR2</td>
<td>Within Cuyahoga County</td>
<td>May erect suitable markers</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>5533.93</td>
<td>Union Workers Memorial Bridge</td>
<td>05-31-2010</td>
<td>I-480</td>
<td>Bridge spanning Cuyahoga River and Ohio Canal</td>
<td>May erect suitable markers</td>
<td>12</td>
<td></td>
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<tr>
<td>5533.931</td>
<td>Fred Krum Memorial Interchange</td>
<td>05-31-2010</td>
<td>I-77 Shuffel Street</td>
<td>Interchange of I-77 and Shuffel Street, Northwest, Jackson Township, Stark County</td>
<td>May erect suitable markers</td>
<td>4</td>
<td></td>
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<tr>
<td>5533.94</td>
<td>Cpl. Joshua Harmon Memorial Highway</td>
<td>09-22-2008</td>
<td>I-90</td>
<td>Within Willoughby Hills Corp Limit</td>
<td>May erect suitable markers</td>
<td>12</td>
<td></td>
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<tr>
<td>5533.95</td>
<td>William Holmes McGuffey Memorial Highway</td>
<td>05-31-2010</td>
<td>I-680</td>
<td>SR711 to SR7</td>
<td>May erect suitable markers</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>5533.96</td>
<td>Sgt. Michael W. Finke, Jr., Memorial Highway</td>
<td>05-31-2010</td>
<td>SR18</td>
<td>I-71 to Summit County Line</td>
<td>May erect suitable markers</td>
<td>3</td>
<td></td>
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</table>
# Table 297-18. Memorial Highways and Bridges Established by ORC Sections 5511.01 and 5511.09

This list needs review and updating. An updated version is under development and is expected to be available later this year.

<table>
<thead>
<tr>
<th>ORC Section</th>
<th>Name</th>
<th>Effective Date</th>
<th>Route</th>
<th>Beginning and Ending Points*</th>
<th>Action Required</th>
<th>Districts Affected</th>
<th>Comments</th>
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<tbody>
<tr>
<td>5511.01</td>
<td>104th Timberwolf Division Highway</td>
<td>08-03-1959</td>
<td>SR104</td>
<td>Columbus to US52</td>
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<td>6, 9</td>
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<td></td>
<td><strong>Anthony Wayne Parkway</strong></td>
<td></td>
<td>US42</td>
<td>Cincinnati to Yellow Springs</td>
<td>7, 8</td>
<td></td>
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<td>SR47</td>
<td>Greenville to Indiana State line</td>
<td>7</td>
<td></td>
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<tr>
<td></td>
<td>****</td>
<td></td>
<td>SR49</td>
<td>Greenville to Michigan State line</td>
<td>1, 2, 7, 8</td>
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<td></td>
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<td>****</td>
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<td>US68</td>
<td>Cincinnati to Yellow Springs</td>
<td>7, 8</td>
<td></td>
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</tr>
<tr>
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<td>****</td>
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<td>SR121</td>
<td>Greenville to Indiana State line</td>
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<td>US127</td>
<td>Cincinnati to Greenville</td>
<td>7, 8</td>
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<td>****</td>
<td></td>
<td>US24</td>
<td>Greenville to Michigan State line</td>
<td>7, 8</td>
<td></td>
<td>Need to check begin/end points</td>
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<td>****</td>
<td></td>
<td>US27</td>
<td>Greenville to Michigan State line</td>
<td>7, 8</td>
<td></td>
<td>Need to check begin/end points</td>
</tr>
<tr>
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<td>****</td>
<td></td>
<td>SR29</td>
<td>Greenville to Michigan State line</td>
<td>7, 8</td>
<td></td>
<td>Need to check begin/end points</td>
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<tr>
<td></td>
<td>****</td>
<td></td>
<td>SR111</td>
<td>Greenville to Michigan State line</td>
<td>7, 8</td>
<td></td>
<td>Need to check begin/end points</td>
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<tr>
<td></td>
<td>****</td>
<td></td>
<td>SR637</td>
<td>Greenville to Michigan State line</td>
<td>7, 8</td>
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<td>Need to check begin/end points</td>
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<td>5511.01</td>
<td>Benjamin Franklin Highway</td>
<td>05-23-1930</td>
<td>US224</td>
<td>Entire length in Ohio</td>
<td></td>
<td>1, 2, 3, 4</td>
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<tr>
<td>5511.01</td>
<td>Blue Star Highway</td>
<td>11-30-1948</td>
<td>US40</td>
<td>Entire length in Ohio</td>
<td>To be marked</td>
<td>5, 6, 7, 8, 11</td>
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<tr>
<td>5511.01</td>
<td>Catholic War Veterans of the USA Highway</td>
<td>11-30-1948</td>
<td>I-280(?)</td>
<td>Oregon to Toledo</td>
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<td>2</td>
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<tr>
<td>5511.01</td>
<td>Dix Expressway</td>
<td>07-01-1970</td>
<td>SR3</td>
<td>Wooster bypass</td>
<td>To be erected</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>SR83</td>
<td>Wooster bypass</td>
<td>To be erected</td>
<td>3</td>
<td></td>
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<tr>
<td>5511.01</td>
<td>Edison Highway</td>
<td>12-08-1931</td>
<td>SR113</td>
<td>Bellevue to Elyria</td>
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<td>3, 12</td>
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<tr>
<td>5511.01</td>
<td>General Dwight D. Eisenhower Memorial Highway</td>
<td>01-22-1970</td>
<td>I-70</td>
<td>Entire length in Ohio</td>
<td>To be erected in rest areas</td>
<td>5, 6, 7, 8, 11</td>
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<tr>
<td>5511.01</td>
<td>Jack Nicklaus Freeway</td>
<td>05-01-1981</td>
<td>I-270</td>
<td>Entire length in Ohio</td>
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<td>5511.01</td>
<td>Jackie Mayer</td>
<td>01-31-1962</td>
<td>US66</td>
<td>Huron to Venice</td>
<td>To be marked</td>
<td>3</td>
<td>Unknown end point</td>
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<td>5511.01</td>
<td>John Glenn, Jr. Highway</td>
<td>03-02-1962</td>
<td>US40</td>
<td>Zanesville to Cambridge</td>
<td>To be marked</td>
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<td>5511.01</td>
<td>Lincoln Highway</td>
<td>08-01-1930</td>
<td>US30</td>
<td>Entire length in Ohio</td>
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<td>1, 3, 4, 11</td>
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<tr>
<td>5511.01</td>
<td>Marine Corps League Memorial Highway</td>
<td>01-22-1970</td>
<td>US33</td>
<td>Entire length in Ohio</td>
<td></td>
<td>1, 5, 6, 7, 10</td>
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<tr>
<td>5511.01</td>
<td>Moody-Jackson Highway</td>
<td></td>
<td>SR315</td>
<td>Within Columbus</td>
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<td>5511.01</td>
<td>Phil Niekro Highway</td>
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<td>US40</td>
<td>Within Belmont County</td>
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<td>11</td>
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<tr>
<td>5511.01</td>
<td>Road of Remembrance</td>
<td>06-17-1930</td>
<td>SR7</td>
<td>Steubenville, Youngstown to North Kingsville</td>
<td></td>
<td>Need to check begin/end points</td>
<td></td>
</tr>
<tr>
<td>ORC Section</td>
<td>Name</td>
<td>Effective Date</td>
<td>Route</td>
<td>Beginning and Ending Points*</td>
<td>Action Required</td>
<td>Districts Affected</td>
<td>Comments</td>
</tr>
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<td>5511.01</td>
<td>Ronald Reagan Highway</td>
<td>07-13-1933</td>
<td>I-77</td>
<td>Marietta to US40</td>
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<td>5, 10</td>
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<tr>
<td>5511.01</td>
<td>White Highway</td>
<td>10-25-1966</td>
<td>SR43</td>
<td>Sandy Ave SE in Criton Township to Wellowdale Avenue in Sandy Township</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>
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298 FIGURES INDEX

298-1 Signing for Median Crossovers

*Figure 298-1* illustrates the recommended signing layout for a median crossover (*see Section 201-2*).

298-2 STOP Signs at Intersections

*Figure 298-2* illustrates several variations for placement of STOP signs at intersections. See *Section 201-3* for further details.

298-3 Ramp Location Codes

*Figure 298-3* defines the ramp location codes used for the extrusheet signs identification system (*see Section 210-2*). This coding system is based on the system established for recording accident data.

298-4a Regulatory and Warning Signs

*Figure 298-4a* illustrates Regulatory and Warning Signs discussed in this Manual which are not shown in the OMUTCD (*see Sections 201 and 202*).

298-4b Regulatory and Warning Signs (Continued)

*Figure 298-4b* continues the illustrations of Regulatory and Warning Signs discussed in this Manual which are not shown in the OMUTCD.

298-5a Route and Information Signs

*Figure 298-5a* is used to illustrate Route and Information Signs discussed in this Manual which are not shown in the OMUTCD (*see Sections 204, 206 and 207*).

298-5b Route and Information Signs (Continued)

*Figure 298-5b* continues the illustrations of Route and Information Signs discussed in this Manual which are not shown in the OMUTCD.

298-5c Route and Information Signs (Continued)

*Figure 298-5c* continues the illustrations of Route and Information Signs discussed in this Manual which are not shown in the OMUTCD. This figure includes illustrations of sample Logo and TODS signs.

298-6a Rest Area and Miscellaneous Signs

*Figure 298-6a* continues the illustrations of Rest Area Signs and miscellaneous others discussed in this Manual which are not shown in the OMUTCD.

298-6b Rest Area and Miscellaneous Signs (Continued)

*Figure 298-6b* continues the illustrations of Rest Area Signs and miscellaneous others discussed in this Manual which are not shown in the OMUTCD.
298-6c Rest Area and Miscellaneous Signs (Continued)

*Figure 298-6c* continues the illustrations of Rest Area Signs and miscellaneous others discussed in this Manual which are not shown in the OMUTCD.

298-7 Amish Buggy Signing where Paved Shoulder Becomes Narrower

*Figure 298-7* illustrates the situation described in *Section 202-6* regarding signing for a narrow shoulder on a route used by Amish buggies.

298-8 Placement of Overhead Exit Direction Sign - Span Type

*Figure 298-8* illustrates placement of overhead exit gore signs of the span type.

298-9 Placement of Overhead Exit Direction Sign - Cantilever Type

*Figure 298-9* illustrates placement of cantilever signs (*see Section 240-4.3*).

298-10 Placement of Overhead Diverging Gore Sign - Span Type

*Figure 298-10* illustrates placement of overhead diverging gore signs of the span type.

298-11 Sight Distance Requirements for Overhead Guide Signs

*Figure 298-11* illustrates sight distance requirements for overhead signs.

298-12 Design Chart for TC-12.30 Sign Supports

*Figure 298-12* is used in designing TC-12.30 sign supports (*see Section 240-4.3*).

298-13 Design Chart for Overhead Sign Support Trusses

*Figure 298-13* is used in designing sign supports trusses (*see Section 240-4.5*).

298-14 Design Chart for Single Post Installations

*Figure 298-14* is used in designing single post installations (*see Section 240-5.2*).

298-15 Design Chart for Two Post Installations

*Figure 298-15* is used in designing two post installations (*see Section 240-5.2*).

298-16 Design Chart for Two Beam Installations

*Figure 298-16* is used in designing two beam installations (*see Section 240-5.3*).

298-17 Design Chart for Three Beam Installations

*Figure 298-17* is used in designing three beam installations (*see Section 240-5.3*).

298-18 Design Chart for TC-17.10 Sign Supports

*Figure 298-18* is used in designing TC-17.10 sign supports (*see Section 240-4.5*).
298-19 Two and Three Beam Installation Details

*Figure 298-19* defines dimensions used in designing the supports (*see Section 240-5.3*).

298-20 TC-16.21 Overhead Sign Support

*Figure 298-20* illustrates design details needed and provides a sample table for use in a plan (*see Section 240-4.3*).

298-21 TC-17.10 Span Wire Sign Support

*Figure 298-21* illustrates design details needed and provides a sample table for use in a plan (*see Section 240-4.5*).

298-22 Lane-Use Control Signs Index

*Figure 298-22* illustrates various Lane-Use Control signs not shown in the OMUTCD, and provides code number and size information (*see Section 201-10*).

298-23 Mounting a Sign Support on Concrete Barrier

*Figure 298-23* illustrates a sign support developed to mount signs on concrete barrier.

298-24 Staking Sign Locations

*Figure 298-24* is an illustration supporting the discussion in *Section 250-3.1* about staking.

298-25 Foundation Excavations

*Figure 298-25* illustrates a foundation excavation, as described in *Section 250-3.2*.

298-26 Solid Wood Posts

*Figure 298-26* presents design details for solid wood posts used as sign supports, as described in *Section 221-5*.

298-27 Design Chart for Solid Wood Posts

*Figure 298-27* provides a design chart for solid wood posts used as sign supports (*Section 221-5*).

298-28 Example of Signing for an Expressway At-Grade Intersection with a Numbered Route

*Figure 298-28* illustrates recommended Guide Sign placement for expressway at-grade intersections with numbered routes, as described in *Section 209-6*.

298-29 Example of Signing for an Expressway At-Grade Intersection with an Unnumbered Route

*Figure 298-29* illustrates recommended Guide Sign placement for expressway at-grade intersections with unnumbered routes, as described in *Section 209-6*.

298-30 Example of Signing for a Multi-Lane Rural Conventional Road Intersection with an Important Public Road

*Figure 298-30* illustrates recommended Guide Sign placement for intersections of major conventional roads with important public roads, as described in *Section 209-6*. 

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298-31 Example of Signing for a Single Lane Rural Conventional Road Intersection with an Important Public Road

*Figure 298-31* illustrates recommended Guide Sign placement for intersections of conventional roads with important public roads, as described in *Section 209-6*.

298-32 Example of Signing for a Single Lane Rural Conventional Road Offset Intersection with an Important Public Road

*Figure 298-32* illustrates recommended Guide Sign placement for offset conventional road intersections with important public roads, as described in *Section 209-6*.

298-33 Signing for Optional Lane Exits - Without Secondary Exits

*Figure 298-33* illustrates recommended Guide Sign placement for optional lane exits without secondary exits, as described in *Section 209-7*.

298-34 Signing for Optional Lane Exits - Secondary Exits-Low Volume Primary Exit

*Figure 298-34* illustrates recommended Guide Sign placement for optional lane exits with secondary exits and a low volume primary exit, as described in *Section 209-7*.

298-35 Signing for Optional Lane Exits - Secondary Exits-High Volume Primary Exit

*Figure 298-35* illustrates recommended Guide Sign placement for optional lane exits without secondary exits and a low volume primary exit, as described in *Section 209-7*.

298-36 Signing for Optional Lane Exits - Secondary Exits- Major Split

*Figure 298-36* illustrates recommended Guide Sign placement for optional lane exits with a major split exit, as described in *Section 209-7*.

298-37 Examples of Signing for Historical Markers

*Figure 298-37* illustrates examples of signing for historical markers, as described in *Section 205-6*.

298-38 Example of Route Signing for Municipal Street Systems

*Figure 298-38* illustrates an example of route signing for municipal street systems, as described in *Section 204-6*.

298-39 Example of Freeway and Expressway Rest Area Signing

*Figure 298-39* illustrates an example of freeway and expressway rest area signing, as described in *Section 208-1*.

298-40 Example of Conventional Road Rest Area Signing

*Figure 298-40* illustrates an example of conventional road rest area signing, as described in *Section 208-1*.

298-41 Example of Conventional Road Rest Area Signing

*Figure 298-41* illustrates an example of conventional road rest area signing, as described in *Section 208-1*. 

2-204 October 23, 2002 Revised April 20, 2012
298-42 Example of Clearance Signs on a Low Clearance Structure

Figure 298-42 illustrates an example of Clearance signs on a low clearance structure, as described in Section 202-7.

298-43 Example of Freeway Transition Signing

Figure 298-43 illustrates an example of freeway transition signing, as described in Section 202-9.

298-44 Example of Conventional Highway Transition Signing

Figure 298-44 illustrates an example of conventional highway transition signing, as described in Section 202-9.
Intentionally blank.
Figure 298-1. Signing for Median Crossovers

(Figure to be updated in July quarterly revision)
Figure 298-2. STOP Signs at Intersections
Figure 298-3.  Ramp Location Codes
Figure 298-4a. Regulatory and Warning Signs

- **NO ENGINE BRAKE**
  - R20-H1
  - (Sec. 201-7)

- **END ENGINE BRAKE RESTRICTION**
  - R20-H2
  - (Sec. 201-7)

- **6PM-6AM**
  - 500 FT
  - 2 MILES
  - R10-H20bP
  - (Sec. 201-7)

- **STATE LAW**
  - MOVE OVER OR SLOW DOWN FOR STOPPED LAW ENFORCEMENT AND PUBLIC SAFETY VEHICLES
  - R25-H1
  - (Sec. 201-8)

- **SHOULDER NARROWS**
  - W11-H14P
  - (Sec. 202-6)

- **NEXT 500 FT**
  - NEXT 1 MILE
  - NEXT 2 MILES
  - R10-H20cP
  - (Sec. 201-7)

- **USING ROADWAY AHEAD**
  - W11-H14a
  - (Sec. 202-6)
Figure 298-4b. Regulatory and Warning Signs (Continued)

W13-H10P  (Sec. 202-4)

W13-H11P  (Sec. 202-4)
Figure 298-5a. Route and Information Signs

D5-H51P  (Sec. 208-3)

D5-H52P  (Sec. 208-3)

D6-H5  (Sec. 206-8)

D7-H10P  (Sec. 206-12)

D10-H8  (Sec. 206-15)

D10-H8a  (Sec. 206-15)

D20-H1  (Sec. 204-3)

D20-H2  (Sec. 204-3)

D12-2  (Sec. 206-6)
Figure 298-5b. Route and Information Signs (Continued)
Tourist Oriented Directional Signing (TODS)
(Other variations possible)
(Section 207-3)

Specific Service Signing (LOGO)

E9-H1
(Other variations possible)
(Sec. 207-2)
E9-H17
(Other variations possible)
(Sec. 207-2)
Figure 298-6a. Rest Area and Miscellaneous Signs

<table>
<thead>
<tr>
<th>Sign Description</th>
<th>Dimensions</th>
</tr>
</thead>
<tbody>
<tr>
<td>TOURIST INFO CENTER</td>
<td>D5-H7aP</td>
</tr>
<tr>
<td></td>
<td>108” x 48”</td>
</tr>
<tr>
<td>TOURIST INFO</td>
<td>D5-H7bP</td>
</tr>
<tr>
<td></td>
<td>108” x 24”</td>
</tr>
<tr>
<td>TOURIST INFO CENTER NEXT RIGHT</td>
<td>D5-H7c</td>
</tr>
<tr>
<td></td>
<td>144” x 72”</td>
</tr>
<tr>
<td>OHIO WELCOME CENTER</td>
<td>D5-H9aP</td>
</tr>
<tr>
<td></td>
<td>120” x 48”</td>
</tr>
<tr>
<td>LOCAL TOURIST INFO CENTER NEXT RIGHT</td>
<td>D5-H7d</td>
</tr>
<tr>
<td></td>
<td>156 x 72”</td>
</tr>
</tbody>
</table>
Figure 298-6b. Rest Area and Miscellaneous Signs

- NO FACILITIES (Sec. 208-4)
- D5-H17
- D5-H18 (Sec. 208-5)
- D5-H21 (Sec. 208-5)
- D5-H22 (Sec. 208-5)
- D5-H23 (Sec. 208-5)
- D5-H24 (Sec. 208-5)
- D5-H25 (Sec. 208-5)
- D5-H26 (Sec. 208-5)
- D5-H27 (Sec. 208-5)
- D5-H28 (Sec. 208-5)
- D5-H29 (Sec. 208-5)
- D5-H30 (Sec. 208-5)

Ohio Department of Transportation
District 10

Rest Area Regulations
See Bulletin Board

$2500 Penalty
Malicious
Destruction of Property
Sec. 2979:03 Rev. Code

These Rubbish Cans
For Use of Traveling
Motorist Only
Local Residents
Will Be Prosecuted
O.R.C. 515.07

No Pets
Allowed in
Building

Pet Owners
Do Not Exercise
Pets in Picnic Areas
Use Either End of
Parking Area

No Children
Under 12
Beyond This Point
Unless Accompanied
By Parent

No Swimming

Rest Area 10-2
Washington 1-77:315

Rest Area 01-02
Figure 298-6c. Rest Area and Miscellaneous Signs (Continued)
Figure 298-7. Amish Buggy Signing where Paved Shoulder Becomes Narrower
Figure 298-8. Placement of Overhead Exit Direction Sign - Span Type

(Figure to be updated in future revision)
Figure 298-9. Placement of Overhead Exit Direction Sign - Cantilever Type

X = Ramp Lane Width

* Locate the left edge of the sign 12 feet left of the pavement edge when there are three or more directional lanes.
Figure 298-10. Reserved for Future Information
Figure 298-11. Sight Distance Requirements for Overhead Guide Signs (Mainline and Ramps)
Figure 298-12. Design Chart for TC-12.30 Sign Supports
Figure 298-13. Design Chart for Overhead Sign Support Trusses
Figure 298-14. Design Chart for Single Post Installations

*Single #4 square posts are approved for installation in exposed locations. Single #4 U-channel posts are not approved for installation in exposed locations and can only be installed in protected locations.

**Single #6 U-channel posts are not approved for installation in exposed locations and can only be installed in protected locations.
Figure 298-15. Design Chart for Two Post Installations

* Two #4 and #6 U-channel and #4 square posts are not approved for installation in exposed locations and can only be installed in protected locations.
Figure 298-16. Design Chart for Two Beam Installations

MAX. SIGN AREA  SQ.FT. (m²)
TWO BEAM INSTALLATIONS
SIGNS 19'-0" (5.8 m) OR LESS IN LENGTH
Figure 298-17. Design Chart for Three Beam Installations

MAX. SIGN AREA SQ.FT. (m²)
SIGNS OVER 19'-0" (5.8 m) IN LENGTH
THREE BEAM INSTALLATIONS
Figure 298-18. Design Chart for TC-17.10 Sign Supports
Figure 298-19. Two and Three Beam Installation Details
Figure 298-20. TC-16.21 Overhead Sign Support
Figure 298-21. TC-17.10 Span Wire Sign Support
Figure 298-22. Lane-Use Control Signs Index

R3-5a           R3-5L         R3-5R           R3-6L          R3-6R         R3-H6a           R3-H6b          R3-H6e
30x36           30x36         30x36           30x36           30x36          30x36              42x36           30x36
36x42           36x42         36x42           36x42           36x42
R3-H8          R3-H8ba       R3-H8bb       R3-H8bc       R3-H8bd       R3-H8be       R3-H8bf         R3-H8bg
30x30            30x30            30x30            30x30           30x30           30x30            30x30             30x30
R3-H8bh          R3-H8bj           R3-H8bk          R3-H8bm         R3-H8bn         R3-H8bp        R3-H8bq
36x30              36x30               36x30              36x30         36x30            30x30            36x30
R3-H8bs   R3-H8bt  R3-H8bu              R3-H8a                   R3-H8b                    R3-H8ca
36x30     42x30                  42x30                  48x30                      48x30                       48x30
R3-H8cb                R3-H8cc                R3-H8cd                R3-H8ce                R3-H8cf
48x30                    48x30                    48x30                    48x30                    48x30
R3-H8cg                R3-H8ch                R3-H8cj                R3-H8ck               R3-H8cm
48x30                     48x30                    48x30                    48x30                   48x30
R3-H8cn                  R3-H8cp               R3-H8cq                R3-H8cs                R3-H8ct
48x30                      48x30                    48x30                    48x30                     48x30
R3-H8cu                R3-H8cv                R3-H8cw                 R3-H8cx                R3-H8cy
48x30                     48x30                    48x30                     48x30                    48x30
Figure 298-22. Lane Use Control Signs Index (Continued)
Figure 298-23. Mounting a Sign Support on Concrete Barrier
Figure 298-24. Staking Sign Locations
Figure 298-25. Foundation Excavations
Figure 298-26. Solid Wood Posts

Recommended wind pressure to use in size calculations:

Wind pressure on sign = 15 lb/ft²
Wind Pressure on exposed post = 18 lb/ft²

<table>
<thead>
<tr>
<th>Nominal Post Size (inches)</th>
<th>Hole Diameter (inches)</th>
<th>No. of Posts Permitted in 7’ Path in Exposed Locations</th>
<th>Minimum Recommended Embedment Depth (feet)</th>
<th>Maximum Recommended Allowable Moment per Post (ft-lb)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 x 4</td>
<td>None</td>
<td>2</td>
<td>3.5</td>
<td>1050</td>
</tr>
<tr>
<td>4 x 6</td>
<td>1 ½</td>
<td>2</td>
<td>4</td>
<td>2540</td>
</tr>
<tr>
<td>6 x 6</td>
<td>2</td>
<td>1</td>
<td>4.5</td>
<td>3880</td>
</tr>
<tr>
<td>6 x 8</td>
<td>3</td>
<td>1</td>
<td>5</td>
<td>6580</td>
</tr>
</tbody>
</table>
Figure 298-27. Design Chart for Solid Wood Posts
(See Section 221-5 and Figure 298-26 for additional information.)

Two Post Installations
(Nominal Post Size in inches (mm))
Figure 298-28. Example of Signing for an Expressway At-Grade Intersection with a Numbered Route
(Figure to be updated in future revision)
Figure 298-29. Example of Signing for an Expressway At-Grade Intersection with an Unnumbered Route
Figure 298-30. Example of Signing for a Multi-Lane Rural Conventional Road Intersection with an Important Public Road
Figure 298-31. Example of Signing for a Single Lane Rural Conventional Road Intersection with an Important Public Road

Distance “D” is determined in accordance with OMUTCD Table 2C-4, Condition B.

Revision Note: Revise sizes of D3-H1 and D3-H1b to 72” x 12”.
Figure 298-32. Example of Signing for a Single Lane Rural Conventional Road Offset Intersection with an Important Public Road
(Figure to be updated in future revision)

Distance “D” is determined in accordance with MUTCD Table 2C-4, Condition B.

Revision Note:
1. Revise the sign code number D3-H2 above to D3-H1.
2. Revise the sign code number D3-H2a above to D3-H1b.
3. Revise the legends on both of these signs from all capitals to upper/lowercase letters.
Figure 298-33. Signing for an Optional Lane Exit without a Secondary Exit

(Figure to be updated in future revision)
Figure 298-34. Example of Signing for an Optional Lane Exit with a Secondary Exit – Low-Volume Primary Exit

(Figure to be updated in future revision)
Figure 298-35. Example of Signing for an Optional Lane Exit with a Secondary Exit – High-Volume Primary Exit

(Figure to be updated in future revision)
Figure 298-36. Example of Signing for an Optional Lane Exit with a Secondary Exit – Major Splits
(Figure to be updated in future revision)
Figure 298-37. Examples of Signing for Historical Markers

Historical Marker located along Two-Lane Roadway

Historical Marker located along Multi-Lane Roadway

Historical Marker located on Intersecting Road with Two-Lane Roadway

Historical Marker located on Intersecting Road with Multi-Lane Roadway
Figure 298-38a. Example of Route Signing for Municipal Street Systems
Figure 298-38b. Example of Route Signing for Municipal Street Systems (Continued)
Figure 298-39. Example of Freeway and Expressway Rest Area Signing

(Figure to be updated in future revision)
Figure 298-40. Example of Conventional Road Rest Area Signing

(Figure to be updated in future revision)
Figure 298-41. Example of Conventional Road Rest Area Signing

(Figure to be updated in future revision)
Figure 298-42. Example of Clearance Signs on a Low Clearance Structure

Note: The W12-2a sign shall be used when the 10 foot chord (center) clearance of the overhead structure is 13.5 feet or less.
Figure 298-43. Example of Freeway Transition Signing
Figure 298-44. Example of Conventional Highway Transition Signing

Note: Refer to the OMUTCD for sign placement.
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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 (CMS) sections as well. It should be recognized, however, that the information in the CMS and SCDs does not necessarily provide the only method to achieve a given objective.
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301 PAVEMENT & CURB MARKINGS

301-1 General

OMUTCD Chapters 3A and 3B present information on pavement markings. Additional standards and guidelines are provided herein. Chapters 340 through 343, 350 and 360 of this Manual present additional design, specification and Supplement information, and Standard Construction Drawings (SCDs) TC-71.10, TC-72.20 and TC-73.10 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 904, respectively.

301-2 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 and heat-fused preformed thermoplastic. Pavement marking materials for application on ODOT-maintained highways should be selected from Table 397-1.

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

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

1. Local maintaining agencies shall agree in writing to maintain such markings in-kind in the future.
2. The policy regarding ODOT-maintained highways in Villages is contained in Section 301-3.

301-3 Pavement Marking in Incorporated Villages

ORC Section 5521.01 provides that the Director of Transportation, upon request by, and approval of, the legislative authority of a Village, shall maintain, repair and apply standard longitudinal pavement markings 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 Administration, Maintenance Section’s 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 CMS 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. The standard width for center lines on ODOT-maintained highways shall be 4 inches. The standard width for lane lines and edge lines on ODOT-maintained interstates and interstate look-alikes and rural multi-lane divided highways shall be 6 inches, and the standard width for channelizing lines shall be 12 inches. On all other ODOT-maintained highways, the standard width for lane lines and edge lines shall be 4 inches and the standard width for channelizing lines shall be 8 inches. 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.

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

The general standards for Crosswalk Lines 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.

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 for the handicapped. This information is available from the Access Board at www.access-board.gov and from the Ohio ADA at www.ada-ohio.org. A bulletin specifically addressing accessible parking is also available from the Access Board website.

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 OMTUD Figures 3B-22 through 3B-26, 3B-28 through 3B-30, and Appendix F of the Sign Designs and Markings Manual). OMTUD Section 3B.20 establishes general standards for pavement marking words, symbols and arrows, and 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 OMTUD 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 OMTUD and TEM Parts 7, 8 and 9, respectively.

The optional narrow elongated arrow design mentioned in the note in OMTUD 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.

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 OMTUD Figure 3B-7 and 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 OMTUD 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 see **Section 342-4 (Plan Note 342-4)** when Speed Measurement Markings are included in a plan.

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 to the OSHP Aviation Section Headquarters on the Air Speed Check Zone Request Form (**Form 396-1**).

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

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

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

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

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

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

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

5. If for some reason the request is not practical, the District shall return the request to the OSHP Aviation Section Headquarters (at the address noted in item 4c) explaining the reason for not complying with the request.

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

   a. Update its records,

   b. Complete the ODOT portion of the request form,

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

   d. Allow the markings to wear out.
300 MARKINGS

Traffic Engineering Manual

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 Section 802 and 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 (from the City of Columbus) are available upon request from the Standards Section of the Office of Traffic Engineering (OTE).

301-13 Fire Hydrant Markers

OMUTCD Section 3B.11 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 Traffic Engineering. Generally, this is an urban issue and has been left to local jurisdictions to address as needed.

The blue pavement markers are, of course, subject to the same problems as our standard raised pavement markers (RPMs) in areas subject to snowfall. It has been noted that, if the primary concern is to attract attention quickly to a nearby hydrant, there are other methods that can be used, such as small signs, 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.

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>

301-14.2 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. When used for those situations, the spacing of markings shall be as noted in Section 301-14.1. Also see SCD TC-72.20, Freeway Entrance and Exit Ramp 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 Islands 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 feet spacing begins at both ends of the island. Also see 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 Shields for Pavement Markings

Because of the potential hazard for motorcycles, elongated route shields for pavement markings shall not be installed on ODOT-maintained highways unless specifically approved by the Office of Traffic Engineering.

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.
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302 RAISED PAVEMENT MARKERS

302-1 General

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

Temporary raised pavement markers are addressed in Section 605-11.12, SCDs MT-95.70, 96.11 and 99.30. Supplement 1056 specifies the Prequalification Procedure for Work Zone Raised Pavement Markers.

302-2 Guidelines and Placement Standards

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

SCDs TC-65.10 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.

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 Traffic Engineering (OTE) shall:
   a. Develop specifications and standards;
   b. Evaluate new RPM materials; determine the method of RPM installation, maintenance and replacement;
   c. Administer the term purchase contract for RPM materials; and
   d. Conduct Quality Assurance Reviews (QARs) at least every two years in each District.

2. The District shall:
   a. Carry out the RPM program in a manner to install 100 percent of the RPMs on all eligible ODOT-maintained highways;
b. Replace RPMs that are removed/disturbed, for whatever reason, as soon as practicable;

c. Maintain a roadway inventory of all RPMs; and

d. Systematically replace RPM prismatic reflectors.

302-4 Maintenance

To be effective, RPMs must be properly maintained to keep prismatic reflectors and castings in good condition. Proper maintenance can be best accomplished by a program which emphasizes replacement of removed/disturbed RPMs as soon as practicable in conjunction with a systematic replacement of RPM reflectors on a two to four year cycle. The length of the replacement cycle would be 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 online 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 SCD TC-65.11 at narrow and one-lane bridges. The center line pavement marking shall be stopped 160 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.
RESERVED FOR FUTURE INFORMATION
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 SCD TC-61.10, CMS Item 620 and CMS 720. Delineator reflector and flexible post color shall match that of the nearest edge line.

304-2 Delineator Types

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

304-3 Application Guidelines

In accordance with the provisions of CMS 620.02, on ODOT-maintained routes, only flexible delineator posts on the qualified products list shall be installed for roadside delineation. This list is available at: http://www.dot.state.oh.us/Divisions/ConstructionMgt/Materials/Pages/QPL.aspx (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 Median Openings for Private Access

When it is determined that delineation of a median opening for private access is needed, a rectangular yellow (Type D) delineator should be erected at the median nose on the centerline of the median, on each side of the opening (see Figure 398-1). If the median width exceeds 40 feet, this delineator should be erected 20 feet from the pavement edge. Additional delineators may be erected up to 200 feet upstream from the median nose.

304-5 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 SCD TC-61.10. 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.

304-6 Delineation for Left-Turn Lanes in Medians

Delineation is recommended for parallel and tapered left-turn lanes at intersections which are not illuminated. Delineators should be erected 4 to 6 feet from the edge of roadway, but not less than 2 feet from the edge of a paved or usable shoulder. This is illustrated in Figures 398-3 and 398-4. On curbed sections, the delineators should be erected 2 feet behind the face of the curb.

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

OMUTCD Section 2B.32 provides information on the R4-7b sign. Sections 2C.63, 2C.64, 2C.65 and 2C.66 of the OMUTCD and Section 202-14 of this Manual provide information on object markers.

304-7 Delineators for Type E-98 Anchor Assemblies

A Type C or Type D delineator should be installed on a flexible post at the head of all Type E-98 guardrail end terminals in accordance with Plan Note R113 (see L & D Manual Volume One, Appendix B).
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 Plan Insert Sheet 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.
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307  BARRIER REFLECTORS

307-1  General

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

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

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

Systematic replacement of barrier reflectors should be scheduled on a five-year cycle.

310  ISLANDS

OMUTCD Chapter 31 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 One Section 300 includes additional information about medians and curbs.

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

CMS 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 Sheeting

Type G retroreflective sheeting (see CMS 730.19) shall be used on cones and tubular markers used at night, barricades and drums, delineators, object markers, end-of-roadway markers, guardrail anchor assemblies and impact attenuators. Information about guardrail anchor assemblies and impact attenuators is provided in the L&D Manual Volume One, Section 603. Information about the use of Type G 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 One, Appendix B).

320-5 Barrier Reflectors

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

Barrier reflectors shall be purchased only from companies on the QPL maintained by the Office of Materials Management. The manufacturer shall submit to ODOT a sample of the reflector along with a catalog description showing recommended installation procedures and certified test data from an independent test laboratory. ODOT will evaluate these samples to determine conformance with CMS 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.

Revised October 15, 2010

October 23, 2002

3-25
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330 PLANNING / PROGRAMMING

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

   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).
   g. Object Marker locations (Table).
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341 PLAN PREPARATION / PRODUCTION

341-1 General

The L&D Manual Volume Three and 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 SCDs TC-71.10, TC-72.20 and TC-73.10. These should be drawn to appropriate scale for the contractor to properly place the markings.

3. Subsummary tabulations shall be made of the various markings, as required in the Construction and Materials Specifications (CMS) (i.e., CMS Items 642, 643, 644, 645, 646, 647, and 817). 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

4. Payment for all pavement marking items in the General Summary shall be carried as CMS Items 642, 643, 644, 645, 646, 647, and 817 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."

### 341-3 Work Zone Pavement Marking Materials

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

### 341-4 Raised Pavement Markers

As noted in *Section 302-2*, raised pavement markers (RPMs) should be included in new and resurfacing construction projects on ODOT-maintained highways. They may also be included in the plans at other locations as specified in the 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 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.
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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 CMS, both the note and the bid item will be “as per plan.” Where there are design instructions pertaining to a specific note, they are listed at the end of the note. These notes may be modified to further define the conditions of a project or maintaining agency.

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

342-2 Handicap Symbol Marking

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 the Figure 3B-22 of the Ohio Manual of Uniform Traffic Control Devices, 2012 edition, 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 or 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.

Place the markings at 0.25 mile intervals over a 1 mile length of 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 shall be according to the pavement marking material used and shall include the surveying work. The five markings placed in each 1 mile of roadway shall equal one zone. One zone shall be measured as 1 Each for Air Speed Zone Marking.

**Designer Note:** This note may 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>Daytime</td>
</tr>
<tr>
<td>Nighttime</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.
343 SPECIFICATIONS

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

- 620 and 720 Delineators
- 621 and 721 Raised Pavement Markers
- 626 and 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>CMS 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>817</td>
<td>Spray Thermo Plastic Pavement Markings</td>
</tr>
</tbody>
</table>

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

The CMS 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/constructionmgmt/pages/proposalnotessupplementalspecificationsandsupplements.aspx](http://www.dot.state.oh.us/divisions/constructionmgmt/pages/proposalnotessupplementalspecificationsandsupplements.aspx)
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350 CONSTRUCTION

350-1 General

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

350-2 Work Zone Performance Evaluations

The performance evaluation described in CMS 614.11 shall be conducted according to the ratings given in Table 397-3 for color, Table 397-4 for night visibility, and Table 397-5 for test line durability.

350-3 Raised Pavement Marker (RPM) Casting Installation

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

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

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

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

   b. Each casting must be centered lengthwise in the pavement cut, and there should be a 1/8 inch 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. A separate brochure providing a reprint of the information in this Section and Section 350-3 is available upon request from the Office of Traffic Engineering. The following describes the procedure for replacing an RPM reflector:

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

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

4. 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 Remediaal Action for Improperly Installed RPM Castings

RPM castings shall be installed properly in accordance with CMS Item 621.03 (Layout), CMS 621.04 (Installation of RPM Casting), and 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).

Illustration 4

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

Illustration 5

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

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) 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 Delineator on Curves and Tangent Sections

Delineators shall be spaced 400 feet apart on the tangent sections.

Delineators on the horizontal curves shall be spaced according to the table in the 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 One, 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 One, 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 A and A2 reflectors on the guardrail blockout.

3. Install Type B and B2 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 B and B2 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 CMS 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/Pages/default.aspx.
350-8.3 Application of Pavement Marking Materials

Pavement marking materials shall be applied according to CMS Items 640 and 740 as follows:

1. Traffic paint, CMS 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, CMS 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 feet.

   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, CMS 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.

   a. Material Type, Item 917.
   b. Glass Beads, Item 740.09 Type G.
   c. Application of Spray Thermoplastic, Item 817.
      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.
      iii. The temperature of spray 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 10 pounds per 100 square feet.
      v. Spray thermoplastic material shall be applied at a thickness of 45 mils.
      vi. 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 CMS 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 CMS 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. Per SCD TC-73.10, pavement marking lines shall be placed as follows:
   a. Edge lines shall be applied 6 inches from the pavement edge.
   b. Lane lines shall be applied 2 inches to the left of a joint.
   c. Center lines shall be applied 2 inches from a joint.

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 under laying old pavement is visible and the casting is missing.
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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.
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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 OTE forms web page:
www.dot.state.oh.us/Divisions/HighwayOps/Traffic/Pages/Forms.aspx
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# Air Speed Check Zone Request

## Form 396-1. Air Speed Check Zone Request

### OSP District Office
- **Request No.:** ____________
- **Date:** __/__/____
- **By Lt.** ____________
- **County:** ____________
- **Post:** ____________
- **Phone:** (____) ______—____

### ZONE(S) DATA

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<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>

### OSP Aviation Section
- **Date Reviewed:** __/__/____
- **Approved**
- **Date Forwarded to ODOT District ___ Office:** __/__/____
- **Necessity:** ____________
- **Disapproved**
- **Date Returned to OSP District Office:** __/__/____
- **c:** Highway Patrol Post District ___

### ODOT District Office
- **Reviewed by:** ____________
- **Name/Title:** ____________
- **Date:** __/__/____
- **Practical**
  - **Date of Layout:** __/__/____
  - **By:** ____________
  - **Registered Surveyor**
  - **Date Work Completed:** __/__/____
  - **By:** ____________
  - **Traffic Control Sup’t**
  - **Date Returned to the OSP 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 Throughfare Divided
- 30 Major Throughfare 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 ODOT.

(January 15, 2010) October 23, 2002
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### 397 TABLES INDEX

**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 Rating Daytime Color of Long Line Pavement Marking**

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

**397-4 Night Visibility Rating for Long Line Pavement Marking**

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

**397-5 Durability Rating for Long Line Pavement Marking**

As noted in *Section 350-2*, when conducting the performance evaluation described in CMS Item 614.11 the ratings given in *Table 397-5* shall be used.
Table 397-1. Material Selection for Pavement Marking and Expected Marking Life** in Years

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

(See next page for related notes.)

<table>
<thead>
<tr>
<th>Remaining Pavement Surface Life *</th>
<th>Asphalt</th>
<th>Concrete</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ADT &lt; 5,000 Years</td>
<td>ADT &gt; 5,000 Years</td>
</tr>
<tr>
<td>0 - 2 years</td>
<td>Water-Based Paint 1 Polyester 2  Spray Thermo 2 Water-Based Paint 1</td>
<td>Polyester 2 Water-Based Paint 1</td>
</tr>
<tr>
<td>3 - 4 years</td>
<td>Polyester 3 Spray Thermo 2 Water-Based Paint 1</td>
<td>Polyester 2 Spray Thermo 1 Water-Based Paint 1</td>
</tr>
<tr>
<td>&gt; 4 years</td>
<td>Thermo 4 Polyester 3 Spry Thermo 2</td>
<td>Epoxy 4 Spray Thermo 2 Water-Based Paint 1</td>
</tr>
<tr>
<td>New Surface</td>
<td>Alkyd Paint 1 Water-Based Paint 1</td>
<td>Alkyd Paint 1 Water-Based Paint 1</td>
</tr>
<tr>
<td>i) &lt;40° F</td>
<td>Alkyd Paint 1 Water-Based Paint 1</td>
<td>Alkyd Paint 1 Water-Based Paint 1</td>
</tr>
<tr>
<td>ii) 40 to 50° F</td>
<td>Water-Based Paint 1 Water-Based Paint 1</td>
<td>Water-Based Paint 1 Water-Based Paint 1</td>
</tr>
<tr>
<td>iii) &gt; 50° F</td>
<td>Thermo 4 Water-Based Paint 1</td>
<td>Epoxy 4 Water-Based Paint 1</td>
</tr>
</tbody>
</table>

### b. Long Line Pavement Marking – Multilane or Priority System

(See next page for related notes.)

<table>
<thead>
<tr>
<th>Remaining Pavement Surface Life *</th>
<th>Asphalt</th>
<th>Concrete</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ADT &lt; 5,000 Years</td>
<td>ADT &gt; 5,000 Years</td>
</tr>
<tr>
<td>0 - 2 years</td>
<td>Polyester 2 Water-Based Paint 1 Spray Thermo 2 Water-Based Paint 1</td>
<td>Polyester 2 Water-Based Paint 1</td>
</tr>
<tr>
<td>3 - 4 years</td>
<td>Polyester 3 Spray Thermo 2 Water-Based Paint 1</td>
<td>Polyester 2 Spray Thermo 1 Water-Based Paint 1</td>
</tr>
<tr>
<td>&gt; 4 years</td>
<td>Thermo 4 Polyester 3 Spry Thermo 2</td>
<td>Epoxy 4 Spray Thermo 2 Water-Based Paint 1</td>
</tr>
<tr>
<td>New Surface</td>
<td>Alkyd Paint 1 Water-Based Paint 1</td>
<td>Alkyd Paint 1 Water-Based Paint 1</td>
</tr>
<tr>
<td>i) &lt;40° F</td>
<td>Alkyd Paint 1 Water-Based Paint 1</td>
<td>Alkyd Paint 1 Water-Based Paint 1</td>
</tr>
<tr>
<td>ii) 40 to 50° F</td>
<td>Water-Based Paint 1 Water-Based Paint 1</td>
<td>Water-Based Paint 1 Water-Based Paint 1</td>
</tr>
<tr>
<td>iii) &gt; 50° F</td>
<td>Thermo 4 Water-Based Paint 1</td>
<td>Epoxy 4 Water-Based Paint 1</td>
</tr>
</tbody>
</table>
### Table 397-1. Material Selection for Pavement Marking and Expected Marking Life in Years (continued)

#### c. Auxiliary Pavement Marking – 2-Lane and Multilane or Priority System

| Remaining Pavement Surface Life * | Asphalt | | | Concrete | | | |
|----------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|
|                                  | ADT < 5,000 | ADT > 5,000 |          | ADT < 5,000 | ADT > 5,000 |          |          |          |
| **Type**                  | Years    | Years    |          | Years    | Years    |          |          |          |
| 0 - 2 years                | Water-Based Paint 1 | Water-Based Paint 1 | Spray Thermoplastic 2 | Alkyd Paint 1 | Water-Based Paint 1 | Heat Fused Preformed Tape 2 | Spray Thermoplastic 2 | Alkyd Paint 1 | Water-Based Paint 1 |
| 3 - 4 years                | Heat Fused Pre-formed Tape 4 Polyester 1-2 | Heat Fused Pre-formed Tape 2 | Heat Fused Pre-formed Tape 3 | Thermoplastic 2 | Spray Thermoplastic 2 | Water-Based Paint 1 | Heat Fused Preformed Tape 2 |
| > 4 years                  | Heat Fused Pre-formed Tape 4 Polyester 1-2 Water-Based Paint 1 | Heat Fused Pre-formed Tape 2 | Heat Fused Pre-formed Tape 3 | Thermoplastic 2 | Spray Thermoplastic 2 | Water-Based Paint 1 | Heat Fused Preformed Tape 2 |
| New Surface                | Same as used for long lines | Same as used for long lines | Same as used for long lines | Same as used for long lines |
| i) <40° F                  | | | | |
| ii) 40 to 50° F            | | | | |
| iii) > 50° F              | | | | |

**Notes:**

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

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

1. Spray thermoplastic works well for retracing existing thermoplastic. For other materials, check with material suppliers.
2. Auxiliary markings not regularly run over by traffic will last 1.5 to 2 times longer.
3. Surface preparation may be required to remove old markings as recommended by supplier.
4. Remove curing compound completely from new concrete surfaces - follow CMS Item 641.05.
5. Polyester pavement marking material is addressed in CMS Item 643. Since it adheres best to a worn surface, polyester is not to be placed until new asphalt pavement has been open to traffic at least fourteen days. Polyester pavement marking material shall only be used on CMS Item 446 or 448 pavements. This material shall not be used on the following asphalt concrete surfaces due to poor bonding qualities: open graded courses, slurry seal, **Supplemental Specification (SS) 805 Rubberized Sand Asphalt**, and **SS 807 Latex Modified Emulsified Asphalt Pavement Course**. Any Asphalt Concrete (Item Special) should be questioned before considering placement of polyester material on it.
6. Primer is required for thermoplastic when used on concrete.
7. Due to the high cost of preformed material, it should only be considered for use where extra long life is needed or in certain applications, such as bridge decks where thermoplastic has not adhered well.
8. Epoxy should only be used on pavements in good condition after surface preparation has been accomplished per manufacturer recommendations.
9. 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.
### Table 397-2. Area Calculations for Words and Symbols

<table>
<thead>
<tr>
<th>WORDS</th>
<th>square feet</th>
</tr>
</thead>
<tbody>
<tr>
<td>TYPE</td>
<td>HEIGHT 6 ft.</td>
</tr>
<tr>
<td>STOP</td>
<td>17</td>
</tr>
<tr>
<td>ONLY</td>
<td>17</td>
</tr>
<tr>
<td>SCHOOL(^1)</td>
<td>27</td>
</tr>
</tbody>
</table>

#### Handicap Symbol

<table>
<thead>
<tr>
<th>Height in.</th>
<th>Width in</th>
<th>Area Square ft.</th>
</tr>
</thead>
<tbody>
<tr>
<td>41</td>
<td>36</td>
<td>2.7</td>
</tr>
</tbody>
</table>

#### LANE-USE ARROWS square feet

<table>
<thead>
<tr>
<th>ARROW TYPE</th>
<th>SIZE</th>
<th>AREA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Turn Arrow</td>
<td>8.0</td>
<td>17</td>
</tr>
<tr>
<td>Straight Arrow</td>
<td>9.5</td>
<td>13</td>
</tr>
<tr>
<td>Combined Arrow</td>
<td>12.75</td>
<td>28</td>
</tr>
<tr>
<td>Lane-Reduction Arrow</td>
<td>18.0</td>
<td>46</td>
</tr>
</tbody>
</table>

#### R X R SYMBOL square feet \(^1\)

<table>
<thead>
<tr>
<th>WIDTH (W)(^2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>8 ft. min.</td>
</tr>
<tr>
<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 397-3. Rating Daytime Color of Long Line Pavement Marking

<table>
<thead>
<tr>
<th>Scale</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>White and yellow are very vivid and rich in appearance, and are very effective in delineation.</td>
</tr>
<tr>
<td>9</td>
<td>White and yellow are very distinctive and definite in color.</td>
</tr>
<tr>
<td>8</td>
<td>White and yellow appear somewhat grayish; yellow may appear to have a brownish or greenish tint.</td>
</tr>
<tr>
<td>7</td>
<td>White and yellow are dull and grayish; yellow may appear to be green, brown or off-white.</td>
</tr>
<tr>
<td>6</td>
<td>White and yellow appear very dull.</td>
</tr>
</tbody>
</table>

**Note:** The color rating is a subjective field assessment of the vividness of the white markings and the richness of the yellow markings when viewed under dispersed daylight conditions on dry pavement, in accordance with the table below.

Ideally, color should be assessed under uniformly overcast conditions. If it is necessary to conduct evaluations under clear or partly cloudy conditions, the color assessment should be made with the sun as near transit as practical, as the angle of the incident rays of the sun can have a significant effect on the appearance of the color of the pavement markings. Viewing the line with the sun behind and low on the horizon should be avoided, as this can impart a level of retroreflectivity to the pavement marking. Under certain circumstances, especially during the fall and winter, when the sun is low on the horizon even at transit, it may be necessary to view the line in the opposite direction to avoid excessive retroreflectivity imparted from the sun.

The evaluation process is conducted as follows: A trained evaluator observes the line from a distance of 100 feet (±10 feet), and rates the color as per the table below. For lane lines, this distance can be approximated by standing midway between two lane lines, and looking beyond the nearest two lane lines to the third.

In all cases, the color rating is expressed as an integer value.
### Table 397-4. Rating Night Visibility of Long Line Pavement Marking

<table>
<thead>
<tr>
<th>Uniformity</th>
<th>Retroreflectivity</th>
<th>Nighttime Color</th>
</tr>
</thead>
<tbody>
<tr>
<td>+4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Line is completely consistent in appearance, with no distinguishable variations</td>
<td>+3 Line is very bright</td>
<td>+3 White appears as very clean reflected light; yellow is distinctive and definite in color</td>
</tr>
<tr>
<td>+3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Line is generally consistent in appearance, with minimal variations</td>
<td>+3 Line is very bright</td>
<td>+3 White and yellow appear somewhat grayish; yellow may appear to have a brownish or greenish tint</td>
</tr>
<tr>
<td>+2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Line is generally consistent in appearance, but with distinctly brighter and darker areas</td>
<td>+2 Line is bright</td>
<td>+2 White and yellow are dull and grayish; yellow may appear to be green, brown or off-white</td>
</tr>
<tr>
<td>+1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Line is inconsistent in appearance, with distinctly brighter and darker areas</td>
<td>+1 Line appears adequate, but with unimpressive brightness</td>
<td>+1 White and yellow appear very dull</td>
</tr>
<tr>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Line is very inconsistent in appearance and may appear blotchy</td>
<td>0 Line has minimal brightness; line is discernable but only marginally effective</td>
<td>0 White and yellow appear very dull</td>
</tr>
</tbody>
</table>

**Note:** Night visibility is a subjective rating based on the appearance of the pavement marking line on dry pavement to a trained evaluator in a vehicle when viewed under low beam headlight illumination at night. The night visibility rating consists of an evaluation of three distinct attributes:

- **Uniformity** – The ability of the line to provide a consistent, unvarying appearance along its length and across its width.
- **Retroreflectivity** – The brightness of the line in the return of incident illumination.
- **Nighttime Color** – The vividness of the white markings and the richness of the yellow markings when seen with retroreflected light.

The rating scales for each of these attributes is described in the tables above.

The evaluation process is conducted as follows: With appropriate traffic control in place, slowly drive through the test section at night with low beam headlights, and observe the test line. First, rate the uniformity of the line appearance. Second, rate the line retroreflectivity. Finally, rate the color. Add up the three individual scores to get a composite rating for the line.

In all cases, the night visibility rating is expressed as an integer value.
Table 397-5. Durability of Long Line Pavement Marking

<table>
<thead>
<tr>
<th>Rating</th>
<th>Percentage of Line Remaining</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>100</td>
</tr>
<tr>
<td>9</td>
<td>90</td>
</tr>
<tr>
<td>8</td>
<td>80</td>
</tr>
<tr>
<td>7</td>
<td>70</td>
</tr>
<tr>
<td>6</td>
<td>60</td>
</tr>
<tr>
<td>5</td>
<td>50</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Rating</th>
<th>Percentage of Line Remaining</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>40</td>
</tr>
<tr>
<td>3</td>
<td>30</td>
</tr>
<tr>
<td>2</td>
<td>20</td>
</tr>
<tr>
<td>1</td>
<td>10</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

**Note:** Durability is the rating of the adherence of the pavement marking material to the sound pavement surface, based on the percentage of the material remaining adhered. Durability is not an assessment of the thickness of the material or retention of optical elements, but rather an analysis of the amount of bare, sound pavement showing that was once covered with pavement marking material.

Durability is an objective assessment, although there exists no mechanical means to reliably and quickly measure durability in the field. Therefore, the field assessment of pavement marking durability must be made by trained evaluators.

The evaluation process is conducted as follows: Several trained evaluators observe the test line by viewing vertically from above. An assessment of the durability is made by each. The durability rating is agreed upon in the field by a consensus of the evaluators.

If line deterioration is inconsistent throughout the length of the test section, several line segments should be evaluated. Each segment should be a minimum of ten feet in length, and no less than 2% of the total length of the line. The durability rating is the lowest rating for any line segment, as agreed upon by a consensus of the evaluators.

Portions of the line subjected to unusual wear, such as at driveways or from line tracking prior to final curing, should be categorically excluded from the durability assessment. In addition, failures within the pavement must be recognized and discounted when assessing the durability of the pavement marking.

In all cases, the durability rating is expressed as an integer value.
398 FIGURES INDEX

398-1 Standard Delineation for Median Opening for Private Access

As noted in Section 304-4, Figure 398-1 provides detail guidelines in marking a median opening for private drive access.

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 Standard Delineation for Parallel Left-Turn Lane

As noted in Sections 202-14.3 and 304-6, Figure 398-3 provides detail guidelines for marking a parallel left-turn lane.

398-4 Standard Delineation for Tapered Left-Turn Lane

As noted in Sections 202-14.3 and 304-6, Figure 398-4 provides detail guidelines for marking a tapered left-turn lane.
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Figure 398-1. Standard Delineation for Median Opening for Private Access

Note: If the median width exceeds 40 feet, the delineator at the median nose should be erected 20 ft from the pavement edge.
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 OMUTCD Section 3B.01).
Figure 398-3. Standard Delineation for Parallel Left-Turn Lane

Note: This figure is intended to show standard delineation only - not all necessary pavement markings and signing are shown.
Figure 398-4. Standard Delineation for Tapered Left-Turn Lane

Note: This figure is intended to show standard delineation only - not all necessary pavement markings and signing are shown.
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400  GENERAL

400-1  Introduction

OMUTCD Section 1A.13 defines a Highway Traffic Signal as:

“...defined as a highway traffic signal by which traffic is warned or directed to take some specific action. “Highway traffic signal” does not include a power-operated sign, steadily-illuminated pavement marker, warning light, or steady burning electric lamp.”

OMUTCD Section 1A.13 defines a Traffic Control Signal (or traffic signal) as:

“any highway traffic signal by which traffic is alternately directed to stop and permitted to proceed.” [4511.01(RR), ORC].

The various types of traffic signals are discussed in OMUTCD Part 4.

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, operation and maintenance of the various traffic signal devices.

400-2  Construction Projects

Chapter 140 addresses the general application of ODOT standards, specifications and standard construction drawings in the design of construction projects. Chapter 450 provides additional construction related information specific to traffic control signals.

400-3  Force Account (ODOT Operations) Work

Districts performing force account signal work must comply with the requirements in the OMUTCD and this Manual. It is recommended that the Districts follow the provisions in the applicable signing related Standard Construction Drawings (SCDs) and Construction and Material Specifications (CMS) sections as well. It should be recognized, however, that the information in the CMS and SCDs does not necessarily provide the only method to achieve a given objective.
401 TRAFFIC CONTROL SIGNALS - GENERAL

401-1 General

OMUTCD Chapter 4D presents information on the design, location and use of traffic control signals. Construction details are shown on the SCDs TC-81.10 through TC-85.20. Traffic signal equipment is specified in CMS Items 632 and 633, and CMS 732 and 733.

401-2 Installation of Traffic Signals on State Highways

Policy 516-002(P) documents ODOT policy regarding installation of traffic control signals and intersection control beacons on state highways. A copy has also been included in the Appendix of this manual (Chapter 15).

401-3 Periodic Review of Signals

As noted in OMUTCD Section 4B.02, changing traffic patterns may render an existing traffic signal either inefficient or no longer necessary. Therefore, the responsible agency should periodically conduct a traffic engineering study to evaluate the efficiency and necessity of traffic signals under its jurisdiction and determine if revisions may be needed. This traffic engineering study may lead to changing the signal timing, signal phasing, vehicle or pedestrian detection, roadway geometry, or the complete removal of the traffic signal.

Traffic signal installations that are not properly designed and maintained for current traffic conditions, or are no longer warranted, can result in the following conditions:

1. Excessive traffic delay.
2. Increased disobedience of the signal indications.
3. The use of less adequate routes in order to avoid such signals.
4. Increased accident frequency, especially rear-end accidents.

Some signalized intersections and/or signalized corridors may be eligible to apply for, and participate in, the Systematic Signal Timing & Phasing Program (SSTPP). See Section 1213-6 for more information about this program.

401-4 Removal of Traffic Signals Under ODOT Jurisdiction

If a traffic engineering study indicates that the traffic signal is no longer justified, the traffic signal should be removed by a uniform procedure that will consider public input, accidents, site considerations and an appropriate replacement type of traffic control device. Therefore, when ODOT determines that an existing traffic signal installation no longer meets signal warrants as contained in the OMUTCD, or is no longer the appropriate form of traffic control, the District shall proceed through the following removal process to document and determine if the signal installation should be removed:

1. To determine if the traffic signal is still needed, the District shall prepare a traffic engineering study for the signal installation documenting the following information, as appropriate:
   a. Warrant analysis summary. If reasons other than the standard warrants were used to justify the signal installation, determine if these reasons are still valid.
   b. Accident history.
   c. Site conditions, especially sight distance problems.
d. Public, business, school board or governmental complaints resulting in the original signal installation.

e. Present and future developmental growth.

f. Known reasons for change in traffic patterns or volumes.

g. Capacity analysis for the alternate traffic control scheme most likely to be installed if the signal is removed.

h. Analysis of the cost of continued signal operation versus a one time signal removal cost.

i. Discussion of traffic volume growth needed to warrant the signal.

2. Based on the traffic engineering study, the District shall decide whether to proceed with the removal process or defer signal removal. If the removal is deferred, the District shall document the reasons for deferral. The signalized location shall be reconsidered for removal every year until a signal warrant or other determination of permanent retention is satisfied.

3. If the District decides to proceed with the removal process, the following steps shall be taken:

a. Inform the local media, schools, governmental agencies and local emergency/safety forces of ODOT’s intent to study the signalized location for removal.

b. Remove or reduce intersection sight distance restrictions, if needed.

c. Install the SIGNAL UNDER STUDY FOR REMOVAL (W3-H12) sign next to the signal heads on each approach.

d. Check the controller cabinet wiring to ensure that the color of the flashing indications will agree with the alternate traffic control scheme.

e. Install the alternate traffic control devices, such as STOP signs and advance Warning Signs. Existing Stop Lines on the uncontrolled approaches should not be removed at this time.

f. Place the signal in flashing operation for ninety days, in conjunction with item 3e above.

4. If the signal is put in flashing operation for ninety days in anticipation of removal, the District shall monitor accident experience during the ninety-day flashing period:

a. If accidents of types susceptible to correction by traffic signal control have increased by more than two, the signalized location shall remain in flashing operation for an additional sixty-day period. If more than two such accidents occur in the second sixty-day period, the District should retain the signal in stop-and-go operation until the site conditions can be improved to reduce the accident frequency.

b. If accidents of types susceptible to correction by traffic signal control have not increased by more than two, continue with the removal process.

c. The District shall also monitor, investigate and respond to the concerns of the public during this period.

5. If the District decides to proceed with the removal process after considering the information gathered in item 4:

a. The signal heads shall be bagged or removed, and the traffic signal turned off for a sixty
day period.

b. The accidents shall be monitored to determine if the absence of flashing traffic signals results in an increase in accidents. If accidents occur, the District may consider conversion of the traffic signal to a flashing intersection control beacon.

6. If it is decided to continue with removal of the signal, the District shall remove the signal heads, poles, foundations (1 foot below grade), pull boxes, overhead cables and controller. Underground conduit and cables may be abandoned in place. If the District wants to monitor the site for an extended period of time, the poles and cables may be left in place for one year.

7. The District shall notify all affected parties of the removal of the signal and the termination of any agreements that were in effect. If a signal permit exists for the signal removal location, the District will notify the Office of Traffic Engineering of the signal removal so that a statewide database on Village signal permits can be maintained.

401-5 Identifying Maintenance Responsibility for a Traffic Signal

Road users often have a need to know the maintaining agency of a traffic signal in order to report malfunctions or signal timing problems. Many agencies install a sign or a decal on the controller cabinet to inform the public of the responsible agency and give a telephone number to report problems.

In general, the maintaining agency of a traffic signal can be determined as follows:

1. **City/Village**: Inside the corporation limits of a City or Village, the City/Village is responsible for the traffic signal unless the signal is located at the end of an Interstate ramp in which case, ODOT may maintain the signals.

2. **ODOT**: Outside the corporation limits of a City or Village, traffic signals at intersections where at least one of the highways is a State or US Route are maintained by ODOT. ODOT is responsible for all signals at Interstate ramps.

3. **County**: Outside the corporation limits of a City or Village and the involved highways are not State or US Routes, the County will maintain the signal if at least one of the highways is a County Route.

4. **Township**: Outside the corporation limits of a City or Village and the involved highways are not State, US or County Routes, the Township will maintain the signal.

401-6 Village Signal Permit Procedures

Requests by village authorities for permission to install and operate traffic control signals on state highway extensions within villages *(Form 496-8)* should be substantiated by appropriate traffic studies and submitted to the District Deputy Director. If it is determined that a traffic control signal is warranted, authorization for the installation of a traffic control signal will be issued to the village authorities.

The authorization is valid for 180 days. During this time, the village shall prepare and submit to ODOT an operation plan for the proposed traffic signal installation *(Form 496-9)*. Upon approval of this plan, the village may purchase and install the traffic control signal. The fact that the Director of Transportation is authorized to determine whether a traffic control signal is warranted does not relieve the village authorities in any way from bearing the costs of purchasing, installing and maintaining the traffic signal equipment.

As soon as the traffic control signal has been installed and put in operation, the certification at the bottom of the form shown in Form 496-9 should be filled out and returned to the District Deputy Director. The final Traffic Control Signal Permit *(Form 496-10)* will then be issued by the
Director of Transportation and his agent will install an identification tag (I1-H2) with the correct permit number. Table 497-9 shows the range of Village Signal Permit numbers to be used by each District.

A request for modification of the hours of operation or timing of these village traffic control signals shall be submitted to the District Deputy Director for approval using Form 496-11. However, requests for alteration of any other aspect of the operation of a traffic signal covered by permit shall be submitted using the form shown in Form 496-8.

It is the responsibility of the village authorities to periodically review their traffic signals.

401-7 Signal Agreements

401-7.1 General
Stop-and-Go Traffic Signals may be installed at driveways or roadways to private entities. For the purpose of this document "Private Entity" refers to any non-public highway access and may include: local agency, developer, school, church, company, private individual.

Signals should not be installed unless they meet the warrants as outlined in the current version of the Ohio Manual of Uniform Traffic Control Devices (OMUTCD).

Unless otherwise noted below, all design, construction, maintenance, electrical and related costs for signals, that are installed for the benefit of a private entity shall be paid by the Private Entity or their legally authorized representative.

Prior to issuing a Right-of-Way Permit (MR509) for the installation or modification of a signal for a private entity, the District shall have a signed Maintenance Agreement which, amongst other requirements, will stipulate an annual maintenance fee due to ODOT from the private entity.

Ongoing electrical energy cost payments will be established in the agreement and in accordance with District policy.

401-7.2 Signalized Intersection Types and Costs
These signalized intersections may take a number of scenarios, of which the following describes the most common:

1. Private Drive only ("T" Intersection)
2. Private Drive across from Private Drive
3. Private Drive across from Public Road (not warranting signalization)
4. Private Drive across from Public Road (warrants signalization, but agency choosing not to signalize)
5. Private Drive across from Public Road (warranted and approved for signalization)

If another scenario arises that is not covered herein, the District should consult with the Office of Traffic Engineering.

Responsibility of costs associated with each scenario above:
1. All costs assumed by Private Entity(s). Maintenance Agreement(s) required.
2. All costs assumed by Private Entity(s). Maintenance Agreement(s) required.
3. All costs assumed by Private Entity(s). Maintenance Agreement(s) required.
5. All costs assumed by ODOT. No Maintenance agreement. Right-of-Entry Agreement may be necessary.
In each of these scenarios the private drive can be warranted or unwarranted for signalization.

In all cases, if ODOT is requiring the signal due to ODOT concerns (e.g.: safety countermeasure), all costs are assumed by ODOT. No maintenance agreement is required, but a Right-of-Entry Agreement may be necessary. If additional features (e.g.: turn phases, additional lane on driveway) above and beyond the ODOT requirements are requested by the private entity (and approved by ODOT), the installation costs shall be borne by the private entity.

401-7.3 Signal Reconstruction
If an ODOT project (e.g.: widening) requires replacement of a signal or its components, all costs to do so shall be the responsibility of ODOT.

If signal or component replacement, repair or modification is required due to private entity actions (e.g.: widening, pavement milling, relocating drive, expansion of property, significant increase in traffic generation), these costs shall be the responsibility of the private entity.

If a signal must be replaced due to age and/or deterioration of its components, all costs shall be the responsibility of ODOT.

401-7.4 Signal Maintenance Agreements
There are two types of agreements which may be necessary:

1. A Maintenance Agreement is used if fees will be required of the private entity,
2. A Right-of-Entry Agreement is used if signal appurtenances are located on the private property and require access by ODOT to maintain. The Right-of-Entry agreement may be part of the maintenance agreement or may stand alone.

Only standard agreements approved by the ODOT Chief Legal Office should be used. Standard Agreements are provided on the network O:\Traffic\Signals\Agreements\Standard Agreements. The README.doc gives a brief description of each agreement and how it should be used.

Where a standard agreement must be modified, it shall be done in consultation with the Office of Traffic Engineering and must be approved by the Chief Legal Office.

Agreements should be updated/amended when:
1. ODOT policy changes the terms of the existing agreement (e.g.: change in maintenance fees)
2. Private property changes ownership
3. Warranting conditions change affecting fee distribution (e.g.: formerly non-warranting public street becomes warranting or the classification (major/minor) of the generator changes.)

Agreements shall be memorialized in the "Miscellaneous Book" at the counties Record’s Office. The district office responsible for creating the signal agreements will work with the district Real Estate Office to have the agreement recorded. Any costs for recording the Agreement should be paid for by the District. When required, the District and developer or local agency must sign and notarize the agreement prior to the agreement being recorded.

401-7.5 Agreement Distribution List
The original signed copy of the agreement will be filed by the creator with color scanned PDF format copy sent to the District Auditor/Finance Office and a scanned or paper copy to the district’s signal maintenance file.
401-7.6 Maintenance Agreement Fees
The current annual maintenance fee is $3000 per Stop-and-Go intersection that involves a private entity.

Fees for Stop-and-Go traffic signals at opposing private drives are as follows:
- Single Major Generator = $3000
- Major Generator and Major Generator = $1500 / $1500
- Major Generator and Minor Generator = $2250 / $750

A major generator is a private entity that generates sufficient traffic to warrant a Stop and Go traffic signal. A minor generator is a private entity that does not generate sufficient traffic to warrant a Stop and Go traffic signal.

If the classification of a generator changes (minor to major or major to minor) or a generator is added to the intersection, any existing signal agreements should be updated accordingly.

401-7.7 Collection of Maintenance Agreement Fees
Annual maintenance fees shall be invoiced each January in advance of the year which maintenance is to be provided by the District in which the signal is located.

There will be situations where the District cannot collect the fees required by the agreement. This can be for any number of reasons including, but not limited to, the Private Entity cannot make or refuses to pay the required maintenance fees or the Owner of the property cannot be located. The District should make every attempt to locate the property owners and verify that they have not relocated or changed ownership. Districts should adhere to the following plan on delinquent invoices (providing Central Office Finance will all correspondence):

- 30 Days delinquent: Follow up letter and/or email sent to the Private Entity
- 60 Days delinquent: 2nd follow up letter and/or email sent to the Private Entity
- 90 Days delinquent: Phone call or personal visit to the Site
- 120 Days delinquent: Conference call with Central Office Finance on status

During the follow up process if payment is still not satisfied (120 Days delinquent), the District will install a “Signal Under Study for Removal” sign. At the conclusion of the study the signal should be removed if it does not create an unsafe condition to the general motoring public. Should at the District’s discretion, the removal of the signal creates an unsafe condition to the general motoring public, District Finance will notify Central Office Finance and the balance of the invoice will be sent to the Ohio Attorney General’s Office for further collections. Central Office Finance will act as ODOT’s intermediary with the AG’s Office. Once an invoice is sent to the AG’s Office for collection, it shall not be counted against a District for QAR requirements. The District will continue to maintain the signal(s) in question until such a time that a decision is made to remove the signal or a resolution is provided by the AG’s Office. Any action taken with the signal or a delinquent invoice will involve District Finance, Central Office Finance and the Office of Traffic Engineering.

If the following year, a signal maintenance agreement invoice needs to be created for an invoice that is currently outstanding at the AG’s Office from previous years, the process will start over again as a new invoice.

401-7.8 Property Transfer without Agreement
The new property owner will be sent a new agreement to sign. After the new agreement is signed an invoice will be sent to the owner for the prorated maintenance fee per the agreement. A letter should also be sent and include items similar to the following.
Located at the ingress and egress at the above location there is an existing traffic signal that was installed through a previous signal agreement with the State of Ohio. According to State Law, the Ohio Department of Transportation cannot install or maintain traffic signals on public, State and US routes to private driveways unless an agreement is entered into by both parties.

The agreement is a standard agreement developed by the Departments Chief Legal Counsel that cannot be modified. This agreement must be signed and returned to this office along with the proper payment no later than 30 days from receipt of this letter.

Failure to return the signed signal agreement and payment may result in the District performing a traffic engineering study of the subject location which could lead to the removal of the existing traffic signal.

401-7.9 Removal of Signal / Termination of Agreement

If failure to receive payment either due to refusal or inability to pay by the private entity or inability to locate the private entity by the District the following options should be pursued:

Notify the private entity(s) of pending signal (or signal phase) removal by letter with copies to all property tenants 30 days in advance of any removal action.

Post "Signal Under Study for Removal" signs (only if complete signal is proposed for removal) for two weeks with the signal in Stop-and-Go operation. Portable Changeable Message Sign (PCMS) may also be utilized.

Place signal on flash and follow signal removal process.

401-8 Open Architecture Traffic Signal Controllers

An open architecture traffic signal controller is a general purpose computer that is adapted for traffic signal control with software and input/output connections. An example of this type of traffic signal controller is the Model 2070. The software can be purchased separately from the controller and installed by the user. In certain instances, this can result in an agency using only one brand of software but obtaining competitive bids on the hardware.

ODOT has software licenses for 2070 controllers for any District to use. The licenses include local controller, master controller and personal computer interface software. The Model 2070 controller can be used with NEMA TS-1, NEMA TS-2 or Caltrans 332/336 cabinets.

401-9 Americans with Disabilities Act (ADA) Requirements

The ADA requirements are issued and regulated by the US Justice Department. Generally, there are four major ADA requirements that effect traffic signal projects:

1. Accessible pedestrian signals;
2. Audible pedestrian pushbuttons (locator tones);
3. Curb ramps;
4. Truncated domes (tactile bumps on the curb ramp).
See Sections 404-3 and 440-8 for details on these requirements. Web addresses for ADA Accessibility Guidelines information are shown in Table 197-3.

401-10 Special or Off-Duty Law Enforcement Officer Operation of ODOT Traffic Signal Procedures

Before a special or off-duty law enforcement officer (LEO) can operate an ODOT traffic control signal, authorization shall be obtained from ODOT.

Applications for permission to operate an ODOT traffic control signal (Form 496-14) by a special or off-duty LEO shall be submitted to the District Deputy Director a minimum of 21 days prior to the event for which the permit is being requested. If it is determined that the operation is acceptable, a permit for the operation of the traffic control signal shall be issued (Form 496-15).

Application shall be made by the private employer hiring the special or off-duty LEO. Application by the special or off-duty LEO is unacceptable.

The operation of the traffic control signal by the special or off-duty LEO shall conform to the Ohio Manual of Traffic Control Devices (OMUTCD).

Examples of events requiring a permit are church services, football or basketball games, midnight madness sales, farm science reviews and county fairs.
402 TRAFFIC CONTROL SIGNAL NEEDS STUDIES

402-1 General

All new or reconstructed signalized intersections shall be warranted based on OMUTCD Chapter 4C; however, for roadway projects that have a minor impact on the existing signals, signal warrants may not be necessary. An example is a pavement planing and resurfacing project which will destroy and replace loop detectors.

The satisfaction of a traffic signal warrant or warrants shall not in itself require the installation of a traffic control signal.

Considerations such as geometrics and lack of sight distance generally have not been accepted in lieu of satisfying signal warrants. These considerations may allow an otherwise unwarranted traffic signal to be retained at 100 percent local cost.

402-2 Traffic Volumes

In addition to proper signal warrant analysis, good signal design requires recent volume data. Therefore, for existing intersections, actual turning movement counts should be used for signal warranting purposes. The traffic counts shall not be over three years old and should, at a minimum, include the 8 hours that contain the greatest percentage of daily traffic.

If the actual turning movement counts fail to satisfy a signal warrant, it may be acceptable to use traffic volumes projected to the second year after project completion. The Office of Modeling and Forecasting should provide the projected traffic volumes. Twenty-year design ADT or DHV (Design Hourly Volumes) shall not be used for signal warrants. Seasonal Adjustment Factors should be applied to the actual traffic counts.

When actual side street volumes do not exist, such as at a proposed development or new road, an eighth highest hour factor may be used with the ADT for warrant purposes. This factor is obtained from the Office of Modeling and Forecasting, and usually ranges from 0.054 to 0.050 of the ADT. Hourly distribution factors should not be used to develop 8 hours of warrant data from the ADT as hourly distribution factors vary greatly depending on the type of development surrounding an intersection.

Consideration should be given to operating a signal, which was warranted based on project traffic, as a flasher until actual traffic volumes satisfy signal warrants and make signalization appropriate.

402-3 Signal Warrant Practices and Procedures

402-3.1 General

As noted above, the warrants used to evaluate the need for a traffic control signal at a particular location are described in OMUTCD Chapter 4C.

PC Warrants should be used for all ODOT Signal Warrant analysis.

402-3.2 Warrant Numbers 1, 2, and 3 (Volumes)

For determining the number of approach lanes, a short left-turn lane is not usually considered an approach lane (OMUTCD Section 4). Usually, the number of approach lanes refers to through lanes. An exception might be where a through lane develops into an exclusive turn lane or high-turning volumes require double turning lanes.

For new ODOT signals, warrant numbers 1, 2, and 3 shall be based on the 100 percent
values (OMUTCD Chapter 4) and right turn reduction factors.

For new ODOT signals, warrant numbers 1, 2 and 3 can be based on the 70 percent values (OMUTCD Chapter 4) combined with engineering judgment, Warrant 7 (Crash Experience) and right turn reduction factors.

For retention of existing ODOT Signals, warrant numbers 1, 2 and 3 can be based on the 70 percent values (OMUTCD Chapter 4) and engineering judgment.

Signals installed under Warrant No. 3 should be traffic-actuated.

402-3.3 Warrant No. 4 (Pedestrian Volume)

Intersections approved under this warrant shall utilize pedestrian signal heads. Signals based only on Warrant No. 4 or Warrant No. 5 should also control the minor street or driveway.

If installed at a non-intersection crossing the traffic control signal shall be pedestrian-actuated.

402.3.4 Warrant No. 5 (School Crossings)

Intersections approved under this warrant shall utilize pedestrian signal heads. Signals based only on Warrant No. 4 or Warrant No. 5 should also control the minor street or driveway.

The designer shall show that the intersection is used as a school crossing. This may include:

1. School route plan developed by the school system.
2. Count of pedestrians during the study period. OMUTCD Section 4C.06 requires a minimum of 20 students during the highest crossing hour.
3. Presence of school crossing guards.
4. Map showing the location of the school relative to the intersection.

In order to show that there is less than one acceptable gap per minute, the designer shall present the following:

1. Street crossing time based on width and crossing speed.
2. The number of gaps in the traffic stream that exceed the minimum crossing time during the study period. These gaps may be measured in the field or approximated using two different equations to find the probability of a gap greater than the crossing time.

\[ t = \text{required gap time (seconds)} \]
\[ t = 3 \text{ seconds} + \left[ \frac{\text{Width of crossing (ft)}}{3.5 \text{ (ft./sec.)}} \right] \]
\[ T = \text{length of time period for which the volume } V \text{ applies (seconds)} \]
\[ V = \text{two way vehicular volume across the crossing path in time period } T \]
\[ e = \text{base of the natural system of logarithms, having an approximate value of } 2.718 \]

The expected number of gaps per hour which are equal to or greater than \( t \) will be:
\[ V e^{-V/\sqrt{T}} \]

The expected number of \( t \)-second intervals per hour which are free of cars will be:
\[ \frac{T}{t} e^{-V/\sqrt{T}} \]
402-3.5 Warrant No. 6 (Coordinated Signal System)

Warrant No. 6 shall not be used as the sole warrant in an ODOT signal warrant analysis.

402-3.6 Warrant No. 7 (Crash Experience)

Warrant No. 7 should only be used to warrant a signal if the 70 percent volume warrants are met.

Any traffic signal installed solely on this warrant should be semi-traffic-actuated with control devices which provide proper coordination if installed at an intersection within a coordinated system and normally should be fully traffic-actuated if installed at an isolated intersection.

The following types of accidents are susceptible to correction by traffic signal control:

1. Those involving substantially right-angle collisions or conflicts, such as occur between vehicles on intersecting streets.
2. Those involving conflicts between straight-moving vehicles and crossing pedestrians.
3. Those between straight-moving and left-turning vehicles approaching from opposite directions, if an independent time interval is allowed during the signal cycle for the left-turn movement.
4. Those involving excessive speed, in cases where signal coordination will restrict speed to a reasonable rate.

Traffic control signals cannot be expected to reduce the following types of accidents:

1. Rear-end collisions, which often increase after signalization.
2. Accidents involving pedestrians and turning vehicles when both move during the same interval.
3. Other types of pedestrian accidents, if pedestrians or drivers do not obey the signals.
4. Collisions between vehicles proceeding in the same or opposite directions, one of which makes a turn across the path of the other. This is particularly true if no independent signal interval is provided for these turn movements.

402-3.7 Warrant No. 8 (Roadway Network)

Warrant No. 8 shall not be used as the sole warrant in a ODOT signal warrant analysis.

402-3.8 Warrant No. 9 (Intersection Near Highway-Rail Grade Crossing)

The purpose of Warrant No. 9 is to provide a warrant for a traffic signal where a highway-rail grade crossing is in close proximity to an intersection and a traffic signal is not warranted under any of the other traffic signal warrants. This is especially beneficial where the clear storage distance (see Part 8) is less than a design vehicle length and gaps are infrequent on the road parallel to the track(s).

Signals installed based on Warrant No. 9 shall have minor street actuation, train preemption, and flashing-light grade crossing signals, and should also have automatic gates.
402-4 Unwarranted Existing Signalized Intersections

Every effort should be made to encourage removal of an existing unwarranted signal installation. The designer should realize that all existing unwarranted signals cannot always be removed, most often because of public or political pressures on the maintaining agency. If the removal of signals and the placement of STOP signs is agreed to, the work should be at normal project participation.

If the local agency insists that a large number of unwarranted signals be retained, the State should reevaluate if the project should continue. Reasons for retention of existing unwarranted signals shall be documented.
If an existing unwarranted signalized intersection is retained, the following applies:

1. All work and equipment at the intersection shall be at 100 percent local cost. Written confirmation is required from the local agency.
2. If within a system, signal control equipment shall be upgraded to be compatible with the system (same manufacturer for all controller software).
3. If within an area approved for special design considerations (such as mast arms, aesthetically designed poles, etc.), the unwarranted intersection shall be upgraded to these standards.
4. If it is not necessary to upgrade equipment except for the controller, the existing intersection signals, signs and pavement markings shall be in conformance with the OMUTCD. Deficiencies may be corrected by the project (at 100 percent local cost) or by the local maintaining agency. The intersection shall conform to the OMUTCD by the final inspection of the construction project.

402-5 Removing Right-Turn Vehicles from Signal Warrant Analysis

At intersections under ODOT’s jurisdiction, the following procedure should be used to determine how much, if any, right-turning traffic from the minor street to remove from the signal warrant analysis. This does not apply to traffic signal warrant analyses on state route extensions in villages or on projects within local jurisdictions that require ODOT oversight.

From the “Minor Street Analysis Parameters” (see Tables 497-7 and 497-8) select the closest minor-leg lane configuration. Enter the configuration number under the MINOR STREET column on the “Right Turn Factorization Sheet” (see Forms 496-12 and 496-13). If both minor legs are being studied and have different configurations, include both and note next to the hour which leg or direction is being selected.

Note the number of lanes on the critical mainline approach. The critical mainline approach is the major-street leg whose through movement is in conflict with the right turn from the minor leg. Turn lanes on the major street are not usually considered a lane in this instance because a turn lane on the major route does not conflict with a right-turning vehicle from the minor leg.

Calculate the Critical Mainline Approach Volume per Lane. This is the hourly through volume of the critical mainline approach divided by the number of through lanes on the approach plus the hourly right-turning volume if it is not served by an exclusive right-turn lane on the mainline. Record this number in the Mainline Approach Volume per Lane column on the “Right Turn Factorization Sheet.”

Determine the Base Right Turn Reduction Percentage or Base Reduction. After determining which lane configuration best represents the leg that is being studied and based on the movements for each hour, calculate the percent reduction “R” or Base Reduction for each hour and record in the Base Reduction column on the “Right Turn Factorization Sheet.” Transfer this same number to the Base Right-Turn Reduction % column on the same sheet.
Calculate the Mainline Congestion Factor. This is a reduction of the Base Right-Turn Reduction. Its purpose is to allow for the vehicles which are unable to turn right during exceedingly high volume on the major street. This reduction is five percent for mainline approach volumes of 400 vehicles per hour per lane and is increased by five percent for every 100 vehicles per hour per lane. The Mainline Congestion Factors for Limiting Right-Turn Reductions are shown at the bottom of the “Minor Street Analysis Parameters” sheet. Select the appropriate reduction based on the mainline volume per lane and record the reduction in the Mainline Congestion Factor % column on the “Right Turn Factorization Sheet.”

Calculate the Adjusted Right-Turn Reduction. This is the Base Right-Turn Reduction minus the Mainline Congestion Factor. If less than 0, then the Adjusted Right-Turn Reduction equals 0%. Record this number in the Adjusted Right-Turn Reduction % column for each hour.

Calculate the Adjusted Right Turns. This is (1 - % Adjusted Right-Turn Reduction) multiplied by the Right-Turn Volume from the selected minor leg. Record this number in the Adjusted Right Turns column.

Determine the new Adjusted Minor-Street Volume by adding the Adjusted Right Turns to the through and left-turn volumes for each hour. Record this number in Adjusted Minor-Street Volumes column on the “Right Turn Factorization Sheet” for each hour. This number shall be used in the signal warrant analysis.
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403-1 General

OMUTCD Chapter 4D presents information on the design, location and use of traffic control signals. Construction details are shown on SCDs TC-81.10 through TC-85.20. Traffic signal equipment is specified in CMS Items 632 and 633, and CMS 732 and 733.

403-2 Yellow Change and Red Clearance Intervals

The vehicle change interval (or phase change interval) described in OMUTCD Section 4D.26 consists of the yellow change interval and the red clearance interval. A yellow signal indication shall be displayed following every CIRCULAR GREEN or GREEN ARROW signal indication. The function of the yellow change interval (Y) is to warn traffic of an impending change in the right-of-way assignment. For ODOT-maintained signals, the yellow change interval should be followed by a red clearance interval (AR) of sufficient duration to permit traffic to clear the intersection before conflicting traffic movements are released. For more efficient operations, start-up time for the conflicting movements may be considered when setting the length of the red clearance interval. The durations of the yellow change interval and the red clearance interval shall be predetermined.

The length of the phase change interval can be determined using the following equation, in which \[ t + \frac{V}{2a + 64.4g} \] represents the yellow change interval in English units and \[ \frac{(W + L)}{V} \] represents the red interval:

\[
Y + AR = t + \frac{V}{2a + 64.4g} + \frac{(W + L)}{V} \quad \text{ (for English units)}
\]

- \( t \) = perception/reaction time of driver, (typically assumed to be 1 second)
- \( V \) = approach speed, ft/s, (Posted Speed Limit or the 85th-Percentile Speed)
- \( a \) = deceleration rate, ft/s\(^2\), (typically assumed to be 10 ft/s\(^2\))
- \( W \) = width of intersection, ft, (measured from the near side Stop Line to the far edge of the conflicting traffic lane, along the actual vehicular path)
- \( L \) = length of vehicle, ft, (typically assumed to be 20 feet)
- \( g \) = approach grade, percent of grade divided by 100, (plus for upgrade, minus for downgrade)

Yellow change intervals typically are in the range of three to six seconds, and the red clearance interval should have a duration not exceeding six seconds.

403-3 Off-Peak Flashing Operation of Traffic Control Signals

Using a flashing operation at a signalized intersection during off-peak or low-volume periods may increase the efficiency of the intersection. It also reduces fuel consumption by the traveling public because of the fewer starts and stops, and helps to improve the environment by reducing air and noise pollution. The signal head itself consumes a significantly lower amount of power during flashing operation as compared to regular signal operation. Flashing operation at a signalized intersection during off-peak hours is cost effective and should be considered at those intersections where safety would not be compromised. Actuated signals should not flash during off-peak hours. However, each intersection considered for flashing operation should be carefully analyzed, since recent research also indicates that accident rates may increase, especially at night.
The following considerations should be taken into account when making a decision to use off-peak flashing operation at a signalized intersection:

1. Flashing operation may be appropriate at simple, four-legged or three-legged intersections where the minor street drivers have an unrestricted view of approaching main street traffic and the traffic volume meets the criteria in item 2 below.

2. The two-way main-street volume should not exceed 200 vehicles per hour (vph). However, if the two-way main street volume is greater than 200 vph and the ratio of main street volume to minor street volume is greater than 3, flashing operation may be appropriate.

3. In areas where night establishments are located and driving while under the influence of alcohol may occur, flashing operation should not begin until one hour after these establishments close.

4. A “speedway” effect can be avoided and uniform speeds can be achieved by maintaining enough regularly operating signals at appropriate spacing to provide signal progression at the desired speed.

5. When a traffic control signal is put on flashing operation, a yellow indication is normally used for the major street and red indications are used for all other approaches. The OMUTCD stipulates that yellow indications shall not be used for all approaches. OMUTCD Sections 4D.11 and 4D.12 list requirements for flashing operations.

6. After off-peak flashing operation has been implemented, the accident pattern should be monitored. The signal should be changed to regular operation if the accident pattern and/or severity increases. The following guidelines should be used:
   a. A short-term rate of three right-angle accidents in one year.
   b. A long-term rate of two right-angle accidents per million vehicles entering during the flashing operation, if the rate is based on three to five observed right-angle accidents.
   c. A long-term rate of 1.6 right-angle accidents per million vehicles entering during the flashing operation, if the rate is based on six or more observed right-angle accidents.

7. When a traffic control signal is interconnected with an adjacent highway-rail grade crossing, night or off-duty flashing operation should not be used.

403-4 Approach Monitoring

All ODOT-maintained traffic signals shall be designed to use an approach monitoring concept. Approach monitoring makes use of the dual indication monitoring capabilities of the NEMA plus or NEMA extended monitor. The approach monitoring concept will not function if the “plus” features in the monitor are disabled or not available. Intersections designed for approach monitoring permit the “plus” monitor to detect total loss of a signal color indication on an approach basis rather than a per phase basis. With approach monitoring, the loss of all green, yellow or red indications on an approach place the intersection into flash. ODOT’s primary intent however is to catch the red out.

To detect a “no load” signal condition, a basic signal design is necessary. The approach monitoring design requires each approach to be wired separately. Each has its own load switch and its own monitor channel. The final equipment requirement is a NEMA plus monitor programmed to accommodate the approach monitor design.

403-5 Traffic Law Photo Monitoring

Substitute House Bill Number 30, passed by the 127th General Assembly, took effect September 12, 2008. This law imposes certain responsibilities on local authorities who choose to use traffic law photo monitoring devices. Section 201-14 addresses the local authority’s duties, which include assuring that the yellow change interval exceeds by 1 second the yellow change
interval determined in accordance with Section 403-2.

As noted in Section 201-14, no traffic law photo monitoring device shall be installed at any intersection or on any highway maintained by ODOT.

403-6 Emergency-Vehicle Preemption Control Systems

403-6.1 General

As noted in OMUTCD Section 4D.27, preemption systems are used to give certain vehicles control over traffic signals. These systems use devices located on an approaching vehicle to preempt the normal operation of signalized intersections. This Section provides a consistent method for funding traffic control signal preemption systems if needed.

Over the years, several methods of providing priority control of traffic signals have been developed. The first method, which is not covered by this Section, involves a hard-wired signal system. For example, personnel in the fire station can activate one or more circuits by pushbutton to preempt a series of signalized intersections. This system is usually not proprietary and is localized to the main arterial intersections near the fire station.

The intent of this Section is to cover a second method of priority control which involves equipping the vehicle with a preemption emitter and equipping the signalized intersection with preemption receivers. These systems tend to use proprietary equipment, and once a local governmental agency installs the equipment, the agency is restricted to the same brand and type of preemption equipment in order to have emitters and receivers work together.

Vehicle-activated systems can use light (optics), sound or radio signals (includes GPS systems) to activate a receiver at the intersection. Optical and sound-activated systems are extensively used in Ohio. The optical system uses a strobe-type light emitter mounted on the vehicle and sound-activated systems use the siren from the vehicle. Each system has benefits inherent in the type of signal used.

The decision to install and maintain a preemption control system shall be made by the maintaining agency.

The cost for the installation and maintenance of a preemption control system at ODOT signals shall be assumed by the requesting agency.

403-6.2 Procedures

For new preemption systems, ODOT will participate at the normal project participation rate in the acquisition and installation of a generic preemption system as determined by the lowest contract bid price. In addition to obtaining generic bids, a local governmental agency may request alternate bids if they desire a specific brand of preemption equipment and agree to pay any extra cost above the generic bid price. A Plan Note specifying three different preemption systems by manufacturer and model is equivalent to a generic bid item.

When a municipality adds intersections to its existing preempt system, it can obtain the same type of equipment by either the use of alternate bids or, if justified, proprietary bids.

For proprietary bids to be considered justified, the existing preempt system must control an appreciable part of the municipality’s intersections before it can be considered to represent the municipality’s standard. As a measure of this standard, the existing system must constitute at least fifty percent of the signalized intersections of a municipality. If this test is met, a proprietary bid requested by the municipality will be given consideration. Otherwise, alternate bids may be used to limit State and Federal participation to the generic system costs.
403-6.3 Preemption Emitters

The quantity of vehicle hardware provided with the system shall be as determined by the municipality, but should not exceed three emitters for each signalized intersection which will be equipped with preemption as a part of the project. Only fire, emergency medical, police and transit vehicles are eligible to be equipped. If alternate bids are used and the desired system utilizes vehicle-mounted emitters, the cost of this hardware shall be included in the alternate bid cost for comparison to the generic bids.

403-6.4 Local Maintaining Agency Policies

As a requirement for inclusion of vehicle preemption equipment in the contract, the local governmental agency shall have policies for the use of preemption. For safety forces, the policies shall specify the types of emergency calls for which preemption may be employed and shall define any use of preemption when lights and sirens are not simultaneously employed. For transit vehicles, the policies shall define when and under what conditions the preemption may be employed.

When possible, municipalities are strongly encouraged to develop signal preemption policies which coordinate with surrounding City, County and Township forces. They should take into account mutual aid agreements, access to hospitals and transit where a vehicle operates outside of its normal jurisdiction.

403-7 Flashing Yellow Arrow (FYA) Operation

The OMUTCD Section 4D.18 permits the use of a flashing yellow arrow (FYA) indication on applicable protected/permissive left-turn phases. However, the FYA indication shall not be used with traffic control signals on ODOT-maintained highways until such time as design and traffic signal cabinet standards approved by the Office of Traffic Engineering (OTE) have been developed and tested, and educational materials on the intended use of this new signal indication have been made available to the public.

Once the cabinet standards have been developed and tested, permission for pilot installation of the FYA may only be granted by OTE on a case-by-case basis to monitor and determine any crash and safety benefits. An education campaign shall be part of any project introducing this device in an area, and as noted in OMUTCD Section 4D.18, the LEFT TURN YIELD ON FLASHING YELLOW ARROW (R10-H12c) sign shall be used with the FYA for at least five years (see OMUTCD Figure 4D-7).

403-8 SIGNAL OPERATION CHANGED Sign (W23-H2a, W23-H2b)

Concurrent with the actuation of any new signal operation which alters the sequence of the signal displays from the existing operation, a SIGNAL OPERATION CHANGED sign (W23-H2a or W23-H2b) should be installed. The signs should be displayed for a minimum of fourteen days and a maximum of thirty days.

The W23-H2a sign should be installed on all approaches to an intersection and the W23-H2b sign should be installed on the span wire or mast arm adjacent to the signal heads.

The following are examples of signal operation modifications which would normally warrant installation of the sign:

1. Installation of a protected left turn
2. Switching from a lead to lagging left turn (or vice versa).
3. Installation of a split phase where two directions used to run together

The following are examples of signal operation modifications which normally not warrant installation of the sign:
1. Installation of a NO TURN ON RED sign.
2. Actuated phase being set to min (max) recall due to detector malfunction.

### 403-9 Yellow Trap

Yellow Trap is a term used to describe a condition which occurs during certain yellow change intervals. During a Yellow Trap event, drivers facing a CIRCULAR YELLOW signal indication are mistakenly led to complete their movement in order to clear the intersection by the display of the CIRCULAR YELLOW signal indication. What they fail to realize is that opposing motor vehicles are facing a CIRCULAR GREEN signal indication and not a CIRCULAR YELLOW signal indication. This condition can occur under the following conditions:

1. When Protected/Permissive Left-Turn Signal Face Displays are used and the sequence is changing from a concurrent through movement to a through and left-turn movement in the same direction of travel (lagging left turn).

2. During a transition into preemption, with or without Protected/Permissive Left-Turn Signal Face Displays and the sequence is changing from a concurrent through movement to a through and left-turn movement in the same direction of travel (lagging left turn).

Depending on the nature of the yellow trap condition, it may be necessary to address the condition in order to implement the desired signal sequence. The following are examples of methods which may be used to resolve the yellow trap condition:

1. Left-turn signal face displays on an approach to the intersection where yellow trap occurs can be changed to Protected Only displays.

2. Opposing movements may be reconfigured to provide exclusive or “split” phase sequencing.

3. During a transition into preemption, the controller sequence may be designed such that both directions of travel transition to red before the display of a green indication on a single approach. This ensures that there is a simultaneous display of CIRCULAR YELLOW on both approaches prior to the display of green on a single approach.

The use of W25-1 and W25-2 signs (ONCOMING TRAFFIC HAS EXTENDED GREEN and ONCOMING TRAFFIC MAY HAVE EXTENDED GREEN, respectively) are not recommended by ODOT to resolve a yellow trap condition.

The signal plans shall contain plan notes to omit calls to protected/permitted left-turn phases as necessary to resolve yellow trap conditions. The traffic signal controller programming shall incorporate this information to resolve yellow trap conditions.

Whenever preemption is provided, careful consideration must be given to the design of the signal sequence under all modes to prevent the display of yellow trap.

### 403-10 Railroad Preemption Control Systems

#### 403-10.1 General

As noted in OMUTCD Section 4D.27, railroad preemption systems are used to give trains (both heavy and light rail) control over traffic signals. These systems use an interconnection between the railroad control system and the traffic signal controller to preempt the normal operation of signalized intersections. **TEM Part 8** provides detailed information regarding railroad preemption, standardized terminology and associated design requirements. This Section addresses minimum functional requirements for traffic signal control equipment to provide the proper operation required for railroad preemption.

Traditional railroad preemption interconnection has relied on a single pair of wires which were
normally closed through a relay in the railroad signal control equipment to provide a failsafe mode of operation. This normally closed circuit is required by OMUTCD Section 8C.09. If the connection between the wires was opened, the railroad preemption sequence in the traffic signal controller was initiated.

In recent years, much research has been conducted to further understand the operational needs transitioning into and during the railroad preemption sequence as well as the functioning of the interconnection circuit. The results of this research have led to significant changes in the TEM to implement new technology to further enhance safety at signalized intersections adjacent to railroad grade crossings.

ODOT has developed a recommended practice for the design and functionality of the railroad interconnection. This recommended practice is contained in TEM Part 8. It provides information on both the traffic signal controller interface and the railroad warning system interface (see Section 804-4). There is also a requirement for an indicator panel to verify that the railroad circuitry is activating the interface at the traffic signal controller cabinet.

**403-10.2 Controller Functionality**

In order to properly implement railroad preemption operation, additional requirements have been developed for the operation of railroad preemption in the controller unit. The functionality has been divided into a basic set of requirements and an enhanced set of requirements. All new controller units which are to be interconnected with a railroad warning system must provide the following basic operational features:

1. Per unit setting for alternate minimum green interval during entry into any railroad preemption sequence.
2. Per unit setting for alternate pedestrian walk interval during entry into any railroad preemption sequence.
3. Per unit setting for alternate pedestrian change interval during entry into any railroad preemption sequence.
4. Two independent railroad preemption sequences.
5. Three programmable sequence steps. The first step may be programmed to create an all red state for resolution of yellow trap. The first step is followed by up to two track clearance green intervals per preemption sequence with an individual setting for minimum track clearance green for each interval. Each track clearance green interval shall be programmable for no phases (all red), a single phase, or a pair of non-conflicting phases. Each overlap shall be capable of being forced to red or green during each track clearance green interval. The gate down control input shall hold the second (final) track clearance green interval.
6. Ability to program railroad dwell interval as all red (no phase(s)), any phase or pair of non-conflicting phases or to provide limited sequence of programmed or permitted phases.
7. Ability to inhibit pedestrian movements per phase during railroad dwell interval.
8. In the event the controller unit is operating under manual control and either railroad preemption input goes false, the manual control shall be inhibited and the railroad sequence shall govern. Once the railroad preemption input goes true and the manual control input is active, manual control shall be restored.
9. A maximum preemption timer shall be provided for each preemption sequence. This timer shall have a minimum range of 0 to 10 minutes with a maximum 1 minute
resolution. This timer shall begin to time whenever the railroad preemption input goes false. This timer is reset whenever the railroad preemption input returns to a true state. If the maximum railroad preemption expires and the railroad preemption input is still false, the controller unit shall exit the dwell sequence and transition to soft all-red flash. If the railroad preemption input returns to a true state after the controller unit has entered the flash state, the controller unit shall exit the all red flash state via a programmable steady all red period followed by the startup phase(s).

10. The following inputs shall be provided for railroad preemption:

a. Railroad Preemption Sequence #1 Activation – This input is normally true with no train present. It is false whenever railroad preemption sequence #1 is in effect.

b. Railroad Preemption Sequence #1 Supervision - This input is normally false with no train present. It is true whenever railroad preemption sequence #1 is in effect.

These two inputs shall both change state whenever the railroad preemption sequence becomes active. If the two inputs are ever both true and both false at the same time, a railroad preemption error shall be logged and the controller unit should transition the signal display to soft all-red flash. The controller unit should exit the soft all-red flash state via a normal start-up sequence whenever the railroad preemption inputs resume a normal state.

c. Railroad Preemption Sequence #2 Activation – This input is normally true with no train present. It is false whenever railroad preemption sequence #2 is in effect.

d. Railroad Preemption Sequence #2 Supervision - This input is normally false with no train present. It is true whenever railroad preemption sequence #2 is in effect.

These two inputs shall both change state whenever the railroad preemption sequence becomes active. If the two inputs are ever both true or both false at the same time, a railroad preemption error shall be logged and the controller unit should transition the signal display to soft all-red flash. The controller unit should exit the soft all-red flash state via a normal start-up sequence whenever the railroad preemption inputs resume a normal state.

e. Railroad Preemption Sequence #1 Gate Down – This input is normally false with no train present. It is true whenever railroad preemption sequence #1 is in effect and the appropriate railroad gate or gates are down.

f. Railroad Preemption Sequence #2 Gate Down – This input is normally false with no train present. It is true whenever railroad preemption sequence #1 is in effect and the appropriate railroad gate or gates are down.

i. If a single track clearance interval is used, the controller unit should time the programmed value for the track clearance green interval and then hold in the track clearance green interval.

ii. If two track clearance intervals are used, the controller unit should time the programmed value for the first track clearance green interval and then advance to the second track clearance green interval. The controller unit should time the programmed value for the second track clearance green interval and then hold in the track clearance green interval.

iii. Once the track clearance hold state is reached, the controller unit should not leave until the proper gate down input is received. Once the gate down input is received and the track clearance green interval has completed timing its programmed value, the sequence should advance to the programmed dwell
interval. If the gate down input is received prior to completion of the track clearance green interval, the track clearance green interval shall remain active until the timer has completed its programmed period of time.

iv. If the sequence has advanced to the dwell interval and the gate down input is lost, the sequence should revert to the track clearance green hold interval until the gate down input is again received.

11. A hardware output for controller unit health shall be provided. This output shall be false whenever the controller unit has detected a fault, is in conflict flash or has a true input for stop timing. This output shall also be set false if the maximum preemption period timer has expired or a communication error is detected.

12. Any controller unit proposed for use on a project where railroad preemption is required shall be furnished to the signal shop for testing prior to acceptance.

Controller units required to provide enhanced railroad preemption functionality must provide the following functions in addition to the basic features described above:

1. The controller unit shall have the ability to accept the preemption input and output functions via a serial port utilizing IEEE 1570 protocol. IEEE 1570 is the standard ITS HRI interface for railroad wayside devices and highway field devices. Information regarding the use and operation of this protocol is available from the IEEE. The following functionality is required:
   a. Communication port input for activation of railroad preemption sequence #1.
   b. Communication port input for activation of railroad preemption sequence #2.
   c. Communication port input for activation of the railroad warning system.
   d. Communication port input for railroad preemption sequence #1 gate down control.
   e. Communication port input for railroad preemption sequence #2 gate down control.
   f. Communication port input for railroad island occupancy.
   g. Communication port output for traffic signal health.

2. The following additional controller unit features shall be provided:
   a. Setting for the Maximum RWTT. Whenever the preemption activation input goes false, the controller unit shall calculate the actual RWTT. If the controller unit determines that surplus time is available prior to initiating track clearance, then the preemption sequence shall provide the ability to permit other movements to begin as long as adequate time remains to transition to track clearance green when required.
   b. Dynamic RWTT adjustment on train restart. If the railroad warning system active input goes false prior to the completion of RWTT, any remaining alternate minimum green, alternate pedestrian walk or pedestrian change time shall be set to zero. This will assure the beginning of the track clearance green interval following the completion of any remaining green extension time, yellow change and red clearance time.
   c. Comprehensive railroad preemption log throughout the railroad preemption sequence. Logging shall include eight controller state changes prior to the activation of the preemption sequence, all state changes throughout the preemption sequence and eight state changes following the completion of the preemption sequence. Each
state change shall be logged including date and time (to one second resolution). The log shall include each phase green, yellow and red, each pedestrian walk, pedestrian change and DONT WALK, and each overlap green, yellow and red. In addition, the log shall include the state change of each preemption control input from the railroad.

3. Any controller unit proposed for use on a project where railroad preemption is required shall be furnished to the signal shop for testing prior to acceptance.

403-10.3 Cabinet Functionality

In order to properly implement railroad preemption operation, recommended design guidelines have been developed which describe both the traffic signal controller cabinet and railroad warning system interconnection *(see Section 804-4)*.
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400  TRAFFIC SIGNALS  Traffic Engineering Manual

404  PEDESTRIAN CONTROL FEATURES

404-1  General

Pedestrian signal indications (see OMUTCD Figure 4E-1) are special types of traffic signal indications intended for the exclusive purpose of controlling pedestrian traffic. Pedestrian signals are discussed in OMUTCD Chapter 4E. Construction mounting details are shown on SCD TC-85.10, and pedestrian signal equipment is specified in CMS Item 632 and CMS 732.

404-2  Pushbuttons

OMUTCD Section 4E.08 addresses pedestrian detection, usually accomplished using pushbuttons.

On actuated signal phases, if there is a reasonable expectation of regular pedestrian use, the phase shall be equipped with pedestrian pushbuttons to provide access to all corners of the intersection with sufficient time to safely cross the highway; and countdown pedestrian heads, applicable signs and ADA ramps shall be provided.

This is especially important on side-street phases where the signal green time is usually based on a short initial green interval with the green time extended by signal actuations. The initial green interval is usually not long enough to allow a pedestrian to cross the mainline. The pedestrian pushbutton will initiate a guaranteed crossing time without input from vehicular traffic. The pushbutton will also provide the pedestrian with a means to cross the mainline when there is no side-street traffic to initiate the signal phase for the pedestrian crossing.

If pushbuttons are provided, they shall be wheelchair accessible according to current ODOT pedestrian design standards. Pedestrian signal heads and marked crosswalks shall be required whenever pushbuttons are provided. When pushbuttons are provided, pushbuttons shall allow pedestrians to reach all corners of the intersection. Designers should be aware of this requirement and consider the possible future location of crosswalks when locating stop bars and stop bar detectors at signals that do not presently include pedestrian facilities.

404-3  Accessible Pedestrian Signals and Locator Tones

As noted in Section 401-9, use of accessible pedestrian signals and locator tones are major ADA requirements that affect traffic signals. Accessible Pedestrian Signals supplement visual WALK indications and are designed to aid visually impaired pedestrians; and Locator Tones enable pedestrians who have visual disabilities to locate the pushbutton.

The installation of Accessible Pedestrian Signals and/or Locator Tones may be considered at ODOT-maintained traffic signals when an engineering study, which considered the factors specified in OMUTCD Sections 4E.09 and 4E.10, has been conducted and the following minimum conditions are met:

1. The proposed intersection crosswalk must be signalized.
2. The audible devices should be retrofittable to the existing traffic signal hardware.
3. The signalized intersection should be equipped with pedestrian pushbuttons.
4. The selected crosswalk must be suitable for the installation of Accessible Pedestrian Signals and/or Locator Tones, in terms of surrounding land use and traffic patterns.
5. There must be a demonstrated need for the audible devices in the form of a request from an individual or group that would use the audible signal.
6. The individual or group requesting the device should agree to train the visually impaired users in the use of the Accessible Pedestrian Signals and/or Locator Tones, as appropriate.

Additional guidance is available in OMUTCD Part 4.
405 FLASHING BEACONS

405-1 General

Flashing Beacons are addressed in OMUTCD Chapter 4L.

405-2 STOP Signs and Intersection Control Beacons

A STOP sign shall be used with a flashing red Intersection Control Beacon.

405-3 Rectangular Rapid Flashing Beacon (RRFB)

FHWA has issued an Interim Approval (IA-11) for use of this device. The procedures for use of interim approval items are described in OMUTCD Section 1A.10. See Sections 240-9 and 242-8 for information on use of these beacons on ODOT-maintained highways.
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406 SPECIAL PURPOSE TRAFFIC CONTROL SIGNALS

406-1 General

OMUTCD Chapters 4G through 4L present information on miscellaneous types of highway traffic signals including signals for emergency-vehicle traffic, lane-use control, movable bridges, freeway entrance ramps and one-lane, two-way facilities.

406-2 Temporary Traffic Signals

Temporary traffic signals are currently addressed in OMUTCD Section 4D.32. Additional information about traffic signals used in temporary traffic control zones is provided in OMUTCD Section 6F.84 and Part 6 of this Manual.

406-3 Traffic Control Signals for Emergency Vehicle Access Guidelines

Traffic control signals for emergency vehicle access may be justified if the cross-corner sight distance is less than the appropriate value given in Figure 498-1, or if the volume of traffic during an average day exceeds the values given below:

<table>
<thead>
<tr>
<th>Number of Lanes</th>
<th>ADT (Both Directions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 or more</td>
<td>16,000</td>
</tr>
<tr>
<td>3</td>
<td>9,000</td>
</tr>
<tr>
<td>2</td>
<td>6,000</td>
</tr>
</tbody>
</table>

OMUTCD Chapter 4G presents information on the design and operation of traffic control signals for emergency vehicle access. Also, see TEM Section 403-6 for information about Preemption Control Systems.
Intentionally blank.
407-1 General

This Chapter is used to address other traffic control electrical devices, including active signs, used on ODOT-maintained highways.

407-2 PREPARE TO STOP WHEN FLASHING Signs (W3-H4a)

407-2.1 General

The PREPARE TO STOP WHEN FLASHING (PTSWF) sign (W3-H4a) is used to provide drivers approaching a traffic signal with additional information concerning the changing of the traffic signal indication from green to yellow. Drivers who are past the dilemma zone will usually decide to continue through the intersection when the yellow indication is displayed, while drivers who have not yet entered the dilemma zone will decide to stop. This sign can also be used to provide advance information when the geometric design of the intersection approach prevents the signal display from being seen in time to stop.

407-2.2 Applications

Any proposed ODOT or federally-funded PTSWF sign installations must be reviewed and approved by the Office of Traffic Engineering (OTE). Installation of the PTSWF sign should only be implemented upon failure of the progressive application of countermeasures described in Section 407-2.3. The following are typical applications for PTSWF signs:

1. A location (usually four-lane divided) with high approach speeds (> 45 miles per hour), a high rear-end accident rate, and evidence of rear-end conflicts (skid marks) at the intersection.

2. A remote rural location with high speeds where the presence of a signal is unexpected.

3. A location with high approach speeds and diminished signal sight distance due to horizontal and/or vertical curves or structures.

4. A location with a high percentage of high-speed truck traffic with frequent violations of the clearance interval and excessive angle and rear-end accidents.

Installing PTSWF signs in corridors where multiple signals exist is not recommended.

The installation of a signal can be expected to significantly increase rear-end accidents even at locations without the above described characteristics. No signalized intersection is likely to be completely free of rear-end accidents. Consequently, restraint should be exercised in the use of PTSWF signs since the overuse of any warning device can reduce its effectiveness. It should also be noted that the use of this device reduces the efficiency and safety of the signal operation by delaying the termination of the green and compromising true gap-out phase transitions. Also, studies of PTSWF applications have shown that vehicle speeds through the intersection may increase.

407-2.3 Procedure / Reviewing Other Countermeasures

Prior to installation of the PTSWF signs, it should be determined that proper advance signing has been in place and that the detectors are operating correctly and are located beyond the dilemma zone for the approach speeds involved. Ideally, detection should exist at or upstream of the PTSWF sign. If the detectors and Signal Ahead (W3-3) signs are improperly located, this should be corrected and evaluated before installing PTSWF signs. Other
detector design techniques to minimize dilemma zone exposure may also be employed.

Generally, the PTSWF sign should be used only where conventional traffic control devices have been tried and found ineffective in reducing accidents, or where operational problems related to rear-end, or other accidents caused by failure to stop, have occurred. The brightness and reliability of LED traffic signal lamps have improved the visibility distance of signal indications. For existing signalized intersections, the following progressive application of countermeasures should be utilized to address accidents caused by failure to stop:

1. Installation of a single Signal Ahead (W3-3) sign.
2. Dual W3-3 signs.
3. Oversized, dual W3-3 signs.
4. W3-3 signs with continuously flashing beacons.
5. Extended Call - Delay Call Loops (EC-DC Loops).
6. PTSWF (W3-H4a) signs, timed concurrently with the yellow change (YC) and all-red (AR) clearance intervals.
7. PTSWF signs, with advance warning time.

### 407-2.4 Operations and Placement

The PTSWF sign installation is addressed in Plan Insert Sheet (PIS) 203020 and typically consists of the following equipment:

- PTSWF sign,
- Flashing beacons,
- Sign bracket assembly,
- Sign support with breakaway foundation,
- Flasher and flash control assembly, and
- Wiring to connect flashing beacons and controller.

Auxiliary equipment shall be provided in the signal controller to operate the PTSWF sign beacons. This equipment shall be set to: 1.) time concurrently with the YC and AR intervals or 2.) start the sign beacons flashing for a predetermined advance warning time (with variable settings) before the termination of green. Flashing operation of the PTSWF sign shall typically end when green is displayed to the approach. The beacons shall be activated simultaneously. The beacons shall not be activated when the signal controller operation goes to “flash” mode. For high-speed applications at four-legged intersections, PTSWF signs shall be employed for both directions of a roadway unless there are factors which would dictate the need for one direction only. When PTSWF signs are used on four-lane divided highways, dual installation should be the default treatment.

When a PTSWF sign is added to an approach with W3-3 signs with beacons already in place, the beacons on the W3-3 signs shall be removed.

The symbolic Signal Ahead (W3-3) sign shall be used in conjunction with a PTSWF sign and governed by the following provisions:
The W3-3 sign shall always be located in advance of the PTSWF sign. It shall be no closer than 200 feet to the PTSWF sign, and must also meet the minimum placement criteria described in MUTCD Section 2C.36.

The following factors are needed to determine PTSWF sign location (S) and timing (T):

\[ t = 1.0, \text{perception-reaction time in seconds} \]
\[ 1.47 = \text{conversion factor from miles per hour to feet per second} \]
\[ V_1 = 85\text{th-percentile approach speed, mph} \]
\[ V_2 = 15\text{th-percentile approach speed, mph} \]
\[ f = 0.266 \text{ coefficient of friction (wet)} \]
\[ g = \text{approach grade, percent/100} \]
\[ S = \text{sign location from stop line, ft} \]
\[ T = \text{delay timing, sec.} \]

Distance [1.47(t)(V_2), space in front of the dilemma zone where most drivers would not attempt to stop] = q

Delay timing, sec = \( t \)

Sign location from stop line, ft = S

Approach grade, percent/100 = \( V_1 \)

Coefficient of friction (wet) = \( f \)

5th-percentile approach speed, mph = \( V_2 \)

85th-percentile approach speed, mph = \( V_1 \)

Conversion factor from miles per hour to feet per second = \( 1.47 \)

1.0, perception-reaction time in seconds = \( t \)

If the PTSWF sign is installed after the W3-3 sign (which is usually the case), the W3-3 sign may require relocation to comply with the 200-foot sign spacing criteria.

Similarly, choose smaller of these two for Warning Time where DZ is the dilemma zone:

\[ S = \begin{cases} 
\text{smaller of these two for Warning Time} & \text{if } S_{\text{mean}} < 1.47(t)(V_2) \\
S_{\text{mean}} & \text{if } S_{\text{mean}} \geq 1.47(t)(V_2) \end{cases} \]
407-2.5 Typical PTSWF Advance Warning Times

The following table is provided for convenience and reflects level approach grades, 1.0 second perception-reaction time and 0.266 coefficient of friction:

<table>
<thead>
<tr>
<th>$V_{15}$ (mph)</th>
<th>45</th>
<th>50</th>
<th>55</th>
<th>60</th>
<th>65</th>
<th>70</th>
</tr>
</thead>
<tbody>
<tr>
<td>45</td>
<td>4.0</td>
<td>4.5</td>
<td>5.0</td>
<td>5.6</td>
<td>5.8</td>
<td>6.0</td>
</tr>
<tr>
<td>50</td>
<td>4.1</td>
<td>4.6</td>
<td>5.2</td>
<td>5.8</td>
<td>6.0</td>
<td></td>
</tr>
<tr>
<td>55</td>
<td>4.3</td>
<td>4.8</td>
<td>5.4</td>
<td>6.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>60</td>
<td>4.5</td>
<td>5.1</td>
<td>5.7</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>65</td>
<td></td>
<td></td>
<td></td>
<td>4.7</td>
<td>5.3</td>
<td></td>
</tr>
<tr>
<td>70</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>5.0</td>
<td></td>
</tr>
</tbody>
</table>

407-2.6 Criteria for Removal

The following should be used as criteria for removal:

1. When there are two or more signalized intersections on the same route and the spacing between each signal is 0.5 mile or less.
2. When a signal becomes part of a coordinated system.
3. When the posted speed is reduced to less than 45 miles per hour.
4. Upon mitigation of the condition that caused the sight distance limitation where the PTSWF sign is installed.

Prior to removal of the PTSWF signs, the signs shall be covered and flashers disconnected for a minimum of ten days.

407-2.7 Alternatives to Removal

If existing PTSWF installations with advance warning time are to remain in place, the advance warning time should be eliminated. In this approach, signal operation is simplified by driving the PTSWF beacons concurrently with the associated phase yellow clearance and all red intervals. This is equivalent to reducing the PTSWF advance warning time to zero. The preferred zero-warning-time implementation shall use a separate load switch and/or flasher module to activate the PTSWF flasher using a wire of the yellow and red load switch outputs.

Older PTSWF installations with timing based on earlier TEM formulas should have the advanced warning time reduced to comply closely with the new formula. If a District decides the older PTSWF warning time must be maintained, then the control zone of the signal shall be extended to 100 feet upstream from the PTSWF sign to assure that no vehicles between the PTSWF sign and the next downstream detector are caught in the Dilemma Zone at the end-of-green. Consider using advanced dilemma zone radar detection with this alternative.
408 IN-ROADWAY LIGHTS

408-1 General

In-Roadway Lights (see OMUTCD Chapter 4N) are considered a type of Highway Traffic Signal. They are installed in the roadway surface to warn road users that they are approaching a condition on or adjacent to the roadway that might not be readily apparent and might require the road users to slow down and/or come to a stop. Typical uses for this device would be marked school crosswalks and marked midblock crosswalks. In-Roadway Warning Lights at crosswalks shall not be used at crosswalks controlled by YIELD signs, STOP signs, or Traffic Control Signals.

408-2 Use of In-Roadway Lights on State Highways

Because of the high speeds and volumes associated with state highways, an engineering study should be conducted to determine if other measures, such as increased signing and pavement marking, should be implemented before the use of in-roadway crosswalk warning lights on ODOT-maintained highways. Any engineering study pertaining to the installation of in-roadway lights on state highways should be coordinated with the Office of Traffic Engineering.

The use of in-roadway lights at highway-rail grade crossings should also be coordinated with the Ohio Rail Development Commission (ORDC). The ORDC’s web address is http://www.dot.state.oh.us/divisions/rail/Pages/default.aspx
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420 MATERIALS AND SIGNAL HARDWARE

420-1 General

Construction details are shown on SCDs TC-81.10 through TC-85.20. Traffic signal equipment is specified in CMS Items 632 and 633 and CMS 732 and 733.

CMS and SCD information may be viewed on-line at http://www.dot.state.oh.us/Divisions/ConstructionMgt/OnlineDocs/Pages/2010CMS.aspx and www.dot.state.oh.us/Divisions/Engineering/Roadway/DesignStandards/traffic/SCD/Pages, respectively.

420-2 Patented or Proprietary Materials, Specifications or Processes

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

420-3 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.

420-4 Vehicular Signal Heads

420-4.1 General

Standards related to vehicular signal heads are addressed generally in OMUTCD Chapter 4D.

For any project using State or Federal funds, louvered reflective backplates in accordance with CMS 732.22 are required for all new signal heads (backplates are required for both mast-arm and span-wire installations). It is recommended that signal heads be polycarbonate plastic and be tethered per Plan Insert Sheet (PIS) 208521 to minimize sway for span-wire type configurations. A signal support analysis should be performed on all existing strain poles and mast-arm type signal supports to insure they are structurally adequate for the proposed changes. If span-wire supports are found deficient for backplates in all directions, then the intersection should be analyzed for mainline or East/West backplates only. Written documentation and calculations are required if the proposed additions/changes cannot be implemented.

420-4.2 Signal Head Color

In ODOT-maintained traffic signal installations, the vehicular signal head housings and the outside of the visors shall be highway yellow or black. The two colors shall not be mixed within an intersection.

420-4.3 Signal Lens

Signal lenses may be made of glass or plastic. In ODOT-maintained traffic signal installations, glass signal lenses should be used. At rural ODOT intersections, the signal may dwell in a phase for long periods of time during the night causing heat damage to a plastic lens.

The size of signal lenses may be 8 inch or 12 inch depending on the provisions of OMUTCD Section 4D.15. In ODOT-maintained traffic signal installations, the 12-inch lens should be
used. The 8-inch lens is typically used for low-speed, urban applications.

420-4.4 Location of Five-Section Signal Heads for Protected/Permissive Turns

OMUTCD Sections 4D.17 through 4D.20 contain the requirements for signal head use for protected/permissive left turns. In protected/permissive signal phasing, the left (or right) turns can be made in both a protected (green arrow) and a permitted (circular green) signal phase.

“Shared” five-section signal face:

Because the circular signal indications in this five-section signal head apply to both the through and turning vehicles, the signal head should be located on an extension of the Channelizing Line that separates the through and turn lanes. The “shared” type of five-section signal face is used extensively throughout Ohio.

Left-turn lanes on four-lane highways with wide medians are often separated from the through lanes by a large painted channelizing island in order to provide good alignment and sight distance for opposing left-turn vehicles. In this case, the five-section head should be located in front of the left-turn lane with an R10-12 sign, LEFT TURN YIELD ON GREEN, next to the signal head. Two additional three-section signal heads should be provided for the through-traffic lanes. The maintaining agency should monitor accidents for this type of operation with the wide median. ODOT’s experience in some parts of the State showed that left-turning drivers were not yielding on the circular green and the phase operation had to be converted to “protected only.”

420-4.5 Aluminum versus Polycarbonate

Vehicular signal heads are manufactured in either aluminum or polycarbonate plastic. The choice of which material to use will be made by the maintaining agency. Many urban jurisdictions prefer the use of polycarbonate, because they are much lighter and easier to handle. Because of the lighter weight, they are often used when adding left-turn signal heads to an existing signal support system. Polycarbonate signal heads are most often associated with rigid-mounted signal heads on mast arms where wind sway will not be a factor.

In ODOT-maintained traffic signal installations, aluminum signal heads should be used to reduce signal head sway in windy conditions unless rigid mounting or span-wire tethers are used. The preferred signal head material for any installation with backplates and tethers, per Plan Insert Sheet (PIS) 208521, is polycarbonate.

420-4.6 Programmable Signal Heads

A programmable signal head utilizes a special optical lens that can be “programmed” to provide the signal display to only desired portions of the roadway. The programming is accomplished by masking (with tape) portions of the lens through the rear of the housing or by steerable LED arrays behind the lens. Applications for the use of programmable heads may be severely skewed roadways where the signals may be visible from more than one approach and closely spaced intersections, or closely spaced intersections.

Because the lens is programmed to be visible from certain areas, the signal head should be rigid mounted or tethered. Programmable signal heads are much more expensive than a regular signal head and, if programmed incorrectly, can create an unsafe condition. Signal designers should give careful thought to their use and provide plan sheets clearly showing the desired visibility cutoffs.

See Section 450-10.5 for additional details on optically programmable signal heads.
420-4.7 Signal Indications on the Stem of a T Intersection

For through traffic, a minimum of two signal faces shall be provided and shall be continuously visible per the requirements of OMUTCD Section 4D.11.

On the stem of a T intersection, where there is no through traffic, at least one of the turning movements shall be provided with dual indications. If two three-section heads are used, one with a left-turn green arrow and the other with a right-turn green arrow, the approach does not meet the minimum requirements of the OMUTCD. Two circular greens are sufficient, or two circular greens with one or two arrows (four-section heads) are acceptable. The purpose of providing dual indications is to ensure that if one lamp fails, a second lamp will be provided to the predominant movement.

420-4.8 Signal Head Clearance

OMUTCD Section 4D.15 requires that the bottom of the signal housing and any related attachments to a vehicular signal face located over a roadway shall be at least 15 feet above the pavement. The top of the signal housing of a vehicular signal face located over a roadway shall not be more than 25.6 feet above the pavement. For new construction, SCD TC-85.20 requires a clearance of 16 to 18 feet above the pavement elevation at the center of the roadway, 17 feet if tethered. If the installation cannot be adjusted to the proper clearance, the engineer, in consultation with the maintaining agency, may direct the use of drop pipes or waive the maximum clearances requirement for each head.

420-4.9 Use of Balance Adjusters Prohibited

Balance adjusters shall not be used on signal installations with backplates. Experience has shown that balance adjusters allow enough twisting motion in the signal head to produce tether wire fatigue at the tether attachment point.

420-5 Detector Loop Placement

420-5.1 General

Figures 498-3 through 498-5 illustrate suggested loop placements for traffic control signals in the following situations: High-Speed Mainline vs. Large-Volume Side Street, Mainline vs. Ramp/T Intersection, and High-Speed Mainline vs. Low-Speed Side Street, respectively. Section 450-10.7 provides additional detail information about loop placement and wiring.

These are intended only as suggestions for detector placement and a naming convention. Actual placement will depend on individual conditions and District practices. Electronic copies of the drawings are available upon request.

420-5.2 Detection of Motorcycles and Bicycles

For any project using State or Federal funds, all stop line detection zones shall reliably detect motorcycles and bicycles, and all dilemma zone detectors shall reliably detect motorcycles. To assist the traffic signal designer, the following information is provided:

1. Motorcycles and bicycles are more easily detected by inductance loop detectors (ILDs) when traveling over a wire that is parallel or skewed to the direction of travel. All loop configurations have a bicycle/motorcycle dead zone at their center.

2. Video stop line detection is usually a reliable detection system for motorcycles and bicycles. The detection zone at the stop line should be kept small so that motorcycles and bicycles will impact a larger percentage of the detection zone. Other detection zones may be added in advance of the stop line detection zone to provide large area detection. Locking of detection calls may be required during nighttime hours, especially at unlighted intersections.
3. An 8-foot wide rectangle or square ILD in a lane of 12 feet or less in width places the wires too close to the edge of pavement or adjacent lane to be considered a traveled path for motorcycles. A 6-foot wide ILD in a 12-foot wide lane will position the wires closer to the traveled path, increase sensitivity in the center of the zone, and allow the detector unit sensitivity setting to be increased while minimizing adjacent lane false calls.

4. The long rectangular stop line ILD is not a reliable detector of small vehicles. While the commonly used rectangular ILD has good detection of high-bed vehicles, the center dead zone does not reliably detect motorcycles and bicycles. Increasing sensitivity to a level that will detect motorcycles and bicycles may cause false calls in the adjacent lane.

5. For dilemma zone detection, the commonly used 6-foot diamond, square, or rectangle shape may not reliably detect motorcycles traveling in the center of the lane over the ILD corners. The Angular Design Detection (ADD) loop shown on SCD TC-82.10 will provide more reliable detection.

6. To provide large area ILD detection at stop lines:
   a. The Powerhead configuration provides both motorcycle/bicycle and large area detection with a single loop. Shorter Powerhead loops (e.g., 6 x 20 feet) provide the best performance, with a maximum permissible length of 35 feet.
   b. A short quadrupole (10 feet or less) with 3-6-3 wire configuration can be used at the stop line for the detection of motorcycles and bicycles, with a longer rectangular or ADD ILD in advance of the quadrupole to detect other vehicles including high-bed vehicles. This arrangement provides better performance than a single Powerhead loop, but requires more detector module channels.
   c. A series of 6 foot rectangular ILDs can be used to provide a zone of coverage in advance of the stop line with the ILD at the stop line being either a short Powerhead or a short parallel quadrupole.
   d. The stop line ILD shall not be wired to any other loops and shall have its own detector channel.
   e. System loops may be 6 x 6 foot square or diamond shapes.

At locations of high bicycle use or where the outline of the ILD is not visible on the pavement, signing and pavement marking (OMUTCD Section 9B.13 and Figure 9C-7) may be used to denote the location on the ILD for the most reliable detection area after testing with a bicycle.

All stop line detection zones should be tested for a bicycle target, and all dilemma detection zones tested for a motorcycle target for reliable detection. See Figure 498-27 for standard vehicle test targets.

420-5.3 Inductive Loop Detection Zones at High Speed or Freeway Ramp Locations

Figures 498-3 through 498-5 illustrate suggested loop placements for traffic control signals in the following situations: High-Speed Mainline vs. Large-Volume Side Street, Mainline vs. Ramp/T Intersection, and High-Speed Mainline vs. Low-Speed Side Street, respectively. Section 450-10.7 provides additional detail information about loop placement and wiring.

These are intended only as suggestions for detector placement and a naming convention. Actual placement will depend on individual conditions and District practices. Electronic copies of the drawings are available upon request.

420-5.4 Video Detection Prohibited for Dilemma Zone Applications

Video detection shall not be used for advance (Dilemma Zone) detection on any approach with a posted or prevailing speed of 35 mph or greater. Video detection is suitable for stop line applications only. Within 200 feet of the stop line, video detection may be employed for
(green) extension detection. Beyond 200 feet, extension detection shall be provided by inductive pavement loops or Advance Dilemma Zone Detection System (Section 442-39).

420-5.5 Second-Car Detection

420-5.5.1 Background

The use of second-car detection eliminates timing of the associated protected left-turn phase when only one vehicle is waiting for service. This amounts to an “early return” of the opposing green through movement equal to the minimum duration for the left turn. In general, left turns have minimum times similar to those below, to be used for this example calculation:

1. Minimum Green: 7 seconds
2. Yellow Change: 4 seconds
3. All-Red Clearance: 1 second

The total for this minimum phase time is 12 seconds. The queue clearance time (QCT) in seconds is given by:

\[ QCT = 4 + 2n \] (where \( n \) = the number of vehicles clearing from queue past the stop line).

Rearranging, we can calculate the number of vehicles (per opposing through lane) that move into the intersection during this interval: \( n = 0.5 \times (QCT - 4) \).

For the typical left-turn phase timings above, this gives: \( n = 0.5 \times (12 - 4) = 4 \).

Thus, only an additional four vehicles per lane are cleared in the opposing through phase by eliminating the protected left-turn movement using second-car detection. The signal designer is advised to consider this minor increase in through-phase service volume relative to the safety considerations associated with eliminating the protected left-turn interval.

420-5.5.2 Use of Second-Car Detection

The deliberate placement of protected/permissive left turn presence loops and detection zones at locations with their trailing edge more than one vehicle length behind the stop line is sometimes used by signal designers. The rationale for this placement is the perceived increased efficiency obtained by skipping the associated left-turn phase if only one vehicle is present at the stop line, forcing that vehicle to make a permissive turn at some point during the adjacent green through phase. Such operation yields its greatest mainline efficiency benefit under heavy through volume conditions. However, under heavy volume conditions, the permissive left turn often cannot be made until the opposing phase termination. For high-speed, multi-lane, divided highways, offset-left approaches and other conditions, this can be a dangerous vehicular movement, contributing to angular collisions.

For the reason noted above, left-turn second-car detection shall not be used at ODOT-maintained signals under (but not limited to) the following conditions:

1. High approach speeds (over 35 mph posted or prevailing).
2. More than one opposing through lane regardless of approach speeds.
3. Median-divided highways.
4. Offset left-turn lanes.
5. Left-turn lanes with permitted U-turns.
6. An intersection with PREPARE TO STOP WHEN FLASHING advance warning flashers.
7. High-skew or other geometrics or conditions with limited visibility.
421 SIGNAL SUPPORTS

421-1 General

MUTCD Section 4D.33 presents information on the lateral placement of signal supports. Construction details are shown on SCDs TC-21.20, TC-81.10 and TC-81.21. Signal supports are specified in CMS Item 632 and CMS 732.

CMS and SCD information may be viewed on-line at http://www.dot.state.oh.us/Divisions/ConstructionMgt/OnlineDocs/Pages/2010CMS.aspx and www.dot.state.oh.us/Divisions/Engineering/Roadway/DesignStandards/traffic/SCD/Pages/, respectively.

421-2 Signal Support Inspections

A statewide uniform practice for the periodic inspection of the structural components of ODOT-maintained signal supports is necessary to assure their structural integrity. All strain pole and mast arm supports should be periodically inspected. The inspections should be conducted in a systematic and organized manner that will be efficient and minimize the possibility of any item being overlooked. The use of an inspection form is recommended. See Section 496-1 for a Sample Signal Support Inspection Form which may be used as is or modified by the District as desired. A copy of this form may be downloaded from the OTE Forms web page at: www.dot.state.oh.us/Divisions/Operations/Traffic/Pages/Forms.aspx.

Supports should be visually inspected from the ground. Binoculars should be used as an aid for visual inspections. Use of a bucket truck or other means is not necessary on a routine basis, but may be used to more closely examine a defect that has been detected from the ground. Anchor bolts should be tested for structural integrity by sounding with a hammer. Non-destructive testing procedures, such as dye penetrant, ultrasonics, and magnetic particle, are not necessary on a routine basis, but can be used to define the extent of a defect that has been detected by visual means. Written documentation of all inspections should be kept.

Items to be inspected should include, but not be limited to, foundation concrete, soil around foundation, anchor bolts and nuts, structural members and structural connections.

Deficiencies to be inspected for should include, but not be limited to, cracks in concrete, soil erosion, non-bearing leveling nuts, loose anchor nuts, bent or distorted structural members, cracked welds, missing or loose hardware, and corrosion.

Appropriate corrective action, in accordance with sound engineering practices, should be taken to correct detected deficiencies. Repairs should be made within a reasonable time frame, commensurate with the extent of the deficiencies found. Temporary remedial actions, up to and including complete removal of the structure, may be appropriate until permanent repairs can be accomplished. Written documentation of corrective actions should be kept.

All signal supports shall be inspected at a maximum five-year interval. New signal supports shall be inspected at the time of construction.
This Chapter has been reserved to address, as needed, planning and programming information related to traffic control signals.

The Systematic Signal Timing & Phasing Program (SSTPP) is funded by the ODOT Safety and Congestion Program. Its purpose is to systematically update the timing and phasing of signal systems at approved candidate intersections and/or corridors. See Section 1213-6 for more information regarding this program.
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440 DESIGN INFORMATION

440-1 General

The L&D Manual Volumes One and Three and Chapter 140 provide general background regarding design information for ODOT projects, including the three-stage review process typically used for traffic control plans. Additional design information has been provided in this Chapter, including checklists for Stage 2 and 3 submittals (see Section 440-7). See Chapter 441 for additional information specifically related to plan preparation. Plan Notes are addressed in Chapter 442 and Chapter 443 provides a listing of related CMS items.

440-2 Electrical Power for Traffic Signals

Each signalized location should, whenever possible, be powered from a separate, independent power source point arranged with the power company. This should be a 120 volt (two-wire) service of adequate ampacity for the predicted loads. A 120/240 volt, three-wire, service should only be considered when it will also be used to power a few roadway luminaries at the intersection, and in this case, disconnects shall be arranged so that it is possible to disconnect the lighting circuit for repairs without disturbing signal operation.

SCD TC-83.10 addresses pole mountings for controllers and power service. ODOT-maintained signals shall use padlocks at all times to prevent unauthorized disconnect operation.

Provision of traffic signal power service will cover the same general considerations as designated for separate independent sign lighting power services (Section 240-7.7, 1 and 3). The availability of power at various locations in the intersection may tend to make some locations more favorable for the controller mounting.

Plan Note 442-2 (see Section 442-2) should be included on projects with traffic signals. The name and address of the power company and the voltage to be supplied shall be specified in the appropriate blanks.

440-3 Single-Arm Overhead Signal Support

Various types of overhead signal supports are depicted in Table 497-4. In designing a single-arm overhead signal support, the following instructions are used in conjunction with SCD TC-81.21 for new supports and SCD TC-81.20 for retrofit situations:

1. Determine the approximate arm length as the horizontal distance from the pole flange plates to a point 1 foot beyond the most remote attachment (signal or sign).

2. Locate each signal or sign on the arm. Select the proper area for each signal head from Table 497-5, and for a sign.

3. Calculate the area moment design factor (K) by multiplying each area (A) by the distance (b) from its attachment point to the pole centerline and add the products.

\[ K = b_1A_1 + b_2A_2 + b_3A \]

See figure shown on next page. Area moment for standard luminaires and bracket arms may be calculated as 3L, where L = length of bracket arm in feet.
4. For a new support, select the proper design based on maximum arm length (from TC-81.21) and area moment design factor (K) from the design chart shown below.

<table>
<thead>
<tr>
<th>Design No.</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>11</th>
<th>12</th>
<th>13</th>
<th>14</th>
</tr>
</thead>
<tbody>
<tr>
<td>K</td>
<td>637</td>
<td>787.5</td>
<td>937.5</td>
<td>1575</td>
<td>1780</td>
<td>1995</td>
<td>2380</td>
<td>2641</td>
</tr>
<tr>
<td>Max Arm Length (ft)</td>
<td>25</td>
<td>32</td>
<td>38</td>
<td>38</td>
<td>45</td>
<td>48</td>
<td>60</td>
<td>70</td>
</tr>
</tbody>
</table>

5. As long as the K value is not exceeded, it is acceptable to exceed the “Maximum Design Area” shown on TC-81.21.

6. When an existing TC-81.20 support is to be retrofitted with backplates and/or rigid-mounted signals, the following design chart shall be used.

<table>
<thead>
<tr>
<th>Design No.</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>11</th>
<th>12</th>
</tr>
</thead>
<tbody>
<tr>
<td>K</td>
<td>318.5</td>
<td>378</td>
<td>412.5</td>
<td>825</td>
<td>845.5</td>
<td>1045</td>
</tr>
<tr>
<td>Max Arm Length (ft)</td>
<td>25</td>
<td>32</td>
<td>38</td>
<td>38</td>
<td>45</td>
<td>48</td>
</tr>
</tbody>
</table>

7. The value should not exceed that listed for the selected design number. If the values are exceeded, the designer shall be responsible for determining the support size required.

8. Any mast arm length greater than 59 feet is required to have a wind damping system.

9. If the design numbers for the supports at a particular intersection are similar (for example, 2 design number 11 and 2 design number 12 at the same intersection), then the smaller supports may be changed to the larger design number in the plans.

The designer shall submit detailed structural calculations showing the adequacy of any proposed non-standard signal support design. The proposed design shall include the foundation. The plan
designer shall include a Plan Note reflecting the non-standard signal support design requirements in this section. The note shall include requirements for an engineer’s seal on both structural calculations and shop drawings for the proposed structure.

Calculations must be submitted to the owner agency for approval prior to fabrication. Shop drawings may be provided at time of delivery of the structure.

The supports shall be designed using the 2009 Edition of the AASHTO Standard Specifications for Highway Signs, Luminaires, and Traffic Signals. The following criteria shall be used for the design:

- Basic Wind Speed – 90 mph
- Design Life – 25 years
- Fatigue Category III

The support designs shall **not** include galloping or truck induced gust loading.

### 440-4 Two-Arm Signal Support Design

Various types of overhead signal supports are depicted in Table 497-4. To determine arm and pole sizes for the two-arm signal supports where the arms are approximately at 90 degrees (± 15 degrees), proceed as follows:

1. Considering each arm as a single arm signal support, follow the design instructions noted in Section 440-3 for SCD TC-81.21.

2. Using the arm sizes detailed for the SCD TC-81.21 design numbers selected in step 1, use the following chart to select the pole size required.

![Chart](chart.png)

Where the following defines the related pole designations:
Pole Designations

<table>
<thead>
<tr>
<th>Pole Designations</th>
</tr>
</thead>
<tbody>
<tr>
<td>A TC-81.21</td>
</tr>
<tr>
<td>B TC-81.21</td>
</tr>
<tr>
<td>C TC-81.21</td>
</tr>
<tr>
<td>D TC-81.21</td>
</tr>
<tr>
<td>E TC-12.30</td>
</tr>
<tr>
<td>F TC-12.30</td>
</tr>
<tr>
<td>G TC-12.30</td>
</tr>
<tr>
<td>H TC-12.30</td>
</tr>
<tr>
<td>I TC-12.30</td>
</tr>
<tr>
<td>J TC-12.30</td>
</tr>
<tr>
<td>K TC-12.30</td>
</tr>
<tr>
<td>L TC-12.30</td>
</tr>
</tbody>
</table>

3. The SCD TC-81.21 or TC-12.30 design number for the pole shall be used in the plans as reference for the proper pole base and foundation details.

4. SCD TC-81.21 will apply for arm details and arm attachments.

440-5 Span Wire Signal Support Design Software (SWISS)

ODOT has developed a software program to calculate the moment at the base of a strain pole for various span wire configurations. The base moment is compared to SCD TC-81.10 to select an adequately sized strain pole for the span wire configuration analyzed. The software program is available to consultants and local jurisdictions on the Office of Roadway Engineering (ORE) website.

Unless specifically necessary, all strain poles for a given span shall be the same design number. This is done by setting all pole designs in the plan to be the same design number as the largest pole indicated by the SWISS software.

The use of H-spans is discouraged in favor of the Box-With-Tails span configuration. Bullrings shall be located along imaginary diagonal lines between the poles. Questions about span wire configuration selection can be directed to the ORE staff.

See Table 497-6 for the height from the bottom of the signal head to the messenger wire or mast arm.

440-6 Traffic Signal Timing Analysis

440-6.1 Traffic Signal Timing Software

ODOT currently uses versions 6 and 7 of Synchro (signal timing and coordination) and SimTraffic (simulation) software.

440-6.2 Diamond Interchange Traffic Signal Timing

When developing traffic signal timing for diamond interchanges, the designer should also analyze the interchange using controller phasing operation developed by the Texas Department of Transportation. The interchange signal operation typically uses one controller to operate both ramp intersections. Two forms of the controller operation are available:

Three-phase diamond operation is best suited for wide interchanges (>400 feet) with
adequate internal left-turn storage and heavy through movements usually associated with rural/suburban type interchanges. The 3-phase operation may provide better two-way arterial coordination than the 4-phase operation.

Four-phase diamond operation is best suited for interchanges where the ramp intersections are close together and have heavy left turning movements usually associated with urban type interchanges. This operation will usually reduce congestion within the interchange and should be considered where arterial left turn storage is inadequate.

The signal timing analysis for the diamond interchange is initially performed in Passer III which provides various signal timing/cycle length combinations with performance measures for each. Synchro/SimTraffic software is then used to analyze the arterial performance of the various cycle lengths to obtain the best match for the arterial system operation.

Plan Insert Sheets (PISs) are available for both the 3-phase and 4-phase operations that provide controller and detector information that can be included in the signal plans.

440-7 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. Base plan drawn to a scale of 1:20 and it shall include roadway base lines.
   b. Traffic signal pole locations and skew angles, if required. Reference numbers for all poles.
   c. Signal head locations and direction; identify signal heads having turn arrow lenses, louvers or special optically programmed features; signal head sizes; and reference numbers for all signal heads.
   d. Signal controller location and orientation.
   e. Detector locations, loop configurations and detector chart (Form 496-4).
   f. Underground conduit and pull boxes.
   g. Overhead sign locations, whether on signal spans, mast arms or located on separate supports.
   h. Legend for symbols used.
   i. Pavement marking pertinent to the signal operation.
   j. Signal phasing diagram, method of addressing yellow trap (where applicable) or field hook-up chart (see Forms 496-19 and 496-20) and signal timing. See Forms 496-3 and 496-5 for typical signal timing charts.
   k. Handicap ramp locations.
   l. Right-of-Way lines.
   m. Corporation lines.
   n. Any existing features to be incorporated into the new signal. Any decision to reuse equipment must be based on a field check of the structural integrity and condition of the devices and agreement with the maintaining agency.
   o. Other physical features within the intersection and sidewalk area which may conflict with traffic flow, pedestrian flow or sight distance.
2. Stage 3 Plan Requirements:
   a. General Notes.
   b. Estimated quantities.
   c. Special details.
   d. Pole orientation chart.
   e. Wiring diagram. It shall indicate the type of cable and number of conductors connecting each signal head, pedestrian head, detector, push button, etc.
   f. Coordination timing. All coordination timings shall be in seconds.

The Traffic Signal Stage 3 check list is given in Form 496-2.

440-8 ADA Requirements on Traffic Signal Projects

440-8.1 General

As noted in Section 401-9, there are generally four major ADA requirements that affect traffic signal projects:

1. Accessible pedestrian signals;
2. Audible pedestrian pushbuttons (locator tones);
3. Curb ramps;
4. Truncated domes (tactile bumps on the curb ramp).

440-8.2 Accessible Pedestrian Signals and Locator Tones

Section 404-3 covers accessible pedestrian signals and locator tones at ODOT-maintained traffic signals. On traffic signal projects, local governmental agencies may install these devices at their intersections if it is part of their local policy/standards.

A common mistake made at rural type intersections is to provide a pedestrian pushbutton on a pole that is located far back from the roadway. When provided, pedestrian pushbuttons shall be accessible to the disabled. This may mean providing a paved pathway back to the pushbutton. Alternatively, a pedestal can be provided to put the pushbutton near the intersection.

440-8.3 Curb Ramps

Refer to Location and Design Manual, Volume 1, Section 306 for basic guidelines for pedestrian facilities (curb ramps and sidewalks).

On traffic signal projects, ADA compliant curb ramps shall be provided at locations where work is being performed. This includes upgrading any existing curb ramps to meet current ADA design requirements. Generally, every intersection where a traffic signal is installed or upgraded shall be provided with ADA compliant curb ramps. In cases where an intersection is not disturbed, i.e., only running aerial interconnect, curb ramp work would not normally be required (though the locals may include the work). If the interconnect is being trenched
through an intersection, curb ramps would be required as part of the project. The litmus test is if the work being proposed will disturb the intersection, then curb ramp work will be required. For maintenance type work, curb ramp work would not be required. Controller and cabinet upgrade only locations shall be considered substantial enough to require curb ramp upgrading.

440-8.4 Truncated Domes (TDs)

TDs are raised “bumps” used by people with vision impairments to be able to feel where the ramps are. All new, existing or upgraded curb ramps shall have truncated domes upon completion of a traffic signal project.

Roadway Engineering’s SCD BP-7.1 addresses new ramps, and BP-7.2 addresses existing curb ramps. For guidance in the use of these drawings, contact the Office of Roadway Engineering. The information is available on-line at: www.dot.state.oh.us/divisions/prodmgt/roadway/pages/default.aspx

440-9 Paying Locals with Project Funds

On some projects, the local authorities desire to have one of their employees in attendance when the contractor is working in their traffic signal controller cabinets. This is a legitimate request and the plans should include a general note requiring the contractor to inform the local authorities prior to working in their traffic signal controller cabinets. The cost of providing the local employees shall be borne by the local authorities. Project funds shall not be used to pay the local representative’s salary, either straight or overtime pay.
441 PLAN PREPARATION / PRODUCTION

441-1 General

The L&D Manual Volume Three and Chapter 140 generally describe ODOT plan preparation and production guidelines. Additional information is provided in this Chapter and Chapter 440 regarding traffic signal items in plans.

441-2 Reserved for Future Information

This Section is reserved for future information.

441-3 Signal and Sign Supports

The following location requirements apply to Stage 2 Plans:

1. Consider sight distance conflicts between signals and overhead signs included within the project, as well as other visibility obstructions. Signals take precedence for prime locations.

2. Combine signal, sign and/or light poles where practical; in so doing the support shall be a signal support bid item.

3. Distance from Stop Line to signal heads shall be in accordance with O M U T C D Sections 4D.13 and Figure 4D-4. Stop Lines shall be located to suit geometric conditions, then signal head locations provided to suit.

4. Minimum lateral clearances to pole or signal equipment attached thereto shall be as per Section 600 of the L&D Manual Volume One.

5. Where sidewalks are encountered, signal poles and equipment shall be located behind them if physically possible.

6. Locate signal poles behind existing guardrail wherever possible, with a minimum clearance of 6.5 feet from the face of guardrail to the centerline of the support. Other signal equipment shall have a minimum clearance of 6 feet from the face of guardrail to the nearest edge of the equipment.

7. Determine the exact location by station to the nearest 1 foot. This information will be needed in Stage 3 Plans.

441-4 Power Service

Tentative power service locations shall be specified as needed on the plans either on the signal support or at separate service poles (separate bid item). The contractor's work will generally consist of providing sufficient length of two-wire power cable out of the weatherhead, to which the power company will make their attachments and connections. See Section 450-9 for the measurement of power and service cables.

See Section 440-2 for design information on electrical power for traffic signals. Prior to filing the tracings, the design agency shall confirm in writing, agreements made with the power company, to the District Production Administrator and City Traffic Engineer (if applicable).

441-5 Underground Facilities

Conduit runs shall usually be limited to 200 feet between pull boxes, but up to 400 feet may be used if the run is straight and not too full.
Conduit crossing bridge structures shall, if possible, be included in parapets. As an alternative, it may be attached to the underside of the parapet by means of clamps. Necessary flexible conduit at expansion joints shall be provided.

Conduit under the roadway shall be a minimum of 3-inch diameter. All conduit shall be of sufficient size to contain the conductors as per the National Electric Code. See Section 450-3.4 for additional information.

441-6 Quantities

In the General Summary, all quantities should be shown in whole units of measurement, except concrete which shall be shown to a tenth of a cubic yard and any pavement marking item measured in miles, which shall be shown to a hundredth of a mile.

441-7 Bid Item Descriptions

Bid item descriptions are required to exactly match the descriptions published in the “Item Master.” This “Item Master” is available from the ODOT Design Reference Resource Center (DRRC) web page at www.dot.state.oh.us/drrc/Pages/default.aspx.

When the standard bid item description is inappropriate, the words "As Per Plan" shall be added to the description, and a note shall be provided to describe the deviation from the standard specifications and/or details. See Chapter 442 for examples of typical Plan Notes.

441-8 Signal Support, Detail Design Requirements

Figures 498-36, 498-37 and 498-38 provide examples of tables for presenting signal support information in the plans for support types described in SCDs TC-81.10 and TC-81.21.

Use of the sample tables is recommended as a means of uniformly presenting support information to the contractor or support manufacturer. The support designer should note that the orientation angles consist of:

- A field angle that establishes the angular relationship between the project centerline perpendicular and a pole feature (handhold or mast arm) which serves as an index.
- Angles for all pole appurtenances that are measured from this index pole feature.

Complete instructions for designing the single arm overhead signal support described in SCD TC-81.21 are contained in Section 440-3. Instructions for the design of two-arm signal supports are contained in Section 440-4.

The following information relates to the detail design of signal supports for Stage 3 plans.

1. Foundation elevations and span wire attachment heights are optional for signal strain poles. Top and bottom foundation elevations should be provided if foundation dimensions are not as shown on SCD TC-21.20, or when steep roadside slopes or roadway superelevation would make foundation elevations difficult to otherwise determine.

2. Station and offset information is not necessary for signal strain poles in the strain pole table. Poles should be clearly labeled and locations dimensioned on the signal intersection sheets.

3. Do not give conduit angles for foundations because these will be field located by the contractor according to the plans and field conditions. An exception would be for unused, capped conduit ells for future use.
4. A column may be added to define the street from which the centerline and angles are determined.

5. For a project with many installations, a column for cross reference to the signal or sign plan sheet should be added.

6. Elevation views of the signal spans are optional. However, if elevation views are not used, span dimensions between signal heads and signs shall be shown on each signal intersection sheet.

7. Strain poles (SCD TC-81.10) can typically be located with the base plate either square or at 45 degrees to the roadway centerline. The pole and foundation are designed for loading in any direction and the anchor bolts do not need to be located exactly in line with the resultant span wire load.

8. If two pedestrian signal heads are located on a pole, the designer must choose between a single mounting bracket for two heads or separate mounting brackets for each head. Also, SCD TC-85.10 allows field installation of holes with alternate mounting methods instead of threaded blind half couplings. The maintaining agency's choice of mounting method should be clearly noted in the plans.

9. If luminaire bracket arm attachment plates are required, a column should be listed in the table to show the orientation angles. The plan should note whether one or two plates are required. The power company or maintaining agency should be contacted concerning any special mounting attachment requirements. ODOT standards are shown on SCD HL-10.12.

441-9 Service Cable

In CMS 732, service cable is specified primarily as aluminum conductors. This was done because aluminum is typically most cost effective in these sizes, and more readily available. The specification allows the substitution of copper conductors of one size smaller. This is because the greater conductivity and lower resistance of copper approximately accounts for one wire size. For instance, a #8 AWG copper conductor with an ampacity of 45 AMPs may be substituted when the plan calls for a #6 AWG aluminum conductor which would have an ampacity of 50 AMPs.

This relationship is considered acceptably close for the required usage. The specifications call for appropriate connectors to match wire material.

There is a potential problem if the designer uses a specific size of copper service cable, out of habit, without recognizing that the change to aluminum has effectively reduced ampacity of these cables by 12 to 25 percent.

A similar relationship exists for cases where long runs of service cable require consideration of voltage drop.

Under CMS Item 632 and CMS 732, service cables should be sized to the following minimums:

<table>
<thead>
<tr>
<th>Total Control Load (AMPS)</th>
<th>Aluminum Wire Size (AWG)</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>#10</td>
</tr>
<tr>
<td>30</td>
<td>#8</td>
</tr>
<tr>
<td>45</td>
<td>#6</td>
</tr>
<tr>
<td>65</td>
<td>#4</td>
</tr>
</tbody>
</table>

Also note that aluminum service cable (duplex or triplex) is not readily available in smaller than #8 AWG.
441-10 Two-Arm Signal Supports

Section 440-4 describes the procedure for designing a two-arm signal support. As noted in that Section, the SCD TC-81.21 or TC-12.30 design number for the pole may be used in the plans as reference for the proper pole base and foundation details. SCD TC-81.21 will apply for arm details and arm attachments.

The bid item for the structure should be in the form:

Item 632 (Combination) Signal Support, Type (TC-12.30 or TC-81.21) Design ___ Pole, with
Mast Arms TC-81.21 Design ___ and TC-81.21 Design ___

A detailed elevation view and any other special details required for the two-arm support that are not covered by the SCD should be included in the plans.

441-11 Guarantees

For projects not requiring detail guaranteeing, the requirements of CMS Item 633 will apply. On traffic control projects or other projects where the cost for traffic control is more than one-third of the total cost, a Plan Note based on Section 442-15 may be included. The period of guarantee should be adjusted in relation to equipment complexity, i.e., 90 days for simple equipment, 120 days for traffic adjusted equipment and a maximum of 180 days for computerized control of many intersections. When the note is included, notice of the fact should be communicated in the transmittal of final tracings to Central Office, so that affected groups may make provision in the proposal for the extended completion date.

441-12 Alternate Bids

The use of alternate bidding procedures must be requested and the maintaining agency must agree in writing to the procedure. Alternate bids are typically used for projects where a particular type or brand of equipment is desired, usually the signal controller. Section 442-16 presents an example of an alternate bid note (Plan Note 442-16) setting up an alternate bid item in the plans. This note should be placed in the plans at the end of the general notes for traffic signal items. In the general summary, the alternate bid item should be at the end of the list of traffic signal items.
442 PLAN NOTES

442-1 General

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

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

442-2 Power Supply for Traffic Signals

Electric power shall be obtained from the ___________ at the location indicated on the plans. Power supplied shall be ____ volts.

Designer Note: See Sections 440-2 and 441-4.

442-3 Reserved for Future Use

442-4 632, Removal of Traffic Signal Installation

Traffic signal installations, including signal heads, cable, messenger wire, strain poles, cabinet, controller, etc., shall be removed in accordance with CMS 632.26 and as indicated on the plans. Removed items shall be reused as part of a new installation on the project or stored on the project for salvage by (name of agency receiving stored items) in accordance with the listing given herein.

(Items to be reused)

(Items to be stored)

In the event the items stored on the project for salvage by the local agency are not removed, the Contractor shall, when directed by the Engineer in writing, remove and dispose of the items at no additional cost to the project.

Designer Note: This note shall be included on projects where existing traffic signal installations are being removed. A listing of items to be reused and/or stored must be included. Pull boxes to be removed shall be itemized separately and paid for under Item 625 “Pull Box Removed”.

442-5 632, Interconnect Cable, Misc.: (by Size), with Support Messenger, As Per Plan

The Contractor will be permitted to use either of two types of interconnect cable construction and installation under this item as follows:

1. Integral messenger type interconnect cable meeting the requirements of CMS 732.19. Under this method any sections of cable shown in the plans to be contained in controllers, cabinets, poles, conduits or supported on messenger wire installed for other purposes shall have the supporting messenger and jacket web neatly removed by the use of a tool specifically designed and sized for this purpose. Deviations from the cable routing shown in the plan, for the sole purpose of reducing the amount of messenger to be removed, will not be permitted. The cable shall be installed with approximately one twist for each 15 feet of span length.
2. Separate interconnect cable meeting the requirements of CMS 732.19 plus a 1/4 inch messenger wire and lashing meeting the requirements of CMS 732.18. Under this method the Contractor will install a separate 1/4 inch messenger to support the spans of interconnect cables in all locations where the plans show interconnect cable which is not otherwise supported by a signal messenger wire or other suitable support. Utilization of existing messenger wire, not provided by the project or designated therein as available for use, is prohibited. Deviation from the cable routing shown in the plans, for the purpose of reducing the need for separate messenger wire, will not be permitted.

In either case the number of splice locations shall be kept to a minimum.

Measurement will be based upon the number of feet of CMS Item 632, "Interconnect Cable, Misc.: (by size), with Support Messenger, As Per Plan" in place in accordance with the method described in CMS 632.29 and no separate payment will be provided for any separate messenger wire used to support interconnect cables.

**Designer Note:** This note may be used on projects with overhead interconnect cable, if acceptable to the maintaining agency.

442-6 **632, Loop Detector Units, by Type, As Per Plan**

In addition to the requirements of CMS Item 632 and CMS 732.07 or 732.08, loop detector units shall have the following requirements or features:

- The output device shall be a relay, and all contacts shall be in the wiring harness.
- The unit shall be self-tuning.
- The unit's electrical connection plugs or wiring harness shall allow ready replacement with a single channel amplifier as described in CMS 732.07.
- Each unit shall be labeled to correspond to its phase and direction.
- Delay inhibit shall be connected on all detector harnesses for their respective phase greens.

**Designer Note:** This note should be included for projects which will be maintained by Districts that use NEMA TS-1 controller cabinets. Bid items are not used unless detector units are installed in an existing cabinet.

442-7 **Reserved for Future Use**

442-8 **Reserved for Future Use**

442-9 **632, Loop Detector Lead-In Cable, Direct Burial**

This work shall include furnishing and installing loop detector lead-in cable of the type required in CMS 732.19. Installation shall be by cable plow or vibratory cable plow to a minimum depth of 18 inches. All entries into pull boxes, conduit systems, foundation or other enclosures shall be free of sharp edges and be covered by insulated bushings. Following installation, the ground surface shall be restored to the original contour and surface condition.

**Designer Note:** This method may be considered in lieu of cable in conduit to reduce project costs. It is applicable to long underground runs in tree lawns or grassed roadsides where minimal interference with driveways or utilities is expected, and where disturbance of the area due to construction is not contemplated. If the cable is to be routed up a pole, a conduit riser (extending below ground with an insulated bushing) should be called for and detailed.
442-10 632, Combination Signal Support, Type TC-81.21 and Sign Support, TC- (with Light Pole Extension)

This support shall consist of a TC-___ Design ___ pole with a TC-81.21 Design ___ signal arm and a TC-___ Design ___ sign support arm (with light pole extension). All signal support items required by CMS Item 632 and all sign support items required by CMS Item 630 shall be included as part of this support.

Payment will be at the contract unit price and will be full compensation for all labor, materials, tools, equipment and other incidentals necessary for each support furnished, in place, complete and accepted.

Designer Note: This note shall be used when combination traffic signal supports and sign supports are desired. The blanks shall be filled in with appropriate SCD numbers and designs.

442-11 632, Combination Strain Pole, Type TC-81.10 and Sign Support, Type TC- (with Light Pole Extension)

This support shall consist of a TC-___ Design ___ pole with a TC-___ Design ___ sign support arm (with light pole extension). All signal support items required by CMS Item 632 and all sign support items required by CMS Item 630 shall be included as part of this support.

Payment will be at the contract unit price and will be full compensation for all labor, materials, tools, equipment and other incidentals necessary for each support furnished, in place, complete and accepted.

Designer Note: This note shall be used when combination traffic signal strain poles and sign supports are desired. The blanks shall be filled in with appropriate SCD numbers and designs. The following is a bid item example: Combination Strain Pole, Type TC-81.10 and Sign Support, Type TC-12.30 (with Light Pole Extension).

442-12 Strain Pole Foundation Elevations

Elevations shown in the plans for strain pole foundations are for computational purposes only. The actual elevation of the foundation shall be in accordance with SCD TC-21.20 provided the existing slope is less than 6:1.

At locations where the existing slope is 6:1 or greater, the buried depth of foundation, as shown in SCD TC-21.20 shall apply to the low side of the slope. The top of the foundation shall be set 2 inches above the existing surface on the high side of the slope. The additional depth of foundation necessary to meet these requirements shall be added to the formed top.

Designer Note: This note shall be used when strain pole foundations are located in slopes of 6:1 or greater.

442-13 632, Vehicular Signal Head (LED), Color, By Type, (with Backplate) As Per Plan

In addition to the requirements of CMS Item 632 and CMS 732, the following requirements shall apply:

1. All upper signal support hardware and piping up to and including the wire inlet fitting shall be ferrous metal for signal displays of two or more sections.

2. Glass lenses shall be used for any lenses not using an LED lamp.

3. The entrance fitting shall be of the tri-stud design with serrated rings in order to achieve
positive locking.

**Designer Note:** This note should be included for projects which will be maintained by ODOT.

### 442-14 632, Power Service, As Per Plan

Power service shall be as per CMS Item 632 and SCD TC-83.10 with the following exceptions:

1. The meter base mounting height shall be no more than 5 feet high to the center of the meter base from the ground.

2. The Contractor shall supply the necessary meter bases.

3. All power services shall be metered. The meter shall have a lever operated bypass.

Disconnect switch enclosures furnished in accordance with CMS Item 632, Power Service, as per plan, shall include a padlock equal to Master no. 4BKA or Wilson Bohannon 660, with lock body of bronze or brass and keying shall be to the state master.

The Contractor shall contact the meter section of the power company for information regarding the meter base installation prior to ordering poles. The Contractor will be responsible for requesting and scheduling any inspections the power company may require for the power service hook up. The Contractor shall be responsible to contact the power company for the electrical service connection. Under no circumstances shall the Contractor splice power cable into the power company’s circuits. The voltage supplied shall be nominally 120 volts. The Contractor is responsible for obtaining any necessary permits and the paying of all fees. The Contractor shall pay all power charges until the signal is accepted by the maintaining agency.

**Designer Note:** This note may be used when requested by the maintaining agency.

### 442-15 Guarantee

The Contractor shall guarantee that the traffic control system installed as part of this contract shall operate satisfactorily for a period of _____ days following completion of the 10-day performance test. In the event of unsatisfactory operation the Contractor shall correct faulty installations, make repairs and replace defective parts with new parts of equal or better quality. Equipment, material and labor costs incurred in correcting an unsatisfactory operation shall be borne by the Contractor.

The guarantee shall cover the following items of the traffic control system: controllers and associated equipment, detector units, interconnection items and master control equipment.

Customary manufacturer’s guarantees for the foregoing items shall be turned over to the state or the maintaining agency following acceptance of the equipment.

The cost of guaranteeing the traffic control system will be incidental to and included in the contract unit price of the various items making up the system.

**Designer Note:** See Section 441-11.
442-16 633, Alternate Bid Item

633 Controller Unit, Type ___, with Cabinet, Type ___

(Example of a standard bid item)

633 Controller Unit, Type ___, with Cabinet, Type ___ (Acme) - Alternate Bid

The controller shall be a Model (xx-99 as manufactured by Acme Signal Company, Santoy, Ohio) and shall incorporate or be furnished with all the design features, auxiliary equipment, accessories, and prewired cabinet features as required in the standard bid item.

Payment will be at the contract unit price for each, in place, all connections made and wiring completed, tested and accepted.

(Example of an alternate bid item)

Designer Note: See Section 441-12.

442-17 632 Vehicular Signal Head, (LED), Color, By Type, (with Backplate), As Per Plan

In addition to the requirements of CMS 632 and 732, the following requirements shall also apply:

Signal Sections: (if polycarbonate signal heads are to be required, include items 1 thru 3)
1. Signal heads and visors shall be constructed of polycarbonate plastic and meet ITE specifications.
2. Pipe, spacers and fittings constructed of polycarbonate plastic may be used in lieu of galvanized steel or aluminum.
3. Proper exterior colors shall be obtained by use of colored plastic material rather than painting.
   [#. Glass lenses shall be used for any lenses not using an LED lamp.]

Mounting Hardware: (select items as needed)
[#. All signal heads shall be rigidly mounted to the mast arm with the (color) lens located in front of the mast arm.]
[#. All upper signal support hardware and piping up to and including the wire inlet fitting shall be ferrous metal for signal displays of two or more sections.]
[#. The entrance fitting shall be of the tri-stud design with serrated rings in order to achieve positive locking.]

The Department will measure “Vehicular Signal Head, (LED), Color, By Type, (with Backplate), As Per Plan” by the number of complete units furnished and installed, and will include all support and mounting hardware, disconnect hangers, closure caps, dimmers, and lamps as specified.

Designer Note: Since maintaining agencies will use different combinations of LED/incandescent lamp and aluminum/polycarbonate signal sections, this note will allow the designer to choose the various options that will provide the maintaining agency with features that they prefer. Items that are enclosed in brackets [ ] should be carefully considered and retained or deleted based on maintaining agency preferences. Care should be taken not to include duplicate requirements for the same item. Some designer notes are in italics.
442-18 632 Pedestrian Signal, (LED), (Countdown), Type A2, As Per Plan

In addition to the requirements of CMS 632 and 732, the following requirements shall also apply:

(if polycarbonate signal heads are to be required, include the following items)

[1. Signal heads and visors shall be constructed of polycarbonate plastic and meet ITE specifications.]

[2. Pipe, spacers and fittings constructed of polycarbonate plastic may be used in lieu of galvanized steel or aluminum.]

[3. Proper exterior colors shall be obtained by use of colored plastic material rather than painting.]

The Department will measure “Pedestrian Signal Head, (LED), (Countdown), Type A2, As Per Plan” by the number of complete units furnished and installed, and will include all support and mounting hardware, closure caps, and lamps as specified.

Designer Note: Since maintaining agencies will use different combinations of LED/incandescent lamp and aluminum/polycarbonate signal sections, this note will allow the designer to choose the various options that will provide the maintaining agency with features that they prefer. Items that are enclosed in brackets [ ] should be carefully considered and retained or deleted based on maintaining agency preferences. Care should be taken not to include duplicate requirements for the same item. Some designer notes are in italics.

442-19 632 Relamp Existing Signal Section with LED Lamp Unit, By Lens Type, As Per Plan

This item of work shall consist of replacing the 12 inch lens and incandescent lamp in an existing signal head section with a 12 inch LED lamp unit.

The light emitting diode (LED) signal lamp units shall meet the requirements of CMS 732.04-C. An LED signal lamp unit shall be furnished and installed for the type of signal lens specified in the bid item description.

[The existing reflector unit and lens shall be removed and returned to the maintaining agency. The existing incandescent lamp shall be disposed of by the contractor.]

The Department will measure “Relamp Existing Signal Head with LED Lamp Units, By Lens Type, As Per Plan” by the number of complete units furnished and installed, and will include all hardware and lamps as specified.

Designer Note: Since maintaining agencies will use different combinations of LED/incandescent lamp and aluminum/polycarbonate signal sections, this note will allow the designer to choose the various options that will provide the maintaining agency with features that they prefer. Items that are enclosed in brackets [ ] should be carefully considered and retained or deleted based on maintaining agency preferences. Care should be taken not to include duplicate requirements for the same item.

442-20 633 Controller Unit, Type 170E, with Cabinet, Type (332 or 336), As Per Plan

The 412C PROM module for the local controller shall be supplied without controller software to the ODOT District Office 14 days in advance of when the software is needed. The PROM modules shall be configured for Wapiti software and include a blank PROM module for program installation. ODOT will install the local controller software program. The Contractor shall pick up the PROM modules with the installed software from District. It shall be the Contractor’s responsibility to use the returned PROM modules to program the signal controllers per the plans.
The Contractor shall not reassign the detector inputs in order to reduce the number of 2-channel detector units supplied, but shall use the standard CalTrans input file designations.

**Designer Note:** This note should be used at signalized intersections using Type 170E local controllers that are to be owned and maintained by ODOT.

### 442-21 633 Controller Unit, Type 2070L, with Cabinet, (By Type), As Per Plan

The controller unit shall be equipment manufactured in conformance to the California Department of Transportation (Caltrans) specifications titles “Transportation Electrical Equipment Specifications (TEES).” The controller unit, Model 2070L, shall be an Econolite Model 2070L, Build: 1.01.08.02b, Siemens Model 2070L, Build: 6.2.0.0.0.81, or approved equal.

The 2070L controller unit shall include the following:

1. Unit Chassis
2. 2070-1B CPU module
3. 2070-2A Field I/O Module
4. 2070-3B Front Panel
5. 2070-4A Power Supply
6. 2070-7A Serial Communication Module

The controller shall be supplied without traffic signal intersection control software. The controller shall be supplied with Microware Embedded OS-9 Release 1.3 or later with kernel edition #376 or later, as required by Caltrans TEES. For warranty purposes, a vendor-specific decal, as per ODOT CMS 733.02 shall be applied to each controller unit at time of delivery to the project.

The controller shall be shipped by the Contractor to the ODOT Signal Shop, 1606 West Broad Street, Columbus, Ohio 43223, either directly or via the ODOT District Office, a minimum of 14 days in advance of when the software is needed. ODOT will install the local intersection control software. The controller will then be performance tested by the ODOT Signal Shop. Every effort shall be made to have loading and performance testing completed by the ODOT Signal Shop within 2 weeks of receipt of an individual controller; larger groups of controllers submitted at the same time may take longer. Should any controller fail this performance test after being loaded with ODOT-licensed software, the software will be removed by the ODOT Signal Shop and the controller rejected. Rejected controllers will be returned, either directly to the Contractor or to the ODOT District Office. Controllers passing the performance test will be labeled by the ODOT Signal Shop with the OS Image Number, CPU serial number, Software Revision Number, and upload date. This label is not to be removed by the Contractor and serves as proof that the controller has been loaded, tested and approved for initial installation on the project. Such proof does not alter the required 10-day Performance Test outlined in CMS Sections 632 and 633.

The Contractor shall not reassign the cabinet detector inputs in order to reduce the number of 2-channel detector units supplied, but shall use the standard Caltrans Input File designations.

**Designer Note:** This note should be used at signalized intersections using Type 2070L local controllers that are to be owned and maintained by ODOT.

### 442-22 633 Controller, Master, Traffic Responsive, As Per Plan

The 412B2 PROM module for the Type 170E master controller shall be supplied without controller software to the ODOT District Office 14 days in advance of when the software is needed. The PROM modules shall be configured for Wapiti software and include a blank PROM module for program installation. ODOT will install the master controller software program. The Contractor shall pick up the PROM modules with the installed software from District. It shall be the Contractor’s responsibility to use the returned PROM modules to

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program the signal controllers per the plans.

**Designer Note:** This note should be used at signalized intersections using Type 170E master controllers that are to be owned and maintained by ODOT

**442-23 633 Controller, Master, Traffic Responsive, As Per Plan**

The Type 2070 master controller shall be supplied without controller software, but will be supplied with the operating system and CalTrans required software. The controller unit shall be delivered to the ODOT District Office 14 days in advance of when the software is needed. ODOT will install the master controller software program. The Contractor shall pick up the controller unit with the installed software from District. It shall be the Contractor's responsibility to program the Type 2070 signal controller per the plans.

**Design Note:** This note should be used at signalized intersections using Type 2070 master controllers that are to be owned and maintained by ODOT.

**442-24 Reserved for Future Use**

**442-25 633 Preemption**

This item of work shall consist of furnishing and installing preemption equipment in the locations and local controllers as shown in the plans. The preemption shall conform to ODOT Specification 633 and shall utilize communications to identify the presence of an emergency priority vehicle. It shall cause the traffic signal controller to select a pre-programmed preemption plan that will display and hold the desired signal phase for the direction of the emergency vehicle.

The communications medium shall employ either sound, light or radio detection techniques to determine and log the presence of the emergency vehicle. The system shall detect the presence of the vehicle through an emitting device located on the emergency vehicle. The system shall activate the preemption sequence by applying a signal to one of the controller's preempt discrete inputs. The system shall be completely compatible with the controller.

The equipment shall be shelf or rack mounted and easily removable and replaceable within the cabinet. The equipment shall be supplied completely wired in the controller cabinet and tested. The system shall be capable of preempting and receiving priority for each approach to the intersection. It shall be possible to detect the emergency vehicle up to 1200 feet from the intersection.

Each intersection shown in the plans shall be supplied with the following components, each bid separately:

1. Preempt receiving unit.
2. Preempt detector cable.
3. Preempt phase selector assembly and interface wiring panel.

If a light activated system is specified, the Contractor shall inventory the City's existing emitters to determine compatibility with the proposed system. If existing emitters are found to be not compatible, then the City shall be supplied (at costs incidental to the system) with the emitters, transmitters, switches, wiring and all required vehicle equipment for the following emergency vehicles. The City shall be responsible for installing vehicle equipment. The model supplied shall be Opticom manufactured by Global Traffic Technologies LLC, Strobecom II manufactured by Tomar Electronics Inc., or approved equal.

If a radio activated system is specified, the Contractor shall supply the above emergency vehicles with emitters at cost incidental to the system. The model supplied shall be Opticom GPS manufactured by Global Traffic Technologies, LLC, Emtrac Priority Management
System Model GPS manufactured by STC, Inc., or approved equal.

If a sound activated system is specified, the Contractor shall inventory the above emergency vehicles to determine compatibility of the sirens with the system. Each vehicle that is determined to be not compatible shall be supplied with new sirens at cost incidental to the system. The model supplied shall be Sonem 2000 manufactured by Traffic Systems LLC, Right-O-Way manufactured by Wapiti Microsystems, or approved equal.

If a light, radio, or sound activated system is not specified, then Contractor may supply any of the three types.

The City shall be supplied with software required to calibrate, log, and operate the system. The software shall be capable of operating under Windows 7, 32-bit operating system. Two (2) operating and instruction manuals shall be supplied with the software.

The Contractor shall thoroughly test the installed system. As a minimum, the Contractor shall verify that all connections are properly made to the controller cabinets. The Contractor shall check that the range setting is proper for each intersection. The Contractor shall determine that all phase selectors are selecting the proper phase and timing accurately. The Contractor shall verify that all vehicle emitters are being properly detected.

If the proposed preempt system is not compatible with the existing system, the Contractor shall provide training for up to fifteen (15) persons in the operation of the system. It shall be provided within 48 hours of the installation of the system. It shall consist of hands-on instruction for a minimum of sixteen (16) hours. The Contractor shall provide training for up to four (4) persons in the installation and maintenance of the system. It shall consist of a minimum of eight (8) hours of instruction. Training shall be supplied within seven (7) days of the installation of the system. All training shall be held in a City supplied location. Training shall be conducted by someone who has performed this within the last year and does it on a regular basis. The cost of training, including course material, travel subsistence and related costs, shall be entirely borne by the Contractor and shall be incidental to the preemption equipment.

Payment for Item 633 “Preemption” shall be made at the contract unit price for each preemption in place and fully operational as shown in the plans, except for those items bid separately.

Designer Note: This note may be used for generic preempt systems. The quantity in the plans should be one each for the system; not the number of intersections.

442-26 633 Preemption Receiving Unit

Receiving units shall consist of a lightweight, weatherproof and directional assembly. Each receiving unit shall be 360 degree adjustable. The receiving unit shall be capable of sending the proper electrical signal to the traffic signal controller via the preemption detector cable. Receiving units shall be supplied with mast arm mounting hardware as shown in the plans.

Furnish preemption receiving units with 60-month warranties or for the manufacturer’s standard warranty whichever is greater. Ensure that the warranty period begins on the date of shipment to the project. Ensure that each unit has a permanent label or stamp indicating the date of shipment.

Payment for Item 633 “Preemption Receiving Unit” shall be at the contract unit price for each receiving unit in place, completely installed at the location shown in the plans, wired, tested and accepted.

Designer Note: The note may be used when preemption is included for in the plans.
442-27 633 Preemption Detector Cable

This item shall consist of furnishing and installing preemption detector home run cable in the locations shown in the plans. It shall connect the preemption receiving units to the phase selectors in the local controller cabinet.

Preemption detector cable shall conform to ODOT Specification 632. Only one external splice shall be permitted between preemption receiver unit and controller cabinet. This splice shall meet the requirements of C&MS 632.23 using a waterproof epoxy splice kit. The cable shall be approved for both overhead and underground use. The jacket shall withstand exposure to sunlight and atmospheric temperatures and stresses reasonably expected in normal installations.

Payment for Item 633 “Preemption Detector Cable” shall be made at the contract unit price per foot for the cable furnished, in place, all connections made and wiring completed, tested and accepted.

Designer Note: This note may be used when preemption is included for in the plans.

442-28 633 Preempt Phase Selector

This item shall consist of furnishing and installing preempt phase selectors including wiring interface panels in the local controller cabinet and all other accessories that are necessary to make the preempt phase selectors completely functional and operational as shown in the plans. This item shall include the extra cabinet space necessary to be located in the local controller cabinets where indicated in the plans.

The phase selectors shall consist of a module or modules that will provide the necessary inputs to the controller. Phase selectors shall be supplied with sufficient quantities of channels to provide preemption for all approaches to the intersection separately. Power shall be obtained from the phase selector or phase selector power supply and not from the local controller timer.

The phase selectors shall have front panel indicators for active preempt channel status. It shall have test switches to activate all preempt channels.

Furnish preempt phase selectors with 60-month warranties or for the manufacturer’s standard warranty whichever is greater. Ensure that the warranty period begins on the date of shipment to the project. Ensure that each unit has a permanent label or stamp indicating the date of shipment.

Payment for Item 633 “Preempt Phase Selector” shall be made at the contract unit price for each phase selector in place, completely installed in the local controller shown in the plans, wired, tested and accepted.

Designer Note: This note may be used when preemption is included for in the plans.

442-29 633 Preempt Confirmation Light, LED

This item shall consist of furnishing and installing preempt confirmation lights including hardware and all other accessories that are necessary to make the preempt confirmation light completely functional and operational as shown in the plans.

A confirmation light shall be supplied for each intersection to indicate that the emergency vehicle has achieved control of the traffic signal.
The confirmation light shall be a vapor tight aluminum lighting fixture. It shall be supplied with a clear globe, LED lamp and mounting hardware to attach to the traffic signal mast arm. The confirmation light shall be powered by a load switch in the traffic signal controller. Signal cable conforming to 732.19 shall be used for confirmation lights. A minimum of 4-conductor cable shall be used with the green wire serving as the safety ground conductor.

Payment for Item 633 “Preempt Confirmation Light, LED” shall be made at the contract unit price for each light in place, completely installed in the location shown in the plans, wired, tested and accepted.

**Designer Note:** This note may be used when requested by the maintaining agency. The signal cable is a separate pay item.

442-30 Pull Box, 24” (600 mm) X 35” (875 mm) X 26” (650 mm)

Pull boxes shall have nominal opening dimensions of 24 inches (600 mm) by 35 inches (875 mm). Materials shall conform to 725.06, 725.07 or 725.08. The word “Traffic” shall be integrally cast as part of the cover or securely fastened with corrosion resistant hardware. The supplied pull boxes shall support a 20,000 pound minimum vertical loading without permanent damage or deflection to the unit. Dispose of surplus material and restore disturbed facilities and surfaces.

The largest bend radius possible shall be maintained for the fiber optic cable.

All costs resulting from the above requirements shall be included in the unit price bid per each for Item 625 “Pull Box, 24” (600 mm) X 35” (875 mm) X 26” (650 mm).”

**Designer Note:** The pull box cited in this note is bell shaped at the bottom to help maintain fiber optic cable minimum bend radii. Any pull box where a splice is required or a change in cable direction is made should use this larger pull box.

442-31 632 Pole Entrance Fitting

A pole entrance fitting shall be provided in accordance with the plan details to allow fiber optic cable entrance into both existing and proposed steel poles. In proposed poles the Contractor shall have the 2 inch (50 mm) entrance holes shown in the details pre-manufactured. Blind half couplings shall be welded into any new strain poles supplied as part of the project.

Existing strain poles shall require the Contractor to field locate the pole entrance hole and drill two pilot holes and use a hole saw to cut the 2 inch (50 mm) hole. All non-galvanized pole surfaces exposed after cutting the hole shall have three coats of zinc enriched paint applied.

No pole entrance fitting holes shall be located vertically within 24 inches (600 mm) of any other holes or blind half couplings.

All costs to provide a pole entrance including material, equipment and labor shall be included in the bid item price for each Item 632 “Pole Entrance Fitting”.

**Designer Note:** The maintaining agency may opt to have the Contractor route drop cables down the outside of strain poles.

442-32 Grounding and Bonding

The requirements of the Construction and Material Specifications (CMS) and the TC series of Standard Construction Drawings are modified as follows:
1. All metallic parts containing electrical conductors shall be permanently joined to form an Effective Ground Fault Current Path back to the grounded conductor in the power service disconnect switch.

   a. Provide an equipment grounding conductor in metallic conduits (725.04) in addition to the conductors specified and bond the conduit to this grounding conductor.

   b. When an equipment grounding conductor is required in plastic conduit (725.05), the installation shall include a separate equipment grounding conductor in addition to the conductors specified.

   c. Metallic conduit carrying the loop wires from in the pavement to the pull box splice location will only be bonded at the pull box end, and will not contain an equipment grounding conductor.

   d. If multiple conduit runs begin and end at the same points, only one equipment grounding conductor is required.

   e. If an equipment grounding conductor is needed in conduit between signalized intersections for underground interconnect cable, the grounding system for each signalized intersection will be separated about midway between the intersections.

   f. The messenger wire at signalized intersections will be used as the conductive path from corner to corner if conduit is not provided under the roadway. When conduit connects the corners of an intersection, an equipment grounding conductor shall be used in the conduit.

2. Conduits.

   a. The 725.04 conduit shall have grounding bushings installed at all termination points. The bushing material shall be compatible with galvanized steel conduit and the grounding lug material shall be compatible for use with copper wire. Threaded or compression type bushings may be used.

   b. The 725.05 conduit shall have the inside and outside diameters of the conduit deburred at all termination points.

   c. Both ends of metallic conduit shall be bonded to the equipment grounding conductor.

   d. Metallic conduit may be bonded to metallic boxes through the use of conduit fittings UL approved for this type of connection, with the box bonded to the equipment grounding conductor.

3. Wire for grounding and bonding.

   a. Use insulated, copper wire for the equipment grounding conductor. Bonding jumpers in boxes and enclosures may be bare or insulated copper wire. Wire size shall be as follows:

      i. Use 4 AWG between the power service and supports, poles, pedestals, controller or flasher cabinets.

      ii. Use a minimum 8 AWG between loop detector pull boxes and the first conduit that requires a larger size as specified in 3.a.i above.

      iii. Use a minimum 8 AWG between the “Prepare to Stop When Flashing” installation (including support) and the first conduit that requires a larger size as specified in 3.a.i above.

      iv. The insulation shall be green or green with yellow stripe(s). For 4 AWG or larger, insulation may also be black with green tape/labels installed at all access points.

   b. In a highway lighting system, the equipment grounding conductor shall be the same wire size as the duct cable or distribution cable circuit conductors, with the minimum conductor size of 4 AWG. Bonding jumpers will be minimum size 4 AWG.

4. Ground rod.

   a. A 3/4 inch Schedule 40 PVC conduit will be used in foundations and concrete walls for the grounding conductor (ground wire) raceway to the ground rod. Should metallic conduit be used, both ends of the conduit shall be bonded to the grounding conductor.

   b. The typical grounding conductor (ground wire) shall be 4 AWG insulated, copper.
5. The green conductor in signal cables (conductor #4) shall not be used to supply power to a signal indication. It will be connected to the signal body as an equipment ground in aluminum heads and it will be unused in plastic heads. Unused conductors shall be grounded in the cabinet. Typical use of conductors is as follows:

<table>
<thead>
<tr>
<th>Cond. no.</th>
<th>Color</th>
<th>Vehicle signal</th>
<th>Pedestrian signal</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Black</td>
<td>green ball</td>
<td>#1 Walk</td>
</tr>
<tr>
<td>2</td>
<td>White</td>
<td>AC neutral</td>
<td>AC neutral</td>
</tr>
<tr>
<td>3</td>
<td>Red</td>
<td>red ball</td>
<td>#1 DW/FDW</td>
</tr>
<tr>
<td>4</td>
<td>Green</td>
<td>equipment ground</td>
<td>equipment ground</td>
</tr>
<tr>
<td>5</td>
<td>Orange</td>
<td>yellow ball</td>
<td>#2 DW/FDW</td>
</tr>
<tr>
<td>6</td>
<td>Blue</td>
<td>green arrow</td>
<td>#2 Walk</td>
</tr>
<tr>
<td>7</td>
<td>White/black stripe</td>
<td>yellow arrow</td>
<td>not used</td>
</tr>
</tbody>
</table>

6. Power Service and Disconnect Switch.
   a. At the power service location, the grounding conductor (ground wire) from the disconnect switch neutral (AC-) bar to the ground rod shall be a continuous, unspliced conductor. If spliced, it shall be an exothermic weld butt splice.
   b. The service neutral (AC-) shall only be connected to ground at the primary power service disconnect switch.
      i. NEMA controller cabinets: If a power service disconnect switch is located before the controller cabinet, the neutral (AC-) and the grounding bars in the controller cabinet shall not be connected together as shown in NEMA TS-2, Figure 5-4.
      ii. If secondary disconnect switches are connected after the primary disconnect switch, the neutral (AC-) shall only be grounded at the primary switch. Equipment grounding conductors shall be brought to the primary switch, but shall be grounded at both secondary and primary switches.

7. Payment – All materials and work required to complete the Effective Ground Fault Current Path system are incidental to the conductors installed by contract.

Designer Note: This note shall be used on all projects with electrical items (631, 632, 633). Figures 498-39 through 498-42 provide examples of wire sizes for equipment grounding conductor.

442-33 804 Fusion Splicer

Furnish a fusion splicer and turn it over to the maintaining agency at the conclusion of the project.

The fusion splicer shall provide a video display of the fibers and shall utilize a direct core light injection system (LID), profile alignment, 3-axis fiber alignment or V-block, and shall be capable of automatically cleaning, positioning (gap) and fusing fibers at the touch of a button. The splice unit shall be capable of splicing either multi-mode or single mode fibers and shall be able to instantly calculate splice loss and display the results in an easily understood manner. The fusion splice unit shall include an attachable heat shrink oven and crimp & go type splice protection crimping device. It shall be able to operate on battery, AC or external DC power. The estimator should be accurate to ± 0.05 db 100% of the time. Certification and testing papers for the fusion splicer shall be submitted with the unit when it is turned over to the maintaining agency. If the unit certification expires before the project completion or if the unit is used by the Contractor during construction, the unit shall be re-certified at the Contractor’s expense before it is turned over to the maintaining agency.

Payment shall be made at the contract unit price per each for Item 804 Fusion Splicer.

Designer Note: This note is required if the plan requires fusion splicing and the maintaining agency wishes to be supplied with a fusion splicer for future maintenance work.
442-34 804 Fiber Optic Termination Tool Kit

Furnish a pre-assembled termination tool kit to be left in good working condition with the maintaining agency for maintenance of the fiber system.

A termination tool kit shall include all tools and materials listed below necessary to terminate the connectors used as part of this project. Termination kits shall include a 200X inspection microscope, hot melt oven, crimp tool, one-step lap film, polishing jig, polishing pad, cooling stand, connector holder, stripping collar, scribe carbide, bottle of 99% isopropyl alcohol, snips, cable stripper, view scope, lint-free cloth and pipe cleaners, jeweler's loupe, pocket ruler and instruction manuals.

The entire kit shall come in a hard-side carrying case.

Payment shall be made at the contract unit price bid per each Item 804 Fiber Optic Termination Tool Kit.

**Designer Note:** This note is required if the maintaining agency wishes to be supplied with a fiber optic termination tool kit for future maintenance work.

442-35 804 Cleave Tool

Furnish a cleave tool and turn it over to the maintaining agency at the conclusion of the project.

Cleave tools are used during splicing to cut the individual single mode fibers as close to a perfect 90 degree angle as possible, thus allowing the highest core to core alignment, and therefore the lowest dB splice loss.

The manufacturers of cleave tools have established "end angle" cleave averages that are based on a minimum of 150 cuts utilizing a minimum of 10 cutters. Based on these test results, cleave tools shall have minimum end angle averages of less than 0.70 degree; and no cut of the 150 cleaves will be allowed to exceed 1.5 degrees. Prior to the splicing of any fiber cable, submit the part number and manufacturer of the cleave tool along with an "end angle" distribution chart which demonstrates the actual 150 cut end angles.

Payment shall be made at the contract unit price bid per each for Item 804 Cleave Tool.

**Designer Note:** This note is required if the maintaining agency wishes to be supplied with a cleave tool for future maintenance work.

442-36 804 Optical Time Domain Reflectometer (OTDR)

Furnish an optical time domain reflector (OTDR) and turn it over to the maintaining agency for their use at the conclusion of the project.

Furnish an OTDR with the following features as a minimum:

A. Field interchangeable source modules for single mode fiber analysis of optical links from 300 feet to 15,000 feet in length.

B. Minimum of 3 user-selectable pulse widths per wavelength.

C. Auto mode button for one button testing.

D. Auto mode or simplified mode for trace naming and storing.

E. Dual trace analysis mode.
F. Event table display.

G. Internal memory for trace storage.

H. Peripheral support for keyboard, mouse, VGA monitor, printer and USB port.

I. PC-based emulation software for Windows XP (to be included with OTDR).

J. System shall be software upgradeable.

K. Internal battery with AC adapter/battery charger.

L. Internal or external printer.

M. Bi-directional analysis through emulation software or internal to OTDR.

N. Reference cable.

O. Fiber Optic Launch Box minimum 1000 feet in length. The launch box type shall match the fiber type that was installed as part of the project. If both Multi-mode fiber and Single-mode fiber were installed, then fiber optic launch boxes of both types shall be provided.

Payment shall be made at the contract unit price bid per each for Item 804 Optical Time Domain Reflectometer (OTDR).

**Designer Note:** This note is required if the maintaining agency wishes to be supplied with an Optical Time Domain Reflectometer for future maintenance work.

**442-37 804 Mechanical Splice Tool Kit**

Furnish a pre-assembled mechanical splice tool kit and turn it over to the maintaining agency for their use at the conclusion of the project.

A mechanical splice tool kit shall include all the tools necessary for the assembly of a mechanical splice. The tools shall allow for easy completion of cable preparation, removal of fiber coating, cleaning and cleaving, prior to completing the splice. Mechanical splice kits typically include a connector assembly tool, cleave tool, No-Nik fiber stripper, micro-strip precision stripper, cable stripper, telecommunication snips, 20X magnifier, lint-free cloth, protective carrying case and manual.

A cleave tool shall be included in the mechanical splice tool kit.

Payment shall be made at the contract unit price bid per each for Item 804 Mechanical Splice Tool Kit.

**Designer Note:** This note is required if the plan requires mechanical splicing and the maintaining agency wishes to be supplied with a mechanical splice tool kit for future maintenance work.

**442-38 804 Fiber Optic Training**

The Contractor shall submit a comprehensive fiber optic training plan for approval within 15 days of notice of signed contract. The training course shall take place prior to installation and may be attended by personnel from the maintaining agency or their designees. This training shall be for up to 12 personnel to be determined by the Engineer.
The training shall be conducted by an approved instructor who can demonstrate a minimum of 2 years experience in fiber optics and fiber optic training. The instructor(s) shall be familiar with the cable types and equipment being installed on this project. The plan shall be for a minimum 3-day fiber optic training course, including lecture, classroom "hands-on," and project field training. Half of the total training course shall be dedicated to various cable splicing and testing equipment workshops.

The course shall teach personnel from the maintaining agency the processes, fine tune techniques and verify a craftsman's abilities to install and inspect cable, fan-out, terminate, splice (both mechanical and fusion), and test (hand held, mini-OTDR and full-size OTDR) fiber optic cable. Specific focus will be on the traffic interconnect systems, with emphasis on "drop and insert" (closed loop) installations. The following subjects shall be covered at a minimum. Course content is not limited to this list.

Safety
Fiber Optic Theory
Cable Types and Applications, Cable Manufacturers Overview
Cable Placement
Sheath Removal
Armor Grounding Methods
Duct Pulling Options
Aerial Pulling Options
Testing Processes Overview (Hand Held Process, Mini-OTDR, OTDR)
Cable Splicing (Mechanical and Fusion, Splice Enclosure)
Splice Enclosure Installation and Splicing Discussion and Workshop
Cable Fan-Out with Kits
Cable Placement (Distribution Box)
Termination (Field) Discussion and Workshop
Testing the System
Closure and Slack Management
Trouble Shooting
System Restoration

The training site shall be provided by the Contractor at a mutually agreed upon location with the maintaining agency. All costs associated for providing the above training shall be included in the lump sum price bid for Item 804 Fiber Optic Training.

**Designer Note:** This note is required if the maintaining agency wishes to have training on the fiber optic cable provided as part of the contract.

### 442-39 633 Advance/Dilemma Zone Detection System

This item of work shall consist of furnishing and installing an Advance/Dilemma Zone Detection unit capable of intersection advance detection control utilizing above ground Digital Wave Radar Techniques. The unit shall be non-intrusive and shall detect vehicles from 50 feet up to 600 feet from the unit. The unit shall provide up to 8 detection zones simultaneously for intersection control. One unit shall be provided per approach, where specified in the plans, covering multiple lanes where advance detection is required. The detection unit shall include the following list of features and capabilities:

- The unit shall provide accurate presence-detection of both stopped and moving vehicles. The unit shall be mounted in a forward-fire, looking at either approaching or departing traffic and shall only detect vehicles in one direction of travel.
- The unit shall be tested to meet NEMA TS2 environmental standards and maintain accurate performance in the following operating conditions:
  - Rain up to 4 inches per hour
  - Freezing rain
  - Snow
  - Wind
- Dust
- Fog
- Changing temperature
- Changing lighting

- The radar design for each unit shall conform to the following:
  - Operating frequency: 10.5–10.55 GHz (X-band)
  - Matrix of a minimum of 16 radars
  - No manual tuning to circuitry
  - Transmits modulated signals generated digitally
  - No temperature-based compensation necessary
  - Bandwidth stable within 1%
  - Printed circuit board antennas
  - Antenna vertical 6 dB beam width (two-way pattern): 80 Degrees
  - Antenna horizontal 6 dB beam width (two-way pattern): 10.5 Degrees
  - Antenna two-way sidelobes: -40 dB
  - Transmit bandwidth: 45 MHz
  - Un-windowed resolution: 11 feet
  - RF channels: 4

- The unit shall include a simple setup routine that shall automatically configure and calibrate the unit for proper operation during installation. The unit shall also be capable of being programmed and updated from a laptop computer or other portable programming device, such as a Pocket PC, via a local or remote ethernet connection using vendor supplied software. The software shall support TCP/IP connectivity, unit configuration back-up and restore, and virtual sensor connections. The graphical user interface shall operate on a Windows platform.

- The unit shall have one full-duplex RS2-232 and one half-duplex RS-485 communication ports and shall have the ability to upgrade firmware over any communication port.

- The unit shall be mounted directly to a pole or most arm, as recommended by the manufacturer. Cable(s) shall be provided as required and recommended by the manufacturer.

- Surge protection devices, as recommended by the manufacturer, shall be included both at the pole where the unit is located to protect the unit and in the traffic cabinet to protect the cabinet electronics.

- Power shall be provided from the traffic cabinet. The unit shall consume less than 10 watts and operate from a DC input between 9 VDC and 28 VDC. Complete and automatic recovery from a power failure shall be within 15 seconds after resumption of normal power.

- All required inputs cards shall be included in the traffic cabinet and shall be compatible with CalTrans, NEMA TS1 and NEMA TS2 detector racks. The cards shall provide true presence detector calls or contact closure to the traffic controller.

- The manufacturer's representative shall be on site during installation and testing and shall provide onsite training on the setup, operation and maintenance of the unit.

- The unit shall come with a 2-year manufacturer supplied warranty.

Payment for Item 633 Advance/Dilemma Zone Detection System shall be made at the contract unit price for each unit, complete and in place including all required cabinet hardware, mounting brackets, cables, conduit, connections tested and accepted, and any other necessary hardware to establish a fully functional detection system.

**Designer Note:** This note may be used when dilemma zone detection is included in the plans.

### 442-40 633 Uninterruptible Power Supply (UPS), Battery Replacement

In addition to the requirements of 733.09, provide four (4) batteries for each existing
Uninterruptible Power Supply (UPS) cabinet location selected.

Batteries shall be provided from the Department’s Qualified Product List.

Furnish batteries certified by the manufacturer to operate over a temperature range of -13 °F to +165 °F.

Place all batteries on battery heater mats in the enclosure.

Batteries shall be warranted for full replacement for two (2) years from date of purchase.

The Department will pay for Item 633 Uninterruptible Power Supply (UPS), Battery Replacement at the contract price bid for each UPS location where the four (4) existing batteries are replaced. Payment shall be full compensation for all labor, materials, tools, equipment, disposal and other incidentals necessary to replace the UPS batteries complete, in place, and accepted.

**Designer Note:** This note is required if the maintaining agency wishes to replace the batteries in an existing Uninterruptible Power Supply as part of a project.

### 442-41 633 - Uninterruptible Power Supply, As Per Plan

In addition to the requirements of CMS 633 and 733, the Contractor shall furnish, install and test Uninterruptible Power Supply (UPS) status indicator lamps that allow maintenance personnel and law enforcement to quickly assess whether a traffic signal cabinet is being powered by a UPS. A 1-inch waterproof NEMA 4X or IP66 lamp with a domed RED lens shall be used to indicate the cabinet is operating under UPS backup power (the “backup” operating condition). This lamp shall be wired using minimum 20ga stranded, insulated hookup wire to the status relay outputs of the UPS. The wires shall be terminated by lugs at the display end and permanently labeled “BACKUP POWER STATUS DISPLAY,” with wire polarity indicated. This item includes programming the UPS status relay outputs to produce the lamp status displays. The status display shall be solid 100% duty cycle (not flashing). The lamp shall be placed in the UPS cabinet wall (not the roof) in such a manner as to be sealed from water intrusion and visible from a vehicle at the stop line in the closest lane of at least one approach to the signalized intersection. The operating voltage of the LED lamp shall be 120V AC.

**Designer Note:** This note is intended to allow maintaining agencies to include an indicator lamp for visual confirmation of UPS status if desired. Maintaining agencies may change or omit the recommended display, if desired, on either new or existing cabinets. The specified domed lens has better visibility than a flat lens, but is slightly more vulnerable to vandalism. A flat indicator lamp may be specified instead, if visibility is good and/or vandalism is a concern. If vandalism is a specific concern, external indicator lamps should not be used. The lamp may be placed on the cabinet roof instead of the wall, if desired. The operating voltage may be changed if required.

### 442-42 Reserved for Future Use

### 442-43 633 – Stop Bar Detection Radar

This item of work shall consist of furnishing and installing a Stop Bar Detection unit capable of intersection detection control utilizing above ground Digital Wave Radar Techniques. The unit shall be non-intrusive and shall detect vehicles from 6 feet up to 140 feet for a 90 degree field of view from the unit. The unit shall provide real-time presence data for at least 10 lanes. The unit shall provide at least 16 detection zones simultaneously for intersection control. One unit shall be provided per approach, where specified in the plans, covering multiple lanes where stop bar detection is required. The detection unit shall include the following list of features and capabilities:
The unit shall provide accurate presence-detection of moving vehicles. The unit shall be mounted in a forward-fire or side-fire position, looking at either approaching or departing traffic and shall only detect vehicles in one direction of travel.

The unit shall be tested to meet NEMA TS2 environmental standards and maintain accurate performance in the following operating conditions:
- Rain up to 1 inches per hour
- Freezing rain
- Snow
- Wind
- Dust
- Fog
- Changing temperature
- Changing lighting

The radar design for each unit shall conform to the following:
- Operating frequency: 24.0–24.25 GHz (K-band)
- Matrix of 16 radars
- No manual tuning to circuitry
- Transmits modulated signals generated digitally
- No temperature-based compensation necessary
- Bandwidth stable within 1%
- Printed circuit board antennas
- Antenna vertical 6 dB beam width (two-way pattern): 65 Degrees
- Horizontal field of view: 90 Degrees
- Antenna two-way sidelobes: -40 dB
- Transmit bandwidth: 245 MHz
- Un-windowed resolution: 2 feet
- RF channels: 8
- Self-test for verifying hardware functionality
- Diagnostics mode for verifying system functionality

The unit shall include a simple setup routine that shall automatically configure and calibrate the unit for proper operation during installation. The unit shall also be capable of being programmed and updated from a laptop computer or other portable programming device, such as a Pocket PC, via a local or remote ethernet connection using vendor supplied software. The software shall support TCP/IP connectivity, unit configuration back-up and restore, and Real-time traffic visualization for performance verification and traffic display. The graphical user interface shall operate on a Windows platform.

The unit shall have two half-duplex RS-485 communication ports and shall have the ability to upgrade firmware over any communication port.

The unit shall be mounted directly to a pole or mast arm, as recommended by the manufacturer. Cable(s) shall be provided as required and recommended by the manufacturer.

Surge protection devices, as recommended by the manufacturer, shall be included both at the pole where the unit is located to protect the unit and in the traffic cabinet to protect the cabinet electronics.

Power shall be provided from the traffic cabinet. The unit shall consume less than 10 Watts and operate from a DC input between 9 VDC and 28 VDC. Complete and automatic recovery from a power failure shall be within 15 seconds after resumption of normal power.

All required inputs cards shall be included in the traffic cabinet and shall be compatible with CalTrans, NEMA TS1 and NEMA TS2 detector racks. The cards shall provide true presence detector calls or contact closure to the traffic controller.

The manufacturer's representative shall be on site during installation and testing and shall provide onsite training on the setup, operation, and maintenance of the unit.

The unit shall come with a 2-year manufacturer supplied warranty.

Payment for Item 633 Stop Bar Detection Radar shall be made at the contract unit price for each unit, complete and in place including all required cabinet hardware, mounting brackets,
cables, conduit and connections tested and accepted.

**Designer Note:** This note may be used when stop line detection is included in the plans.

**442-44 633 – Controller Unit, Type 2070L, As Per Plan**

The controller unit shall be equipment manufactured in conformance to the California Department of Transportation (Caltrans) specifications titles “Transportation Electrical Equipment Specifications (TEES).” The controller unit, Model 2070L, shall be model and build version listed on the ODOT QPL.

The 2070L controller unit shall include the following:
1. Unit Chassis
2. 2070-1B CPU module
3. 2070-2A Field I/O Module
4. 2070-3B Front Panel
5. 2070-4A Power Supply
6. 2070-7A Serial Communication Module

The controller shall be supplied without traffic signal intersection control software. The controller shall be supplied with Microware Embedded OS-9 Release 1.3 or later with kernel edition #376 or later, as required by Caltrans TEES. For warranty purposes, a vendor-specific decal, as per ODOT CMS 733.02 shall be applied to items 1 through 4 of the list above at time of delivery to the project.

The controller shall be shipped by the Contractor to the ODOT Signal Shop, 1606 West Broad Street, Columbus, Ohio 43223, either directly or via the ODOT District Office, a minimum of 14 days in advance of when the software is needed. ODOT will install the local intersection control software. The controller will then be performance tested by the ODOT Signal Shop. Every effort shall be made to have loading and performance testing completed by the ODOT Signal Shop within 2 weeks of receipt of an individual controller; larger groups of controllers submitted at the same time may take longer. Should any controller fail this performance test after being loaded with ODOT-licensed software, the software will be removed by the ODOT Signal Shop and the controller rejected. Rejected controllers will be returned, either directly to the Contractor or to the ODOT District Office. Controllers passing the performance test will be labeled by the ODOT Signal Shop with the OS Image Number, CPU serial number, Software Revision Number, and upload date. This label is not to be removed by the Contractor and serves as proof that the controller has been loaded, tested and approved for initial installation on the project. Such proof does not alter the required 10-day Performance Test outlined in CMS Sections 632 and 633.

The Contractor shall not reassign the cabinet detector inputs in order to reduce the number of 2-channel detector units supplied, but shall use the standard Caltrans Input File designations.

**Designer Note:** This note should be used at signalized intersections using Type 2070L local controllers that are to be owned and maintained by ODOT.

**442-45 632- Signal Support, Mechanical Damper for TC-81.21 Mast Arm (Greater Than 59' in Length), As Per Plan**

This item shall consist of the Contractor installing a tuned mechanical stockbridge or mass-spring type damper on a TC-81.21 mast arm signal support to reduce the possibility of harmonic vibrations caused by wind loads. A mechanical damper shall be applied to all mast arms over 48 feet in length. The installed damper shall be capable of reducing the loaded maximum vertical movement at the tip of the arm to 8 inches measured from the highest to the lowest point of deflection at wind speeds of 5-20 mph.

All attachment hardware connections shall be stainless steel. Stockbridge-type dampers shall have a stainless steel safety chain anchored to the mast arm to prevent weights from falling
should they become separated from the rest of the assembly. The damper shall be attached to the arm within 8 feet of mast arm tip. Installation shall be per the manufacturer’s guidelines. Static dampers such as horizontal flat sign mountings shall not be used. Acceptable devices include the following or approved equal:

1. Union Metal Alcoa Damper Device – DWG. NO. 2G-1817-C1
2. Valmont Structures Alcoa Device – DWG. NO. OH104242P1

Payment for Item 632 “Signal Support, Mechanical Damper for TC-81.21 Mast Arm (Greater Than 59’ in Length), As Per Plan” shall be made at the contract unit price per each complete and in place, and shall include all labor, materials, and equipment necessary to complete the work.

**Designer Note:** This note is required on all projects installing **TC-81.21** Mast Arms greater than 59 feet in length.

### 442-46 632 - Signal Support, (By Type), As Per Plan

In addition to provisions of the ODOT CMS, furnish and install signal poles as specified in the plans.

The signal support designer shall provide drawings of a signal support with structural aspects of the design and materials in compliance with the 2001 AASHTO Standard Specifications, with 2006 Interim Revisions, for Structural Supports for Highway Signs, Luminaires, and Traffic Signals. The signal support shall be ASTM A595 Grade A with a minimum yield strength of 50 ksi. The following design parameters shall be used:

1. Basic Wind Speed = 90 mph
2. Design Life = 25 years
3. Fatigue Category = III
4. Galloping: No
5. Truck Induced Gust: No

Submit, to the Engineer prior to incorporation: two copies of the signal support drawings and shop drawings, which identify and describe each manufactured signal support and signal support item which is being incorporated into the construction. The signal support drawings and shop drawings shall each be reviewed, sealed, stamped, and dated by two Ohio registered Professional Engineers.

Payment for Item 632 “Signal Support, (By Type), As Per Plan” shall be made at the contract unit price per each complete and in place, and shall include all signal support design, labor, materials, and equipment necessary to complete the work.

**Designer Note:** This note is required on all projects where non-standard signal supports are included in the plans.

### 442-47 632 – Signalization, Misc.: Unlash and Relash Messenger Wire

The Contractor shall remove existing messenger wire lashing rods and reinstall them as necessary for the installation of any new cables on the existing intersection signal spans. The cables shall enter the existing strain pole through the pole cable entrance fitting and use the existing conduit system to get to the controller cabinet. The new cables shall be supported by a new cable support assembly at the top of the strain pole.

The new signal cables shall be bid by separate bid items.

Payment for Item 632 “Signalization Misc.: Unlash and Relash Messenger Wire” shall be made
at the contract unit price per per foot and shall include all labor, materials, cable support assemblies and equipment to install new cables on existing signal span wire installations.

**Designer Note:** This note is intended for use on projects where unlashing and relashing the messenger wire is required in the plans. Typical use would be for a traffic signal retrofit, where a new signal head and associated cables are to be added to the existing span.

**442-48 632 – Signalization, Misc.: FAA Type L-864 Obstruction Lighting, LED**

This item consists of installation and testing of FAA L-864-compliant obstruction lighting for marking of structures over 150 feet. Location and wiring shall be as shown in the Bridge Plans. Each obstruction lamp shall utilize Light Emitting Diodes (LEDs). The obstruction lamp shall have a written minimum 5-year manufacturer warranty. The lamp shall be ETL verified to FAA Advisory Circular AC150/5345-43F, Type L-864 and shall be one of the following or approved equal:

1. Specialty Tower Lighting Model RB-LED
2. International Tower Lighting Model IFH-1710
3. Point Lighting Model PFB-37001

Each obstruction lamp shall have its own controller, housed in its own metal enclosure accessible by maintenance personnel standing at floor level. The controller shall operate at 120VAC, 60Hz and have its own dedicated circuit breaker in a nearby panelboard as detailed in the Bridge Plans. The controller shall produce the appropriate FAA-required flashing rate, and the obstruction lamp shall operate continuously twenty-four (24) hours per day, with no intervening photocell control. The controller shall provide at least one unused alarm status output in the form of a dry-contact or solid-state relay closure that responds to defective or inoperative obstruction lamp conditions. At least one relay with complete contacts (Normally Open, Normally Closed, and Common) shall be provided. Alarm relay contact ratings shall be at least 500 mA resistive at 120VAC/30VDC. The controller shall provide at least one visible alarm status indicator for lamp failure indication. This indicator shall be in the form of a panel-mounted red dome-type LED visible from the outside of the enclosure.

The controller enclosure shall utilize a vertically hinged, swing-open door, and be rated NEMA 3R, minimum. Enclosure shall include at least one commercial grade NEMA 5-15 receptacle to accommodate wireless communication equipment to be installed later by ODOT for alarm status monitoring. An integral shelf shall be provided for this equipment inside the enclosure, and shall provide an open, accessible space for equipment measuring at least twelve (12) inches wide, eight (8) inches deep, and six (6) inches in height.

The Contractor shall fully test the system and arrange for acceptance inspection of the Obstruction Lighting installation by ODOT District signal maintenance personnel after the system is operational. During acceptance inspection, the Contractor shall demonstrate the proper operation of all lamps and alarms. Contractor shall provide written manufacturer warranty and all operating manuals for obstruction lighting controller and lamp to ODOT District signal maintenance personnel at the time of inspection.

The Department shall measure LED FAA Type L-864 Obstruction Lighting by each individual obstruction light, complete and installed including any control devices and all wiring and conduits.

**Designer Note:** Although obstruction lighting is thought of as an incidental bridge item, this note appears in the TEM as a 632 Item because bridge lighting maintenance typically falls to District signal and lighting electricians. FAA regulations require daily visual monitoring of obstruction lighting by the operator (ODOT) if they are not equipped with automatic monitoring. Very fast notification and response times are required for repair of malfunctioning obstruction lights. The use of LED lighting significantly reduces ODOT’s maintenance operations and provides much better reliability by eliminating the frequent outages and routine lamp changes.
associated with obstruction lights using older incandescent lamp technology. The use of cellular modems for automatic monitoring is recommended and is coordinated through the Office of Traffic Engineering.

442-49 632 – Signalization, Misc.: Bridge-Mounted Marine Navigation Lighting, LED

This item consists of installation and testing of IALA/AISM-compliant, U.S. Coast Guard approved marine navigation lighting for marking of structures over navigable waters. Location and wiring shall be as shown in the Bridge Plans.

Each marine navigation lamp shall utilize Light Emitting Diodes (LEDs). The marine navigation lamp shall have a written minimum 5-year manufacturer warranty. The lamp shall meet the color, brightness (range), sectoring, and divergence requirements as shown in the Plans and approved by the applicable Coast Guard District. The lamp shall be manufactured by one of the following manufacturers or an approved equal:

1. Tideland Signal Corporation, Houston, TX
2. B&B Roadway, Russellville, AL
3. Pharos Marine Automatic Power, Houston TX

Each marine navigation lamp shall have its own controller/power supply, housed in its own metal enclosure accessible by maintenance personnel, as shown on the Bridge Plans. The controller shall operate at 120VAC, 60Hz and have its own dedicated circuit breaker in a nearby panelboard as detailed in the Bridge Plans. The marine navigation lamp shall operate continuously twenty-four (24) hours per day, with no intervening photocell control. The controller shall provide alarm status output in the form of a blue LED confirmation light visible to ODOT maintenance personnel from deck level to indicate defective or inoperative marine navigation lamp conditions.

The Contractor shall fully test the system and arrange for acceptance inspection of the Marine navigation Lighting installation by ODOT District signal maintenance personnel after the system is operational. During acceptance inspection, the Contractor shall demonstrate the proper operation of all lamps and alarms. Contractor shall provide written manufacturer warranty and all operating manuals for marine navigation lighting controller and lamp to ODOT District signal maintenance personnel at the time of inspection.

The Department shall measure Bridge-Mounted Marine Navigation Lighting by each individual marine navigation light, complete and installed including any control devices and all wiring and conduits.

Designer Note: Although marine navigation lighting is thought of as an incidental bridge item, this note appears in the TEM as a 632 Item because bridge lighting maintenance typically falls to District signal and lighting electricians. The use of LED lighting significantly reduces ODOT’s maintenance operations and provides much better reliability by eliminating the frequent outages and routine lamp changes associated with marine navigation lights using older incandescent lamp technology.

442-50 633 Controller Unit, Type 170E, with Cabinet, By Type

In addition to the requirements of CMS 633 and 733, the following requirements shall also apply:

1. Controller units shall be equipment manufactured in conformance with the California Department of Transportation (CalTrans) specifications titled “Transportation Electrical Equipment Specifications.” The manufacturer of the controller units shall be listed on the CalTrans QPL.
2. All circuit boards shall be vertically mounted. Ribbon cables, if used, shall terminate with properly rated and easily repairable connectors on each end. Ribbon cables shall not terminate onto plug-in modules.
3. The power supply shall be modular and easily removable from the chassis.
4. The unit shall contain separate input and output modules.
5. The controller unit shall include a Model 412C Program Module with the memory configuration for the software either shown in the plans or as provided by the maintaining agency.
6. All memory, microprocessor and ACIA devices shall be socket mounted. Sockets shall have machined beryllium copper contacts with gold plating.

Two controller unit manuals with schematics shall be supplied with each controller unit.

Controllers shall be warranted for a period of 60 months or for the manufacturer's standard warranty, whichever is greater. The warranty period shall begin on the date of shipment to the project. Each unit shall have a permanent label or stamp indicating the date of shipment.

Payment for Item 633 Controller Unit, Type 170E, with Cabinet, By Type shall be made at the contract unit price per each controller unit with software, all required auxiliary equipment, loop detector units and a prewired cabinet, with all items completely wired and tested. Ground mounted cabinets will include anchor bolts and conduit ells for installation in the foundation. Pole mounted cabinets will include pole mounting hardware.

**Designer Note:** This note may be used when the maintaining agency wishes to use 170E type controllers.
443 SPECIFICATIONS

ODOT specifications for the furnishing and installation of traffic signal equipment are contained in the following CMS sections, Supplemental Specification and Supplements.

625 and 725 Trench, conduit, ground rods and pull boxes
632 and 732 Traffic signal equipment
633 and 733 Traffic signal controllers

Supplement 1046 covers the prequalification procedure for incandescent vehicular signal lamps.

Supplement 1048 covers the prequalification procedure for loop detector sealant.

Supplement 1063 addresses signal construction personnel requirements.

Supplement 1076 covers the prequalification procedure for conflict monitors used with 2070 controllers.

Supplement 1094 defines the certification procedure for signal support and strain pole fabricators.

Supplement 1095 covers the prequalification procedure for Model 242 DC Isolators.

Supplement 1097 covers the prequalification procedure for LED vehicular and pedestrian signal lamps.

CMS sections, the Supplemental Specification and Supplements related to specific traffic signal items are referenced individually as they are discussed in this Manual.

Information on the CMS may be viewed on-line at http://www.dot.state.oh.us/Divisions/ConstructionMgt/OnlineDocs/Pages/2010CMS.aspx and information on Supplemental Specifications and Supplements may be viewed at http://www.dot.state.oh.us/Divisions/ConstructionMgt/OnlineDocs/Pages/ProposalNotesSupplementalSpecificationsandSupplements.aspx.
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450 CONSTRUCTION

450-1 General

Information in this Chapter is intended to serve as a guide for construction personnel where the contractor furnishes and installs traffic control devices and appurtenances. However, it may also be useful for maintenance personnel performing the same functions. Inspection procedures for the various type traffic control devices are outlined, mainly in the form of check lists to assist project personnel in performing their duties. This information points out the various important features of each device and references the applicable specification or standard drawing. Illustrations are used for easy recognition of the device or feature being discussed.

All CMS Item 632 and 633 devices should be checked against the Qualified Product List before they are incorporated into a project. This list may be viewed on-line at: http://www.dot.state.oh.us/Divisions/ConstructionMgt/Materials/Pages/QPL.aspx.

For purposes of this Chapter, see CMS 101.03 for definitions of the terms “contractor” and “engineer.”

450-2 Foundations

See Section 250-3 for additional information relative to concerns in the installation of foundations for poles and controller cabinets.

450-3 Electrical Appurtenances

450-3.1 General

This section will be used to provide additional information about various electrical appurtenances involved in the traffic signal installations, such as pull boxes, conduit and ground rods.

450-3.2 Pull Boxes

Pull boxes shall be of the specified sizes (see SCD HL-30.11 and the plans), typically 18 inches or 24 inches, and the specified material.

The word on the cover should be “TRAFFIC” when the pull box is part of a traffic signal system unless the plans require the word “ELECTRIC” or other marking. The word shall be formed on the surface or displayed on an attached metal plate in accordance with CMS 725.06, 725.07, 725.08 or 725.12.

The location of pull boxes shall be as shown on the plans. However, pull boxes in low drainage areas may be adjusted to eliminate drainage problems, or feasible methods of positive drainage may be used in accordance with CMS Item 611 and details on SCD HL-30.11, with the approval of the engineer.

Pull boxes located in sidewalks, traffic islands and curbed areas close to the roadway, where wide turning vehicles could drive over them, may be adjusted to eliminate the problem, or a concrete pull box with a heavy duty lid may be used with the approval of the engineer.

450-3.3 Trench

Trenching shall be in accordance with CMS 625.13 and as shown in Figure 498-7. Any change in dimensions will require approval by the engineer.
Trenching may be in earth or in paved areas, according to plan details. Trenching and subsequent restoration of surfaces in paved areas shall be in accordance with SCD HL-30.22. Trenching work in paved areas shall be divided into two pavement depths for payment; less than 6 inches and 6 inches or greater, as described in CMS 625.22.

The trench in paved areas may be 4 inches wide when cut by a Vermeer type trencher. In this case, the trench shall be backfilled with concrete full depth, except that the bottom 4 inches above the conduit may be CMS 625.13 tamped backfill.

450-3.4 Conduit

Metal conduit shall comply with CMS 725.04, with sizes according to the plans. It shall be made from domestically produced steel, and the domestic steel content of the conduit shall be certified by the manufacturer or supplier before it is approved for installation.

The routing of loop detector wire in conduit through curb or under shoulder shall be as shown on SCD TC-82.10.

Conduit containing cable and/or wire shall have the terminal at the high end completely sealed in an approved manner, with removable sealing compound or a molded plastic or rubber device compatible with the conduit, cable jacket and wire insulation, according to CMS 625.12.

After placement, a conduit which will not have cable or wire pulled into it during construction shall have a pull wire installed in it, and the terminal at the high end shall be sealed with removable sealing compound, a molded plastic or a rubber device, according to CMS 625.12.

Difficult pulling and possible jacket skinning may occur when an attempt is made to install too many cables or wires within a given conduit. The reason could be design error in new systems or attempts to insert an excess number or size of cable or wire in existing conduit.

Good electrical practice requires that the combined cross section of all cables and wire within a conduit should be less than (or equal to) 40 percent of the conduit inside area:

\[ a_1 + a_2 + a_3 + \text{etc.} \leq 0.40C_i \]

\[ a = \text{cable or wire across section area, sq. in. (mm}^2) \]
\[ C_i = \text{conduit inside area, sq. in. (mm}^2) \]

A calculation can be made using the above formula. The cross section area of conduit, cable and wire is shown in Table 497-1.

450-3.5 Ground Rod

A ground rod shall be driven below groundline near the foundation of every strain pole and
overhead sign or signal support whether there is power in the vicinity or not, as shown on SCDs TC-21.20, TC-32.10 and TC-32.11.

Ground rods shall comply with CMS 725.16 and be installed in accordance with CMS 625.16. A ground wire of insulated 600-volt No. 4 AWG 7-strand soft drawn copper shall be attached by an exothermic weld. The typical exothermic weld procedure is described in Section 450-3.6. Insulating varnish shall be applied to the weld and any exposed conductor.

450-3.6 Exothermic Weld

The following procedure is typical and may be used unless the manufacturer=s instructions differ.

1. The end of the ground wire shall be in an unflattened, unbent, clean and dry condition to assure a good weld.
   a. Bent and out-of-round conductor wire will hold the mold open causing weld material leakage. A cable cutter should be used to make undeformed ends. If a hacksaw is used, the insulation should first be peeled, as the saw tends to coat the cable with plastic material which must be cleaned off.
   b. Corroded cable shall be cleaned. Oily or greasy cable should be cleaned with a solvent that dries rapidly and leaves no residue. Very greasy cable can be “cooked out” by dipping into molten solder.
   c. Wet cable can cause the blowing of molten metal out of the mold, and the cable should be dried by a hand torch or a quick drying solvent such as alcohol.

2. Ground rod ends which have been mutilated in driving can hold the mold open and should be cut off. Rod ends shall be clean and dry.

3. The weld mold shall be clean before use. Damp or wet molds can cause porous welds and should be dried by heating.

4. The cable shall be inserted into the side of the mold so the cable is 1/8 inch back from the center of the tap hole. The mold shall be placed on the ground rod so the cable sits on top of the rod (see Figure 498-8). A clamp or locking pliers should be used on the rod to keep the mold from sliding down during the welding process, and the conductor should be marked at the mold surface so it can be verified that the conductor has not shifted before the weld is made.

5. The steel disk shall be inserted into the crucible and the cartridge contents poured on top, being careful that the disk is not upset. The cartridge should be tapped when pouring, to make sure the starting powder comes out and spreads evenly over the welding powder. A small amount of starting powder should be placed on the top edge of the mold under the cover opening for easy ignition.
   a. The proper cartridge size is marked on the mold tag and is the approximate weight of the powder in grams.
   b. If the proper cartridge size is not available, two or more small cartridges or part of a larger cartridge can be used.

6. The mold cover will be closed and the starting powder ignited with a flint gun. If it is necessary to hold down the cover during the flash of igniting powder, a long tool should be used and the hand should be kept away.
450-4 Power Service for Traffic Signals

450-4.1 General

Power service for traffic signals shall comply with SCD TC-83.10 and the plans. It shall consist of the equipment needed to provide a pole-attached wiring raceway and disconnect switch, for use with separately furnished power cable routed from the service point to the controller cabinet. As shown in Figure 498-9, unless otherwise specified, the equipment includes a weatherhead, a conduit riser with necessary fittings and attachment clamps when required, and a disconnect switch with enclosure (CMS 632.24).

A thorough review of the plans should be made to determine that the specific requirements of the maintaining agency for power service have been satisfied.

A ground wire shall be used as shown on SCD TC-83.10, leading to a ground rod installed in accordance with Section 450-3.5.

The LB type fitting under the controller cabinet (SCD TC-83.10) may have to be installed before erecting the pole because of interference with the foundation.

450-4.2 Electric Meter Base

When required, an electric meter base shall be furnished by the applicable utility and installed by the contractor as part of the power service work.

450-4.3 Conduit Riser and Weatherhead

Power cable is the only type cable or wire permitted through the power service conduit riser.

The conduit riser shall terminate at the meter base, if used; otherwise, termination shall be at the switch enclosure. From there conduit connection to the controller cabinet is as shown on the plans. Conduit connection could be: (a) immediately to the controller cabinet on the same pole; (b) downward by underground conduit and possibly a pull box to a nearby foundation-based controller cabinet; or (c) upward by another riser on the pole to spanwire and a remote cabinet location.

The conduit riser shall comply with CMS 725.04 and the plans, and the weatherhead shall be threaded aluminum or galvanized ferrous metal (CMS 732.16). Risers on painted poles shall be painted to match the poles.

450-4.4 Disconnect Switch

The disconnect switch shall be a UL listed single-throw safety switch or circuit breaker, meeting the voltage and capacity requirements of the specifications. The amperage rating of the fuse or circuit breaker shall be 5 to 10 amperes greater than the peak load rating of the equipment service. The enclosure shall be a UL listed water tight lockable stainless steel NEMA Type 4, supplied with UL listed conduit hubs, and the enclosure shall contain a solid neutral bar normally grounded to the enclosure (CMS 732.21).

450-5 Pole and Support Inspection - General

See Sections 250-4.2 through 250-4.4 for information about pole and support inspection.

450-6 Traffic Signal Supports

450-6.1 General

This Section is used to provide additional information about traffic signal supports. Various
types of overhead signal supports are also depicted in Table 497-4.

450-6.2 Strain Pole Type Support

Strain poles shall comply with the certified drawings, SCD TC-81.10 and the plans. They shall be galvanized unless paint is specified in the plans, and the general features should be inspected in accordance with Section 250-4.2.

Strain poles shall be tapered tubes with a cross section which is circular or a regular polygon of six or more sides.

Strain poles used to support traffic signals or signs (SCD TC-17.10) shall be furnished with one or more span wire clamps with shackles for attachment of messenger wire (see SCD TC-84.20). Only messenger wire may be attached by wrapping twice a round the pole and securing with a three-bolt clamp, as shown in SCD TC-84.20, when used on round, tapered steel strain poles. The tether wire shall not use the alternate wrap method.

Erection of these poles shall be in accordance with the general procedure given in Section 250-4.6, except as noted in this section.

For the initial rake of strain poles, leveling nuts shall be adjusted to provide a rake of one-eighth to one-half inch per foot of pole in the direction opposite to the contemplated span wires and are to be made snug tight. Further adjustment may be necessary to assure that the strain poles are essentially vertical after the application of span wire load.

450-6.3 Single Arm Support

Single arm supports shall comply with the certified drawings, SCD TC-81.21 and the plans. General features of the support shall be inspected in accordance with Section 250-4.2, and except as noted in this section, erection of the support shall be in accordance with the general procedure given in Section 250-4.6.

Welds shall be inspected according to Section 250-4.3 and the galvanizing inspected according to Section 250-4.4.

For arms of two telescoping pieces, a 15 inch overlap is required. The overlapped arms shall be secured with a stainless or galvanized steel through-bolt with hex head or nut(s).

Arm caps shall cover at least 50 percent of the end area (CMS 732.11).

An arm clamp with clevis shall be furnished at each signal position, as well as a hole with a rubber grommet for the outlet of signal cable.

The installation of small signs and their attachment to the arms should be checked. Any possible interference between swinging signals and signs should also be checked.

Blind half couplings shall be located on the pole of the support for mounting pedestrian signal heads or controller cabinets when required by the plans.

Signal heads shall be installed with a clearance above pavement elevation at the center of the roadway of 16 to 18 feet. Drop pipes should be used only when necessary to maintain the clearance between 16 to 18 feet. If the clearance without a drop pipe will be over 18 feet, the engineer will, in consultation with the maintaining agency, direct the use of drop pipes or waive the maximum clearance requirement for each head.

Initial rake shall be adjusted so that under the load of signals, the pole will assume an essentially vertical position and the arm rise be within the limits specified on SCD TC-81.21, i.e., 3 inches minimum and 30 inches maximum. Under ice load, signals shall not drop below
16 feet above the pavement.

450-7  **Sag and Vertical Clearance**

*Figure 498-13* illustrates sag guidelines and vertical clearance standards for traffic signals.

450-8  **Signal Span Messenger Wire and Appurtenances**

450-8.1  **General**

This Section is used to provide additional information about signal span messenger wire and appurtenances.

Note that tether wire is distinct from messenger wire. Messenger wire supports a significant vertical load. Tether wire does not and is used to prevent swinging of hanging items.

450-8.2  **Signal Messenger Wire and Cable**

Messenger wire and accessories shall comply with SCD TC-84.20 and CMS 732.18. Messenger wire diameter shall be in accordance with the plans.

The height at which the messenger wire is to be attached to the pole will, in some instances, be shown on the plans. In cases where this is not shown, the contractor is responsible for determining the proper attachment height. This determination shall consider the relative elevation of pavement to pole foundation top, the desired clearance between pavement and the bottom of each signal, i.e., 16 to 18 feet, the sag in the messenger wire, and the height of each signal.

Alternate methods of attaching messenger wire to strain poles may be used, as follows:

1. Span wire clamp with clevis, anchor shackle and thimbles on the messenger wire, or

2. Messenger wire wrapped twice around the strain pole and secured with a three-bolt clamp of the proper size, when used on round, tapered strain poles.

If the messenger wire attachment to strain poles makes use of the alternative with pole clamps and anchor shackles, the wire is to be hooked through the shackle using a thimble and secured with a three-bolt clamp. A preformed guy grip shall not be used for messenger wire attachment at the pole. Guy grips of the proper size may be used at bull rings (aerial corners).

Thimbles with a correct groove size for the messenger wire (or the wire and eye of guy grips) are to be used at anchor shackles and bull rings. When three-bolt clamps are used, the wire tail is to be served as shown in *Section 450-8.3*. See *Section 450-8.4* for the installation procedure for preformed guy grips.

Messenger wire sag shall comply with CMS 632.22 and *Section 450-7*.

The signal cable shall be attached to the messenger wire by lengths of preformed lashing rod. The lashing rod shall be the proper internal diameter to snugly hold the cable, but not cut into its jacket. See *Section 450-8.6* for further information.

A drip loop shall be formed in the signal cable at each weatherhead, and should extend at least 6 inches below the weatherhead (*see Figure 498-14*).

Cables or groups of cables up to a maximum of four, hanging within pole interiors, shall have their strain relieved by cable support assemblies as described in *Section 450-8.7, Figure 498-14* and SCD TC-84.20.
450-8.3 Messenger Wire Served Ends

Messenger wire may be attached to various accessories by looping the wire to make an eye.

The wire end shall be secured by a three-bolt clamp, and the cut wire end or tail shall be “served” with construction wire or clamped with a sleeve device as shown on SCD TC-84.20. The following illustrations show both serving methods for the wire tail:

![Serving With Wire](image1)

![Sleeve in Position](image2)

450-8.4 Preformed Guy Grips

Preformed guy grips are made of helically shaped high-strength steel wire. They are available in sizes fitting the outside diameters of messenger wire and form an eye permitting attachment to various accessories.

As shown in SCD TC-84.20, they should be used at bull rings of span wire aerial corners (see the following illustration). Thimbles are used in the eye of grips in accordance with standard details in the SCD.

![Thimble](image3)

Grips are installed on an end of the messenger wire by wrapping a first leg of the grip to the messenger wire. In most cases, the accessory to which the grip is to be attached must be inserted in the eye of the grip with a thimble before the second leg of the grip is wrapped. The second leg is then applied to the combined first leg and messenger wire. The following illustrations show the wrapping sequence:
Guy grips shall not be used on messenger wire used for span wire sign supports. In this application, wind load on the signs can cause failure of the grips (see SCD TC-17.10(3)). Guy grips shall not be used for attachment to signal strain poles (SCD TC-84.20(5)).

**450-8.5 Cable and Wire**

In certain instances, the plans will assign a color code usage for each cable, or a typical usage by color code. All connections should be made observing these assignments, and any deviations, if determined necessary, should be recorded. When a color code usage is not provided, good electrical wiring practice would still dictate that color code wiring on the project be consistent. Typically, white is reserved for the neutral or common leg of a circuit. The following provides additional information about various types of cable and wire contained in CMS Table 732.19-1:

1. **Signal cable** is used as the electrical connection between signal heads and the controller cabinet at an intersection. The cable may be either IMSA 19-1, which has a jacket of polyvinyl chloride, IMSA 20-1, which has a polyethylene jacket. The number of conductors and wire gage shall be as specified on the plans. Conductors shall be of copper and stranded, and conductor insulation shall be color coded. Splices are not permitted in signal cable (CMS 632.23), and the cable should be scanned to be sure that there are none. As temperatures decrease, signal cable gets stiffer and harder, becoming brittle when below freezing. In very cold weather, the cable should be handled with care so as not to damage the jacket or insulation when unreeling, flexing and installing. The method of measurement of signal cable is shown in Figure 498-16.

2. **Interconnect cable** is used as the connection between intersections for systems of signals (although there is no significant difference between signal and standard interconnect cable). The cable may be either IMSA 19-1 or IMSA 20-1 as in signal cable, or twisted pair/shielded interconnect cable conforming to RUS PE-39 may be required by the plans.

3. Twisted pair/shielded cables are less prone to pick up induced current as a result of nearby electrical devices or magnetic fields, and are necessary for certain types of communication systems which may be used to interconnect signals. The number of conductors and wire gage shall be as specified. It should be noted that in the case of twisted pair/shielded cable, the number of conductors is typically referred to as the number of pairs (pair count), i.e., six-conductor cable would be referred to as a three-pair cable. Conductors shall be of copper and are usually solid.

4. **Interconnect cable of the integral messenger type** is aerial self-supporting cable with a "figure 8" cross section. The cable may be either IMSA 19-3, which has a jacket of polyvinyl chloride, or IMSA 20-3, which has a polyethylene jacket. Shielded versions, IMSA 19-4 and IMSA 20-4, may be required by the plans. The number of conductors and wire gage shall be as specified. Conductors shall be of copper and stranded, and conductor insulation shall be color coded.
5. Twisted pair/shielded interconnect cable of the integral messenger type conforming to RUS PE-38 may also be required by the plans.

6. **Loop detector wire** is laid in turns in saw slots cut into the pavement and routed by the groove to the edge of pavement and to a pull box. The wire is single-conductor No. 14 AWG. The conductor shall be of copper and stranded. Loop detector wire consists of detector wire inserted into a flexible plastic tubing (CMS 732.19) meeting specifications IMSA 51-5. The tubing shall encase the wire completely from the splice at the lead-in cable through the entire loop turns and back to the splice.

7. **Lead-in cable for detector loops** is spliced to loop wire and routed to detector units in the controller cabinet. The cable shall be two-conductor No. 14AWG meeting specifications IMSA 50-2. Each conductor shall be stranded copper. The conductor pair shall be twisted and shielded.

8. **Power cable** is used as the connection between the service pole or service drop and the controller cabinet. The cable normally is two-conductor and UL:RHH/RHW/USE type. The wire gage shall be as specified. Conductors shall be color coded, of copper and stranded. When specified, power cable may be three conductor. Single conductor cables may be substituted for a two (or three) conductor cable, but color coding should still be provided.

9. **Service cable** is used to bring power to the vicinity of an isolated intersection. The cable is normally two-conductor (duplex) and XHHW type or cross-linked polyethylene with a 0.045 inch minimum jacket. The wire gage shall be as specified. The cable is aerial self-supporting with one conductor being an uninsulated ACSR (aluminum conductor, steel reinforced) messenger wire. An insulated conductor of stranded aluminum is twisted around the messenger. Stranded copper with an AWG one gage higher (wire one size smaller) may be substituted for the aluminum conductor. Three-conductor (triplex) may be specified where two insulated conductors are twisted around the messenger wire. The uninsulated messenger serves as the grounded neutral of the power supply.

10. **Ground wire** is used to connect signal or sign supports to ground rods. The wire shall be single-conductor No. 4 AWG made of seven-strand soft drawn copper with white insulation and rated at 600 volts. The wire is used as part of the Ground Rod item (see 625.16 Grounding).

### 450-8.6 Lashing of Overhead Cable

A preformed helical lashing rod shall be of the proper internal diameter to tightly secure overhead cable(s) to the messenger wire. A lashing rod should not be loose or so tight as to be impressed deeply or cut into the cable jacket. If either deficiency is observed, the proper internal diameter may be determined by the following formula: 

\[
C_{approx} = (0.85) (D+m),
\]

where \(C\) is the lashing rod internal diameter, \(D\) is the cable jacket diameter and \(m\) is the messenger wire gage (all dimensions in inches).

For groups of several cables of differing diameter, the internal diameter of the lashing rod may be best determined by a graphic layout to scale.

Signal cable routed on messenger wire should neatly pass the bull rings in its path. Also, signal cable routed around an aerial corner formed in the span wire at a bull ring should have a radius in its routing small enough to form a tangency with the bull ring.
450-8.7 Cable Support Assemblies

As shown in Figure 498-14, a cable support assembly makes use of a flexible tubular wire mesh device called a cable grip which has a gentle holding action over its length and which is used to eliminate strain or damage to the jacket of cable(s) hanging in the interior of poles.

The support assembly consists of the grip attached to a single “U” eye support bale and a sling when necessary. The grip may be used on an individual cable or a group of cables up to a maximum of four (CMS 632.21). The grip shall be the proper size and strength for the cable(s), of stainless steel or tin coated bronze, and may be either a “closed” or “split with rod” type. The split type is used when a cable end is not available. In this application, the grip mesh is not a continuous tubular weave, but is split for wrapping around the cable(s) and is secured by a rod which is inserted through alternate weaves at each side to form a tube.

The support’s bale shall be hung over the pole J-hook if sufficient length is available; otherwise, a sling shall be made of messenger wire, clamps and thimbles. The sling wire is to be passed through the bale eye, adjusted to the proper length and hung on the J-hook.

Pole interiors should be checked by removing pole caps to verify that cable support assemblies are in place, hung on the J-hook and properly adjusted to eliminate cable jacket strain.

450-8.8 Aerial Interconnect Cable

For aerial interconnect cable, the following standards and guidelines apply:

1. Aerial interconnect cable and accessories shall comply with SCD TC-84.20 (illustrated in part in Figure 498-15). Interconnect cable may be supported on separate messenger wire or be the integral messenger self-supporting type with a “figure 8” cross section, if specified on the plans.

2. Metal poles with messenger wire supported interconnect cable are to be furnished with pole clamps. The pole clamp may provide clevis(es) to which the messenger is attached and terminated, or may provide a stud to which a clamp assembly can be bolted.

3. Messenger wire ends are to be looped and secured with three-bolt clamps or a messenger vise, or a preformed guy grip dead end may be used (see Section 450-8.4). If clamps or vises are used, the wire tail shall be served (see Section 450-8.3). Thimbles with a correct groove size for the messenger wire shall be used to connect to the clevis of the pole clamp.

4. When messenger wire is to be grounded to a metal pole, a ground clamp, an insulated ground wire and a bolt tapped into the pole shall be used (also see item 10 in this section).
5. Wood poles with interconnect cable shall be fitted with through-bolts holding a clamp assembly or with a thimble eye-bolt to which the messenger may be attached and terminated.

6. The clamp assembly shall be suitable to the type of cable support, either messenger wire or self-supported cable with "figure 8" cross section. Clamp assemblies for "figure 8" interconnect cable differ slightly from those intended for use with separate messenger, inasmuch as the clamp used with "figure 8" must allow a small gap for the web of the "figure 8" cable which joins the messenger to the cable.

7. When messenger wire or "figure 8" cable is to be grounded on a wood pole, a ground clamp and an insulated ground wire stapled to the pole and covered by a molding shall be used (also see Item 10 in this section). The ground clamp used with "figure 8" cable shall be a type with teeth to penetrate the jacket over the messenger. The ground wire shall be bonded to an existing ground wire or to a ground rod.

8. Standard interconnect cable shall conform to CMS Table 732.19-1 and have the number of conductors and wire gage specified. There is no difference between standard interconnect cable and signal cable, only in the application. Interconnect cable of the shielded type may be specified in the plans. The interconnect cable should be marked with the correct nomenclature. Solid conductors are not permitted (CMS 732.19) unless specified in the plans. Splices may be used on long lengths of interconnect cable (CMS 632.23) and shall be accomplished only in weathertight splice enclosures. Splice enclosures may be either aerially located on the messenger wire or be a pole-mounted box type (see SCD TC-84.20). Where the aerial enclosure is clamped to the span, it should be within 2 feet of a pole to improve accessibility. No measurement allowance is given for splices.

9. Aerial interconnect cable is to have a sag between three to five percent of pole spans or is to match existing utility lines.

10. Messenger wire supporting interconnect cable, and the integral messenger of self-supporting type cable, is to be grounded in cable runs at the first and last poles and on intermediate poles at intervals not to exceed 1200 feet (also see item 4 of this section for grounding on metal poles, and item 7 for grounding on wood poles).

11. As temperatures decrease, interconnect cable gets stiffer and harder, becoming brittle when below freezing. In very cold weather, the cable should be handled with care so as not to damage the jacket or insulation when unreeling, flexing and installing.

12. Standard interconnect cable may be attached to supporting messenger wire by lengths of preformed lashing rod or by spinning wire. Lashing rods shall be of the proper internal diameter to snugly hold the cable but not cut into its jacket (see Section 450-8.6).

13. Aerial interconnect cable of the integral messenger self-supporting type (with a "figure 8" cross section) shall have its wind stability increased by being twisted or spiraled once every 15 feet of span. This is done by clamping the tensioned cable to every other pole and then going to intermediate poles and twisting the cable before tightening their attachment clamps.

When the interconnect cable is attached to a pole and continues in a relatively straight line past the pole, this is an intermediate support; whereas, if the interconnect cable turns at the pole, it is a corner or turning point. Certain types of clamps may be well suited for intermediate support applications, while other designs are required for corner clamps. The clamps shown on the left side in SCD TC-84.20 are usually not suitable for corner clamps if the change of direction is more than about 10 degrees. See SCD TC-84.21 when the change of direction is more than about 10 degrees.
450-8.9 Tether Wire and Appurtenances

Tether wire and accessories shall comply with Plan Insert Sheets (PISs) 208521 and 208522 and CMS 732.185. S-hook wire diameter shall be in accordance with the strain pole Design Number, as shown in the plans.

The tether span, as shown in the standard drawings, is designed to yield under either high wind loads or vehicle snags. The S-hooks are designed to yield in a wind event, allowing the signal span to revert to a free-swinging configuration. The breakaway tether anchors are designed to release the tether in the event of a vehicle snag.

The use of a backplate and tethered span increase the frontal area of a 3-section signal head by a factor of approximately nine times that of a free-swinging signal head without backplates. Such an increase, in a design wind, will exceed AASHTO allowable stress levels in the strain pole. For this reason, it is important to provide a yielding element on the tether span that unloads the tether at the proper tether wire tension. For purposes of design, ODOT has chosen S-hook sizes based on the strain pole Design Number. The table in PIS 208521 gives the diameter of the S-hook corresponding to various pole Design Numbers. The S-hook must be galvanized mild low-carbon steel. High-strength alloy steels such as Grade 80, sometimes used for load-rated S-hooks in the rigging industry, are not acceptable. These are much too strong for the application and will overload the strain pole in a design wind.

The use of breakaway tether anchors to attach signal heads to tether wire is required. Designs which use an L-shaped clamp, as shown in PIS 208522, are acceptable. These shall be properly installed, with the cable clamped below the pinch bolt, and with the opening facing downward. This allows the tether wire to slip out in the event of a vehicle snag.

The turnbuckle used at the end of the tether span is a tensioning and leveling device, to bring the tether into its proper configuration after erection. On all spans, the tether wire must remain essentially horizontal.

The guy grip end also serves as the anchor point for the safety tie. The safety tie is an accessory feature designed to prevent the loose end of a tether span from dropping into the roadway in the event of an S-hook yield. As such, the safety tie need not be particularly strong. In the event of a strong vehicle snag, the 1/8-inch safety tie is designed to yield at a lower load than the 1/4-inch tether wire. If a full-strength safety tie matching the tether wire diameter were used, the possibility would exist of a snagged tether wire overloading the pole. Since the safety tie is small-diameter wire rope, it is specified to be stainless steel, with stainless steel hardware, to minimize corrosion.

450-9 Method of Measurement for Cable and Wire

Figures 498-16 through 498-20 illustrate the method of measurement for signal cable, interconnect cable, detector lead-in cable, power cable and service cable, respectively. CMS 632.29 also specifies the method of measurement for cable and wire.

450-10 Signal Equipment and Wiring

450-10.1 General

This Section is used to provide additional information about other signal equipment and wiring.

450-10.2 Controller Cabinet

While the layout of controller cabinets may vary, the following requirements and guidelines apply:
1. The prewired cabinet should be checked against certified drawings, the wiring diagram for the cabinet and the plans.

2. The cabinet should be fitted with a small door-in-door (police door) unless otherwise specified. The cabinet should be in good condition, revealing no evidence of damage, with its material free of cracks and pinholes. The doors and seals should fit properly. The cabinet exterior should appear as metallic aluminum unless a color is specified. The cabinet interior may be similar to the exterior or may be flat white. The method of cabinet mounting should be as shown on the plans and the cabinet should be securely mounted.

3. Cabinets equipped with solid state controllers shall be provided with a suitable number of sturdy adjustable metal shelves to mount the specified equipment and to provide the required space for designated future equipment (CMS 733.03).

4. The equipment shall be arranged for easy withdrawal and replacement, without the necessity of disturbing adjacent equipment. The permanent location of equipment within the cabinet, as well as the shelves themselves, should allow free circulation of air and not restrict air flow from fan ducts or vents. Components on shelves and devices on the door shall be arranged so that a 1 inch minimum space separates them when the door is closed. This minimum space shall not be compromised by plugs, wires, controls or similar items. Terminals and panel-mounted devices with exposed contact points located next to shelf-mounted equipment shall be provided with spacers, shelf lips or other means to assure that component units cannot be accidentally moved into contact with any exposed electrical terminal points. A minimum 4 inches clear area from the bottom of the cabinet should be reserved for the routing of cables. No shelf component or panel-mounted item shall be located in the bottom 6 inches (of cabinets, with the exception that terminal blocks only in pedestal or pole mounted cabinets may be installed as close as 4 inches to the bottom.

5. Ready accessibility should be provided for items such as load switches, flasher, relays, terminal blocks and fuses which are mounted on or plugged into panels on the cabinet back or sides. Switches, controls and indicator lights should be easily operable and visible without having to move equipment from their positions.

6. Major equipment items should bear a name plate, brand or indelible marking for identification as to type, model, catalog number and manufacturer’s name or trademark.

7. The furnished controller unit should be checked for the correct type, number of phases, and available control functions required by the plans. Controller units should be furnished with all auxiliary equipment necessary to obtain the operation shown in the plans.

8. When specified, other equipment may be a part of the prewired cabinet, such as: an on-street master, interconnection equipment, preemption equipment, video detection equipment, and special relays.

9. Furnished detector units should be checked to see if the correct quantity is installed, and the proper type used with each loop and each detector phase. When multi-channel detector units are furnished, the plans may require the provision of special cabinet wiring and an adapter harness to allow single channel detector units to be readily substituted.

10. The prewired cabinet should also be checked for the following auxiliary equipment:

   a. A forced air ventilating fan automatically controlled by a thermostat shall be furnished.

   b. A conflict monitor shall be furnished according to CMS 733.03(A.2.c.). The minimum number of monitor channels, related to the number of phases for the intersection, should conform to CMS 733.03.
c. Load switches should be provided in sufficient quantity for the interval sequence shown in the plans. The switches shall be solid state NEMA triple signal type with input indicator lamps. The minimum number of load switch sockets furnished, related to the number of phases for the intersection, shall conform to CMS 733.03.

d. A flasher (or flashers) shall be solid state NEMA type.

e. Relays required for the proper operation of the specified equipment shall be furnished.

f. Lightning protection devices shall be furnished for the protection of solid state controllers. They should be located on the incoming power line and on loop detector leads where these connect to the terminal block. Interconnect cable shall be protected by devices across each conductor and ground (see CMS 733.03(A.2.f.)).

g. A convenience outlet and lamp shall be furnished. The outlet should contain at least one standard three-wire plug receptacle of the ground-fault circuit-interrupting type. The lamp should be an incandescent type, located in the upper part of the cabinet, and controlled by a switch.

h. A main power breaker shall be furnished. The fan, convenience outlet and lamp should be wired on a branch of the AC+ power line preceding the main breaker, so that these may be operated independently of the main breaker control. This preceding branch should itself contain an auxiliary breaker rated at 15 amp.

i. A radio interference filter should be installed in the incoming AC+ power line between the main breaker and solid state equipment. If the equipment furnished does not provide signal and flasher circuit switching at the zero voltage point of the power line sinusoid waveform, filters should also be provided for the load switches and flasher.

j. A manual control cord with push button should be furnished only when the plans so require (CMS 733.03). The cord should be at least 5 feet long.

k. Switches required for the proper operation of specified equipment should be furnished and labeled as to function and setting position. The following switches should be grouped behind the small door-in-door (police door): signal shutdown switch, flash control switch and an automatic/manual transfer switch (when manual control is specified).

l. Terminal blocks should not be obstructed by other equipment. Terminal points should accept spade type wiring terminals except for incoming power terminal points which may be either the type to accept bare wire or spade terminals. Contact between adjacent terminal points may be either by bus bar or by wire jumpers with spade terminals.

11. The incoming power bus should be fed from the line side of the incoming 120 VAC power line after the circuit has passed through the main power breaker. A signal bus relay should control power to the bus supplying power for the signal load switches. The requirement for radio interference filters (CMS 733.03) should be adhered to, with the buses supplying load switches and flashers being filtered if load switches do not switch at the zero voltage point of the power line sinusoid waveform. A common terminal bus insulated from the cabinet should be furnished for the connection of the neutral wire of the incoming 120 VAC power line. This common bus should have sufficient terminal points to accommodate all potential cabinet wiring as well as field wiring. A separate common terminal, insulated from the panel, should be used for the interconnect common (if interconnection is a part of the system).
12. The cabinet should include a ground bus bar with an adequate number (at least three) of ground terminal points (CMS 733.03). This bus bar should be grounded to the cabinet.

13. Wiring bundles should be neatly arranged and grouped as to voltage and function, and they should be lashed or restrained so that they do not interfere with the access to equipment, including terminal blocks or buses. The harnesses should be of sufficient length and should be easily traced through the cabinet. All conductors should be stranded, with labeled spade type terminals or plug connectors. The wiring should be color coded, with solid white for the AC common, black for the AC line side power (AC+), and solid green or white with green stripes for the safety ground.

14. Incoming cable and wire should be identified by tags or bands (CMS 632.05). The size, material and method of tag or band identification should be in accordance with CMS 725.02, except that marking may be by indelible pen on plastic tags instead of embossed letters. The identification on the tags or bands should conform to the wiring diagram for the cabinet and its intersection, with typical abbreviations in accordance with CMS Table 632.05-1, which has been reproduced in this Manual as Table 497-2.

15. Two copies of the schematic and wiring diagram for each cabinet and its intersection should be furnished by the contractor. The diagrams are to be updated to reflect any changes made during construction. The diagrams should be neat and legible, on durable paper, and folded in a moisture-proof envelope fastened to the cabinet interior.

450-10.3 Cable and Wire Identification

As noted in CMS 632.05, cables and wires shall be identified as shown in CMS Table 632.05-1, which has been reproduced in this Manual as Table 497-2.

450-10.4 Vehicular Signal Heads and Wiring

Illustrations of the signal head visors, hangers and wiring discussed herein are presented in Figure 498-21.

1. Signal heads shall conform to the plans, CMS 732.01, SCD TC-85.20 and PIS 208522. Signal heads shall have the correct number of faces (one-way, two-way, three-way or four-way) and each face shall be made up of the correct number of optical sections (one, three, four or five). Sections shall be of the correct lens size, i.e., 8 or 12 inches, color and ball or arrow configuration. Arrow lenses shall be the 12 inch size. It should be noted that arrow lenses are made in Rights, Lefts and Throughs (up). The use of the proper arrow lens should be checked.

2. Lenses shall be aligned properly in their frames so their optical configuration directs most of the light to the forward sector.

3. As noted in Section 420-4.2, signal heads shall have a yellow or black finish, unless otherwise specified in the plan.

4. Cutaway type visors (CMS 732.01) shall be fastened to each optical section, unless open bottom tunnel visors or other types are specified, and the interior finish of the visors shall be flat black.

5. Signals should be clean and the assembly tight. Gaskets should be in good condition and lens door hinges and latches should be in good working order. All openings not used for mounting purposes shall be closed by waterproof caps.

6. Five-section faces, arranged in accordance with SCD TC-85.20, PIS 208522 and the plans, are to use galvanized pipe, elbows and tubular hardware, painted to match the signal head.
7. Swinging signals shall be installed in a plumb condition. A balance adjuster should be used only when necessary to achieve plumb (CMS 632.06).

8. Swinging signals suspended from a mast arm shall be fitted with a universal hanger permitting swinging in both longitudinal and transverse directions (CMS 632.06).

9. When specified by the plans, disconnect hangers shall be used with signal heads.

10. Drop pipes, 1 1/2 inch diameter galvanized pipe, are a source of trouble and are aesthetically unattractive; therefore, they are intended to be used only when they are necessary to permit signals to be suspended above the roadway within a clearance of 16 to 18 feet. Signals supported by span wire, with sag required between 3 and 5 percent (SCD TC-84.20), shall be brought to proper clearance by adjusting the attachment height of the span wire to the poles. Because of the 2 foot clearance tolerance, drop pipes should not be necessary in most cases.

11. When the plans so specify, backplates shall be fitted to signal heads.

12. Signal cable shall be routed into the interior of heads through the entrance fitting using a grommet. The cable shall be routed to each face's terminal block, which is typically in the yellow indication section but may be in the green section. Conductors shall be fitted with spade type terminals and shall be fastened securely to the correct terminal points. Conductors shall be identified according to the wiring diagram. Signal cable shall not be spliced, either between signals or in signal face interiors.

13. External signal cable shall be fashioned into a drip loop extending at least 6 inches below the entrance fitting but shall not chafe on the signal.

14. Lamps shall be light emitting diode (LED) (CMS 732.04(C)). All vehicular signal lamps shall be prequalified in accordance with CMS 732.04(C).

15. Each face of a signal head shall be oriented to its approach of traffic and its locking device securely tightened. Orientation or aiming of standard signals should be done so that the maximum light intensity from a standard signal is directed slightly below the horizontal center; thus, on a level approach, the face of the signal should be essentially vertical. When an approach to a signal is on a grade, the signal may be tilted slightly to point the signal axis parallel to the grade of the approach. Horizontal aiming should orient the axis of signal display parallel to the centerline of the approach for straight approaches when the signal is over the roadway. When the approach roadway is curved, or when a signal is not over the roadway, the axis should be directed at a point on the approach which is 175 to 625 feet in advance of the intersection, the distance being dependent on the speed of approaching traffic. For convenience, OMUTCD Table 4D-2 has been reproduced as Table 497-3.

16. When a vehicular traffic signal head has been erected and faces approaching traffic, it shall either be in operation as a stop-and-go signal or a flasher, or it shall be covered or bagged. This is an OMUTCD requirement (OMUTCD Section 4D.01) and cannot be ignored. Typically, the plans will contain an item for “Covering of Vehicular Signal Heads” which will require the contractor to cover, maintain the covering, and subsequently remove the covering when the signal is ready to commence operation.

17. Normally, the plans will provide the “covering” item for each new signal head, but will not provide them for any existing heads which are to be removed. The intent is that “covering” will be necessary for the new heads until they and their associated controller and wiring have been checked by circuit testing (see Section 450-11), while any existing signals at the intersection will continue to control traffic. When the new signals are uncovered and placed in operation, the existing signals can be quickly removed. Specific
maintenance of traffic requirements in any plan may require a different means to assure the unused signals are not exposed to traffic.

### 450-10.5 Optically Programmed Signal Heads

Programmed heads *(see Section 420-4.6)* shall conform to certified drawings, CMS 732, and the plans. They are to have the correct number of optical sections making up each face. Programmed heads have many points of similarity to regular heads. *Items 2, 3, 5, 11, 12, 13, 16 and 17 of Section 450-10.4* also apply to these signal heads. For more detailed information, see publications by the manufacturer.

Each optical section shall be fitted with a visor and the interior surface of visors shall have a flat black finish.

Programmed heads shall be mounted in a manner permitting little or no motion. If mounted on a mast arm, a rigid adapter shall be used. Heads of more than three vertical sections mounted on a mast arm shall be fitted with pipe backbracing, as shown on SCD TC-85.20. The pipe shall be a minimum of 17 inches behind the signal center axis so that adequate clearance is provided for the programming procedure. If heads are supported by span wire, a tether messenger wire shall be attached to a fitting in the bottom of the signal's lower section.

Customarily the manufacturer’s representative will program the signals, but in accordance with the plans, the contractor is responsible for the correct aiming and masking of the signal so as to be visible to drivers or pedestrians only in the area indicated on the plans.

### 450-10.6 Pedestrian Signal Heads

Pedestrian signal heads shall conform to CMS 732.05, certified drawings, the plans and SCD TC-85.10. Signals shall have the correct type of light source and lettering height in accordance with the plans *(CMS 632.08)*.

Housings shall have a black finish, unless otherwise specified *(CMS 732.05)*. Visors shall be fitted over each message, except one type may have the entire face protected by a flat black sunshade fastened close to the lens. The interior surface of visors shall be flat black finish.

Signals should be clean and the assembly tight. Gaskets should be in good condition and lens door hinges and latches in good working order.

Housings shall be positioned with a minimum set back of 2 feet from the curb and a height of 8 to 9 feet above the sidewalk for adequate clearance. The heads shall be oriented toward their crosswalk and locked securely in position.

Lamps for pedestrian signal heads shall be light emitting diode (LED) *(CMS 732.04(C))*.

Pedestrian push buttons shall conform to *Section 404-2*, certified drawings, and CMS 732.06. Push button housings shall have a yellow finish, unless otherwise specified. The push button shall be positioned 3.5 to 4 feet above the sidewalk.

Push buttons on metal poles shall be installed over a 3/4 inch maximum field drilled hole with edge protected by two coats of zinc-rich paint and a rubber grommet inserted. The push button housing curved back shall be positioned over the hole, wiring routed through to the electrical mechanism and the housing secured by stainless steel screws. Unused holes in the housing shall be plugged. Push buttons on wooden poles shall have their wiring in conduit connected to a fitting of the signal support.

Signal head supports (conduit and fittings) on wooden poles shall be grounded, using a ground clamp and an insulated ground wire stapled to the pole and covered by a molding.
If specified in the plans, pedestrian signal heads may be covered in accordance with CMS Item 632.25.

OMUTCD Section 28.51 addresses standards for the signs used where push buttons are provided to actuate pedestrian signals. The sign legend shall conform to the plans.

450-10.7 Loop Detector Slot and Wire

Figures 498-23, 498-24 and 498-25 illustrate details related to the following discussion of loop detector slots and wiring.

1. Slots cut into the pavement forming rectangular detection loops shall be in accordance with the plans and SCD TC-82.10.

2. The slots shall be a minimum of 3/8 inch in width and shall have a minimum depth of 2 inches in concrete and 4 inches in asphaltic concrete. The maximum depth in concrete shall be 2.5 inches. SCD TC-82.10 requires that loop corners be made at a drilled or bored hole, about 1 1/4 inches in diameter, and with the same depth as the saw slot. Any sharp edges at the saw slots and the holes shall be chiseled out.

3. The slot depth shall accommodate the specified number of turns of wire laid so that the uppermost wire has a covering of at least 3/4 inch. The number of wire turns shall comply with the plans and the table in SCD TC-82.10 (also shown in Figure 498-23). A separate slot leading from the loop to the pavement edge is typically cut for each loop.

4. When permitted by the engineer, loops installed in new asphaltic concrete may be sawed and the loop wire(s) embedded with sealant in a subsurface course with subsequent covering by the surface course.

5. Some plans may specify the use of preformed loops placed on the pavement for covering by a surface course of asphaltic concrete.

6. If the problem of loop installations in brick streets is encountered, the engineer should consult with the local traffic engineer for recommendations.

7. Loop locations may be adjusted to avoid manholes. Loops should not be placed across pavement joints. Instead, lateral and longitudinal adjustments should be considered, with the approval of the engineer. If joint crossing is unavoidable or major pavement cracks are encountered, the following techniques may be used (see Figure 498-24).

   a. In Technique A, the loop wires are laid over the joint or crack within a 3 inch square or circular hole cut to slot depth. The wires are laid in an "S" shape and the hole filled with elastic joint material or asphaltic concrete.

   b. In Technique B, the slot at the joint or crack is saw cut to twice normal width and depth. The wires are laid so as to conform to the deepened slot which is injected with soft-setting butyl rubber up to the depth of the original slot. The original slot depth and the remaining perimeter of the slots are embedded with standard sealant cured to a flexible state.

   c. In Technique C, the slot at the joint or crack is enlarged. The wires are encased in a length of plastic tubing which should be large enough to loosely hold all wires and may be slit lengthwise to facilitate construction. Before placing it in the slot, the ends and the longitudinal slit are to be taped shut to prevent the entry of loop sealant. The enlarged slot is then filled with loop sealant.

8. Before loop wire is placed, all slots shall be brushed, blown clean of loose material and
completely dry.

9. Loop detector wire shall be single-conductor No. 14 AWG insulated wire, type IMSA 51-5 with stranded copper conductors, unless otherwise specified. The wire should be marked at intervals with the wire gage, UL label and type. The detector wire is contained inside a flexible plastic tube, as required by IMSA 51-5.

10. The correct turns of loop wire (Figure 498-23), up to a maximum of six, shall be placed in the slots, to comply with CMS 632.23 and the plans. The wire shall be pushed to the bottom of the slots with a blunt wooden tool (or equivalent) to avoid damaging the insulation.

11. The wires with tubing at the pavement edge or curb shall be led into a conduit of the size shown in SCD TC 82.10. Care should be taken to prevent excessive slack at the point where the wires enter the conduit. The high end of the conduit shall be sealed in accordance with SCD TC 82.10.

12. The detector wire shall be twisted in the conduit leading from the pavement edge to the pull box. The flexible plastic tubing shall cover the wire completely from the splice at the lead-in cable, through the entire loop turns and back to the splice. The tubing provides extra protection from abrasion and allows the wire to slide inside the tubing in case of pavement shift or cracks, thus minimizing the possibility of breakage. Since wire/tubing includes an air pocket, it will tend to float to the surface when sealant is applied to the slot. For this reason it is usually necessary to wedge short lengths of the tubing, or similar devices, into the slot to wedge down the tubing/wire. These are usually needed at 1 to 2 foot intervals.

13. The slots shall be completely filled with approved sealant and left undisturbed until cured to a flexible state. Sealants on the ODOT prequalified list shall be used, in accordance with the manufacturer’s recommendations. Materials which set up to a hard or brittle state are not acceptable.

14. Detector loops are measured as “each” loop installed and the item includes wire, pavement cutting, sealant, conduit and trenching to the pullbox.

450-10.8 Loop Detector Lead-In Cable

Unless otherwise specified, loop detector lead-in cable (CMS Table 732.19-1) shall be two-conductor No. 14 AWG twisted pair shielded, Type IMSA 50-2 with conductors of stranded copper.

Within the pull box, loop wire ends shall be joined to the conductors of the lead-in cable by soldering and covered with insulating material (see Figure 498-25). An approved, poured epoxy waterproof splice kit shall be used. It is understood that epoxy splice kits are easily damaged by freezing temperatures encountered prior to mixing. Damaged epoxy components may sometimes be recognized if either of the components has turned or is streaked milky white.

Lead-in cable shall be routed to the controller cabinet, fitted with soldered spade type terminals and fastened to the correct points of the terminal block. The lead-in cable’s shielding shall be grounded to the ground bus within the cabinet.

If a pull box is not specified on the plans, the splice between the loop wire and lead-in cable shall be made in the first entered pole or pedestal, except where the controller cabinet is mounted on the pole or pedestal. If the controller cabinet is mounted on the pole or pedestal, the loop wires may be routed directly into the cabinet and no lead-in cable is necessary.

Loop detector lead-in cable is measured in accordance with Section 450-9 and Figure 498-
18. The poured epoxy splice in the pull box is included.

450-11 Signal Performance Tests and System Checks

450-11.1 General

Traffic control signal components and the entire system shall be tested as required by various specifications to assure proper operation before acceptance. Ground rods shall be tested for satisfactory low resistance to ground. A circuit test should be performed on all conductors to make sure there are no shorts, crosses and high resistance or other improper connections. A cable insulation or megger test shall be performed on all conductors to verify the integrity of the insulation covering. All traffic control equipment in the controller cabinet should be checked for correct settings and all controls manipulated for assurance of an operable system.

Finally, the traffic control system shall successfully pass a ten-day performance test, which will give an opportunity for any hidden flaws to reveal their presence. As a final “housekeeping” check, equipment should be observed for any evidence of unattached ground wire, unlatched or unbolted doors, etc.

The results of the various tests are to be entered by the contractor on test report forms (Form 496-6) as required by CMS 632.28.

450-11.2 Ground Rod Test

All ground rods shall be tested by the contractor for earth resistance to ground, as required by CMS 632.28(B).

450-11.3 Short-Circuit Test

Before the performance of any cable insulation (megger) test or the ten-day performance test, a short-circuit test shall be performed by the contractor using a volt-ohmmeter or other approved instrument (Form 496-6 and CMS 632.28(C)). Short-circuit tests shall be conducted with all electrical loads, power sources, equipment grounds, and earth grounds disconnected (see Figure 498-28).

Signal cable routed to signal heads may be tested with connection made to the lamp sockets, but without the lamps being installed.

Each conductor shall be measured against every other conductor and ground to assure that no short-circuits, cross-circuits, or other improper connections exist. Continuity should not exist between any conductor and any other conductor including ground.

450-11.4 Circuit Continuity Test

Each circuit branch shall be disconnected and tested by the contractor for continuity by temporarily jumpering each branch at its termination and measuring the temporarily looped circuit for assurance that no open circuits exist (Form 496-6 and CMS 632.28(D)). This testing is illustrated in Figures 498-29 through 498-32. Each circuit branch should be according to plan, with no high resistance connections and with the proper identification.

Lead-in cable for loop detector wire shall be tested before and after the cable is spliced to the loop wire.

Circuit continuity of signal cable may be done by applying 120 volts to each outgoing circuit and observing that only the specific lamps are lighted.
450-11.5 Cable Insulation Test (Megger Test)

This testing is illustrated in Figures 498-33 and 498-34.

1. Each conductor of cable or wire terminating at the controller cabinet shall be tested by the contractor for insulation resistance measured to ground (Form 496-6 and CMS 632.28(E)). A listing of the resistance reading for each conductor is to be included in the test results furnished to the engineer.

2. Cable and wire insulation can be faulty but the imperfections can be easily overlooked, leading to eventual electrical failure of the wiring. Weakening of insulation properties may be caused by poor storage conditions and stress due to rough handling during installation. Dirt is especially troublesome, since it is an electricity conductor and can penetrate small cracks in the insulation.

3. Insulation testing shall be performed with all conductors disconnected from their points on the terminal block in the cabinet so there is no chance of any voltage being present, and to prevent damage to any connected equipment. One megger instrument terminal shall be attached to a termination of jumpered together ends of conductors or to the end of a single conductor cable or wire undergoing testing. The other megger instrument terminal shall be attached to the cabinet ground bus bar.

4. Insulation resistance shall be measured for the wire of roadway loops after the embedding of the wire with sealant in slots.

5. The meter pointer of the megger instrument (or equivalent indication) should be adjusted to zero and the test switch activated. Test duration should be as recommended by the instrument manufacturer.

6. The insulation resistance measured to ground for each conductor shall not to be less than 10 megohms. Cable or wire not meeting this reading shall be replaced.

7. After completion of the cable insulation test, all cabinet wiring shall be connected in accordance with the wiring diagram. The contractor shall demonstrate to the satisfaction of the engineer that all circuits are continuous and operating correctly, free from shorts, crosses and unintentional grounds.

450-11.6 Functional Test

Before energizing the traffic signals the following functional checks should be made (Form 496-6 and CMS 632.28(F)):

1. The incoming AC voltage should be checked.

2. Operation of the following equipment should be checked: cabinet ventilating fan, fan thermostat, and convenience outlet with lamp (when furnished). The filter(s) used with the fan should be unobstructed.

3. Timing settings on solid state controllers should be varied over their ranges and all functions activated to verify that the controls are operable without fault.

4. Timing settings in accordance with the plans should now be entered on the controller, time clock, etc. and checked for corrections. On some projects, timing settings will be provided by the maintaining agency and are not listed in the plans.

5. An agreement should be reached with the contractor and the maintaining agency on the procedure to be followed in the event of a signal failure prior to acceptance.
6. Before signals are energized to control traffic, the maintaining agency should be notified and given an opportunity to check the installation and timing settings.

After energizing the traffic signals the following functional checks should be made. In the event the signals are controlling traffic at the time, these checks should be made with caution to protect the safety of workers, pedestrians and drivers.

1. The function of all cabinet switches should be checked, including the power on/off switch and manual control (when furnished).

2. The traffic signals (and controller indicator lights) should be observed to verify that the controller is timing consistently the intervals and phases set into the controls. A stopwatch is suggested, especially to check critical short intervals. All controller functions should be activated to verify that operation is proper.

3. The detector units should be investigated to determine which pavement loop(s) or other type sensor is associated with which unit. The visual indication of units (light, meter, etc.) should be observed to determine that each vehicle (truck, car, motorcycle, etc.) entering sensor areas is properly detected on the associated unit. All inductive loops shall have their sensitivity set to detect a small, high ground-clearance motorcycle (e.g., 200cc dual sport) at the minimum call strength indication. A loop test target equivalent to this small motorcycle can be fabricated as shown in Figure 498-27. This loop test target can be held parallel to the traveled way, with the bottom at or near ground level in the most sensitive part of the loop (close to the saw cut) to simulate the inductive signature of the desired vehicle. For bicycles, a similar loop test target may be constructed, also shown in Figure 498-27. Once the proper sensitivity is attained, the detector module may occasionally detect adjacent-lane vehicles (“splashover detection”). This is an acceptable condition in order to obtain reliable detection of small two-wheel vehicles. Properly designed and placed loops will exhibit minimal or no adjacent-lane detection, even with detector module sensitivities set for small target detection. (Additional information on loop design for detection of motorcycles and bicycles is available in Section 420-5.2.) When a detector unit is set for “presence,” a detection call should continue as long as a vehicle is positioned over the associated sensor. Concurrent with detection, the appropriate controller indicator should also exhibit the detection. Stop line loops shall be connected to separate detection channels.

4. The flasher switch should be activated to cause the signal heads to flash. Their indications should be checked to verify if they are correct. The flasher switch is then to be returned to the normal or signal mode and a check made of the resumption of normal stop-and-go-operation.

5. The conflict monitor should not be activated by normal signal operation or by the manipulation of cabinet switches. If at any time the monitor is activated, the contractor is required to determine the cause of the problem and make appropriate changes and adjustments before beginning the ten-day performance test. The contractor should test the conflict monitor by artificially causing a number of different conflicting indications and checking that at each test the monitor causes the signals to begin flashing and places the controller in a “stop timing” mode. Artificial conflict may be caused by touching a jumper wire between two load switch outputs that would signal a traffic conflict. Other methods of artificially caused conflicts may be used at the discretion of the contractor.

6. Signals which are interconnected should be observed to determine if offset relationships are maintained in accordance with settings during all periods of the day.

7. When preemption equipment is furnished as part of the cabinet installation, the proper functioning of the equipment should be checked. The equipment should be activated and observations made to determine if the required sequence of intervals and phases is called for in a correct and safe manner.
8. On projects having equipment furnished for future use only, the equipment should be checked to verify that it is properly installed and operable in a correct manner.

Some signal control equipment is intended to vary the timing patterns at different periods of the day or days of the week. To determine if these required changes are occurring at the proper times, it is necessary that observations be made to check the operation at transition times over a period of several days. The change in timing shall not be extremely drawn out or abrupt. The accuracy of time clocks and weekly programmers should be checked. Programmed changes should occur within one minute for clocks of the solid state type. No significant cumulative clock error should be noted during the ten-day performance test.

After successful completion of the ten-day performance test, and after a partial or final acceptance of a project, the contractor is to turn over to the engineer all manuals, diagrams, instructions, guarantees and related material, as required by CMS 632.05. It is recommended that the engineer list this material in the project diary as a permanent record of the transfer. The engineer should transfer the material to the maintaining agency. For ODOT-maintained signals the material should be given to the District Roadway Services Manager.

After a traffic control system project has been accepted by ODOT, the engineer should immediately notify the maintaining agency that as of a certain exact time and date, the agency is responsible for the operation and maintenance of the system.

450-11.7 Ten-Day Performance Test

Before acceptance of the traffic control system, the contractor shall furnish all personnel and equipment required to successfully operate the system continuously for ten consecutive days without major malfunction or failure (CMS 632.28(G)).

At least seven days prior to the beginning of the performance test, the contractor shall notify the engineer of the starting date. The engineer will notify the maintaining agency (CMS 632.28(G)).

The contractor shall arrange with the utility supplying the power for purchase of the energy required to conduct the test. All costs of personnel, equipment, electrical energy and incidentals required to perform the test are to have been included in the contract unit prices for the respective items tested.

Minor failures such as lamps, a single detector or an individual signal head, etc. shall be immediately replaced or repaired and will not cause restart of the test.

A major malfunction or failure, such as a master or local controller, interconnect equipment, etc. will cause termination of the test, and after replacement or repair of the malfunctioning or failed equipment, the beginning of a new ten-day test.

Items which have been repaired or which are replacements are to be monitored by the contractor for a period of ten days to provide assurance of their reliability.

The complete test results are to be furnished to the engineer on test reporting forms in accordance with CMS 625.19. The contractor is to record in the test results the beginning and end of the test, and the method and date of the correction of each fault.

The engineer should record the following events in the project diary: the date of the beginning of the ten-day performance test, a day-by-day record of faults as they occur during the test, and the date of the successful completion of the performance test.

450-11.8 Final Signal Installation Check

After all wiring is completed and all testing completed and accepted, a final inspection of the
traffic control system should be performed to assure a neat and workmanlike appearance.

1. All spare conductors should be connected to the ground bus bar in the controller cabinet.
2. All ground wires should be properly connected.
3. The spade type ends of conductors should be sound. After all testing is complete, they should be reinstalled on their correct points of terminal blocks and tightened.
4. A visual check should be made for any signs of arcing, melted insulation, etc.
5. All debris from wiring work or packaging materials should be cleaned from the bottom of cabinets.
6. Cabinet vents should be checked to assure that they are unobstructed and all filters should be clean and in place.
7. Duct sealing material shall be used to seal the conduit entering the cabinet from the base.
8. All doors on the optical sections of vehicular and pedestrian signal heads shall be closed and latched.
9. No wires or cable should be visible under the base plates of poles and pedestals.
10. The handhole covers on poles and end-frames shall be securely fastened.
11. Pedestals with transformer type bases shall have the access door securely fastened.
12. The covers on pull boxes shall be securely bolted.

450-12 Controller Change Orders

Once a project is bid with 2070, NEMA or 170 controller technologies, it is not permissible to switch to a different technology after the project bids.

This is not allowed even if it is a no cost change order. This practice circumvents the competitive bidding practice and could lead to legal action being taken against ODOT by suppliers who were not afforded the opportunity to bid on the replacement technology type.

These types of change orders are not allowed even if the local maintaining agency requests it. They need to make their preference for controller technology known during the design so that it can be competitively bid.
Intentionally blank.
400 TRAFFIC SIGNALS

460 MAINTENANCE / OPERATIONS

460-1 General

Because traffic signals by their very nature provide positive guidance to conflicting traffic movements, it is imperative that they be maintained in order for them to function reliably. The mean time before failure of a traffic signal installation can be dramatically reduced through proper maintenance practices. The consequence of poor maintenance practices are a reduction in safety to road users and an unnecessarily large exposure to liability claims. District Roadway Services personnel and signal maintenance contractors are required to perform maintenance on traffic signals according to a preset schedule.

460-2 Responsibilities

The Office of Traffic Engineering (OTE) shall:

1. Staff and maintain a central repair facility for the purpose of repairing components of electrical traffic control devices.

2. Assist Districts in maintaining reasonable stock levels of all major electrical items, and their appurtenances, required for new installations and maintenance through the management of annual term contracts and spot purchase contracts.

3. Assist the Districts, through procedure manuals, training programs, inspections, and other methods, in providing quality maintenance.

The OTE Signal Shop shall:

1. Repair, check and make serviceable for installation all signal controllers, signal relays, detectors, flashers, conflict monitors and other associated items.

2. Provide the loop detectors and other miscellaneous parts to custom wire as per plan new controller cabinets purchased by the Districts or rewire/refurbish existing controller cabinets.

3. Periodically provide the Districts with technical information concerning old and new equipment, such as: a list of outdated equipment that will not be repaired by the Signal Shop, changes, problems, software updates and etc. for any equipment owned by ODOT, and other tips or tricks that may help the District personnel.

4. Distribute to the Districts, at least once per calendar year, a list of all equipment, parts, and services available from the Signal Shop.

Each District shall:

1. Maintain a stock of traffic control equipment and other spare parts sufficient for normal preventive maintenance and emergency field repairs.

2. Have a plan to support the extraordinary (i.e., severe storm damage) traffic control equipment needs of the District.

3. Evaluate, authorize and maintain records of all changes in the location or operation of electrical traffic control devices.

4. Transport defective controllers, detector relays, detectors, conflict monitors, etc., to the OTE Signal Shop (or approved contractor/vendor) for service, maintenance and repair, along with a Signal Shop Order and a tag indicating the exact type of malfunction. These units shall at all times be properly cushioned to prevent physical damage during shipping and handling.
5. Generate an “as built” drawing for each electrical traffic control device installation, including each new or upgraded intersection control beacon, school flasher or signal. The drawing shall be in MicroStation V8 or later format and shall include the following, if appropriate:

   a. Geometrics of the intersection.

   b. Materials list.

   c. Layout and location of the detectors, poles, pull boxes, cable runs, span wire, signal and pedestrian heads, controller, power service, phase diagram, detector operation, date of installation, revision block, and any other information which shows the intended operation.

   d. Changes which affect the geometrics of the intersection and/or the operation of the signal shall be added to the drawing as revisions.

These electronic files shall be accessible to the Central Office in a read-only mode. Signal drawings which exist in a raster or single element format and cannot be modified shall be digitized or converted by other means when revisions become necessary.

6. Perform appropriate engineering studies, as needed, upon which revisions in signal operations, e.g., phasing may be based. When such revisions are required, an engineering report and necessary supporting data shall be submitted for approval to the appropriate District staff person.

Some signalized intersections and/or signalized corridors may be eligible to apply for, and participate in, the Systematic Signal Timing & Phasing Program (SSTPP). See Section 1213-6 for more information about this program.

460-3 Preventive Maintenance

460-3.1 General

ODOT-maintained traffic signal installations shall be inspected a minimum of one time annually. In addition to the annual traffic signal inspection, the following routine scheduled maintenance shall be performed by either District Roadway Services section personnel or a signal maintenance contractor.

460-3.2 Traffic Control Signals and Intersection Control Beacons

Every eighty-four months, all LED traffic control signal lamps and intersection control beacons shall be replaced. A twelve month compliance interval shall apply to this process such that no device shall be in service for more than ninety-six months. The entire signal head should be replaced.

Every eighteen months incandescent lamps behind all lenses of Traffic Control Signals and Intersection Control Beacons shall be replaced, and the electrical cable and its connections in and near the signal heads shall be checked.

Every twelve months the conflict monitor shall be tested with an automatic conflict monitor tester.

Conflict monitors that are over 10 years old need to be removed from service.
460-3.3 Other Electrical Traffic Control Devices

For School Flashers, flashing and illuminated signs, and other electrical traffic control devices:

Every twenty-four months incandescent lamps behind all lenses shall be replaced and the electrical cable and its connections in and near the signal head shall be checked; and

Every four years mercury vapor lamps shall be replaced, and all reflectors, lenses, tubes and/or lamps shall be cleaned.

460-3.4 Signal Support Inspection

All signal supports shall be inspected at a maximum five-year interval. New signal supports shall be inspected at the time of construction. Refer to Section 421-2 for additional information on signal support inspections.

460-4 As Required Maintenance

The following maintenance shall be conducted as required:

At signalized intersections, and for School Flashers and Intersection Control Beacons (overhead flashers):

1. Replace premature failure of lamps. Clean all reflectors, lenses, tubes and/or lamps.
2. Repaint painted steel poles, controller housings and signal heads as necessary to maintain good appearance and protection.
3. If required by local conditions of smoke, smog, etc., clean all reflectors, tubes and/or lamps using a mild detergent.

At flashing signs, illuminated signs, and other electrical traffic control devices:

1. Replace premature failure of lamps. Clean all reflectors, lenses, tubes and/or lamps.
2. Maintain and replace all other items as required.

Maintain all signs and pavement markings directly associated with any of these devices.

460-5 Malfunction Response

Each District shall seek the cooperation of the Ohio State Highway Patrol (OSHP), local law enforcement, and ODOT work crews in reporting outages and malfunction of electrical traffic control devices. The District shall provide directions for reporting malfunctions twenty-four hours a day.

Upon becoming aware of a traffic signal malfunction (i.e., single red or yellow outage, power outage, signal on flash, and other malfunctions or damage as deemed necessary), the District shall be reasonably prompt in responding at all times, including outside normal working hours. Other repairs, especially green outages, may be made when practicable.

The District shall establish procedures for addressing malfunction responses. At a minimum these shall include:

1. If necessary, notify the OSHP or other appropriate law enforcement agencies, and ask for immediate assistance with traffic control until operation can be restored to a safe condition.
2. Assure that the signal is examined by a signal electrician or other qualified individual to verify that the signal was not damaged by the outage.

3. When a response is made to a reported traffic signal malfunction, the nature and time of malfunctions and corrective action taken shall be recorded.

4. All maintenance of traffic operations shall follow the requirements of the OMUTCD and Part 6 of this Manual.

460-6 Record Retention

The District shall be responsible for retaining records on all traffic signal maintenance, installations, upgrades, transfers, and removals. These records shall be retained for seven years and then reviewed by the State Archives for possible transfer. If the State Archives determines there is no historical value, they can be destroyed. These records shall include:

1. Date of lamp replacements and a description of all other signal maintenance and repairs preformed.

2. The record response to each reported traffic signal malfunction.

3. Documentation to reflect the history of the signals, shall also be maintained for each location. Copies of the original installation and each revision shall be retained either in paper or electronic form or both.

A current signal timing chart, current “as-built” plan, current programming chart for coordination if necessary, cabinet wiring diagram, and special function device diagrams in each controller housing and in the District office. If laptop computers are used instead of paper copies, a plan for updating all the signal electrician's laptops shall be developed by the District.

460-7 Training

The District shall be responsible for training its personnel. The Office of Training and the Office of Traffic Engineering, in cooperation with the Districts, will make the necessary classes and training available. The schedule for the training classes will depend on the needs of the Districts. The following are recommended classes and training for personnel responsible for the maintenance of electrical traffic control devices:

1. International Municipal Signal Association (IMSA) Training:
   a. Work Zone Safety.
   b. Traffic Signal Technician Level I.
   c. Traffic Signal Technician Level II.


3. Electrical Safety Training

460-8 Organizational Performance Index (OPI)

The Traffic Signal Maintenance Organizational Performance Index (OPI) is intended to establish a measurable performance of the District's traffic signal maintenance. Through the OPI process, Districts will be identified that are adhering to ODOT's traffic signal maintenance policies, and the condition of ODOT traffic signal installations will be quantified.
The **OPI** provides a snapshot view of the condition of the signal installation when the inspector arrived at the intersection.

For more information on the **OPI**, refer to the Traffic Signal Maintenance Inspection Manual *(see Section 495-2)*.

### 460-9 Signal Databases

#### 460-9.1 General

Two enterprise data systems have been created by the **IT Department** for traffic-related items. PC based programs have also been developed for accessing and reporting signal information. Internet and Intranet access have been discussed and details will be worked out as the traffic signal databases evolve.

#### 460-9.2 Traffic Signal Maintenance

This database contains the information from the **Signal Inspection Form (Form 496-7)** and the resulting **OPI** points for the measurable maintenance items. The database allows **ODOT** to track signal maintenance inspections.

#### 460-9.3 Traffic Signal Inventory

This database contains detailed information about every traffic signal installation and may include: location, timing, phasing, equipment information, digital pictures, and a repair history of individual pieces of equipment. The inventory will be completely compatible with the GIS system.

### 460-10 Signal Inspection Items

A sample **Signal Inspection Form** is presented in **Form 496-7**. The PC based interface software will print out this form as either a blank form or with the header information filled in, if the signal installation has already been entered into the signal inventory database.

When a traffic signal installation is originally entered into the signal inventory database, an unique number will be generated by the computer system called the “**ODOT signal system number**.” This number will then become the primary tracking number for all information pertaining to this signal installation. The **District** may also retain the "signal file number" which has been in use for many years as an internal reference.

If the header information is printed out, the inspector should verify the controller and conflict monitor manufacturer and serial number for inventory purposes.

### 460-11 Dark Signals

**ORC Section 4511.132** establishes a driver’s duties upon encountering a dark signal (signal not operating due to a power outage).

When responding to notice of a dark signal, the **District** has the following options available:

1. No action.
2. Generators.
3. Temporary ALL-WAY STOP signs (erected in accordance with **OMUTCD Section 6F.03** – If it cannot be ensured that the signal will come back in all-red flashing mode in conjunction with the temporary STOP signs, STOP signs shall not be placed at the intersection.)
4. Law enforcement officer to flag traffic.

5. ODOT personnel to flag traffic.

The District’s response to a dark signalized intersection may be based on the following factors:

1. Utility company time estimate for repairs.
   a. Short term.
   b. Long term.

2. Power outage being wide area or localized area.

3. Number of roadway lanes or type of roadway.
   a. 2 lane and 2 lane.
   b. 4 lane and 2 lane.
   c. 4 lane and 4 lane.
   d. Freeway ramp, urban.
   e. Freeway ramp, suburban or rural.

4. Prioritized listing of intersections constructed from such factors as volume, roadway types, location, etc.

5. Law enforcement request.

The following devices are also available for responding to a dark signal. Some of these devices need to be in place before the power outage.

1. Battery back-up.

2. Signal head backplate with reflective yellow tape outline.

3. SIGNAL AHEAD sign(s).
470 OTHER CONSIDERATIONS

This Chapter is reserved for any material about other considerations that do not fit into the other Chapters in *Part 4*.

480 RESEARCH

This Chapter is reserved for discussion of research related to traffic control signals.

495 REFERENCE RESOURCES

495-1 General

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

495-2 Traffic Signal Maintenance Inspection Manual

This manual outlines the performance measures for the *Organizational Performance Index (OPI)* for Traffic Signal Maintenance performed by *District* forces. A discussion of each of the signal inspection items is also presented. This manual is available from the *Office of Traffic Engineering*.
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496 FORMS INDEX

496-1 Signal Support Inspection Form

Form 496-1 can be used for inspection of signal supports, as noted in Section 421-2, and is available on-line from the OTE Forms web page at: www.dot.state.oh.us/Divisions/Operations/Traffic/Pages/Forms.aspx.

496-2 Traffic Signal Stage 3 Check List

Form 496-2 is a sample Traffic Signal Stage 3 Check List, as noted in Section 440-7.

496-3 Traffic Signal Controller Timing Chart for Actuated Signals

Form 496-3 is a sample Traffic Signal Controller Timing Chart for Actuated Signals, as noted in Section 440-7.

496-4 Traffic Signal Detector Chart

Form 496-4 is a sample Traffic Signal Detector Chart, as noted in Section 440-7.

496-5 Coordination Timing Chart

Form 496-5 is a sample Coordination Timing Chart, as noted in Section 440-7.

496-6 Report of Electrical Tests

Form 496-6 is used for reporting the results of the standard electrical tests, as noted in Sections 450-11.2, 450-11.3, 450-11.4, 50-11.5 and 50-11.6.

496-7 Signal Inspection Form

Form 496-7 is the Signal Inspection Form described in Sections 460-9.2 and 460-10.

496-8 Application to Install and Operate a Traffic Control Signal

Form 496-8 is used by village authorities to obtain permission to install and operate Traffic Control Signals as described in Section 401-6, and is available on-line from the OTE Forms web page at: www.dot.state.oh.us/Divisions/Operations/Traffic/Pages/Forms.aspx.

496-9 Application for Approval of Traffic Control Signal Operation

Form 496-9 is the operation plan for proposed village Traffic Control Signals as described in Section 401-6, and is available on-line from the OTE Forms web page at: www.dot.state.oh.us/Divisions/Operations/Traffic/Pages/Forms.aspx.

496-10 Permit for Operation of a Traffic Control Signal

Form 496-10 is the Traffic Control Signal Permit as described in Section 401-6, and is available on-line from the OTE Forms web page at: www.dot.state.oh.us/Divisions/Operations/Traffic/Pages/Forms.aspx.

496-11 Application to Modify Operation of a Traffic Control Signal

Form 496-11 is for proposed modifications to village Traffic Control Signals as described in Section 401-6, and is available on-line from the OTE Forms web page at: www.dot.state.oh.us/Divisions/Operations/Traffic/Pages/Forms.aspx.
496-12 Right Turn Factorization Sheet

*Form 496-12* is used in the procedure described in *Section 402-5* for determining how much, if any, right-turning traffic from the minor street to remove from the signal warrant analysis. It is available on-line from the OTE Forms web page at: www.dot.state.oh.us/Divisions/Operations/Traffic/Pages/Forms.aspx.

496-13 Example of a Completed Right Turn Factorization Sheet

*Form 496-13* is a completed example of *Form 496-12*.

496-14 Application for a Permit to Have a Special or Off-Duty Law Enforcement Officer (LEO) to Operate a Traffic Control Signal

*Form 496-14* is the Application for a Permit described in *Section 401-10*, and is available on-line from the OTE Forms web page at: www.dot.state.oh.us/Divisions/Operations/Traffic/Pages/Forms.aspx.

496-15 Permit for a Special or Off-Duty LEO to Operate a Traffic Control Signal

*Form 496-15* is the Permit described in *Section 401-10*, and is available on-line from the OTE Forms web page at: www.dot.state.oh.us/Divisions/Operations/Traffic/Pages/Forms.aspx.

496-16 Reserved for Future Use

496-17 Reserved for Future Use

496-18 Reserved for Future Use

496-19 Field Wiring Hook-Up Chart

*Form 496-19* is the Field Wiring Hook-Up Chart described in *Section 440-7*.

496-20 Example of Field Wiring Hook-Up Chart

*Form 496-20* is an example of a completed Field Wiring Hook-Up Chart.
Support Information

Support Identifier: ___________________________       Date: _______________________
Route: ____________________________________            Direction: ____________________
Intersection of: ________________________________and ___________________________
Design No.: _________________________
Support Type: _____ Strain Pole   ____ Mast Arm  _____ Sign  _____ School
                   _____ Other: ___________________________________________________

Foundation

_____ Concrete Condition   _____ Soil Condition   _____ Anchor Bolts/Nuts
Comments: ___________________________________________________________________
          ______________________________________________________________________

Support Condition

_____ Galvanized   _____ Painted  ______ Wood
  _____ Structural Members  _____ Structural Connections     ______ Down Guy
Damage? _____ Yes _____ No        Pitting? _____ Yes  _____ No
Surface Rust: _____ Minimal   _____ Moderate        _____ Severe
Comments: ___________________________________________________________________
          ______________________________________________________________________

Inspected by: ___________________________    Date: _______________________

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Form 496-2. Traffic Signal Stage 3 Check List

A. General: *Written justification required (see Section F) (DNA) - Does Not Apply

1. Are the following items being used in the project:
   a. *Optically programmed signal heads __________
   b. Mast arms __________
   c. *Thermoplastic markings (general) __________
   d. *Thermoplastic markings only at intersections __________
   e. Special control equipment
      I. Priority control __________
      II. RR preemption __________
      III. Traffic adjusted master __________
      IV. Interconnection __________: Type __________
   f. Combination supports __________
   g. Overhead lane control supports __________
   h. Are all Stage 2 comments compiled with or otherwise explained? __________
   i. Other (list): __________

2. Who is:
   a. furnishing signs __________
   b. erecting signs __________
   c. applying thermoplastic markings __________
   d. applying painted markings __________
   e. removing existing signs __________
   f. removing existing markings __________
   g. provide, maintain, remove temporary markings __________

B. Warrants

1. Have signal warrants for all intersections been resolved?

2. Are all unwarranted signals being removed? If answer is no, list intersections and agreed action at each intersection.

3. If unwarranted signals are not being removed, who is doing the upgrading and interconnecting of these signals and when will work be done?

4. Are traffic signal permits involved (i.e., is any signal within a village and on a State Route)? (Village is incorporated area with population of less than 5000.)

C. Utilities

1. Have the utility companies reviewed the plans and approved of the work in writing?

2. Are utility poles being used for interconnect?

3. Is power service by flat rate contract or meter?

4. Are disconnect switches required at power service points?

5. Will the power company run power service to the signal poles or will triplex service cable be run from power pole to signal pole as part of this project?
Form 496-2. Traffic Signal Stage 3 Check List  (Continued)

6. Are high voltage lines present in the area? 10 feet minimum clearance may be required. Check with power company for specific requirements.

7. Have proposed support locations been field checked for conflicts with overhead lines and underground facilities?

8. Do any lines go over/under railroad tracks?

D. Right-of-Way

1. Are any work agreements or easements required? (For placement of items such as loop detectors, pavement marking, etc. outside of the right-of-way limits.)

2. Are right-of-way (R/W) lines shown on signal intersection plan sheets for checking pole foundations, conduit runs, etc., and are all items within the R/W? Note: certain procedures require temporary easements, etc., even though actual construction is within the R/W (i.e., jacking conduit usually requires a jacking pit).

E. Equipment Responsibility

1. Existing signal installation - Does anyone besides contractor retain existing equipment? If answer is yes, name other parties involved.

2. Are any equipment items being reused? If yes, are these items clearly defined on plan sheets and has consultant field checked these items?

3. Has ownership of all items to be removed been established (control equipment, poles, luminaires, etc., by city, state, utility companies, etc.)?

4. Is the maintaining agency of each signal clearly discernible on the plans?

F. Justification

1. Is justification needed and who will submit it (refer to Section A)?
   a. Thermoplastic __________
   b. Optically programmed signal heads __________
   c. Combination supports (commitment on installment of lighting) __________
   d. Justification for proprietary items __________
   e. Other (list) __________
**Form 496-3. Traffic Signal Controller Timing Chart for Actuated Signals**

Intersection _______________________________________________________________________________________

Maintaining Agency __________________________________________________________________________________

<table>
<thead>
<tr>
<th>Start Up</th>
<th>Dual Entry O</th>
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<tbody>
<tr>
<td>Start In: O y/r flash or O all red</td>
<td>Rest In Red: Ring 1 O Ring 2 O</td>
</tr>
<tr>
<td>Time for Flash or All Red: ________</td>
<td>Overlap</td>
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<tr>
<td>First Phases(s): * ______ &amp; *______</td>
<td>Phases</td>
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<td>Color Displayed O Green; O Yellow</td>
<td>Interval or Feature</td>
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<td>Interval</td>
<td>1</td>
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- **Intersection Movement**
  - Minimum Green (Initial) (Sec.)
  - Added Initial *(Sec./Actuation)*
  - Maximum Initial (Sec.)
  - Passage Time (Preset Gap) (Sec.)
  - Time Before Reduction *(Sec.)*
  - Minimum Gap *(Sec.)*
  - Time To Reduce *(Sec.)*
  - Maximum Green I (Sec.)
  - Maximum Green II (Sec.)
  - Yellow Change (Sec.)
  - All Red Clearance (Sec.)
  - Walk (Sec.)
  - Pedestrian Clearance (Sec.)

- **Recall**
  - Maximum (On/Off)
  - Minimum (On/Off)
  - Pedestrian (On/Off)

- **Memory** (On/Off)

- **Call to Non Actuated**
  - No. 1
  - No. 2

* Volume Density Controls
### Form 496-4. Traffic Signal Detector Chart

<table>
<thead>
<tr>
<th>Loop Designation</th>
<th>Loop Configuration&lt;sup&gt;2&lt;/sup&gt;</th>
<th>Size ft. (m)</th>
<th>Pulse or Presence</th>
<th>Delay (sec.)</th>
<th>Extension (sec.)</th>
<th>Override Phase</th>
<th>Connect to Detector Unit (unit-channel)</th>
<th>Associated Controller Phase</th>
<th>Terminal No.&lt;sup&gt;1&lt;/sup&gt;</th>
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</table>

1. For 332/336 Cabinet
2. Configurations: Powerhead (P), Quadrupole (Q), Angular Design Detector (ADD), Rectangular (R), or Diamond (D)
Form 496-5. Coordination Timing Chart

<table>
<thead>
<tr>
<th>Plan (cycle-secs.)</th>
<th>Splits (G+Y+AR) in seconds</th>
<th>Offset From Phase #</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
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</tbody>
</table>

1. Offsets are measured from reference phase(s) numbered "end of green/beginning of yellow".

2. Coordination timing chart shall be in seconds only (no percentages).

<table>
<thead>
<tr>
<th>(1) TBC Plan Events</th>
<th>(2) Hours</th>
<th>(3)</th>
</tr>
</thead>
<tbody>
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</tbody>
</table>

1. TBC Plan Event (ex. Plan 1 Mon – Fri)
2. Hours shall be in military time (ex. 0600-0800)
3. Cycle/Split/Offset (ex. 1/1/1) or Coordination Plan Number (ex. 1)
4. Plans should be provided for each weekday for the following peak time periods: AM, Midday, PM, and Off-peak. Plans should also be provided for the weekend.
## Short Circuit Test 632.28(C)

<table>
<thead>
<tr>
<th>Pairs Measured</th>
<th>Ohms</th>
<th>Pairs Measured</th>
<th>Ohms</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</tbody>
</table>

## Circuit Continuity Test 632.28(D)

(Zero or Negligible Ohms Required)

<table>
<thead>
<tr>
<th>Pairs Measured</th>
<th>Ohms</th>
<th>Pairs Measured</th>
<th>Ohms</th>
<th>Pairs Measured</th>
<th>Ohms</th>
</tr>
</thead>
<tbody>
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</tbody>
</table>
Form 496-6. Report of Electrical Tests (Continued)

<table>
<thead>
<tr>
<th>Locations</th>
<th>Type of</th>
<th>MegOhms</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Ground Test For Traffic Signals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ground Rod Location:</td>
</tr>
<tr>
<td>----------------------</td>
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</table>

### Functional Test: 632.28(F)

- **Incoming AC 120 Volts**
  - OK
- **Cabinet Fan, Thermostat, Convenience Outlet, and Lamp Operation**
- **Controller timing set as per plan or approved by the Engineer**
- **Switches**
- **Controller functions**
- **Detector Units detect all vehicles, including small motorcycles**
- **Detector Units do not give frequent extraneous calls**
- **Flash Switch Transfer**
- **Monitor is not activated by normal operations**
- **Monitor is not activated by manipulation of cabinet switches**
- **Monitor activated by artificial conflict**
- **Signal transfers to flash when monitor is disconnected**

*See *TEM Section 450-11.6.*
Form 496-7. Signal Inspection Form

TRAFFIC SIGNAL FILE NUMBER: LOCATION:
COUNTY AND ROUTE NUMBER: ODOT SIGNAL SYSTEM NUMBER:

DATE INSPECTED: / / ** Points: TIME REQUIRED: 
CONTROLLER TYPE: ODOT NUMBER: 
MONITOR MODEL: ODOT NUMBER: 
CM: MMU: COORDINATION TYPE:

INSPECTED BY: TITLE: 
INSPECTED BY: TITLE: 

1 TRAFFIC SIGNAL HEAD 

<table>
<thead>
<tr>
<th>Condition</th>
<th>Satisfactory</th>
<th>Unsatisfactory</th>
<th>N/A</th>
<th>Repaired</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1 Alignment **</td>
<td>□</td>
<td>□</td>
<td>□</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>1.2 Date re-lamp **</td>
<td>□</td>
<td>□</td>
<td>□</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>1.3 Clearance Height**</td>
<td>Clearance Ft.</td>
<td>In.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.4 Condition including the following:</td>
<td>lens (dirty, burns, holes), lamp orientation, visors, lamps (all burning), signal head cable condition(splices/wear), Prepare to Stop When Flashing sign, above ground detection, water leaks</td>
<td></td>
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</tr>
</tbody>
</table>

2 OVERHEAD SIGNAL SUPPORT SYSTEM

<table>
<thead>
<tr>
<th>Condition</th>
<th>Satisfactory</th>
<th>Unsatisfactory</th>
<th>N/A</th>
<th>Repaired</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.1 Condition including the following:</td>
<td></td>
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</table>

3 CONTROLLER & CABINET

<table>
<thead>
<tr>
<th>Condition</th>
<th>Satisfactory</th>
<th>Unsatisfactory</th>
<th>N/A</th>
<th>Repaired</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.1 Intersection documentation**</td>
<td>□ Present &amp; Current □ Present &amp; Not Current □ Not Present</td>
<td></td>
<td></td>
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<tr>
<td>3.2 Conflict Monitor or MMU (6 mo. inspection) **</td>
<td>Date: / /</td>
<td></td>
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<tr>
<td>3.3 All detection operational**</td>
<td>□ All working □ 1 Detector Failed □ 2 or more Failed</td>
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<tr>
<td>3.4 Wires and cables labeled</td>
<td></td>
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<tr>
<td>3.5 Cabinet sealed to foundation</td>
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<td>3.6 Lock condition (including Power Service)</td>
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<td>3.7 Filter Clean (Size X X)</td>
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<tr>
<td>3.8 Cabinet lamp working</td>
<td></td>
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<tr>
<td>3.9 GFCI receptacle (test)</td>
<td></td>
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<tr>
<td>3.10 Wire terminations tight</td>
<td></td>
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<tr>
<td>3.11 Prepare To Stop When Flashing Timing (Ph._ = ___ sec.) (Ph._ = ___ sec.)</td>
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<tr>
<td>3.12 Load switch indicators lighting</td>
<td></td>
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<tr>
<td>3.13 Preemption</td>
<td></td>
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<tr>
<td>3.14 Cabinet earth ground (ohms)</td>
<td></td>
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<tr>
<td>3.15 Lightning arresters</td>
<td></td>
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<tr>
<td>3.16 Housing conduit sealed</td>
<td></td>
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<tr>
<td>3.17 Cabinet fan / thermostat</td>
<td></td>
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<tr>
<td>3.18 Cabinet clean? need vacuuming?</td>
<td></td>
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<tr>
<td>3.19 Cabinet hinges, need lubricated?</td>
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</tbody>
</table>

** USED IN DISTRICT OPI RATING**
### Form 496-7. Signal Inspection Form (Continued)

<table>
<thead>
<tr>
<th>Item #</th>
<th>Comments</th>
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APPLICATION
FOR PERMISSION TO INSTALL/MODIFY AND OPERATE
A TRAFFIC CONTROL SIGNAL

To: District Deputy Director

District ________________

Date: ________________

In accordance with the provisions of Sections 4511.10 and 11, Ohio Revised Code, the incorporated Village of ________________ does hereby request authority to install/modify and operate a traffic control signal at the intersection of ________________Street (State Route ________________)
and ________________ Street (State Route ________________).

The enclosed traffic engineering study performed by ____________________________ and dated ________________ indicates that the proposed signal is justified by warrant(s) ________________.

This application is made with the understanding that, if approved by you, the signal will comply with the requirements as stipulated by law.

Village of ________________

County of ________________

__________________________
(Signature of Elected Official)

TRAFFIC CONTROL SIGNAL AUTHORIZATION

To: Village of ________________

You are hereby authorized to install or modify a traffic control signal at this intersection. This is subject to approval, by the Ohio Department of Transportation of the Village-prepared operation plan (sample attached) with the understanding that the traffic control signal will comply with the requirements of the Ohio Manual of Uniform Traffic Control Devices.

The Operations Plan should be submitted as soon as possible because this authorization will automatically expire 180 days from the date issued unless otherwise extended by the Ohio Department of Transportation at the request of the Village.

__________________________
Date

__________________________
District Deputy Director

Form 496-8: For a copy of this form, contact the Office of Traffic Engineering, 1980 West Broad Street, Columbus, Ohio 43223
Form 496-9. Application for Approval of Traffic Control Signal Operation

REQUEST FOR APPROVAL OF A TRAFFIC CONTROL SIGNAL OPERATION PLAN

To: District Deputy Director  
Date _____________________

District ___________________

The traffic control signal we have proposed for the intersection of __________________________ Street (State Route ________) and __________________________ Street (State Route ________) would function in accordance with the attached operation plan dated ________________________.

Village of ______________________
County of ______________________

(Signature of Elected Official)

OPERATION PLAN APPROVAL

The operation plan has been approved/approved with modification (see explanation of modification below) and permission is hereby granted to proceed with the installation.

- Explanation of Approval With Modification -

________________________________________

________________________________________

________________________________________

________________________________________

Date ___________________  
District Deputy Director

CERTIFICATION

Upon completion of the installation/modification as specified in the approved operation plan, fill in the certification below and return the attached copy to the District Deputy Director.

I hereby certify that the Village of ___________________________ has installed/modified, and will operate, the above described traffic control signal in accordance with the approved operation plan and ODOT standards. This signal was placed in operation on ___________________________.

Signed ______________________

Title ______________________

Form 496-9: For a copy of this form, contact the Office of Traffic Engineering, 1950 West Broad Street, Columbus, Ohio 43223
Form 496-10. Permit for Operation of a Traffic Control Signal

STATE OF OHIO
DEPARTMENT OF TRANSPORTATION
OFFICE OF TRAFFIC ENGINEERING
P.O. BOX 899
COLUMBUS, OHIO 43216-0899

Permit Number _______________
Village ______________________
County ______________________
Intersection __________________

PERMIT
FOR THE OPERATION OF A TRAFFIC CONTROL SIGNAL
ON A STATE HIGHWAY

Under authority of Sections 4511.10 and 11 of the Ohio Revised Code, the Director of Transportation, in response to the attached Application and engineering study dated __________, hereby app
subject to the condition(s) and restriction(s) set forth herein, the operation of a traffic control signal
location described below:

I. Location of Signal: _________________________________

II. Operation:

This traffic control signal shall be operated in accordance with the Ohio Manual of Uniform Traffic Control Devices for Streets and Highways (OMUTCD). Signal phasing and hours of operation as a stop signal or a flashing signal shall be in accordance with the latest approved schedule. Initial settings shall be as submitted with the "Request for Approval of a Traffic Control Signal Operation Plan." (Note: It is maintained as "School Signals" or "Seasonal Signals," those signals authorized to operate only certain months of each year, shall be hooded or taken down during the period(s) such signals are authorized to operate.)

III. Village authorities are responsible for periodic review of this signal.

The right is reserved to require the timing schedule of the signal, the days upon which it is operated, the intervals during which it is operated to meet the approval of the Director of Transportation. Revisions to the interval timing or hours of operation schedules shall be submitted to the District Deputy Director of Transportation. Approval of any other aspect of the traffic control signal operation covered by this permit shall not be without the specific approval of the Director of Transportation, after proper application has been made.

This permit is revocable upon thirty days notice by the Director of Transportation if in his opinion the is not being operated or maintained in a proper manner, or that traffic would be better served elimination.

________________________________  __________________________________
Date                                Director of Transportation

(April 20, 2012) October 23, 2002  4-141
APPLICATION
TO MODIFY TIMING OR HOURS OF OPERATION
FOR A TRAFFIC CONTROL SIGNAL

To: DISTRICT DEPUTY DIRECTOR
Date ______________________

Ref: Permit No. ________________

______________________________

______________________________

The incorporated Village of __________________________ hereby requests authority to modify
the □ timing and/or □ hours of operation of the traffic control signal at the intersection of
___________________ Street (State Route ____________) and ________________________
Street (State Route ____________), as noted on the attached timing chart.

The change(s) is/are requested for the following reasons:

1. ________________________________

2. ________________________________

3. ________________________________

This application is made with the understanding that, if approved, the signal timing and hours of operation
will comply with the timing chart which will be returned with the approved change.

Village of _______________________
County of _______________________

(Signature of Elected Official)

______________________________

To: Village of _______________________

The attached interval timing and hours of operation dated ___________________ are herewith
approved.

______________________________  ______________________________
Date                           District Deputy Director

Form 496-11: For a copy of this form, contact the Office of Traffic Engineering, 1980 West Broad Street, Columbus, Ohio 43223
Form 496-12. Right Turn Factorization Sheet

<table>
<thead>
<tr>
<th>Time</th>
<th>Left</th>
<th>Through</th>
<th>Right Total</th>
<th>Adjusted Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>7:00</td>
<td>500</td>
<td>1000</td>
<td>1500</td>
<td>2000</td>
</tr>
<tr>
<td>8:00</td>
<td>600</td>
<td>1200</td>
<td>1800</td>
<td>2400</td>
</tr>
<tr>
<td>9:00</td>
<td>700</td>
<td>1400</td>
<td>2100</td>
<td>2700</td>
</tr>
<tr>
<td>10:00</td>
<td>800</td>
<td>1600</td>
<td>2400</td>
<td>3000</td>
</tr>
</tbody>
</table>

*Any Configuration with *

an Exclusive Right Turn Lane.*

**Municipality:**

**County:**

**Interchange:**

**Approach:**

**Mainline Volume:**

**Mainline Reduction Factor:**

**Adjusted Mainline Volume:**

**Adjusted Mainline Reduction:**

**Adjusted Right Turn:**

**Adjusted Total:**

**Volume:**

**Adjustment:**

**Counting:**

**Date:**

**Comments:**
Form 496-13. Example of a Completed Right Turn Factorization Sheet
Form 496-14. Application for a Permit to Have a Special or Off-Duty Law Enforcement Officer (LEO) to Operate a Traffic Control Signal

To: District Deputy Director

District ________

Date: ________________

In order to process your application for a Permit to operate a traffic control signal, please provide the following information:

1. _______________________________________________________
   Name of Entity requesting permission to operate the traffic signal.
   (Permittee)

2. _______________________________________________________
   _______________________________________________________
   _______________________________________________________
   Address

3. ___________________________________________________________________
   Telephone Number, Fax Number and E-Mail Address

4. ___________________________________________________________________
   _______________________________________________________
   _______________________________________________________
   Location of Traffic Signal(s)

5. _______________________________________________________
   Date(s) and Time(s) of Operation

The following terms and conditions apply to the permit:

1. The permit is revocable at-will and non-assignable.

2. The permit expires upon termination of the event.

3. The Permittee warrants that the traffic control signal will be operated by a special or off duty law enforcement officer with the authority to make an arrest in the jurisdiction where the traffic control signal is located.

4. The Permittee agrees to indemnify and hold harmless the Ohio Department of Transportation (ODOT) and its employees from any and against all suits, costs (including attorneys fees, expenses, and court costs) claims, expenses, liabilities and judgments of every kind and from and against all damages and expenses to which ODOT and its employees may be subject to caused by, resulting from, or arising out of the Permittee’s operation of the traffic control signal. This obligation shall survive the expiration of the permit.

5. Provide a copy of the liability insurance which will cover any damage to ODOT property as a result of operating the traffic control signal.

Signed ____________________________________
Form 496-15. Permit for a Special or Off-Duty LEO to Operate a Traffic Control Signal

This permit is issued to ______________________________________(Permittee) for the purpose of operating the traffic control signal located at ______________.

This permit shall be in effect from __________ until ______________.

_______________________________________         ___ ____________
District Deputy Director            Date
Form 496-19. Field Wiring Hook-Up Chart

<table>
<thead>
<tr>
<th>SIGNAL HEAD #</th>
<th>INDICATION</th>
<th>FIELD TERMINAL</th>
<th>FLASH</th>
<th>SIGNAL HEAD #</th>
<th>INDICATION</th>
<th>FIELD TERMINAL</th>
<th>FLASH</th>
</tr>
</thead>
<tbody>
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Electronic file available upon request.
See **Form 496-20** for a completed sample of this chart.
# Field Wiring Hook-Up Chart

<table>
<thead>
<tr>
<th>SIGNAL HEAD</th>
<th>INDICATION</th>
<th>FIELD TERMINAL</th>
<th>FLASH</th>
<th>SIGNAL HEAD</th>
<th>INDICATION</th>
<th>FIELD TERMINAL</th>
<th>FLASH</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 (WBLT)</td>
<td>R</td>
<td>ø5 R</td>
<td>R</td>
<td>12 (EB)</td>
<td>R</td>
<td>ø6 R</td>
<td>R</td>
</tr>
<tr>
<td></td>
<td>Y</td>
<td>ø5 Y</td>
<td></td>
<td>13 (EB)</td>
<td>Y</td>
<td>ø6 Y</td>
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<td>ø5 G</td>
<td></td>
<td></td>
<td>G</td>
<td>ø6 G</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2,3 (NB)</td>
<td>R</td>
<td>ø2 R</td>
<td>R</td>
<td>14 (EB)</td>
<td>R</td>
<td>ø6 R</td>
<td>R</td>
</tr>
<tr>
<td></td>
<td>Y</td>
<td>ø2 Y</td>
<td></td>
<td>15 (EB)</td>
<td>Y</td>
<td>ø6 Y</td>
<td></td>
</tr>
<tr>
<td></td>
<td>G</td>
<td>ø2 G</td>
<td></td>
<td>G</td>
<td>ø6 G</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>ø3 Y</td>
<td></td>
<td></td>
<td>ø3 Y</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4 (WBRT)</td>
<td>R</td>
<td>ø2 R</td>
<td>R</td>
<td>16 (SBLT)</td>
<td>R</td>
<td>ø4 R</td>
<td>R</td>
</tr>
<tr>
<td></td>
<td>Y</td>
<td>ø2 Y</td>
<td></td>
<td></td>
<td>Y</td>
<td>ø4 Y</td>
<td></td>
</tr>
<tr>
<td></td>
<td>G</td>
<td>ø2 G</td>
<td></td>
<td></td>
<td>G</td>
<td>ø4 G</td>
<td></td>
</tr>
<tr>
<td></td>
<td>ø3 Y</td>
<td></td>
<td></td>
<td></td>
<td>ø5 Y</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5 (SBRT)</td>
<td>R</td>
<td>ø4 R</td>
<td>R</td>
<td>17 (SBLT)</td>
<td>R</td>
<td>ø4 Y</td>
<td>R</td>
</tr>
<tr>
<td></td>
<td>Y</td>
<td>ø4 Y</td>
<td></td>
<td></td>
<td>G</td>
<td>ø4 G</td>
<td></td>
</tr>
<tr>
<td></td>
<td>G</td>
<td>ø4 G</td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td></td>
<td>ø3 Y</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6 (NBLT)</td>
<td>R</td>
<td>ø3 R</td>
<td>R</td>
<td>18 (NBLT)</td>
<td>R</td>
<td>ø3 Y</td>
<td>R</td>
</tr>
<tr>
<td></td>
<td>Y</td>
<td>ø3 Y</td>
<td></td>
<td></td>
<td>G</td>
<td>ø3 G</td>
<td></td>
</tr>
<tr>
<td></td>
<td>G</td>
<td>ø3 G</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7 (NB)</td>
<td>R</td>
<td>ø8 R</td>
<td>R</td>
<td></td>
<td>R</td>
<td>ø4 R</td>
<td>R</td>
</tr>
<tr>
<td></td>
<td>Y</td>
<td>ø8 Y</td>
<td></td>
<td></td>
<td>Y</td>
<td>ø4 Y</td>
<td></td>
</tr>
<tr>
<td></td>
<td>G</td>
<td>ø8 G</td>
<td></td>
<td></td>
<td>G</td>
<td>ø4 G</td>
<td></td>
</tr>
<tr>
<td></td>
<td>ø1 Y</td>
<td></td>
<td></td>
<td></td>
<td>ø1 Y</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8 (NBRT)</td>
<td>R</td>
<td>ø8 R</td>
<td>R</td>
<td></td>
<td>R</td>
<td>ø3 R</td>
<td>R</td>
</tr>
<tr>
<td></td>
<td>Y</td>
<td>ø8 Y</td>
<td></td>
<td></td>
<td>Y</td>
<td>ø3 Y</td>
<td></td>
</tr>
<tr>
<td></td>
<td>G</td>
<td>ø8 G</td>
<td></td>
<td></td>
<td>G</td>
<td>ø3 G</td>
<td></td>
</tr>
<tr>
<td></td>
<td>ø5 Y</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9 (SBLT)</td>
<td>R</td>
<td>ø4 R</td>
<td>R</td>
<td></td>
<td>R</td>
<td>ø3 Y</td>
<td>R</td>
</tr>
<tr>
<td></td>
<td>Y</td>
<td>ø4 Y</td>
<td></td>
<td></td>
<td>Y</td>
<td>ø3 Y</td>
<td></td>
</tr>
<tr>
<td></td>
<td>G</td>
<td>ø4 G</td>
<td></td>
<td></td>
<td>G</td>
<td>ø3 G</td>
<td></td>
</tr>
<tr>
<td></td>
<td>ø7 Y</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10,11 (EBLT)</td>
<td>R</td>
<td>ø1 R</td>
<td>R</td>
<td></td>
<td>R</td>
<td>ø1 Y</td>
<td>R</td>
</tr>
<tr>
<td></td>
<td>Y</td>
<td>ø1 Y</td>
<td></td>
<td></td>
<td>G</td>
<td>ø1 G</td>
<td></td>
</tr>
<tr>
<td></td>
<td>ø1 G</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Location</th>
<th>Description</th>
<th>Code</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>AB (EAST)</td>
<td>W OLD G (ø8)</td>
<td>OUT</td>
<td></td>
</tr>
<tr>
<td>CD (SOUTH)</td>
<td>W OLC G (ø6)</td>
<td>OUT</td>
<td></td>
</tr>
<tr>
<td>EF (WEST)</td>
<td>W OLB G (ø4)</td>
<td>OUT</td>
<td></td>
</tr>
<tr>
<td>DH (NORTH)</td>
<td>W OLA G (ø2)</td>
<td>OUT</td>
<td></td>
</tr>
<tr>
<td>OLA = LS 9</td>
<td>OLC = LS II</td>
<td></td>
<td></td>
</tr>
<tr>
<td>OLB = LS 10</td>
<td>OLD = LS 12</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
497-1 Cross Section Area of Conduit, Cable and Wire

Table 497-1 is used as described in Section 450-3.4 to size conduit based on the number and size of the conductors contained in the conduit.

497-2 Cable and Wire Identification

Table 497-2 is referenced in Section 450-10.3 and is a reproduction of CMS Table 632.05-1.

497-3 Minimum Sight Distance

Table 497-3 is referenced in Section 450-10.4 and is a reproduction of Table 4D.1 from OMUTCD, Section 4D.12.

497-4 Types of Overhead Signal Supports

Table 497-4 depicts various types of overhead signal supports and is referenced in Sections 440-3, 440-4 and 450-6.1.

497-5 Areas for Signal Heads

Table 497-5 presents areas used in Sections 440-3 and 440-4 in designing overhead signal supports.

497-6 Height from Bottom of Signal Head to Messenger Wire or Mast Arm

Table 497-6 presents the height (in feet) from the bottom of the signal head to the messenger wire or mast arm and is referenced in Section 440-5.

497-7 Minor Street Analysis Parameters – Minor Leg Lane Configurations and Right Turn Reductions

Table 498-7 presents parameters used in the procedure described in Section 402-5 for determining how many right-turning vehicles to remove from the minor street traffic in a signal warrant analysis.

497-8 Minor Street Analysis Parameters – Mainline Congestion Factors for Limiting Right Turn Reductions

Table 497-8 presents mainline congestion factors used in the procedure described in Section 402-5 for determining how many right-turning vehicles to remove from the minor street traffic in a signal warrant analysis.

497-9 Village Signal Permit Number Assignments

Table 497-9 assigns numbers to be used by Districts for Village Signal Permits (see Section 401-6).
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### Table 497-1. Cross Section Area of Conduit, Cable and Wire

<table>
<thead>
<tr>
<th>Specification or Material</th>
<th>No. of Conductors AWG</th>
<th>Cross Section Area, Sq. In.</th>
</tr>
</thead>
<tbody>
<tr>
<td>IMSA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>19-1 or 20-1</td>
<td>2/C # 14</td>
<td>.10</td>
</tr>
<tr>
<td></td>
<td>3/C # 14</td>
<td>.13</td>
</tr>
<tr>
<td></td>
<td>4/C # 14</td>
<td>.16</td>
</tr>
<tr>
<td></td>
<td>5/C # 14</td>
<td>.19</td>
</tr>
<tr>
<td></td>
<td>7/C # 14</td>
<td>.22</td>
</tr>
<tr>
<td></td>
<td>9/C # 14</td>
<td>.33</td>
</tr>
<tr>
<td></td>
<td>12/C # 14</td>
<td>.41</td>
</tr>
<tr>
<td></td>
<td>15/C # 14</td>
<td>.48</td>
</tr>
<tr>
<td></td>
<td>18/C # 14</td>
<td>.55</td>
</tr>
<tr>
<td></td>
<td>25/C # 14</td>
<td>.82</td>
</tr>
<tr>
<td></td>
<td>2/C # 12</td>
<td>.12</td>
</tr>
<tr>
<td></td>
<td>3/C # 12</td>
<td>.16</td>
</tr>
<tr>
<td></td>
<td>4/C # 12</td>
<td>.19</td>
</tr>
<tr>
<td></td>
<td>5/C # 12</td>
<td>.23</td>
</tr>
<tr>
<td></td>
<td>7/C # 12</td>
<td>.30</td>
</tr>
<tr>
<td></td>
<td>9/C # 12</td>
<td>.40</td>
</tr>
<tr>
<td></td>
<td>12/C # 12</td>
<td>.50</td>
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<tr>
<td></td>
<td>15/C # 12</td>
<td>.58</td>
</tr>
<tr>
<td></td>
<td>18/C # 12</td>
<td>.74</td>
</tr>
<tr>
<td></td>
<td>25/C # 12</td>
<td>1.00</td>
</tr>
<tr>
<td>UL: RHH/RHW/USE</td>
<td>1/C # 14</td>
<td>.053</td>
</tr>
<tr>
<td></td>
<td>1/C # 12</td>
<td>.061</td>
</tr>
<tr>
<td></td>
<td>1/C # 10</td>
<td>.075</td>
</tr>
<tr>
<td></td>
<td>1/C # 8</td>
<td>.107</td>
</tr>
<tr>
<td></td>
<td>1/C # 6</td>
<td>.138</td>
</tr>
<tr>
<td></td>
<td>1/C # 4</td>
<td>.173</td>
</tr>
<tr>
<td></td>
<td>1/C # 2</td>
<td>.229</td>
</tr>
<tr>
<td>Belden</td>
<td>2/C # 14</td>
<td>.08</td>
</tr>
<tr>
<td>PE Jacket, Shielded</td>
<td>2/C # 14</td>
<td>.11</td>
</tr>
<tr>
<td>RG-6/V (COAX)</td>
<td>1/C # 18</td>
<td>.06</td>
</tr>
<tr>
<td>RG-6/V With Power (COAX)</td>
<td>1/C # 18 (COAX)</td>
<td>.06</td>
</tr>
<tr>
<td></td>
<td>2/C # 16 (Power)</td>
<td>.16</td>
</tr>
<tr>
<td>RG-8/V (Antenna Cable)</td>
<td>1/C # 10</td>
<td>.14</td>
</tr>
<tr>
<td>LDF 4-50 A (Antenna Cable)</td>
<td>1/C 0.189 in.</td>
<td>.32</td>
</tr>
</tbody>
</table>

### Conduit Cross Section Area

<table>
<thead>
<tr>
<th>Nominal Diameter, in.</th>
<th>1/2</th>
<th>3/4</th>
<th>1</th>
<th>1 1/4</th>
<th>1 1/2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inside Diameter, in.</td>
<td>.622</td>
<td>.824</td>
<td>1.049</td>
<td>1.380</td>
<td>1.610</td>
</tr>
<tr>
<td>Inside Area, sq. in.</td>
<td>.30</td>
<td>.53</td>
<td>.86</td>
<td>1.50</td>
<td>2.04</td>
</tr>
<tr>
<td>Nominal Diameter, in.</td>
<td>2</td>
<td>2 1/2</td>
<td>3</td>
<td>3 1/2</td>
<td>4</td>
</tr>
<tr>
<td>Inside Diameter, in.</td>
<td>2.067</td>
<td>2.469</td>
<td>3.068</td>
<td>3.548</td>
<td>4.026</td>
</tr>
<tr>
<td>Inside Area, sq. in.</td>
<td>3.36</td>
<td>4.79</td>
<td>7.38</td>
<td>9.90</td>
<td>12.72</td>
</tr>
</tbody>
</table>
### Table 497-2. Cable Wire and Identification

<table>
<thead>
<tr>
<th>Cable</th>
<th>Tag</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ground</td>
<td>GND</td>
</tr>
<tr>
<td>Power (2 wire) 1 t 120 volt</td>
<td>AC+</td>
</tr>
<tr>
<td></td>
<td>AC- or ACN</td>
</tr>
<tr>
<td>Power (3 wire) 1 t 120/240 volt</td>
<td>AC+1</td>
</tr>
<tr>
<td>Neutral wire</td>
<td>AC+2</td>
</tr>
<tr>
<td></td>
<td>AC- or ACN</td>
</tr>
<tr>
<td>Phase A</td>
<td>ø A</td>
</tr>
<tr>
<td>Phase 1</td>
<td>ø 1</td>
</tr>
<tr>
<td>Phase 1 northbound left turn lanes</td>
<td>ø 1 NBLT</td>
</tr>
<tr>
<td>Phase A, pedestrian signal</td>
<td>ø A PD</td>
</tr>
<tr>
<td>Overlap, phase A + C</td>
<td>ø A + C</td>
</tr>
<tr>
<td>Overlap, phase 1 + 6</td>
<td>ø 1 + 6</td>
</tr>
<tr>
<td>Detector lead-in, phase A</td>
<td>DET A</td>
</tr>
<tr>
<td>Detector lead-in, phase 1</td>
<td>DET 1</td>
</tr>
<tr>
<td>Detector lead-in, phase 1 northbound left turn lanes</td>
<td>DET 1 NBLT</td>
</tr>
<tr>
<td>Detector lead-in, phase A (call type)</td>
<td>DET A CALL</td>
</tr>
<tr>
<td>Detector lead-in, phase 1 (call type)</td>
<td>DET 1 CALL</td>
</tr>
<tr>
<td>northbound thru lanes</td>
<td>NB-THRU</td>
</tr>
<tr>
<td>Detector harness *</td>
<td>DET A</td>
</tr>
<tr>
<td>Interconnect</td>
<td>IC</td>
</tr>
<tr>
<td>Preemption, fire</td>
<td>PE FIRE</td>
</tr>
<tr>
<td>Preemption, railroad</td>
<td>PE RR</td>
</tr>
</tbody>
</table>

* For the detector harness, the tag shall be placed next to the MS plug at the detector amplifier.
Table 497-3. Minimum Sight Distance

<table>
<thead>
<tr>
<th>85th-Percentile Speed (mph)</th>
<th>Minimum Sight Distance (feet)</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>175</td>
</tr>
<tr>
<td>25</td>
<td>215</td>
</tr>
<tr>
<td>30</td>
<td>270</td>
</tr>
<tr>
<td>35</td>
<td>325</td>
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<tr>
<td>40</td>
<td>390</td>
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<tr>
<td>45</td>
<td>460</td>
</tr>
<tr>
<td>50</td>
<td>540</td>
</tr>
<tr>
<td>55</td>
<td>625</td>
</tr>
<tr>
<td>60</td>
<td>715</td>
</tr>
</tbody>
</table>
Table 497-4. Types of Overhead Signal Supports

<table>
<thead>
<tr>
<th>Support Type</th>
<th>Allowable Sign Area, Sq. Ft.</th>
<th>Span or Arm Length, Ft.</th>
<th>Configuration</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>TC-81.21 Signal Support Single Arm</td>
<td>(Small signs may be mounted.)</td>
<td>25 to 70</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TC-81.21 Combination Signal Support</td>
<td>25 to 70</td>
<td></td>
<td></td>
<td>May be used to add a highway lighting and/or signing function to TC-81.21.</td>
</tr>
<tr>
<td>TC-81.10 Strain Pole &amp; Messenger Wire Supported Signals</td>
<td>(Small signs may be mounted.)</td>
<td>25 to 70</td>
<td></td>
<td>See SCD TC-84.20 for messenger wire details.</td>
</tr>
<tr>
<td>TC-81.10 Combination Strain Pole</td>
<td>(Small signs may be mounted.)</td>
<td>25 to 70</td>
<td></td>
<td>May be used to add highway lighting and/or signing function to TC-81.10.</td>
</tr>
</tbody>
</table>
### Table 497-5. Areas for Signal Heads

<table>
<thead>
<tr>
<th>Signal Head Type</th>
<th>Area (Sq. Ft.)&lt;sup&gt;1&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inches</td>
<td>8</td>
</tr>
<tr>
<td>1 Section</td>
<td>2.8</td>
</tr>
<tr>
<td>3 Sections</td>
<td>5.6</td>
</tr>
<tr>
<td>4 Sections</td>
<td>7.0</td>
</tr>
<tr>
<td>5 Sections - Vertical</td>
<td>8.4</td>
</tr>
<tr>
<td>5 Sections - Cluster</td>
<td>7.8</td>
</tr>
<tr>
<td>5 Sections - Mixed</td>
<td>11.4</td>
</tr>
</tbody>
</table>

Note 1. Area includes 5-inch backplate.
Table 497-6. Height from Bottom of Signal Head to Messenger Wire or Mast Arm

### FREE SWINGING

<table>
<thead>
<tr>
<th>Signal Head Type</th>
<th>Height (Feet)</th>
<th>8 in. Sections</th>
<th>12 in. Sections</th>
<th>12 in. Sections with Backplates</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Section</td>
<td></td>
<td>1.7</td>
<td>1.9</td>
<td>-</td>
</tr>
<tr>
<td>3 Sections</td>
<td></td>
<td>3.7</td>
<td>4.2</td>
<td>4.7</td>
</tr>
<tr>
<td>4 Sections</td>
<td></td>
<td>4.7</td>
<td>5.4</td>
<td>5.9</td>
</tr>
<tr>
<td>5 Sections - Vertical</td>
<td></td>
<td>5.7</td>
<td>6.5</td>
<td>7</td>
</tr>
<tr>
<td>5 Sections - Cluster</td>
<td></td>
<td>-</td>
<td>4.5</td>
<td>5</td>
</tr>
<tr>
<td>5 Sections - Mixed</td>
<td></td>
<td>-</td>
<td>4.5</td>
<td>5</td>
</tr>
</tbody>
</table>

### RIGID MOUNT, CENTERED ON RED LENS

<table>
<thead>
<tr>
<th>Signal Head Type</th>
<th>Height (Feet) to Red Lens Center</th>
<th>12 in. Sections</th>
<th>12 in. Sections with Backplates</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Section</td>
<td></td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>3 Sections</td>
<td></td>
<td>2.9</td>
<td>3.4</td>
</tr>
<tr>
<td>4 Sections</td>
<td></td>
<td>4.1</td>
<td>4.6</td>
</tr>
<tr>
<td>5 Sections - Vertical</td>
<td></td>
<td>5.3</td>
<td>5.8</td>
</tr>
<tr>
<td>5 Sections - Cluster</td>
<td></td>
<td>3.2</td>
<td>3.7</td>
</tr>
<tr>
<td>5 Sections - Mixed</td>
<td></td>
<td>3.2</td>
<td>3.7</td>
</tr>
</tbody>
</table>
### Table 497-7. Minor Street Analysis Parameters – Minor Leg Lane Configurations and Right Turn Reductions

<table>
<thead>
<tr>
<th>Case</th>
<th>IF</th>
<th>THEN</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>IF</td>
<td>THEN</td>
</tr>
<tr>
<td></td>
<td>$R &gt; 0.7A$</td>
<td>Reduce $R$ by 60%</td>
</tr>
<tr>
<td></td>
<td>$0.7A \geq R &gt; 0.35A$</td>
<td>Reduce $R$ by 40%</td>
</tr>
<tr>
<td></td>
<td>$R \leq 0.35A$</td>
<td>Reduce $R$ by 20%</td>
</tr>
<tr>
<td>2</td>
<td>IF</td>
<td>THEN</td>
</tr>
<tr>
<td></td>
<td>$R &gt; 3T$</td>
<td>Reduce $R$ by 60%</td>
</tr>
<tr>
<td></td>
<td>$3T \geq R &gt; T/3$</td>
<td>Reduce $R$ by 40%</td>
</tr>
<tr>
<td></td>
<td>$R \leq T/3$</td>
<td>Reduce $R$ by 20%</td>
</tr>
<tr>
<td>3</td>
<td>IF</td>
<td>THEN</td>
</tr>
<tr>
<td></td>
<td>Any configuration with an exclusive right turn lane (usually $\geq$ to 600 ft. long)</td>
<td>Reduce $R$ by 75% In all classes</td>
</tr>
<tr>
<td>4</td>
<td>IF</td>
<td>THEN</td>
</tr>
<tr>
<td></td>
<td>$R &gt; (T + L)$</td>
<td>Reduce $R$ by 65%</td>
</tr>
<tr>
<td></td>
<td>$L &gt; (T + R)$</td>
<td>Use situation 2.</td>
</tr>
<tr>
<td></td>
<td>$L \approx T \approx R$ (± 10 veh)</td>
<td>Reduce $R$ by 40%</td>
</tr>
<tr>
<td></td>
<td>$L \approx T &gt; 3R$</td>
<td>Reduce $R$ by 20%</td>
</tr>
<tr>
<td></td>
<td>$R \approx T &gt; 3L$</td>
<td>Reduce $R$ by 50%</td>
</tr>
<tr>
<td></td>
<td>All other classes</td>
<td>Reduce $R$ by 30%</td>
</tr>
<tr>
<td>5</td>
<td>IF</td>
<td>THEN</td>
</tr>
<tr>
<td></td>
<td>$R &gt; T$</td>
<td>Reduce $R$ by 75%</td>
</tr>
<tr>
<td></td>
<td>$T \geq R &gt; T/2$</td>
<td>Reduce $R$ by 50%</td>
</tr>
<tr>
<td></td>
<td>$T/2 \geq R &gt; T/4$</td>
<td>Reduce $R$ by 30%</td>
</tr>
<tr>
<td></td>
<td>$R &lt; T/4$</td>
<td>Reduce $R$ by 15%</td>
</tr>
</tbody>
</table>

**Legend:**

$L = \text{number of left-turning vehicles}$  
$R = \text{number of right-turning vehicles}$  
$T = \text{number of through vehicles}$  
$A = (L + T + R)$
Table 497-8. Minor Street Analysis Parameters – Mainline Congestion Factors for Limiting Right Turn Reductions

<table>
<thead>
<tr>
<th>Volumes per Lane</th>
<th>Reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 – 399</td>
<td>0%</td>
</tr>
<tr>
<td>400 – 499</td>
<td>5%</td>
</tr>
<tr>
<td>500 – 599</td>
<td>10%</td>
</tr>
<tr>
<td>600 – 699</td>
<td>15%</td>
</tr>
<tr>
<td>700 – 799</td>
<td>20%</td>
</tr>
<tr>
<td>800 – 899</td>
<td>25%</td>
</tr>
<tr>
<td>900 – 999</td>
<td>30%</td>
</tr>
<tr>
<td>1000 – 1099</td>
<td>35%</td>
</tr>
<tr>
<td>1100 – 1199</td>
<td>40%</td>
</tr>
<tr>
<td>1200 – 1299</td>
<td>45%</td>
</tr>
<tr>
<td>1300 – 1399</td>
<td>50%</td>
</tr>
<tr>
<td>1400 – 1499</td>
<td>55%</td>
</tr>
<tr>
<td>1500 – 1599</td>
<td>60%</td>
</tr>
<tr>
<td>etc.</td>
<td>etc.</td>
</tr>
</tbody>
</table>

*Mainline = Approach with right-turns turn into
Table 497-9. Village Signal Permit Number Assignments

<table>
<thead>
<tr>
<th>Districts</th>
<th>Numbers</th>
</tr>
</thead>
<tbody>
<tr>
<td>District 1</td>
<td>1200 - 1699</td>
</tr>
<tr>
<td>District 2</td>
<td>1700 - 2199</td>
</tr>
<tr>
<td>District 3</td>
<td>2200 - 2699</td>
</tr>
<tr>
<td>District 4</td>
<td>2700 - 3199</td>
</tr>
<tr>
<td>District 5</td>
<td>3200 - 3699</td>
</tr>
<tr>
<td>District 6</td>
<td>3700 - 4199</td>
</tr>
<tr>
<td>District 7</td>
<td>4200 - 4699</td>
</tr>
<tr>
<td>District 8</td>
<td>4700 - 5199</td>
</tr>
<tr>
<td>District 9</td>
<td>5200 - 5699</td>
</tr>
<tr>
<td>District 10</td>
<td>5700 - 6199</td>
</tr>
<tr>
<td>District 11</td>
<td>6200 - 6699</td>
</tr>
<tr>
<td>District 12</td>
<td>7000 - 7499</td>
</tr>
</tbody>
</table>
Intentionally blank.
498 FIGURES INDEX

498-1 Emergency Traffic Signal Guidelines

Figure 498-1 illustrates the cross-corner sight distance criteria suggested for use in reviewing requests for Emergency Traffic Signals, as described in Section 406-3.

498-2 Local Government Agency/Utility Force Account Work

Figure 498-2 illustrates the process for administering force account work by a local government agency or utility to an active construction project.

498-3 Suggested Loop Placement for High-Speed Mainline vs. Large-Volume Side Street

Figure 498-3 illustrates suggested loop detector placements as described in Section 420-5 for the intersection of a high-speed mainline with a large-volume side street.

498-4 Suggested Loop Placement for High-Speed Mainline vs. Ramp/T Intersection

Figure 498-4 illustrates suggested loop detector placements as described in Section 420-5 for the intersection of a high-speed mainline with a ramp or T intersection.

498-5 Suggested Loop Placement for High-Speed Mainline vs. Low-Speed Side Street

Figure 498-5 illustrates suggested loop detector placements as described in Section 420-5 for the intersection of a high-speed mainline with a low-speed side street.

498-6 Concrete Pull Box

Figure 498-6 illustrates a concrete pull box as described in Section 450-3.2.

498-7 Trench Details

Figure 498-7 illustrates details of the different types of trench that are described in Section 450-3.3.

498-8 Exothermic Weld

Figure 498-8 illustrates the equipment used for an exothermic weld as described in Section 450-3.6.

498-9 Power Service

Figure 498-9 illustrates the mounting details for the power service components as described in Sections 440-2 and 450-4.

498-10 Strain Pole Supports

Figure 498-10 illustrates details for signal strain poles as described in Section 450-6.2.

498-11 Strain Pole Attachment Details

Figure 498-11 illustrates details for the attachment of span wires to a signal strain pole as described in Sections 450-6.2 and 450-8.
498-12 Single Arm Support

Figure 498-12 illustrates a mast arm signal support as described in Sections 440-3 and 450-6.3.

498-13 Sag and Vertical Clearance Diagram

Figure 498-13 illustrates sag and vertical clearance and is referenced in Section 450-7.

498-14 Cable Support Assembly

Figure 498-14 illustrates the use of a cable support assembly to relieve cable strain inside of a pole as described in Sections 450-8.2 and 450-8.7.

498-15 Aerial Interconnect Cable

Figure 498-15 illustrates attachment details for aerial interconnect cable as described in Section 450-8.8.

498-16 Method of Measurement for Signal Cable

Figure 498-16 illustrates the calculation method for the measurement of signal cables as described in Sections 450-8.5 and 450-9.

498-17 Method of Measurement for Interconnect Cable

Figure 498-17 illustrates the calculation method for the measurement of interconnect cable as described in Sections 450-8.5, 450-8.8 and 450-9.

498-18 Method of Measurement for Detector Lead-In Cable

Figure 498-18 illustrates the calculation method for the measurement of detector lead-in cables as described in Sections 450-8.5, 450-9 and 450-10.8.

498-19 Method of Measurement for Power Cable

Figure 498-19 illustrates the calculation method for the measurement of power cable as described in Sections 450-8.5 and 450-9.

498-20 Method of Measurement for Service Cable

Figure 498-20 illustrates the calculation method for the measurement of service cable as described in Sections 450-8.5 and 450-9.

498-21 Vehicular Signal Heads

Figure 498-21 illustrates the hardware and wiring for signal heads as described in Section 450-10.4.

498-22 Pedestrian Signal Heads

Figure 498-22 illustrates the mounting of pedestrian signal heads as described in Section 450-10.6.

498-23 Loop Detector Placement and Installation

Figure 498-23 illustrates the installation details for loop detectors as described in Section 450-10.7.
498-24 Loop Detector Slots and Wiring

*Figure 498-24* illustrates the installation details for loop detectors as described in *Section 450-10.7.*

498-25 Loop Detector Wiring

*Figure 498-25* illustrates miscellaneous wiring details for loop detector wiring as described in *Section 450-10.8.*

498-26 Magnetometer Probes and Lead-In

*Figure 498-26* illustrates installation details for magnetometer probes as described in *Section 450-10.9.*

498-27 Vehicle Loop Test Targets

*Figure 498-27* illustrates the test targets described in *Sections 420-5 and 450-11.6.*

498-28 Short-Circuit Test

*Figure 498-28* illustrates the connections for the short-circuit test as described in *Section 450-11.3.*

498-29 Circuit Continuity Test of Loop Wire (Before Splice to Lead-In Cable)

*Figure 498-29* illustrates the connections for the continuity circuit test on loop detector wire as described in *Section 450-11.4.*

498-30 Circuit Continuity Test of Loop Wire and Lead-In Cable

*Figure 498-30* illustrates the connections for the continuity circuit test for the entire loop wire and lead-in cable installation after splicing as described in *Section 450-11.4.*

498-31 Circuit Continuity Test of Signal Cable Disconnected from Heads or Other Cable

*Figure 498-31* illustrates the connections for the continuity circuit test for signal cable disconnected from the signal heads and other cables as described in *Section 450-11.4.*

498-32 Circuit Continuity Test of Signal Cable With Cable Connected to the Signal Heads and Lamps Installed

*Figure 498-32* illustrates the connections for the continuity circuit test for signal cable connected to the signal heads with lamps installed as described in *Section 450-11.4.*

498-33 Cable Insulation Test (Loop Detector Wire)

*Figure 498-33* illustrates the connections for the cable insulation test for loop detector wire as described in *Section 450-11.5.*

498-34 Cable Insulation Test (Signal Cable)

*Figure 498-34* illustrates the connections for the cable insulation test for signal cable as described in *Section 450-11.5.*

498-35 Reserved for Future Use
498-36 Plan Details for Strain Poles

*Figure 498-36* presents a sample angle orientation chart for signal strain pole (SCD TC-81.10) appurtenances as described in *Section 441-8*.

498-37 Plan Details for Signal Supports - Arm Lengths

*Figure 498-37* presents a sample chart for mast arm signal supports (SCD TC-81.21) appurtenances as described in *Section 441-8*.

498-38 Plan Details for Signal Supports - Mast Arm Orientation

*Figure 498-38* presents a sample angle orientation chart for mast arm signal support (SCD TC-81.21) appurtenances as described in *Section 441-8*.

498-39 Example of Wire Size for Equipment Grounding Conductor – PTSWF with Pedestrian Indications

*Figure 498-39* presents an example of wire size for equipment grounding conductor as described in *Section 442-32*.

498-40 Example of Wire Size for Equipment Grounding Conductor – PTSWF without Pedestrian Indications

*Figure 498-40* presents an example of wire size for equipment grounding conductor as described in *Section 442-32*.

498-41 Example of Wire Size for Equipment Grounding Conductor – Mast Arms

*Figure 498-41* presents an example of wire size for equipment grounding conductor as described in *Section 442-32*.

498-42 Example of Wire Size for Equipment Grounding Conductor – Span Wire

*Figure 498-42* presents an example of wire size for equipment grounding conductor as described in *Section 442-32*.

498-43 Dilemma Zone Graph

*Figure 498-43* presents a graphical representation of the dilemma zone drivers face when approaching a signalized intersection.
Figure 498-1. Emergency Traffic Signal Guidelines

<table>
<thead>
<tr>
<th>Approach Speed (MPH)</th>
<th>Distance “S”</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>40 ft</td>
</tr>
<tr>
<td>25</td>
<td>230</td>
</tr>
<tr>
<td>30</td>
<td>280</td>
</tr>
<tr>
<td>35</td>
<td>330</td>
</tr>
<tr>
<td>40</td>
<td>370</td>
</tr>
<tr>
<td>45</td>
<td>420</td>
</tr>
<tr>
<td>50</td>
<td>460</td>
</tr>
<tr>
<td>55</td>
<td>510</td>
</tr>
<tr>
<td>60</td>
<td>560</td>
</tr>
</tbody>
</table>
Figure 498-2. Local Government Agency/Utility Force Account Work

1. Submission to District
2. Evaluate
3. Draft Agreement and Send to Agency for Signature
   - If Required, Send to FHWA for Approval.
4. Send to Contract Sales for Director's Signature and Encumbrance No.
5. Return Copy of Signed Agreement and Formal Approval to Local Agency or Utility
6. Work Performed
7. Billings Submitted to District
8. Reviewed by District
9. Submit to Business & Human Services Administrator for Payment
Figure 498-3. Suggested Loop Placement for High-Speed Mainline vs. Large-Volume Side Street (1 of 4)
(For better legibility, portions of this sample layout have also been shown separately.)

Sample Page Layout
Figure 498-3.  Suggested Loop Placement for High-Speed Mainline vs. Large-Volume Side Street (2 of 4)
### Figure 498-3.  Suggested Loop Placement for High-Speed Mainline vs. Large-Volume Side Street (3 of 4)

#### LOOP DETECTOR CHART

<table>
<thead>
<tr>
<th>LOOP</th>
<th>CONFIGURATION</th>
<th>SIZE FT (m)</th>
<th>Ø</th>
<th>AM P NO.</th>
<th>DELAY (SEC)</th>
<th>MODE</th>
<th>REMARKS</th>
</tr>
</thead>
<tbody>
<tr>
<td>L-1</td>
<td>ADD(^1)</td>
<td>SEE BELOW(^2)</td>
<td>1</td>
<td>pulse</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>L-2</td>
<td>ADD(^1)</td>
<td>SEE BELOW(^2)</td>
<td>1</td>
<td>pulse</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>L-3</td>
<td>ADD(^1)</td>
<td>SEE BELOW(^2)</td>
<td>2</td>
<td>pulse</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>L-4</td>
<td>ADD(^1)</td>
<td>SEE BELOW(^2)</td>
<td>2</td>
<td>pulse</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>L-5</td>
<td>ADD(^1)</td>
<td>SEE BELOW(^2)</td>
<td>3</td>
<td>pulse</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>L-6</td>
<td>ADD(^1)</td>
<td>SEE BELOW(^2)</td>
<td>3</td>
<td>pulse</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>L-7</td>
<td>ADD(^1)</td>
<td>SEE BELOW(^2)</td>
<td>4</td>
<td>pulse</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>L-8</td>
<td>ADD(^1)</td>
<td>SEE BELOW(^2)</td>
<td>4</td>
<td>pulse</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>L-9</td>
<td>POWERHEAD (L)x6 (6.1x1.8)(^2)</td>
<td>5</td>
<td>3</td>
<td>presence</td>
<td>delay inhibited during green phase</td>
<td></td>
<td></td>
</tr>
<tr>
<td>L-10</td>
<td>POWERHEAD (L)x6 (6.1x1.8)(^2)</td>
<td>6</td>
<td>presence</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>L-11</td>
<td>POWERHEAD (L)x6 (6.1x1.8)(^2)</td>
<td>7</td>
<td>10</td>
<td>presence</td>
<td>delay inhibited during green phase</td>
<td></td>
<td></td>
</tr>
<tr>
<td>L-12</td>
<td>ADD/QUAD(^1)</td>
<td>variable</td>
<td>7</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>L-13</td>
<td>POWERHEAD (L)x6 (6.1x1.8)(^2)</td>
<td>8</td>
<td>3</td>
<td>presence</td>
<td>delay inhibited during green phase</td>
<td></td>
<td></td>
</tr>
<tr>
<td>L-14</td>
<td>ADD(^1)</td>
<td>SEE BELOW(^2)</td>
<td>9</td>
<td>pulse</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>L-15</td>
<td>ADD(^1)</td>
<td>SEE BELOW(^2)</td>
<td>10</td>
<td>pulse</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>L-16</td>
<td>POWERHEAD (L)x6 (6.1x1.8) (^2)</td>
<td>11</td>
<td>3</td>
<td>presence</td>
<td>delay inhibited during green phase</td>
<td></td>
<td></td>
</tr>
<tr>
<td>L-17</td>
<td>POWERHEAD (L)x6 (6.1x1.8) (^2)</td>
<td>12</td>
<td>10</td>
<td>presence</td>
<td>delay inhibited during green phase</td>
<td></td>
<td></td>
</tr>
<tr>
<td>L-18</td>
<td>POWERHEAD (L)x6 (6.1x1.8) (^2)</td>
<td>13</td>
<td>3</td>
<td>presence</td>
<td>delay inhibited during green phase</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Notes:**
1. Configuration Terms: ADD = Angular Design Detection; QUAD = Quadrupole
2. For size information see Standard Construction Drawing TC-82.10.  (L)=Length, variable as needed, maximum 35 feet.

<table>
<thead>
<tr>
<th>X FT (m)</th>
<th>SPEED (MPH)</th>
</tr>
</thead>
<tbody>
<tr>
<td>450 (135)</td>
<td>60</td>
</tr>
<tr>
<td>400 (120)</td>
<td>55</td>
</tr>
<tr>
<td>350 (105)</td>
<td>50</td>
</tr>
<tr>
<td>300 (90)</td>
<td>45</td>
</tr>
<tr>
<td>250 (75)</td>
<td>40</td>
</tr>
</tbody>
</table>
Figure 498-3. Suggested Loop Placement for High-Speed Mainline vs. Large-Volume Side Street (4 of 4)

<table>
<thead>
<tr>
<th>MAIN LINE LOOP NOTES</th>
<th>SIDE STREET LOOP NOTES</th>
</tr>
</thead>
<tbody>
<tr>
<td>(A) L1 through L8 are used to extend main-line green. L1, L2, L7 and L8 are placed to mitigate high-speed dilemma zone conflicts. L3, L4, L5, L6 and L15 are used to mitigate lower speed dilemma zone conflicts.</td>
<td>(A) L9, L10, L11, L17 and L18 are used to call and extend the side street green phases.</td>
</tr>
<tr>
<td>(B) For permitted phasing, L13, L15 and L16 can be used to extend mainline green. The designer should look at turn volumes, capacity analysis and traffic patterns to determine if it is desirable to extend mainline green with left-turn traffic. If it is not desirable, L13 and L16 can be omitted.</td>
<td>(B) L9 and L18 can be used to call and extend both the protected and permitted phases as described in (B) and (C) under mainline loop notes.</td>
</tr>
<tr>
<td>(C) For protected turn phasing, L13, L15 and L16 are used to call and extend protected (turn arrow) phases. NOTE: It is possible to switch detector outputs (detector switching) in order to use L13 and L16 to extend the mainline green phase (permitted) after the protected turn phase has terminated.</td>
<td>(C) L9 and L18 can be placed 30 to 50 feet behind the stop line if protected/permitted phasing is used (3rd vehicle detection).</td>
</tr>
<tr>
<td>(D) L13 and L16 can be placed 30 to 50 feet behind the stop line if protected/permitted phasing is used (3rd vehicle detection).</td>
<td></td>
</tr>
</tbody>
</table>
Figure 498-4. Suggested Loop Placement for Mainline vs. Ramp/T Intersection (1 of 4)
(For better legibility, portions of this sample layout have also been shown separately.)

Sample Page Layout
Figure 498-4. Suggested Loop Placement for Mainline vs. Ramp/T Intersection (2 of 4)
Figure 498-4. Suggested Loop Placement for Mainline vs. Ramp/T Intersection (3 of 4)

### LOOP DETECTOR CHART

<table>
<thead>
<tr>
<th>LOOP</th>
<th>CONFIGURATION</th>
<th>SIZE FT (m)</th>
<th>Ø</th>
<th>AMP NO.</th>
<th>DELAY (SEC)</th>
<th>MODE</th>
<th>REMARKS</th>
</tr>
</thead>
<tbody>
<tr>
<td>L-1</td>
<td>ADD '</td>
<td>SEE BELOW²</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td>pulse</td>
</tr>
<tr>
<td>L-2</td>
<td>ADD '</td>
<td>SEE BELOW²</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td>pulse</td>
</tr>
<tr>
<td>L-3</td>
<td>ADD '</td>
<td>SEE BELOW²</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td>pulse</td>
</tr>
<tr>
<td>L-4</td>
<td>ADD '</td>
<td>SEE BELOW²</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td>pulse</td>
</tr>
<tr>
<td>L-5</td>
<td>ADD '</td>
<td>SEE BELOW²</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td>pulse</td>
</tr>
<tr>
<td>L-6</td>
<td>ADD '</td>
<td>SEE BELOW²</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td>pulse</td>
</tr>
<tr>
<td>L-7</td>
<td>ADD '</td>
<td>SEE BELOW²</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td>pulse</td>
</tr>
<tr>
<td>L-8</td>
<td>ADD '</td>
<td>SEE BELOW²</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td>pulse</td>
</tr>
<tr>
<td>L-9</td>
<td>POWERHEAD (L)x6 (6.1x1.8 )²</td>
<td>5</td>
<td>3</td>
<td>presence</td>
<td>NOT delay inhibited</td>
<td></td>
<td></td>
</tr>
<tr>
<td>L-10</td>
<td>POWERHEAD (L)x6 (6.1x1.8 )²</td>
<td>6</td>
<td>10</td>
<td>presence</td>
<td>NOT delay inhibited</td>
<td></td>
<td></td>
</tr>
<tr>
<td>L-11</td>
<td>ADD '</td>
<td>SEE BELOW²</td>
<td>7</td>
<td>3</td>
<td>presence</td>
<td>delay inhibited during green phase</td>
<td></td>
</tr>
<tr>
<td>L-12</td>
<td>POWERHEAD (L)x6 (6.1x1.8 )²</td>
<td>8</td>
<td>3</td>
<td>presence</td>
<td>delay inhibited during green phase</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Notes:**
1. Configuration Terms: ADD= Angular Design Detection
2. For size information see Standard Construction Drawing TC-82.10. (L)=Length, variable as needed, maximum 35 feet.

<table>
<thead>
<tr>
<th>X FT</th>
<th>SPEED (MPH)</th>
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</thead>
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<tr>
<td>450</td>
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<td>50</td>
</tr>
<tr>
<td>300</td>
<td>45</td>
</tr>
<tr>
<td>250</td>
<td>40</td>
</tr>
</tbody>
</table>
Figure 498-4. Suggested Loop Placement for Mainline vs. Ramp/T Intersection (4 of 4)

**MAIN LINE LOOP NOTES**

(A) L1 through L8 are used to extend main-line green. L1, L2, L7 and L8 are placed to mitigate high-speed dilemma zone conflicts. L3, L4, L5 and L6 are used to mitigate lower speed dilemma zone conflicts.

(B) For permitted phasing, L12 can be used to extend mainline green. The designer should look at turn volumes, capacity analysis and traffic patterns to determine if it is desirable to extend mainline green with left-turn traffic. If it is not desirable, L12 can be omitted.

(C) For protected turn phasing, L12 is used to call and extend protected (turn arrow) phases. NOTE: It is possible to switch detector outputs (detector switching) in order to use L12 to extend the mainline green phase (permitted) after the protected turn phase has terminated.

(D) L12 can be placed 30 to 50 feet behind the stop line if protected/permitted phasing is used (3rd vehicle detection).

**RAMP/T INTERSECTION LOOP NOTES**

(A) L11 is located at the designer’s discretion. Typical placement is for a 35 mph design speed. This reflects the slowing conditions at a ramp/T intersection.

(B) L9 and L10 are placed on delay. After the delay time has expired, these loops call the ramp/T intersection green phase. The delay time for these loops is not inhibited. This keeps L9 and L10 from extending the green phase.

(C) L11 is on delay. This prevents the loop from calling the green phase. Once the green phase arrives (called in by L9 and L10), the loop is delay inhibited. This allows L11 to extend the ramp/T intersection green phase.
Figure 498-5.  Suggested Loop Placement for High-Speed Mainline vs. Low-Speed Side Street (1 of 4)
(For better legibility, portions of this sample layout have also been shown separately.)

Sample Page Layout
Figure 498-5. Suggested Loop Placement for High-Speed Mainline vs. Low-Speed Side Street (2 of 4)
**LOOP DETECTOR CHART**

<table>
<thead>
<tr>
<th>LOOP</th>
<th>CONFIGURATION</th>
<th>SIZE FT (m)</th>
<th>Ø</th>
<th>AMP NO.</th>
<th>DELAY (SEC)</th>
<th>MODE</th>
<th>REMARKS</th>
</tr>
</thead>
<tbody>
<tr>
<td>L-1</td>
<td>ADD³</td>
<td>SEE BELOW⁴</td>
<td>1</td>
<td>pulse</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>L-2</td>
<td>ADD³</td>
<td>SEE BELOW⁴</td>
<td>1</td>
<td>pulse</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>L-3</td>
<td>ADD³</td>
<td>SEE BELOW⁴</td>
<td>2</td>
<td>pulse</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>L-4</td>
<td>ADD³</td>
<td>SEE BELOW⁴</td>
<td>2</td>
<td>pulse</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>L-5</td>
<td>ADD³</td>
<td>SEE BELOW⁴</td>
<td>3</td>
<td>pulse</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>L-6</td>
<td>ADD³</td>
<td>SEE BELOW⁴</td>
<td>3</td>
<td>pulse</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>L-7</td>
<td>ADD³</td>
<td>SEE BELOW⁴</td>
<td>4</td>
<td>pulse</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>L-8</td>
<td>ADD³</td>
<td>SEE BELOW⁴</td>
<td>4</td>
<td>pulse</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>L-9</td>
<td>POWERHEAD</td>
<td>(L)x6 (6.1x1.8)⁴</td>
<td>5</td>
<td>10¹</td>
<td>presence</td>
<td>delay inhibited during green phase</td>
<td></td>
</tr>
<tr>
<td>L-10</td>
<td>POWERHEAD</td>
<td>(L)x6 (6.1X1.8)⁴</td>
<td>6</td>
<td>3²</td>
<td>presence</td>
<td>delay inhibited during green phase</td>
<td></td>
</tr>
<tr>
<td>L-11</td>
<td>POWERHEAD</td>
<td>(L)x6 (6.1X1.8)⁴</td>
<td>7</td>
<td>3²</td>
<td>presence</td>
<td>delay inhibited during green phase</td>
<td></td>
</tr>
<tr>
<td>L-12</td>
<td>POWERHEAD</td>
<td>(L)x6 (6.1x1.8)⁴</td>
<td>8</td>
<td>10¹</td>
<td>presence</td>
<td>delay inhibited during green phase</td>
<td></td>
</tr>
<tr>
<td>L-13</td>
<td>POWERHEAD</td>
<td>(L)x6 (6.1x1.8)⁴</td>
<td>9</td>
<td>3²</td>
<td>presence</td>
<td>delay inhibited during green phase</td>
<td></td>
</tr>
<tr>
<td>L-14</td>
<td>POWERHEAD</td>
<td>(L)x6 (6.1x1.8)⁴</td>
<td>10</td>
<td>3²</td>
<td>presence</td>
<td>delay inhibited during green phase</td>
<td></td>
</tr>
</tbody>
</table>

**Notes:**
1. Large delay used to give vehicles a chance to turn right on red.
2. Small delay used to keep left turning vehicles from other street crossing/clipping loop and putting in errant calls.
3. ADD= Angular Design Detection
4. (L)= length, variable as needed, maximum 35 feet.

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<th>SPEED (MPH)</th>
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<td>300</td>
<td>45</td>
</tr>
<tr>
<td>250</td>
<td>40</td>
</tr>
</tbody>
</table>
Figure 498-5.  Suggested Loop Placement for High-Speed Mainline vs. Low-Speed Side Street (4 of 4)

MAIN LINE LOOP NOTES

(A) L1 through L8 are used to extend main-line green. L1, L2, L7 and L8 are placed to mitigate high-speed dilemma zone conflicts. L3, L4, L5 and L6 are used to mitigate lower speed dilemma zone conflicts.

(B) For permitted phasing, L13 and L14 can be used to extend mainline green. The designer should look at turn volumes, capacity analysis and traffic patterns to determine if it is desirable to extend mainline green with left-turn traffic. If it is not desirable, L13 and L14 can be omitted.

(C) For protected turn phasing, L13 and L14 are used to call and extend protected (turn arrow) phases. NOTE: It is possible to switch detector outputs (detector switching) in order to use L13 and L14 to extend the mainline green phase (permitted) after the protected turn phase has terminated.

(D) L13 and L14 can be placed 30 to 50 feet behind the stop line if protected/permitted phasing is used (3rd vehicle detection).

SIDE STREET LOOP NOTES

(A) L9 through L12 are used to call and extend the side street green phases.

(B) L10 and L11 can be used to call and extend both the protected and permitted phases as described in (B) and (C) under the mainline loop notes.

(C) L10 and L11 can be placed 30 to 50 feet behind the stop line if protected/permitted phasing is used (3rd vehicle detection).
Figure 498-6. Concrete Pull Box

- Fastened at 4 corners
- Pull ring or pry slot
- Preformed joint filler when abutting concrete
- Openings or knockouts
- Aggregate
Figure 498-7. Trench Details

IN PAVED AREA
Figure 498-8. Exothermic Weld
Figure 498-9. Power Service
Figure 498-10. Strain Pole Supports
Figure 498-11. Strain Pole Attachment Details

[Diagram showing strain pole attachment details with labels such as 'J Hook', 'Pole Cap with Set Screws', '3-Bolt Clamp', 'Thimble', 'Anchor Shackle', 'Serve with Wire or Strand Sleeve', 'Bullring (Aerial Corners)', 'Preformed Guy Grips', 'Weatherhead in Pole or on Conduit Riser', 'Cable Support Assembly', 'Drip Loop', 'Combination Pole', 'Roadway Lighting Luminaire Arm (Not Included)', 'Extended Strain Pole', 'Handhole', 'Span Wirf Clamp']
Figure 498-12. Single Arm Support
Figure 498-13. Sag and Vertical Clearance Diagram

PERCENT SAG = \( \frac{\text{SAG}}{\text{SPAN}} \times 100 \)

ALLOWABLE SAG IS 3 TO 5 PERCENT OF SPAN

CLEARANCE 18 FT. (5.5 m) MAX.,
16 FT. (4.9 m) MIN.

DROP PIPE INSTALLED ONLY WHEN NECESSARY TO MAINTAIN CLEARANCE

SAG FOR SIMPLE SPANS
Figure 498-14. Cable Support Assembly
Figure 498-15. Aerial Interconnect Cable

[Diagram of aerial interconnect cable setup with labels and instructions for installation and connection details.]
Figure 498-16. Method of Measurement for Signal Cable

**Calculation for Pole Mounted Cabinet:**

\[ \text{Length} = 5 \text{ ft.} \times 0.5 \text{ m} + A + 10 \text{ ft.} \times 3 \text{ m} + B + C1 + 5 \text{ ft.} \times 0.5 \text{ m} \]

**Calculation for Ground Mounted Cabinet:**

\[ \text{Length} = 5 \text{ ft.} \times 0.5 \text{ m} + A + 10 \text{ ft.} \times 3 \text{ m} + B + C2 + D + E + 5 \text{ ft.} \times 0.5 \text{ m} \]
Figure 498-17. Method of Measurement for Interconnect Cable

EXPLANATION OF FIGURE:

EXAMPLE WITH 5 POLES

CALCULATION FOR POLE MOUNTED CABINET:

\[ \text{LENGTH} = 5 \text{ FT, (0.5 m)} \times C_1 + D + E + F + G + H \times 5 \text{ FT, (0.5 m)} \]

CALCULATION FOR GROUND MOUNTED CABINET:

\[ \text{LENGTH} = 5 \text{ FT, (0.5 m)} \times A + B + C_2 + D + E + F + G + H_2 \times 5 \text{ FT, (0.5 m)} \]
Figure 498-18. Method of Measurement for Detector Lead-In Cable

CALCULATION FOR POLE MOUNTED CABINET:
LENGTH = 5 FT. (1.5 m) + A + B + C + DI + 5 FT. (1.5 m)

CALCULATION FOR GROUND MOUNTED CABINET:
LENGTH = 5 FT. (1.5 m) + A + B + C + D2 + E + F + 5 FT. (1.5 m)
Figure 498-19. Method of Measurement for Power Cable

**Calculation for Pole Mounted Cabinet:**

LENGTH = 5 FT. (1.5 m) + A1 + 5 FT. (1.5 m)

**Calculation for Ground Mounted Cabinet:**

LENGTH = 5 FT. (1.5 m) + A2 + B + C + 5 FT. (1.5 m)
Figure 498-20. Method of Measurement for Service Cable

Example with 3 Service Poles

Calculation:
Length = 5 ft. (1.5 m) + A + B + C + 5 ft. (1.5 m)
Figure 498-21. Vehicular Signal Heads

Hangers for Signal Heads

Visors for Signal Heads

Wiring a Signal Head

Strip Length:
Cable jacket must extend into the signal enclosure.
Figure 498-22. Pedestrian Signal Heads
Figure 498-23. Loop Detector Placement and Installation

<table>
<thead>
<tr>
<th>Lane Width</th>
<th>Rectangular and Powerhead</th>
<th>Quadrupole</th>
<th>Angular Design</th>
</tr>
</thead>
<tbody>
<tr>
<td>11 FT (3.35 m) and Larger</td>
<td>6 FT (1.83 m) Width</td>
<td>6 FT (1.83 m) Width</td>
<td>A = 4.5 FT (1.37 m)</td>
</tr>
<tr>
<td>Less Than 11 FT (3.35 m)</td>
<td>5 FT (1.52 m) Width</td>
<td>6 FT (1.83 m) Width</td>
<td>A = 4.0 FT (1.22 m)</td>
</tr>
</tbody>
</table>
Figure 498-24. Loop Detector Slots and Wiring

**Technique A**

CUT OUT PAVEMENT AND JOINT MATERIAL TO DEPTH OF SAWCUT APPROXIMATELY 3 IN (75 mm) SQUARE OR 3 IN (75 mm) DIAM. LAY WIRES IN *S*-SHAPE, FILL WITH ELASTIC JOINT MATERIAL OR ASPHALT.

**Technique B**

NOTE: LOOP CONDUCTORS MUST FOLLOW SAW CUT TO BOTTOM FERRING SLACK SECTION AT JOINT.

**Technique C**

3/4" (19 mm) RIGID PLASTIC CONDUIT
Figure 498-25. Loop Detector Wiring
Figure 498-26. Magnetometer Probes and Lead-In
Figure 498-27. Vehicle Loop Test Targets

1. Two turns, ends shorted. Simulates a small motorcycle.
2. One turn, ends shorted. Simulates a bicycle.
3. Set vertically on or just above pavement to test detection areas and adjust sensitivity accordingly (see Section 450-11.6).
Testing is to be done with all electrical loads, power sources, equipment grounds, and earth grounds disconnected.

Connect to chosen conductor. Connect to different conductor, repeat test until each conductor pair is measured.

<table>
<thead>
<tr>
<th>Wire Connected</th>
<th>Pairs Measured</th>
</tr>
</thead>
<tbody>
<tr>
<td>White</td>
<td>White/Red</td>
</tr>
<tr>
<td></td>
<td>White/Orange</td>
</tr>
<tr>
<td></td>
<td>White/Green</td>
</tr>
<tr>
<td></td>
<td>White/Black</td>
</tr>
<tr>
<td>Red</td>
<td>Red/Orange</td>
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<tr>
<td></td>
<td>Red/Green</td>
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<td></td>
<td>Red/Black</td>
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<tr>
<td>Orange</td>
<td>Orange/Green</td>
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<tr>
<td></td>
<td>Orange/Black</td>
</tr>
<tr>
<td>Green</td>
<td>Green/Black</td>
</tr>
</tbody>
</table>

Conductors may be jumped together for testing to ground. If a short is revealed, individual conductors may then be tested to ground to isolate the faulty conductor.
Figure 498-29. Circuit Continuity Test of Loop Wire (Before Splice to Lead-In Cable)

TURN FUNCTION SELECTOR TO RESISTANCE. A RESISTANCE OF ZERO OHMS SHOULD BE INDICATED. IF A HIGH RESISTANCE IS FOUND THE LOOP INSTALLATION IS UNACCEPTABLE.
Figure 498-30. Circuit Continuity Test of Loop Wire and Lead-In Cable
Figure 498-31. Circuit Continuity Test of Signal Cable Disconnected from Heads or Other Cables Such as Interconnect and Loop or Magnetometer Lead-In
Figure 498-32. Circuit Continuity Test of Signal Cable With Cable Connected to the Signal Heads and Lamps Installed

RED LIGHTS ONLY SHOULD BE ILLUMINATED WHEN 120 VOLTS IS CONNECTED TO THE WHITE AND RED WIRES, YELLOW LIGHTS WHEN WHITE AND ORANGE WIRES ARE CONNECTED, AND GREEN LIGHTS WHEN WHITE AND GREEN WIRES ARE CONNECTED.

CONNECT TO RED CONDUCTOR. REPEAT TEST FOR OTHER COLORED CONDUCTORS.

CONNECT TO WHITE CONDUCTOR

THE BLACK CONDUCTOR IS USUALLY A SPARE AND IS NOT CHECKED IF THIS PROCEDURE IS FOLLOWED.

CONVENIENCE OUTLET IN CABINET (120 VOLTS)
Figure 498-33. Cable Insulation Test (Loop Detector Wire)
Figure 498-34. Cable Insulation Test (Signal Cable)

LEDs/Lamps Left In

Connect other lead to wires

White/Black
Red
Yellow
Blue
Black
White

Green

Megger

Must read more than 10 megohms

Connect one lead to cabinet ground

Some models incorporate a ground or drain terminal (see manufacturers instructions)
Figure 498-35. Reserved for Future Use
Figure 498-36. Plan Details for Strain Poles

<table>
<thead>
<tr>
<th>From Sheet No.</th>
<th>Reference Sheet</th>
<th>Pole No.</th>
<th>Design No.</th>
<th>Pole Height ft (m)</th>
<th>Span Wire Attached Ht. (ft)</th>
<th>Index Line Angle (Deg.)</th>
<th>Pedestrian Signals</th>
<th>Pedestrian Push buttons</th>
<th>Controller</th>
<th>Power Service</th>
<th>Cable Entrance 12&quot; (0.3 m) from Top</th>
<th>Luminaire Bracket</th>
<th>Interconnect Pole Splice Box</th>
<th>Angle (Deg.) from Index Line</th>
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</thead>
<tbody>
<tr>
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</tbody>
</table>

* See Section 441-8.

Notes:
1. All angles are measured clockwise.
2. The index line goes through the center of the handhole.
**Table 498-37. Plan Details for Signal Supports - Arm Lengths**
*(table is continued in Figure 498-38)*

<table>
<thead>
<tr>
<th>Support No.</th>
<th>Design No.</th>
<th>Pole Height ft. (m)</th>
<th>L ft. (m)</th>
<th>L1 ft. (m)</th>
<th>L2 ft. (m)</th>
<th>L3 ft. (m)</th>
<th>L4 ft. (m)</th>
<th>Elevation A</th>
<th>Elevation B</th>
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</thead>
<tbody>
<tr>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Notes:
1. All angles are measured clockwise.
2. Base plate is oriented square to Mast Arm A (largest arm) even if the support has two arms.

<table>
<thead>
<tr>
<th>Mast Arm A Angle (Deg.)</th>
<th>Mast Arm B</th>
<th>Pedestrian Signal</th>
<th>Pedestrian Button</th>
<th>Power Service</th>
<th>Controller</th>
<th>Luminaire Bracket</th>
<th>Handhole</th>
<th>Cable Entrance 12&quot; (0.3m) from top</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Figure 498-39. Example of Wire Size for Equipment Grounding Conductor – PTSWF with Pedestrian Indications
Figure 498-40. Example of Wire Size for Equipment Grounding Conductor – PTSWF without Pedestrian Indications
Figure 498-41. Example of Wire Size for Equipment Grounding Conductor – Mast Arms
Figure 498-42. Example of Wire Size for Equipment Grounding Conductor – Span Wire
Figure 498-43. Dilemma Zone Graph

Mathematical Description of Dilemma Zone:

\[ d_{go} = 6.3v - 125 \approx d_{stop} - 200 \]
\[ d_{stop} = 7.2v \]

\[ v > 30 \text{ mph} \]

(Source: Adapted from Missouri DOT)
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<td>REFERENCE RESOURCES</td>
<td>5-3</td>
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</table>
OMUTCD Part 5 is titled “Traffic Control for Low-Volume Roads,” and is intended to specifically supplement and reference the criteria for traffic control devices commonly used on low-volume roads. A low-volume road is defined as:

A low-volume road shall be a facility lying outside of built-up areas of Cities, towns, and communities, and it shall have a traffic volume of less than 400 AADT.

A low-volume road shall not be a freeway, expressway, interchange ramp, freeway service road, or a road on a designated State highway system. In terms of highway classification, it shall be a variation of a conventional road or a special purpose road as defined in OMUTCD Section 1A.13.

A low-volume road shall be classified as either paved or unpaved.

The OMUTCD standards apply as appropriate to all public highways and OMUTCD Part 5 is available for reference in situations that may arise where engineering judgment indicates that some modification of the existing standard may be appropriate. TEM Part 5 has been reserved to address, as needed, additional information on the subject. However, roads under ODOT’s jurisdiction should not fall into this category since, by definition, low-volume roads cannot be on a designated State highway system.

Various reference resources that may be useful have been noted in Sections 193 and 194.
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600 GENERAL

600-1 Introduction

The information provided in this Part of the TEM is intended to supplement OMTUCD Part 6 by presenting ODOT policies, standards, guidelines, practices and procedures concerning the design and application of various types of temporary traffic control. Examples of situations which require temporary traffic control include highway construction and maintenance work, utility work, special events (e.g., tournaments and festivals) and incidents (e.g., traffic accidents and chemical spills).

In addition to typical methods for maintaining traffic through temporary traffic control zones, this Part also provides suggestions for when detours may be used and guidelines for the preparation of plans. It does not address every conceivable condition. Each situation is unique; therefore, the temporary traffic control used should take into consideration the individual characteristics of the particular situation.

One function of this Part is to serve as a guide for the designer in developing strategies to maintain traffic during construction activity, and in preparing a set of maintenance of traffic plans for incorporation into a set of highway construction plans. *Tables 697-1a through 697-1f* present a review of the pros and cons of various temporary traffic control options.

Information on policies, guidelines and standards related to temporary traffic control devices and their use are located in the early Chapters of this Part. For example, *Chapter 602* addresses the various elements of a temporary traffic control zone, *Chapter 604* addresses flagger control, *Chapter 605* discusses the individual devices, and typical applications are addressed in *Chapter 607*. Information specifically related to design, construction and maintenance functions is located in the later Chapters (*Chapters 640 through 660*).

600-2 Construction Projects

*Chapter 150* addresses the general application of ODOT standards, specifications and Standard Construction Drawings (SCDs) to construction projects, while this Part provides additional detail information.

Coordination with other projects is necessary in order to minimize the inconvenience to road users (*see Section 640-17*). This may require communication among several government jurisdictions, various offices within ODOT and several contractors.

Projects should be scheduled to avoid routing a detour (*Section 602-6*) through another construction site. See *Section 640-16* for information regarding work on detours and alternate routes. *Sections 640-17 and 640-18.2.5* address signing for adjacent projects.

600-3 Force Account (ODOT Operations) Work

Districts performing force account work must comply with the requirements in the OMTUCD and this Manual. It is recommended that the Districts also follow the provisions in applicable SCDs and Construction and Materials Specifications (CMS) sections. However, it should be recognized that information in the SCDs and CMS does not necessarily provide the only method to achieve a given objective.
600-4 Public Communication

Communicating the details of highway improvement projects is desirable and necessary. The traveling public, businesses, schools and communities are all impacted by a construction project. In general, road users find it difficult to accept the disruption of travel caused by work activities; therefore, maintaining good public relations is very important, especially on major projects.

Public meetings, news releases and media alerts, among other communication tools, should be used to communicate to the public and to maintain good public relations. Involvement of the news media and local authorities in publicizing the existence of, and the reasons for, work activities can be of great assistance in keeping the public well informed.

600-5 High vs. Low-Volume Highways

Part 5 addresses traffic controls for the category of roads known as Low-Volume Roads (LVR). Generally, ODOT-maintained highways do not fall within the LVR category defined in Part 5.

However, traffic volume is a useful criteria when addressing levels of traffic control appropriate in various situations. Therefore, the terms “low-volume” and “high-volume” are often used. For purposes of this Part, unless defined otherwise for a specific situation, “high-volume” describes a highway with an ADT greater than 4,000, and a “low-volume” street or highway has an ADT of 4,000 or less.

600-6 Incident Management Areas

OMUTCD Chapter 6I and Chapter 608 specifically address additional information about control of traffic through traffic incident management areas.
601  FUNDAMENTAL PRINCIPLES

601-1  General

The control of road users through a temporary traffic control zone is an essential part of highway construction, utility work, maintenance operations and incident management. However, the safety of those road users and workers in temporary traffic control zones shall also be an integral and high-priority element of every project from planning through design and construction. Maintenance and utility work should also be planned and conducted with the safety of drivers, bicyclists, pedestrians and workers considered at all times.

The objective of temporary traffic control in general is to provide for the safe and expeditious movement of traffic through work zones and incident areas by doing the following:

1. Alerting the road user;
2. Telling the road user what to do;
3. Guiding the road user through or around the site; and
4. Protecting the worker.

OMUTCD Section 6B.01 outlines various principles and procedures that experience has shown tend to enhance the safety of road users and workers in work zones and incident areas.

601-2  Work Zones on Interstates and Other Freeways

As much as safely possible, methods for traffic control should produce the least possible effect on traffic operations by minimizing the frequency or time of hindrance to normal traffic flow.

In an attempt to minimize delay to road users on Interstate and other freeway projects, ODOT has developed Policy 516-003(P), Traffic Management in Work Zones Interstate and Other Freeways (see Section 1511). This policy establishes standards for acceptable traffic queuing. Predicted queue lengths resulting from decreased capacity of the highway at a work site on Interstate and other freeways shall not exceed the standards set by this policy.

On the basis of this policy, Permitted Lane Closure Schedules (PLCSs) have been established for each District. OTE has consolidated this information into a statewide system of maps/schedules available from the OTE website at http://plcm.dot.state.oh.us. The maps and related scheduling information shall be reviewed periodically by the Districts and updated as needed. Use of the PLCSs in the design process is described in Section 630-4.

The concepts presented in Policy 516-003(P) should also be considered for application on non-freeway projects.
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602  TEMPORARY TRAFFIC CONTROL ELEMENTS

602-1  General

This Chapter addresses various basic elements of temporary traffic control, e.g., Temporary Traffic Control Plans (also known as Maintenance of Traffic Plans), definitions of the components of a traffic control zone, tapers and one-lane, two-way traffic control.

602-2  Temporary Traffic Control Plans

A Temporary Traffic Control (or Maintenance of Traffic) Plan describes temporary traffic control measures to be used for facilitating the road users through a work zone. These plans play a vital role in providing a continuity of safe and efficient traffic flow when a work zone, incident or other event, temporarily disrupts the normal flow of traffic. See Section 640-1 for further information.

Depending on what’s needed, these plans may range in scope from very detailed to simply a reference to a manual figure, a typical drawing or a sketch in the contract document.

602-3  Temporary Traffic Control Zones

As noted in Section 1501-3, a temporary traffic control zone is an area of a highway where road user conditions are changed because of a work zone or incident by the use of temporary traffic control devices, flaggers, law enforcement officers or other authorized personnel.

A work zone is an area of a highway with construction, maintenance or utility work activities. A work zone is typically marked by signs, channelizing devices, barriers, pavement markings, and/or work vehicles. It extends from the first Warning Sign or high-intensity rotating, flashing, oscillating, or strobe lights on a vehicle to the END ROAD WORK sign or the last temporary traffic control device.

A traffic incident management area is an area of a highway where temporary traffic controls are imposed by authorized officials in response to an emergency road user occurrence, a natural disaster, hazardous material spill, or other unplanned incident.

602-4  Components of Temporary Traffic Control Zones

602-4.1  General

The temporary traffic control zone established for a particular work activity or incident begins with the first advance warning device and ends at the point beyond the work area where traffic is no longer affected. As noted in OMTCD Section 6C.03, most zones include the following elements: advance warning area, transition area, activity area and termination area. These four areas are described in OMTCD Sections 6C.04 through 6C.07 and Figure 6C-1. Some of this information is repeated here in Sections 602-4.2 through 602-4.5, and Figure 698-1.

602-4.2  Advance Warning Area

An advance warning area is the section of highway where road users are informed about the upcoming work zone or incident area. The advance warning area may vary from a single sign or flashing amber light on a vehicle to a series of signs starting a mile or more in advance of the transition area.

The advance warning area should be long enough to give road users adequate time to respond to conditions. For most situations, the length of the advance warning area should be:
1. One-half to 1 mile for freeways or expressways.
2. One-quarter mile for rural highways.
3. At least one block for urban streets.

Advance warning may be eliminated when the activity area is sufficiently removed from the road users' path so that it does not interfere with the normal flow.

602-4.3 Transition Area

When a lane or shoulder closure is used, or when traffic is shifted, a transition area shall be used to channel traffic from the normal travel lanes into the path required to move around the work area. The transition area should be obvious to road users, with the correct path clearly marked.

Transition areas usually involve strategic use of tapers (see Section 602-5), which because of their importance are discussed separately.

In mobile operations, the transition area moves with the work space.

602-4.4 Activity Area

602-4.4.1 General

The activity area is the section of the highway where the work activity takes place. It is comprised of the work space, the traffic space and the buffer space.

When work occurs on a high-volume, highly congested facility, an incident management vehicle storage space may be provided so that emergency vehicles (for example, tow trucks) can respond quickly to road user incidents. If used, this storage area should not extend into any portion of the buffer space.

602-4.4.2 Work Space

The work space is that portion of the highway closed and set aside for workers, equipment and material, and a shadow vehicle if one is used upstream. They are usually delineated for road users by channelizing devices or, to exclude vehicles and pedestrians, by temporary barriers.

Work spaces may remain in fixed locations or may move as work progresses.

There may be several work spaces within the project limits (even separated by several miles); however, each work space should be adequately signed to inform road users and reduce confusion.

602-4.4.3 Traffic Space

The traffic space is that portion of the highway in which road users are routed through the activity area.

602-4.4.4 Buffer Space

As shown in OMUTCD Figures 6C-1 and 6C-2 and Figure 698-1, the buffer space is a lateral and/or longitudinal area that separates road user flow from the work space or an unsafe area, and might provide some recovery space for an errant vehicle. The activity area may contain one or more lateral or longitudinal buffer spaces.
The buffer space should be free of work activity, equipment, material, work or shadow vehicles, workers, and the workers' personal vehicles.

A longitudinal buffer space may be placed in advance of a work space. It may also be used to separate opposing road user flows that use portions of the same traffic lane, as shown in OMUTCD Figure 6C-2.

Typically, the buffer space is formed as a traffic island and defined by channelizing devices. When a formidable device, such as a shadow vehicle or an arrow board, is placed in such an island, only the area in front of (upstream of) the device functions as a buffer.

A longer buffer space should be used when high speed highways or high truck volumes are involved, or when the work area is located around a curve, over a hillcrest or on a downgrade.

The lateral buffer space may be used to separate the traffic space from the work space, or from such areas as excavations or pavement-edge drop-offs. A lateral buffer space also may be used between two travel lanes, especially those carrying opposing flows. The width of a lateral buffer space should be determined by engineering judgment.

602-4.5 Termination Area

The termination area shall be used to return road users to their normal path. The termination area shall extend from the downstream end of the work space to the END ROAD WORK signs, if posted.

602-5 Tapers

602-5.1 General

Tapers are an important element of a temporary traffic control zone. They may be used in both the transition and termination areas. As noted in OMUTCD Section 6C.08, whenever tapers are to be used in close proximity to interchange ramps, crossroads, curves, or other influencing factors, it may be desirable to adjust the length of the tapers.

Tapers are created by using a series of channelizing devices and/or pavement markings placed to move the traffic out of or back to its normal path. Types of tapers are shown in OMUTCD Figure 6C-2.

The criteria for determining taper length (L) is shown in OMUTCD Table 6C-3 and should be the minimum used. The minimum desirable taper lengths apply to roadway conditions of relatively flat grades and straight alignment. Longer tapers are not necessarily better than shorter tapers (particularly in urban areas characterized by short block lengths, driveways, etc.). Extended tapers tend to encourage sluggish operation and to encourage drivers to delay lane changes unnecessarily. The real test of taper length involves observation of driver performance after traffic control plans are put into effect.

The maximum space between devices in a taper should approximate the distance in feet of the speed in miles per hour (i.e., a 55 miles per hour speed road should normally have devices spaced about 55 feet apart). It is desirable to provide spacing which is less than the maximum allowable. The spacing is shown in SCDs MT-95.30, 95.31 and 95.32.
602-5.2 Merging Taper

A merging taper requires the longest distances because drivers are required to merge with an adjacent lane of traffic at the prevailing speed. The taper should be long enough to enable merging drivers to adjust their speeds and merge into a single lane before the end of the transition. An example of a merging taper is shown in OMUTCD Figure 6C-2.

602-5.3 Shifting Taper

A shifting taper is used when merging is not required, but a lateral shift is needed. The length L should be used for shift taper lengths when the speed is 50 miles per hour or greater. The length one-half L may be used for shift tapers when the speed is less than 50 miles per hour, except on freeways, expressways, and multi-lane divided or undivided highways, where L should be used for all shift tapers, regardless of speed. Where more space is available, it may be beneficial to use longer taper lengths. Guidance for changes in alignment may also be accomplished by using horizontal curves designed for normal highway speeds. An example of a shifting taper is shown in OMUTCD Figure 6C-2.

602-5.4 Shoulder Taper

A shoulder taper may be beneficial on high-speed roadways with improved shoulders that may be mistaken for driving lanes (when work is occurring in the shoulder area). If used, shoulder tapers approaching the activity area should have a length of about one-third L. If a shoulder is used as a travel lane either through practice or during a temporary traffic activity, a normal merging or shifting taper should be used. An example of a shoulder taper is presented in OMUTCD Figure 6C-2.

602-5.5 Downstream (Ending) Taper

The downstream (ending) taper may be useful in termination areas to provide a visual cue to the driver that access is available to the original lane or path that was closed. When used, a downstream taper should have a minimum length of about 100 feet per lane, with devices spaced about 20 feet apart. An example of a downstream taper is shown in OMUTCD Figure 6C-2.

602-5.6 One-Lane, Two-Way Taper

The one-lane, two-way traffic taper is used in advance of an activity area that occupies part of a two-way roadway in such a way that a portion of the road is used alternately by traffic in each direction. Traffic should be controlled by a flagger or a temporary traffic signal (if sight distance is limited), or a STOP or YIELD sign. A short taper having a maximum length of 100 feet, with channelizing devices at approximately 20-foot spacings, should be used to guide traffic into the one-way section. OMUTCD Figures 6C-3, 6H-10 and 6H-46 illustrate one-lane, two-way traffic control situations using flaggers.

602-5.7 Lane Width Transition

Often it is necessary to decrease the lane width in a work zone. The length of the lane width transition is calculated using the same criteria used in calculating a shifting taper (see Section 602-5.3).

602-5.8 Multiple Tapers

Occasionally it is necessary to close more than a single lane of pavement in order to perform the necessary work on the highway. This may be accomplished by closing or shifting multiple travel lanes, or by a combination of both. Any of these conditions creates a need for more than a single taper. Multiple tapers shall be separated by tangent sections. For example, if
the number of open lanes in one direction of a multi-lane highway is to be reduced by two, then it will be necessary to provide two merge tapers, separated by a tangent section of length 2L as shown in OMUTCD Figure 6H-37 (where L is the minimum permitted taper length of the associated tapers as indicated in OMUTCD Table 6C-3). If there is a reduction of one lane and a shift of the remaining open lanes, then one merge taper and one shift taper shall be provided. The merge taper and the shift taper shall be separated by a tangent section of length one-half L as shown in OMUTCD Figure 6H-32.

602-6 Detours, Alternate Routes and Diversions

A detour is a temporary rerouting of road users onto an existing highway in order to prohibit through traffic within the work zone. As noted in OMUTCD Section 6G.10, detours should be clearly signed over their entire length so that road users can easily use existing highways to return to the original highway. Normally, detours on the state highway system are provided by the District. See OMUTCD Section 6F.50 for related signing, as well as Sections 605-7 and 605-8. OMUTCD Figures 6H-8, 6H-9, 6H-19 and 6H-20 provide examples of detours.

An alternate route is similar to a detour except that the work zone remains open to through traffic. The road user is able to choose between following the route through the work zone, or following the signed alternate route.

A diversion is a temporary rerouting of road users onto a temporary highway or alignment placed around the work space, e.g., median crossovers, runarounds or lane shifts. OMUTCD Figure 6H-7 is an example of a diversion.

Consideration should be given to other projects in the area, traffic patterns, traffic volumes, types of vehicles, local activities and special events when planning detour installations or diversions. This would require that adequate attention be given to proper scheduling of projects in order to avoid simultaneous construction or maintenance activity on parallel highways. Proper scheduling may require coordination between Districts or even within various offices in a single District (see Section 640.16).

Two Standard Operating Procedures (SOPs) maintained by the Office of Maintenance Administration (on their intranet Reference Materials webpage) should be consulted when detours are required:

1. **OPS-103, Detours** is to be used to determine whether work on an existing highway, be it by contract or by ODOT force account, will require the closing of the highway with provision for detours, temporary roads and temporary runarounds, or whether traffic will be maintained through all or portions of the construction project, and to establish reporting procedures.

2. **OPS-104, Maintenance & Repair of Local Roads and Streets Used as: Official Detours, Designated Local Detour Routes, or Haul Roads**, establishes the method for designating a local detour. A local detour is a route, other than the official detour, that is anticipated to be most used by traffic bypassing the closed portion of the highway. Only one local detour shall be designated for each official detour. These documents also discuss the need to coordinate with the local officials and financing procedures.

602-7 One-Lane, Two-Way Traffic Control

602-7.1 General

As noted in OMUTCD Section 6C.10, where traffic in both directions must, for a limited distance, use a single lane, “provision should be made for alternate one-way movement through the constricted section.” Some means of coordinating movements at each end shall be used to avoid head-on conflicts and to minimize delays. Control points at each end should be chosen to permit easy passing of opposing lines of vehicles. At a “spot” obstruction,
however, such as an isolated pavement patch on roadways with lower speeds and adequate
sight distance, the movement may be self-regulating. Alternate one-way traffic control may be
accomplished as appropriate by flagger control (OMUTCD Section 6C.11), a flag-carrying or
official car (OMUTCD Section 6C.12), a pilot car (OMUTCD Section 6C.13), traffic signals
(OMUTCD Section 6C.14), or by using stop or yield control. This Section provides additional
information regarding flagger control, the use of traffic signal and the use of STOP or YIELD
signs (see OMUTCD Section 6E.01 for flagger qualifications).

602-7.2 Flagger Method

This method of one-lane, two-way traffic control is described in general in OMUTCD 6C.11.

When a single flagger is used, the flagger should be stationed on the shoulder opposite the
obstruction or work space, or in a position where good visibility and traffic control can be
maintained at all times. When good visibility and traffic control cannot be maintained by one
flagger station, traffic may be controlled by a flagger at each end of the section. One of the
flaggers should be designated as the coordinator. Flaggers should be able to communicate
with each other orally, electronically, or with manual signals. These manual signals should
not be mistaken for flagging signals. The use of radios may also be desirable even though
visual contact is possible.

602-7.3 Temporary Traffic Signal Method

As noted, traffic signals may be used to control vehicular traffic movements in temporary
traffic control zones. They should be considered for half-width bridge reconstruction on
low- to moderate-volume highways. When used, traffic signals shall be installed at each
approach to the one-lane section, and drivers shall be apprised of their presence by means of
the Signal Ahead sign preceded by appropriate Construction Warning Signs (see OMUTCD
Figure 6H-12).

602-7.4 Stop or Yield Control Method

STOP or YIELD signs may be used to control traffic on low-volume roads at a one-lane, two-
way work zone when drivers are able to see the other end of the one-lane, two-way operation
and have sufficient visibility of approaching vehicles. If the STOP or YIELD sign is installed
for only one direction, then the STOP or YIELD sign should face road users who are driving
on the side of the roadway that is closed for the work activity area. The approach to the side
that is not closed must be visible (for a distance equal to the safe-passing sight distance for
that approach) to the driver who must yield or stop (see OMUTCD Figure 6H-11).

602-8 Work Vehicles

The general term “work vehicle” refers to any of the vehicles used in performance of the work
(i.e., those used to do the work, haul material, equipment or workers and to provide traffic
control). The term is also used to refer specifically to one of the two types of vehicles generally
used in temporary traffic control, i.e., “work vehicles” and “shadow vehicles.”

When differentiating between the types of vehicles in the zone, “work vehicle” refers to those
vehicles used to do the work or haul material, equipment, or workers.

A “shadow vehicle” is used for traffic control. It may be used within the traffic control zone to
provide advance warning for traffic, or to guide traffic into the proper lane by the use of signs or a
flashing arrow board. The shadow truck should be positioned a sufficient distance in advance of
the workers or equipment being protected so that there will be sufficient distance, but not so
much so that errant vehicles will travel around the shadow truck and strike the protected workers
and/or equipment.
During working hours, the shadow vehicle shall display a yellow high-intensity rotating, flashing, oscillating, or strobe light. For additional protection, the shadow vehicle may be equipped with a truck-mounted attenuator (TMA) (see Section 605-15.3).

A shadow vehicle may also be placed, unoccupied, within the traffic control zone immediately in advance of the work space in a stationary operation. When a shadow vehicle is used in this way, a separate space should be provided for it. This space should be long enough to accommodate the vehicle itself, plus an open space in front of the vehicle to provide for the “roll ahead” which may occur following impact. This area is usually delineated by channelizing devices.

CMS 614.03 contains information about delineation requirements for work vehicles (also see Supplemental Specification 800). Also, the document described in Section 695-4, Quality Standards for Temporary Traffic Control Devices and Acceptable Delineation Methods for Vehicles, provides illustrations of acceptable delineation for supply vehicles.
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603 PEDESTRIAN AND WORKER SAFETY

603-1 General

In addition to creating vehicular restrictions, work zones and incident areas may also cause conflicts for pedestrian traffic and workers. Pedestrians and workers are exposed to hazardous conditions from both the work activity and the traffic. This Chapter addresses the need to provide for pedestrian and worker safety in temporary traffic control zones. Also see OMUTCD Chapter 6D.

603-2 Pedestrian Considerations

Where pedestrian traffic is present, pedestrian safety and needs must be addressed. See OMUTCD Sections 6D.01 and 6D.02.

There are three threshold considerations in planning for pedestrian safety in temporary traffic control zones on highways and streets:

1. Pedestrians should not be led into conflicts with work vehicles, equipment, or operations.
2. Pedestrians should not be led into conflicts with vehicles moving through or around the work zone or incident area.
3. Pedestrians should be provided with a safe, convenient travel path that replicates as nearly as possible the most desirable characteristics of sidewalks or footpaths.

In accommodating the needs of pedestrians, it should always be remembered that the range of pedestrians that can be expected is very wide, including the blind, the hearing impaired, and those with walking handicaps. All pedestrians need protection from potential injury and a smooth, clearly delineated travel path.

Therefore, every effort should be made to separate pedestrian movement from both work site activity and vehicular traffic.Whenever possible, signing should be used to direct pedestrians to safe street crossings in advance of an encounter with a temporary traffic control zone. Signs should be placed at intersections so that pedestrians, particularly in high-traffic-volume urban and suburban areas, are not confronted with mid-block activity areas that will induce them to skirt the temporary traffic control zone or make a mid-block crossing. It must be recognized that pedestrians will only infrequently retrace their steps to make a safe crossing. Consequently, ample advance notification of sidewalk closures is critically important. Refer to OMUTCD Figures 6H-28 and 6H-29 for typical traffic control device usage and techniques for pedestrian movement through work areas. Traffic control for a pedestrian detour is also presented in SCD MT-110.10.

Cuts into work areas across pedestrian walkways should be kept to a minimum, because they often create unacceptable changes in grade and rough or muddy terrain. Pedestrians cannot be expected to traverse these areas willingly. They will tend to avoid the cuts by attempting non-intersection crossings.

The engineer in charge of traffic control for temporary traffic control zones should provide both a sense of security and safety for pedestrians walking past work sites and consistent, unambiguous channelization to maintain foot traffic along the desired travel paths. The activity area should be regularly inspected so that effective pedestrian temporary traffic control is maintained.

603-3 Worker Considerations

Equally as important as the safety of road users traveling through the work zone or incident area is the safety of workers (see OMUTCD Section 6D.03). Temporary traffic control zones present
temporarily and constantly changing conditions that are unexpected by the road user. This creates an even higher degree of vulnerability for the personnel on or near the roadway.

Maintaining the temporary traffic control zones with road user flow inhibited as little as possible, and using temporary traffic control devices that get the road user’s attention and provide positive direction are of particular importance.

The following are key elements of traffic control management that should be considered in any procedure for assuring worker safety:

1. Training - All workers should be trained in how to work next to vehicular traffic in a way that minimizes their vulnerability. Workers having specific temporary traffic control responsibilities should be trained in temporary traffic control techniques, device usage and placement.

2. Worker Safety Apparel - All workers exposed to the risks of moving roadway traffic or construction equipment should wear highly-visible safety apparel (see OMUTCD Sections 6D.03 and 6E.02).

3. Temporary Traffic Barriers - Temporary traffic barriers should be placed along the work space depending on such factors as lateral clearance of workers from adjacent traffic, speed of traffic, duration of operations, time of day and volume of traffic.

4. Speed Reduction - Reducing the speed of vehicular traffic, mainly through regulatory speed zoning (see Section 640-18), funneling, lane reduction, or the use of law enforcement officials or flaggers should be considered.

5. Shadow Vehicle - In the case of mobile and constantly moving operations, such as pothole patching and striping operations, a shadow vehicle, equipped with appropriate lights, Warning Signs and/or a rear-mounted impact attenuator may be used to protect the workers from impacts by errant vehicles.

6. Road Closure - If alternate routes are available to handle road users, the road may be closed temporarily. This may facilitate quicker project completion and thus further reduce worker vulnerability.

7. Law Enforcement Use - In highly vulnerable work situations, particularly those of relatively short duration, law enforcement units may be stationed to heighten the awareness of passing vehicular traffic and to improve safety through the temporary traffic control zone.

8. Lighting - For nighttime work, consider lighting the temporary traffic control zone and approaches.

9. Special Devices - Judicious use of special warning and control devices may be helpful for certain difficult work area situations. These include rumble strips, changeable message signs, hazard identification beacons, flags and warning lights. Intrusion warning devices may be used to alert workers to the approach of errant vehicles. However, misuse or overuse of special devices or techniques may lessen their effectiveness.

10. Public Information - Improved driver performance may be realized through a well-prepared and complete public relations effort that covers the nature of the work, etc. (see Section 600-4).
604 FLAGGER CONTROL

604-1 General

This Chapter provides information supplementing that presented in OMUTCD Chapter 6E regarding the use of flaggers to provide temporary traffic control.

604-2 Qualifications for Flaggers

Because flaggers are responsible for public safety and make the greatest number of public contacts of all highway workers, they should be able to satisfactorily demonstrate the abilities described in OMUTCD Section 6E.01.

604-3 High-Visibility Safety Apparel

OMUTCD Section 6E.02 addresses the requirements for high-visibility safety apparel for flaggers. The same high-visibility safety apparel is recommended for law enforcement officers (LEOs) when they provide traffic control.

604-4 Hand-Signaling Devices

OMUTCD Section 6E.03 addresses the basic requirements for hand-signaling devices used to control road users through temporary traffic control zones. As noted in that Section, the STOP/SLOW sign paddle is the primary hand-signaling device.

In addition to the requirement for flag use described in OMUTCD Section 6E.03, flag use should be limited to emergency situations; however, they may also be appropriate at some intersections and at low-speed and/or low-volume locations which can best be controlled by a single flagger.

604-5 Automated Flagger Assistance Devices (AFADs)

604-5.1 General

Automated Flagger Assistance Devices (AFADs) enable a flagger(s) to be positioned out of the lane of traffic and are used to control road users through temporary traffic control (TTC) zones. These devices are designed to be remotely operated either by a single flagger at one end to the TTC zone or a central location or by separate flaggers near each device’s location.

For requirements on AFADs, refer to OMUTCD Section 6E.04 and Supplemental Specifications 830 and 930.

There are two types of AFADs:

1. An AFAD (Subsection 605-5.2) that uses a remotely controlled STOP/SLOW sign on either a trailer or a movable cart system to alternately control right-of-way.

2. An AFAD (Subsection 605-5.3) that uses remotely controlled red and yellow lenses and a gate arm to alternately control right-of-way.

AFADs should not be used for long-term stationary work. They might be appropriate under certain conditions for daytime work activities where they are set up and then removed each
day or for some nighttime work activities. Typical applications include TTC activities such as, but not limited to:

1. Bridge maintenance;
2. Haul road crossings; and
3. Pavement patching.

AFADs used on Ohio's highways must be on ODOT's pre-qualified list. Refer to Supplement 1030 for the qualification procedure.

604-5.2 STOP/SLOW Automated Flagger Assistance Devices (AFADs)

A STOP/SLOW AFAD shall include a STOP/SLOW sign that alternately displays the STOP face and the SLOW face of a STOP/SLOW paddle without the need for a flagger in the immediate vicinity of the AFAD or on the roadway.

For information on the requirements and use of a STOP/SLOW AFAD, refer to OMQUTCD Section 6E.05 and Supplemental Specification 930.02.

604-5.3 Red/Yellow Lens Automated Flagger Assistance Devices (AFADs)

If used, a Red/Yellow AFAD shall alternately display a steadily illuminated CIRCULAR RED lens and a flashing CIRCULAR YELLOW lens to control traffic without the need for a flagger in the immediate vicinity of the AFAD or on the roadway.

For information on the requirements and use of a Red/Yellow Lens AFAD, refer to OMQUTCD Section 6E.06 and Supplemental Specification 930.03.

604-6 Hand-Signaling Procedures

STOP/SLOW sign paddle and flag use are illustrated in OMQUTCD Figure 6E-3. The signaling procedures used with the paddle or the flag shall be as described in OMQUTCD Section 6E.07.

ATSSA publishes a pocket-sized Flagger Handbook which may be used for easy reference on flagging procedures (Section 695-3).

604-7 Flagger Stations

Except as noted below for a single flagger at a “spot” location, flagger stations shall be located far enough ahead of the work space, so that approaching traffic has sufficient distance to stop before entering the work space (see OMQUTCD Section 6E.08). OMQUTCD Table 6E-1, which provides information regarding the stopping sight distance as a function of speed, may be used in determining the location of a flagger station. These distances may be increased for downgrades and other conditions that affect stopping distance.

As noted in OMQUTCD Section 6E.08, the flagger should stand either on the shoulder adjacent to the traffic being controlled or in the barricaded lane. A flagger should only stand in the lane being used by moving road users after the road users have stopped. The flagger should be clearly visible to the first approaching road user at all times. The flagger should also be visible to other road users. The flagger should be stationed sufficiently in advance of the workers to warn them (for example, with audible warning devices such as horns, whistles, etc.) of approaching danger by out-of-control vehicles. The flagger should stand alone, never permitting a group of workers to congregate around the flagger station.

At “spot” lane closures where adequate sight distance is available for the safe handling of traffic, the use of one flagger may be sufficient (see OMQUTCD Figure 6H-18 and accompanying notes).
At such a "spot" obstruction, a position may have to be taken on the shoulder opposite the barricaded section to operate effectively.

Except in emergency situations, flagger stations shall be preceded by an advance Warning Sign(s). Under certain geometric and traffic situations, more than one flagger station may be required for each direction of traffic. Also, except in emergency situations, flagger stations shall be illuminated at night.
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TEMPORARY TRAFFIC CONTROL ZONE DEVICES

605-1 General

The design and application of temporary traffic control devices used in temporary traffic control zones should consider the needs of all road users. All traffic control devices used on street and highway construction, maintenance, utility, or incident management operations shall conform to the applicable provisions of the OMUTCD.

OMUTCD Chapter 6F addresses the design and application of traffic control devices for use in temporary traffic control zones. Additional information on the standards and guidelines for the design and use of these devices is included in this Part of the TEM.

The traffic control devices discussed herein include signs, pavement markings, raised pavement markers, channelizing devices, lighting devices, beacons, warning lights, traffic signals, and other devices used to regulate, warn or guide traffic.

Chapter 607 provides additional information on the use of these devices in typical applications, Chapter 640 provides additional design and plan preparation information, Chapter 650 addresses construction issues, Chapter 660 addresses maintenance issues, and Chapter 670 addresses various other considerations.

Crashworthiness and crash testing information on temporary traffic control devices are found in AASHTO’s Roadside Design Guide (RDG) (see Section 193-12). Additional materials and hardware information, including NCHRP 350 information, is addressed in Chapter 620.

As noted in OMUTCD Section 6F.02, where the color orange is required, fluorescent red-orange or fluorescent yellow-orange colors may also be used. The fluorescent version of orange provides higher conspicuousness than standard orange, especially during twilight.

605-2 General Characteristics of Signs

605-2.1 General

Temporary traffic control zone signs convey both general and specific messages by means of words or symbols and have the same three categories as all road user signs: regulatory, warning and guide described in OMUTCD Part 2.

Commonly used work zone signs are discussed in detail in OMUTCD Chapter 6F and in Sections 605-2 through 605-10. Illustrations of temporary traffic control signs that are discussed in this Manual, but not shown in the OMUTCD are provided in Figures 698-3a and 698-3b.

The OMUTCD and this Part of the TEM also provide examples of common applications of these signs. ODOT standards for application of work zone signing on construction projects are provided in the SCDs and this Manual, and material requirements are addressed in Chapter 620 and CMS 614. Also see Part 2 of this Manual for further signing information.

When standard orange flags or flashing warning lights are used in conjunction with signs, they shall not block the sign face.

605-2.2 Design

The colors for Regulatory Signs shall follow the standards in OMUTCD Chapter 2B. Warning Signs in temporary traffic control zones shall have a black legend on an orange background, except for the Railroad Advance Warning Sign (OMUTCD Section 8B.04), and except for signs in OMUTCD Chapter 2C that are permitted to have yellow or fluorescent yellow-green.
backgrounds, and those in OMUTCD Chapter 6I permitted to have fluorescent pink backgrounds (also see Section 605-5.2). Colors for Guide Signs shall follow the standards in OMUTCD Chapter 2D, except for Guide Signs noted in Sections 605-7 and 605-8.

As noted in OMUTCD Section 6F.02, existing yellow or fluorescent yellow-green Warning Signs already in place within temporary traffic control zones may remain in use when applicable. Color for other signs shall generally follow the standard for all highway signs.

605-2.3 Placement

Signs should be placed on the right side of the roadway unless otherwise specified in the OMUTCD or this Manual. On multi-lane divided highways, signs should be dual-mounted unless it is not physically possible to do so. OMUTCD Section 6F.03 and Figure 6F-1 provide guidelines for height and lateral clearance of temporary post-mounted signs. SCD MT-105.10 also addresses temporary sign supports. For increased visibility, a 7 foot mounting height may be used in rural areas.

As noted in OMUTCD Section 6F.03, signs mounted on portable supports may be placed within the roadway itself. Signs may also be mounted on or above barricades. Signs mounted on barricades and barricade/sign combinations shall be crashworthy.

Neither portable nor permanent sign supports should be located on sidewalks, bicycle lanes, or areas designated for pedestrian or bicycle traffic.

Methods of mounting signs other than on posts are illustrated in OMUTCD Figure 6F-2. Except as noted below for mobile operations, signs mounted on portable supports should not be used for a period of more than three days. Signs mounted on Type III barricades should not cover more than fifty percent of the top two rails or thirty-three percent of the total area of the three rails.

For information regarding signing for work zone speed zones see Section 640-18.2.

For mobile operations, a sign may be mounted on a work vehicle, a shadow vehicle, or a trailer stationed in advance of the temporary traffic control zone or moving along with it. The work vehicle, the shadow vehicle, or the trailer may have an impact attenuator.

See Section 221-4 for information about erecting signs on or near utility poles.

605-2.4 Sheeting for Temporary Traffic Control Signs and Hand-Signaling Devices

For flatsheet signs and hand-signaling devices, Type G, H or J retroreflective sheeting shall be provided for the background and for the retroreflective legends. As an exception, any hand-signaling devices in ODOT maintenance inventory with Type F sheeting may remain in use until they have reached the end of their service life. New Type F hand-signaling devices shall not be permitted.

605-3 Regulatory Signs

605-3.1 General

Regulatory Signs in temporary traffic control zones are addressed in OMUTCD Chapter 6F. Section 605-3 will be used to provide additional information about Regulatory Signs discussed in the OMUTCD if needed. Information about Regulatory Signs used in temporary traffic control zones that are not currently addressed in the OMUTCD are discussed in Section 605-4.

If a temporary traffic control zone requires regulatory measures different from those existing, the existing permanent regulatory devices shall be removed or covered and superseded by
the appropriate temporary Regulatory Signs. **OMUTCD Sections 2B.13 and 2B.16 and Chapter 1203** should be consulted before temporary traffic control zone regulatory speed limits are established.

### 605-3.2 ROAD CLOSED Sign (R11-2)

This sign is addressed in **OMUTCD Section 6F.08**. The words BRIDGE OUT (or BRIDGE CLOSED) may be substituted for ROAD (STREET) CLOSED where applicable.

The sign should be erected at or near the center of the roadway on or above a Type III barricade that closes the roadway. The sign shall not be used where traffic is maintained, or where the actual closing is some distance beyond this sign.

### 605-3.3 Weight Limit Signs (R12-1, R12-H1, R12-2, R12-H2, R12-4, R12-H4, R12-5, R12-H5)

These signs are addressed in **OMUTCD Sections 2B.59 and 6F.10**. When weight restrictions are imposed, a marked detour shall be provided for vehicles weighing more than the posted limit. A supplemental distance plaque (R16-H13) shall be provided with the appropriate weight limit sign at the point where the detour is provided.

### 605-4 Special Regulatory Signs

#### 605-4.1 General

**Section 605-4** is intended to address signs developed for use on ODOT-maintained highways that are not currently addressed in the **OMUTCD**. There may be a need for various Regulatory Signs that are not in the **OMUTCD**. They may eventually be incorporated into the **OMUTCD**: however, if their use is limited they may not be incorporated into that manual. Special Regulatory Signs should conform to the general requirements of color, shape and alphabet size and series. The sign message should be brief, legible and clear.

#### 605-4.2 Work Zone Speed Limit Sign (R2-1)

Speed limit reduction through temporary traffic control zones shall be provided as per **Sections 640-18.2 and 1203-2.9**. Where the speed limit reduction is applied, signing shall be as indicated in **Section 642-24 (Plan Note 642-24)**.

#### 605-4.3 Work Zone Increased Penalties Sign (R11-H5a)

**ORC Division 5501.27(A)(1)** requires that the Director of Transportation “adopt rules governing the posting of signs advising motorists that increased penalties apply for certain traffic violations on streets or highways in a construction zone.”

**ORC Division 5501.27(A)(2)** requires that the Director also adopt “rules governing the posting of signs to be used pursuant to **Section 2903.081 of the Ohio Revised Code (ORC)** giving notice to motorists of the prohibitions set forth in **ORC Sections 2903.06 and 2903.08** regarding the death of or injury to any person in a construction zone as a proximate result of a reckless operation offense or speeding offense.”

**ORC Section 4511.98**, states that “The director of transportation, board of county commissioners, or board of township trustees shall cause signs to be erected advising motorists that increased penalties apply for certain traffic violations occurring on streets or highways in a construction zone. The increased penalties shall be effective only when signs are erected in accordance with the guidelines and design specifications established by the director under **ORC Section 5501.27**, and when a violation occurs during hours of actual work within the construction zone.”
Chapter 5501:2-10 of the Ohio Administrative Code (OAC) documents the guidelines established by the Director pursuant to ORC Section 5501.27. For convenience, those guidelines are also presented in this Section. Administrative Code Section 5501:2-10-02 requires that each agency adopt procedures pertaining to requiring a contractor, work crew, or utility to erect, maintain, and remove signs, in conformance with the these guidelines.

Work Zone Increased Penalty signs (R11-H5a) shall be used in construction zones on multi-lane divided highways where the work is expected to last thirty days or more, if the planned work length is at least 0.50 miles and if the construction zone is stationary. The signs may also be erected in any other construction zone at the discretion of the Director.

The signs may be erected for construction zones located on other highways meeting the foregoing requirements (i.e., thirty days, at least 0.50 miles in length, and stationary work) if required by the agency's procedures adopted under 5501:2-10-02(C) or at the discretion of the Director.

The signs should be dual-mounted on a directional roadway of a divided highway, but need only be mounted on the right side of an undivided roadway or ramp.

The first R11-H5a sign shall be placed between the ROAD WORK AHEAD or other similar Warning Sign and the next sign in the sequence. Additional signs are required for long construction zones or where ramps or through streets junction within the construction project work limits. Signs shall be erected on each entrance ramp, near intersections of through roads to advise entering or turning traffic, and at least once every 2 miles through the construction work limits.

The signs shall be furnished, erected, maintained in good condition and/or replaced as necessary and subsequently removed by the entity which erects the traffic controls within the project. Signs shall be mounted at the appropriate offsets and elevations as prescribed by the OMUTCD. They shall be mounted on supports meeting current safety criteria.

Where construction activity affects only one directional roadway of a divided highway with a barrier or wide median, signs shall not be erected for traffic on the opposing directional roadway or ramp.

Signs shall be covered or removed when a construction zone is discontinued for a period of thirty days or more. Additionally the agency may require signs to be covered or removed for a specific shorter period.

Where a series of ROAD WORK AHEAD signs are provided, with supplemental distance plates, on ODOT-maintained highways, the R-11-H5a sign shall be placed following the final ROAD WORK AHEAD sign immediately preceding the location at which construction activity begins.

Erection of R11-H5a signs in a temporary traffic control zone on ODOT-maintained highways can be initiated in three different ways, depending on the nature of the construction:

1. For ODOT construction projects, a determination will be made during the design phase as to whether the proposed construction activities will comply with requirements for the signs. When signs are required, they should be included in the construction contract plans for furnishing, erection, maintenance, covering, removal, etc. by the contractor. Prior to commencement of pertinent construction activities, the project engineer will assure that the assumptions concerning construction conditions are still valid and that the signing still applies in the manner originally determined.

The project engineer shall assure that signs are erected, maintained in good condition, covered, uncovered, repaired, replaced or removed by the contractor in a timely manner.
See Section 642-27 (Plan Note 642-27) for more detail regarding erection of R11-H5a signs on multi-lane construction projects.

2. For maintenance work by ODOT forces, the District Highway Management Administrator shall identify those specific work areas which meet the criteria for erection of R11-H5a signs and arrange for furnishing signs, sign erection, maintenance covering and removal accordingly.

3. For non-ODOT construction, maintenance or utility work, a construction company, utility company or property owner may propose work within the right-of-way of a rural state highway and request a permit for such work under the requirements of SOP PH-P-403. At that time the company or property owner may also request permission to use R11-H5a signs for specified portions of the work. The request shall include a plan showing the proposed size, location and duration of erection of each sign. If approved, it is the responsibility of the company or owner to furnish the appropriate signs and erect, maintain, cover, uncover and remove them in accordance with the requirements of this Section.

<table>
<thead>
<tr>
<th>Code No.</th>
<th>Route Type</th>
<th>Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>R11-H5a</td>
<td>Conventional</td>
<td>24 x 48</td>
</tr>
<tr>
<td>R11-H5a</td>
<td>Major Conventional, Expressway &amp; Freeway</td>
<td>48 x 96</td>
</tr>
</tbody>
</table>

605-5 **Warning Signs**

605-5.1 **General**

Warning Signs in temporary traffic control zones are addressed in OMQTCD Chapter 6F. Section 605-5 will be used to provide additional information about Warning Signs discussed in the OMQTCD if needed. Information about Warning Signs used in temporary traffic control zones that are not currently addressed in the OMQTCD are discussed in Section 605-6.

If a temporary traffic control zone requires Warning Signs different from those existing, the existing permanent Warning Signs shall be removed or covered and superseded by the appropriate temporary Warning Signs.

Signing in the advance warning area (OMQTCD Figure 6C-1 and Figure 698-1) must be adequate to inform the approaching road user of conditions downstream. The ROAD WORK AHEAD sign (W20-1), is normally provided and is followed by appropriate signing for the conditions at the site (see OMQTCD Part 6 and the MT series of SCDs). When there is a need to provide notice for several miles in advance, it is necessary to repeat the ROAD WORK AHEAD sign every mile and to supplement it with a plaque to provide the distance to the beginning of the work. Where traffic queues are expected, advance notice of the potential...
for stopped traffic should be provided by the proper signing, such as BE PREPARED TO STOP (W3-4).

When it is necessary to provide a distance with a warning message, it is ODOT practice to provide this distance on a supplemental plaque mounted below the Warning Sign. The message on the Warning Sign will include the word “AHEAD” rather than the distance. Portable changeable message signs (PCMS) are very helpful in providing advance information to approaching traffic, particularly if this information is to be modified frequently. See Section 605-9 for more information on PCMSs.

605-5.2 Design

As noted in ODOT Section 6F.16, with some exceptions, Warning Signs in temporary traffic control zones shall be diamond shaped with a black symbol or message on an orange background. Mounting or space considerations may justify a change from the standard diamond shape, but such variations require prior approval of the highway authority.

Warning Signs used for incident management may have either an orange background or a fluorescent pink background. However, in emergencies, available signs having yellow backgrounds may be used if neither fluorescent pink nor orange signs are readily available.

605-5.3 Sizes

Except as noted herein, signs used for temporary traffic control zones and incident areas shall be sized based on the provisions of ODOT Chapter 6F.

605-5.4 Spacing

Where highway conditions permit, Warning Signs should be placed at varying distances in advance of the work area, depending on the roadway type, condition and speed. Where a series of two or more Warning Signs is used, the closest sign to the work area should be placed approximately 100 feet away for low-speed urban streets to 1,000 feet away or more for expressways and freeways.

OMUTCD Table 6C-1 presents the suggested spacing of Warning Signs for four general roadway types: urban (low speed), urban (high speed), rural and expressway/freeway.

605-5.5 ROAD (STREET) CLOSED AHEAD Sign (W20-3)

As noted in ODOT Section 6F.20, the ROAD (STREET) CLOSED AHEAD sign (W20-3) should be used ahead of that point where a highway is closed to all traffic, or to all but local traffic. It may be used in conjunction with appropriate distance legends or with other Warning Signs. Where used on high-speed facilities, the 48-inch size sign shall be used. Where speeds are 40 miles per hour or lower and volumes are moderately low, the 36-inch size may be used.

605-5.6 ONE LANE ROAD AHEAD Sign (W20-4)

As noted in ODOT Section 6F.21, the ONE LANE ROAD AHEAD sign (W20-4) shall be used only in advance of that point where vehicular traffic in both directions must use a common single lane. Where used on high-speed facilities, the 48-inch size sign shall be used. Where speeds are 40 miles per hour or lower and volumes are moderately low, the 36-inch size may be used.

605-5.7 LANE(S) CLOSED AHEAD Sign (W20-5, W20-5a)

As noted in ODOT Section 6F.22, the LANE CLOSED AHEAD sign (W20-5) shall be used in advance of that point where one or more lanes of a multi-lane roadway are closed.
The sign may be used in repetition, in conjunction with appropriate distance legends, or with other Warning Signs. Where used on high-speed facilities, the 48-inch size sign shall be used. Where speeds are 40 miles per hour or lower and volumes are moderately low, the 36-inch size may be used.

605-5.8 Flagger Sign (W20-7, W20-7a)

As noted in OMUTCD Section 6F.31, the Flagger symbol sign (W20-7a) should be used before any point where a flagger is stationed to control traffic. The sign may be used in conjunction with other Warning Signs, such as BE PREPARED TO STOP (W3-4). The 48-inch size sign shall be used regardless of highway classification.

605-5.9 SURVEY CREW AHEAD Signs (W21-H6)

As noted in OMUTCD Section 6F.38, the SURVEY CREW AHEAD sign (W21-H6) should be used to warn of survey crews working in or next to the roadway.

605-5.10 Blasting Zone Signs (W22-1, W22-2, W22-3)

As noted in OMUTCD Sections 6F.40 through 6F.43, Blasting Zone signing shall be used in advance of a temporary traffic control zone where explosives are being used.

605-5.11 Construction Arrow Sign (W1-H11)

The Construction Arrow sign (W1-H11) (see OMUTCD Section 6F.50.1) should be used where it is necessary to guide traffic through construction areas, or where road work is in progress. This sign is often placed along lane shifts where it may be determined that traffic guidance is necessary. Examples of use of the Construction Arrow sign are presented in OMUTCD Figures 6H-31, 6H-32 and 6H-36 and in SCDs MT-102.10 and 102.20.

605-5.12 SHOULDER CLOSED Signs (W21-5a, W21-5b)

SHOULDER WORK signs are addressed in OMUTCD Section 6F.37. On expressways and freeways, the RIGHT (LEFT) SHOULDER CLOSED sign (W21-5a) and RIGHT (LEFT) SHOULDER CLOSED AHEAD sign (W21-5b) should be used in advance of the point where the shoulder work occurs and should be preceded by a ROAD WORK AHEAD sign (W20-1).

<table>
<thead>
<tr>
<th>Code No.</th>
<th>Route Type</th>
<th>Size Inches</th>
</tr>
</thead>
<tbody>
<tr>
<td>W21-5a &amp; W21-5b</td>
<td>Conventional</td>
<td>36 x 36</td>
</tr>
<tr>
<td>W21-5a &amp; W21-5b</td>
<td>Expressway &amp; Freeway</td>
<td>48 x 48</td>
</tr>
</tbody>
</table>

605-5.13 Shoulder Drop-Off Sign (W8-17)

OMUTCD Section 6F.44 indicates that the Shoulder Drop-Off sign (W8-17) “should be used when a shoulder drop-off, adjacent to the travel lane, exceeds 3 inches in depth for a continuous length along the roadway, based on engineering judgment.” However, SCD MT-101.90 has been developed to address shoulder drop-off situations on ODOT-maintained freeways, expressways and other highways with speeds of 45 mph or greater and minimal driveways. If the guidance in the SCD is followed, there should be no need for the W8-17 sign.

Where the sign is appropriate, it shall be installed by the end of the day in which the drop-off is created.
605-5.14 UNEVEN LANES Sign (W8-11)

The UNEVEN LANES sign (W8-11) is addressed in OMUTCD Section 6F.45. It should be used during operations that create a difference in elevation between adjacent lanes.

<table>
<thead>
<tr>
<th>Code No.</th>
<th>Route Type</th>
<th>Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>W8-11</td>
<td>Conventional</td>
<td>36 x 36</td>
</tr>
<tr>
<td>W8-11</td>
<td>Expressway &amp; Freeway</td>
<td>48 x 48</td>
</tr>
</tbody>
</table>

605-5.15 NO CENTER LINE and NO EDGE LINE Signs (W8-H12, W8-H12a)

NO CENTER LINE and NO EDGE LINE signs (W8-H12 and W8-H12a) are addressed in OMUTCD Section 6F.47. They should be used when the work obliterates the center or edge line. These signs should be placed at the beginning of the zone and repeated at 2-mile intervals in long zones to remind the road users. They should also be used at major connections, traffic generators, and/or at appropriate intervals as determined by the project engineer, to advise road users entering within the zone. For acceptable temporary pavement marking standards see Section 605-11.11.

<table>
<thead>
<tr>
<th>Code No.</th>
<th>Route Type</th>
<th>Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>W8-H12 &amp; W8-H12a</td>
<td>Conventional</td>
<td>36 x 36</td>
</tr>
<tr>
<td>W8-H12 &amp; W8-H12a</td>
<td>Expressway &amp; Freeway</td>
<td>48 x 48</td>
</tr>
</tbody>
</table>

605-6 Special Warning Signs

605-6.1 General

This Section is intended to address signs developed for use on ODOT-maintained highways that are not currently addressed in the OMUTCD. As noted in OMUTCD Section 6F.51, there may be a need for various Warning Signs that are not in OMUTCD Part 6. Some of these will be found in OMUTCD Part 2 and others may be developed because of special conditions not yet addressed in the OMUTCD. These “special” Warning Signs may eventually be incorporated into the OMUTCD; however, if their use is limited they may not be incorporated into that manual. Special Warning Signs should conform to the general requirements of color, shape and alphabet size and series. The sign message should be brief, legible and clear.

605-6.2 Notice of Closure Signs (W20-H13, W20-H14)

Notice of Closure signs (W20-H13 and W20-H14) are intended to give advance notice to the road user of a scheduled road closure. The information provided on these signs includes the
scheduled date of closure and the number of days of the scheduled closure. The W20-H13 also provides a telephone number for information and is the preferable sign. The selected sign should be erected at the point of closure except that more flexibility is acceptable in locating the signs on ramps. The sign should be erected at least one week in advance of a scheduled road or ramp closure and shall be erected on the right-hand side of the road or ramp, facing traffic. Additional details on placement of the Notice of Closure signs is provided in Section 642-8 (Plan Note 642-8).

605-6.3 No Reentry Signing (W13-H7, W13-H8)

Some freeway and expressway projects require temporary closures of entrance and exit ramps in order to facilitate the work. This can create a situation where motorists are able to exit at an interchange, but are unable to reenter the freeway or expressway because of a temporary closure of the entrance ramp. This can create a situation where the exit and same direction entrance ramps are several miles apart. Since this is not the usual situation, it is not expected by drivers. Although trailblazing to the entrance ramp may be provided, the lack of direct reentry can be confusing and irritating, and some through drivers would choose not to exit at such an interchange if they were given advance warning.

The black on orange NO REENTRY _____ BOUND sign has been developed for this situation. When an entrance ramp closure may create a problem on freeways and expressways, this sign should be mounted as a supplemental panel with one or more of the Guide Signs for the exit. For signs less than 12 feet in width, the two-line sign (W13-H8) is available. This sign width of the W13-H7 or W13-H8 may be increased to match the width of the Guide Sign.

605-7 Guide Signs

605-7.1 General

Guide Signs in temporary traffic control zones are addressed in OMUTCD Chapter 6F. Section 605-7 will be used to provide additional information about Guide Signs discussed in the OMUTCD if needed. Information about Guide Signs used in temporary traffic control zones that are not currently addressed in the OMUTCD are discussed in Section 605-8.

If a temporary traffic control zone requires guidance information different from that existing, the existing permanent Guide Signs shall be removed or covered and superseded by the appropriate temporary Guide Signs.
605-7.2 DETOUR Signs (M4-8, M4-8a, M4-8b, M4-9, M4-9a, M4-9b, M4-H9b, M4-9c, M4-10)

As noted in OMUTCD Section 6F.59, each detour shall be adequately marked with standard temporary Route Signs and destination signs.

A Route Sign or Street Name sign should be placed above or incorporated in the DETOUR sign to indicate the name of the route being detoured.

An End Detour sign (M4-8a or M4-8b) may be used to indicate that the detour has ended.

605-7.3 Advance Work Zone Information Signs

Advance Work Zone Information Signs may be required as part of the maintenance of traffic plan for major construction projects. The need for these signs is usually determined by the corridor management team during their review of the project. The signs are fixed message types and advise the road user of alternate routes, possible delays, etc. The signs are generally located at extreme distances from the work area.

To insure uniformity in the design and application of these signs, the following guidelines apply:

1. These signs shall be shown in the plans whether supplied by the contractor or by others (this choice shall be clearly indicated in the plans). The normal procedure is for the contractor to provide the signs.

2. The location of the signs shall be field checked by the designer to insure that there are no conflicts with existing features and other signs in the area. The designer will assure that signs are not blocked by being too close to other signs and that the road user has sufficient time to read, understand and act on the information provided by all of the signs.

3. The plans shall indicate the legend, level and size of the signs. The signs shall be considered Supplemental Guide Signs as described in OMUTCD Section 2E.35.

4. The signs shall be black on orange (including a black border). The layout shall conform to the OMUTCD and ODOT Guide Sign design standards (see SDM Appendix C).

5. Where appropriate, advance work zone information signs shall make use of the same exit numbers, route numbers, directions and destinations as shown on the permanent Guide Signs.

6. In some instances, instead of providing separate installations, it may be desirable to modify existing overhead Guide Signs. These changes are accomplished by providing black-on-orange overlays to cover portions of the existing signs. Letter size on these overlays should be the same as on the existing signs. When lane arrows are to be covered, rather than using a blank overlay, the legend “LANE CLOSED” shall be used. When a ramp is being closed, rather than using a blank overlay to cover the entire sign, the legend “CLOSED” shall be used on a diagonal overlay (lower left to upper right) on the sign. The size of lettering on overlays and the size of the overlay shall be indicated in the plans. The minimum letter size for “LANE CLOSED” shall be 10-inch E.

7. When regulatory information is provided, it shall be displayed separately as a standard black-on-white sign. Mixing black-on-white regulatory information on a black-on-orange information sign is prohibited.

8. If the road user is being detoured, or if an alternate route is provided, the route should be signed with assemblies consisting of the appropriate black-on-orange (DETOUR OR ALT) markers with a standard Route Sign and arrow plate. If more target value is desired,
this trailblazer information may be shown on an orange panel, M2-H3 type.

9. Route Sign assemblies shall be sized according to the type of road on which they are located in accordance with the OMUTCD.

10. Supports for sign installations shall conform to all existing standards for permanent signs.

11. These signs should not be attached to existing supports.

12. All advance work zone information sign installations located outside of the project work limits shall be paid for under appropriate 630 Items (signs, supports, concrete, breakaway connection, overlays, removals, etc.). They shall not be included in the lump sum bid for Item 614. This requirement does not apply to Advance Warning Signs or to sign installations within the work limits.

605-8 Special Guide Signs

605-8.1 General

Section 605-8 is intended to address signs developed for use on ODOT-maintained highways that are not currently addressed in the OMUTCD. There may be a need for various “special” Information (Guide) Signs that are not in the OMUTCD. They may eventually be incorporated into the OMUTCD; however, if their use is limited they may not be incorporated into that manual. Special Guide Signs should conform to the general requirements of color, shape and alphabet size and series. The sign message should be brief, legible and clear.

605-8.2 TRUCK Marker (M4-4)

This sign shall be used with standard Detour signs when it is necessary to establish a detour for truck traffic, but not other vehicles.

605-8.3 Exit Open/Closed Signs (E5-2, E5-2a, E5-H2b, E5-H2c)

Use of these signs is addressed in OMUTCD Section 6F.28 and Figures 6H-41 and 6H-42.

605-9 Portable Changeable Message Signs (PCMSs)

Portable Changeable Message Signs (PCMS) (see OMUTCD Section 6F.60) are traffic control devices with the flexibility to display a variety of messages to fit the needs of road and street authorities. These signs are used most frequently on high density, urban freeways, but have applications on all types of highways where highway alignment, traffic routing problems or other pertinent conditions require advance warning and information.

In addition to the standards and guidelines in OMUTCD Section 6F.60 and herein, additional guidelines for use of PCMSs can be found in Chapter 641 of this manual, Section 642-41 (Plan Note 642-41), and the Portable Changeable Message Sign handbook PCMS by FHWA, Report No.: FHWA-RD-03-066.

As noted in OMUTCD Section 6F.60, when abbreviations are used, they should be easily understood (see OMUTCD Section 1A-14).

Portable Changeable Message Signs will typically be placed in advance of any other temporary traffic control zone signing and should not replace any required signing. The location of the PCMS may have to be adjusted to keep the sign an appropriate distance in advance of traffic queues. Instead of relocating, an additional PCMS may be employed.

Diesel powered PCMSs should not be used in residential areas at night.
The Approved List of PCMSs for use on ODOT jobs can be found on the ODOT website at http://www.dot.state.oh.us/Divisions/ConstructionMgt/Materials/Approved-List/Pages/default.aspx.

605-10 Arrow Boards

605-10.1 General

An arrow board is a sign with a matrix of elements capable of either flashing or sequential displays (see OMTCD Section 6F.61). This sign shall provide additional warning and directional information to assist in merging and controlling road users through or around a temporary traffic control zone.

Arrow boards are used primarily on multi-lane highways to notify road users of the need to exit the presently occupied lane due to a lane closure. Under such conditions, the use of the arrow board shall be mandatory. Where a multi-lane closure is necessary, a separate arrow board shall be used for each closed lane.

On two-lane highways, the boards may be used only in the caution mode. Display of the arrow or chevron modes shall not be permitted on two-lane highways.

An arrow board should be used in combination with appropriate signs, channelizing devices, or other temporary traffic control devices. Arrow boards will not solve difficult traffic problems by themselves, but can be very effective when properly used to reinforce signs and other traffic control devices. Necessary signs, barricades and traffic control devices shall be used in conjunction with the arrow displays.

Diesel powered boards should not be used in residential areas at night.

The Approved List for arrow boards is posted at: http://www.dot.state.oh.us/Divisions/ConstructionMgt/Materials/Pages/Flashing-Arrow-Panels.aspx. Supplement 1021 addresses the prequalification procedure for arrow boards.

605-10.2 Design

Arrow boards shall meet the minimum size, legibility distance, number of elements, and other specifications shown in OMTCD Section 6F.61 and Figure 6F-6 and in Supplemental Specifications 821 and 921.

Type A arrow boards are appropriate for use on low-speed (< 40 miles per hour) urban streets. Type B arrow boards are appropriate for intermediate-speed (40 to 50 miles per hour) facilities and for maintenance or mobile operations on high-speed (> 45 miles per hour) roadways. Type C arrow boards are intended to be used on high-speed, high-volume roadways.

For additional guidance and requirements on use of arrow boards, see OMTCD Section 6F.61.

605-11 Channelizing Devices

605-11.1 General

Channelizing devices guide road users through the work zone, indicate hazardous areas, and exclude road users from the actual work space. The following Sections provide information on channelizing devices that is in addition to the standards and guidelines provided in OMTCD Chapter 6F. For information on barriers, see OMTCD Sections 6F.70 and 6F.85 and Sections 605-11.7 and 605-14.

Channelizing devices for use in temporary traffic control applications include cones, tubular markers, vertical panels, drums, barricades, and temporary raised islands. Barriers may also
be used as channelizing devices. Intermixing of various types of channelizing devices (e.g., drums and cones) is not permitted.

Channelizing devices and their application shall conform to the OUMTCD, the following TEM Sections and the SCDs. Temporary barriers are discussed in further detail in Section 605-14. Crash cushions are discussed in Section 605-15. Temporary impact attenuators are discussed in Section 605-15.3. Also see Section 640-2 for a discussion of some exceptions.

605-11.2 Placement

As noted in OUMTCD Section 6F.63:

1. The spacing of channelizing devices in a taper should not exceed a distance in feet equal to the speed limit in miles per hour. For example, if the taper is on a roadway with an existing 55 miles per hour speed limit, the devices should be spaced at about 55 feet.

2. To keep traffic out of a closed lane on a tangent section, channelizing devices should be spaced a distance in feet of no more than two times the speed limit in miles per hour.

3. When channelizing devices have the potential of leading vehicular traffic out of the intended traffic space, the devices should be extended a distance in feet of two times the speed limit in miles per hour beyond the end of the transition area. This situation is illustrated for the “southbound” traffic in OUMTCD Figure 6H-39. In this typical application, the line of channelizing devices used for the “southbound” left-lane closing has been extended to help avoid the possibility that the devices used to delineate the crossover may also lead the traffic moving back into the “southbound” left lane into the median area.

When cones are used at night on freeways and other multi-lane highways maintained by ODOT, the maximum cone spacing shall be 40 feet.

All channelizing devices used in maintaining traffic should have a minimum lateral offset from the edge of the traveled lane of 1.5 feet. A lateral offset of less than 1.5 feet may be used in instances when the project length is short. However, attempts to provide larger offsets should be made whenever possible.

605-11.3 Cones

This Section addresses requirements for traffic cones that are in addition to those found in OUMTCD Section 6F.64.

Reflectorization of cones shall be as specified in OUMTCD Section 6F.64, and accomplished with bands of Type G reboundable retroreflective sheeting (CMS 730.191).

Except for pavement marking operations, the minimum height for cones shall be 28 inches. Cones used to protect the line during a pavement marking operation may be 18 inches (see SCD MT-99.20).

In addition to the above requirements the following requirements shall apply:

1. Cones may be used on freeways and other multi-lane highways for either daytime or nighttime operations; however, they shall not be used continuously, day and night. Upon completion of work within the work period, the cones shall be removed. They may again be placed on the highway in order to resume work in the following such work period. Any lane closure which is expected to remain continuously, day and night, shall require the use of drums or barriers.

   Cones used at night on freeways and other multi-lane highways shall be at least 42
inches in height.

Night use of cones on freeways and other multi-lane highways shall be limited to that portion of the closure which is beyond the transition taper area. Night channelization of such transition taper shall be by use of drums.

Maximum spacing of cones, when used at night on freeways and other multi-lane highways, shall be 40 feet.

2. On other highways, there are no restrictions on the duration of work for use of cones, day or night. On these roadways, night use of cones is permitted along the entire zone, along the transition taper and beyond.

605-11.4 Drums

605-11.4.1 General

Section 605-11.4 addresses requirements for drums used to warn or channelize road users. These are in addition to those found in OMUTCD Section 6F.67.

Drums shall be ballasted in accordance with the manufacturer’s recommendations.

Drums shall be kept clean so that retroreflectivity is not compromised. Concrete sawing operations splash residue on sheeting, rendering it ineffective.

Owner identification markings on construction drums shall be no more than 1 inch in character height and located at least 2 inches below the retroreflective band or on the top or bottom horizontal surfaces of the drum.

Retroreflectorization of drums shall be provided by Type G reboundable sheeting complying with the requirements of CMS 730.191. Additional information regarding use of drums is available in CMS 614.03.

605-11.4.2 Lights on Drums

ODOT’s use of warning lights (OMUTCD Section 6F.83 and TEM Section 605-12.5) on drums is limited to Type A flashing lights for identification of spot hazards. ODOT does not use Type C steady-burning warning lights on drums. Research projects sponsored by ODOT and FHWA demonstrated that benefits from steady-burn warning lights mounted on retroreflectorized drums are insignificant. Therefore, the use of these lights on retroreflectorized drums used as channelizing devices was terminated at the end of the 1991 construction season.

ODOT will not fund steady-burning (Type C) warning lights on drums used for the purpose of channelization on ODOT-administered projects. If a local agency desires to include lights on drums for channelization, the additional cost of the lights must be funded with local funds.

605-11.5 Barricades, Tubular Markers and Vertical Panels

This Section addresses requirements for tubular markers, vertical panels, and Type I, II and III barricades that are in addition to those found in OMUTCD Sections 6F.65, 6F.66 and 6F.68, respectively.

Faces of barricades and vertical panels shall be retroreflectorized with Type G or Type H sheeting complying with CMS 730.19 and 730.192.

As with cones (Section 605-11.3), all tubular markers shall be retroreflectorized with bands
605-11.6 Direction Indicator Barricade

The Direction Indicator Barricade (see OMTUTCD Section 6F.69 and Figure 6F-7) may be used in tapers, transitions and other areas where specific directional guidance to road users is necessary. However, if used, Direction Indicator Barricades should be used in series to direct road users through the transition and into the intended travel lane.

The face of the barricade shall be retroreflectorized with Type G or Type H sheeting complying with CMS 730.19 and 730.192.

605-11.7 Barrier Used as a Channelizing Device

Temporary traffic barriers (see OMTUTCD Section 6F.70) shall not be used solely to channelize road users, but also to protect the work space. When used for channelization, temporary traffic barriers should be of a light color for increased visibility. For nighttime use, the temporary traffic barrier shall also be supplemented with delineation. For additional information, refer to OMTUTCD Section 6F.70 and Sections 605-14 and 605-19.

605-11.8 Temporary Raised Islands

Temporary raised islands (see OMTUTCD Section 6F.75) shall be used only in combination with pavement markings and other suitable channelizing devices. Except when recommended by an engineering study, they should only be used on roadways with speeds of 40 miles per hour or less.

605-11.9 Opposing Traffic Lane Divider

The Opposing Traffic Lane Divider sign (see OMTUTCD Section 6F.76) is a delineation device used in a series to separate opposing vehicular traffic on a two-lane, two-way operation. Its use is limited to locations where speeds are 40 miles per hour or less. The Opposing Traffic Lane Divider sign (W6-4) is shown in OMTUTCD Figure 6F-4 (sheet 1 of 3).

605-11.10 Pavement Markings

605-11.10.1 General

Section 605-11.10 provides additional information and support for information in OMTUTCD Section 6F.77. The provisions herein shall not be considered applicable for short-term, mobile or incident management temporary traffic control zones.

Either permanent or temporary pavement markings (OMTUTCD Section 6F.78) shall be in place prior to opening the road or lane to road users. See Section 605-11.11 for additional information on temporary pavement markings.

Adequate pavement markings shall be maintained along paved streets and highways in temporary traffic control zones. The intended vehicle path should be defined in day, night, and twilight periods under both wet and dry pavement conditions. The work should be planned and staged to provide the best possible conditions for the placement and removal of the pavement markings.

Road users should be provided pavement markings within a temporary traffic control zone comparable to the pavement markings normally maintained along such roadways, particularly at either end of the temporary traffic control zone. The following guidelines set forth the level of adequate markings, delineation and obliteration for various temporary traffic control zone situations.
1. All pavement markings shall be in accordance with OMUTCD Chapters 3A and 3B, except as indicated in Section 605-11.11.

2. Pavement markings shall be maintained along highways in all long term stationary temporary traffic control zones (see Section 606-3). The pavement markings shall match the markings in place at both ends of the temporary traffic control zone. Particular attention should be given to ramp gore areas.

3. Pavement markings shall be placed, along the entire length of any surfaced detour or temporary roadway prior to the detour or roadway being opened to road users.

4. Markings should be provided in intermediate-term stationary traffic control zones if practical (see Section 605-11.11, 605-13.2, and 641-10.2). Where pavement marking is not provided, another form of channelization such as drums shall be provided. On multi-lane highways, lane line markings may be necessary, as other forms of channelization may not be appropriate.

5. Warning Signs, channelizing devices and delineation shall be used to indicate required road user paths in temporary traffic control zones where it is not possible to provide a clear path by pavement markings.

6. For long-term stationary operations, pavement markings in the temporary traveled way that are no longer applicable shall be removed or obliterated as soon as practical. Pavement marking obliteration shall leave a minimum of pavement scars and shall remove old marking material. Painting over existing pavement markings with black paint or spraying with asphalt shall not be accepted as a substitute for removal or obliteration. Removable, nonreflective, preformed tape may be used where markings need to be covered temporarily (see Section 605-11.10.2).

7. All markings and devices used to delineate road user paths shall be carefully reviewed during daytime and nighttime periods.

605-11.10.2 Conflicting Pavement Markings

Conflicting pavement markings shall be removed by an approved method which will not scar the pavement or may be covered with removable, nonreflective, preformed tape which blends in with the existing pavement surface. Should it be decided to use the removable tape, the tape must be closely monitored, as it may be displaced due to traffic passing over it or inclement weather conditions. See Section 620-6 and CMS 614.11 and 641.10 for additional information.

605-11.11 Temporary Pavement Markings

As noted in Section 605-11.10.1, either permanent or temporary pavement markings shall be in place prior to opening the road or lane to traffic.

Temporary, or interim, pavement markings are those that are allowed to remain in place until the earliest date when it is practical and possible to install pavement markings that meet the OMUTCD Part 3 standards for pavement markings. They should not be left in place for more than fourteen days unless justified by an engineering study.

In areas of long-line work such as resurfacing, where the roadway or lane remains open during construction, the new pavement marking shall be placed within fourteen days of removal or obliteration of the existing line(s). NO EDGE LINES (W8-H12a) signs shall be erected at locations lacking necessary edge lines.

All temporary pavement markings, including pavement markings for No-Passing Zones, shall conform to the requirements of OMUTCD Chapters 3A and 3B with the following exceptions:
1. All interim broken-line pavement markings shall use the same cycle length as permanent markings and be at least 4 feet long, except that half-cycle lengths with a minimum of 2-foot stripes may be used for roadways with severe curvature (see OMUTCD Section 3A.06). This applies to white lane lines for traffic moving in the same direction and yellow center lines for two-lane roadways when it is safe to pass.

2. The center line shall either be full dimensional for No-Passing Zones or an abbreviated Class II center line may be used for a maximum of three consecutive calendar days as long as DO NOT PASS (R4-1) and PASS WITH CARE (R4-2) signs are erected as required by CMS 614.04. At the end of the three day time period, a center line consisting of full dimensional no passing markings must be installed. Also, signs may be used instead of pavement markings on low-volume (as defined in Section 500) roads for longer periods. These signs should be placed in accordance with OMUTCD Sections 2B.28, 2B.29 and 2C.45.

3. Edge lines shall be provided except for short periods (3 days maximum) at locations where another form of identification is provided, such as drums or cones.

4. Interim gore marking shall be continuous 4-inch lines placed at the theoretical gore of an exit ramp or diverging roadway.

605-11.12 Raised Pavement Markers

The use of temporary raised pavement markers in temporary traffic control zones is addressed in OMUTCD Section 6F.79, Section 641-25 and in SCD MT-99.30.

Raised pavement markers should be considered for use along center lines and lane lines on surfaced detours or temporary roadways, and other changed or new travel-lane alignments.

605-11.13 Delineators

As noted in OMUTCD Section 6F.80, delineators may be used in temporary traffic control zones to indicate the alignment of the roadway and to outline the required vehicle path through the temporary traffic control zone. When used, delineators shall be used in combination with, or be supplemental to, other traffic control devices.

Delineators shall be mounted on crashworthy supports so that the retroreflective unit is approximately 4 feet above the near roadway edge. The standard color for delineators used along both sides of two-way streets and highways and the right side of one-way roadways shall be white. Delineators used along the left side of one-way roadways shall be yellow. Spacing along roadway curves should be as set forth in OMUTCD Section 3F.04, and should be such that several delineators are always visible to the driver.

605-12 Lighting Devices

605-12.1 General

Lighting devices (OMUTCD Section 6F.81) should be provided in temporary traffic control zones based on engineering judgment. They may be used to supplement retroreflectorized signs, barriers and channelizing devices.

Four types of lighting devices are commonly used in temporary traffic control zones. They are floodlights, flashing warning beacons, warning lights and steady-burn electric lamps.

During normal daytime maintenance operations, the functions of flashing warning beacons are adequately provided by high-intensity rotating, flashing, oscillating, or strobe lights on a maintenance vehicle. Vehicle hazard warning lights are permitted to be used to supplement
these lights; however, they shall not be used instead of the vehicle’s high-intensity rotating, flashing, oscillating, or strobe lights.

605-12.2 Floodlights

Standards and guidelines for the use of floodlights in temporary traffic control situations are addressed in OMUTCD Section 6F.82.

Lighting is often provided to illuminate the roadway at locations of significant geometric change. For example:

1. All temporary crossover areas shall be illuminated as shown in SCD MT-100.00.

2. Some projects involve special situations. If a project requires illumination for special situations, the Office of Traffic Engineering should be contacted for design guidance.

605-12.3 Flashing Warning Beacons

Flashing Warning Beacons (see OMUTCD Section 6F.77) are often used to supplement a temporary control device.

The temporary terminus of a freeway is an example of a location where Flashing Warning Beacons alert drivers to the changing roadway conditions and the need to reduce speed in transitioning from the freeway to another roadway type.

605-12.4 Steady-Burn Electric Lamps

As noted in OMUTCD Section 6F.83, steady-burn electric lamps are a series of low-wattage, yellow, electric lamps, generally hard-wired to a 110-volt external power source. They may be used in place of Type C steady-burning Warning Lights (see Section 605-12.5).

605-12.5 Warning Lights

Warning lights are portable, powered, yellow lens-directed, enclosed lights (see OMUTCD Section 6F.78). They may be used in either flashing (Type A or B) or steady (Type C) modes. The light weight and portability of warning lights are advantages that make these devices useful as supplements to the retroreflectorization on signs and channelizing devices. See Section 605-11.4.2 for additional information about the use of steady-burn warning lights with drums.

605-13 Temporary Traffic Control Signals

605-13.1 General

It is often necessary to install temporary traffic signals in order to maintain traffic through temporary traffic control zones. As noted in OMUTCD Section 6F.84, temporary traffic control signals used to control road user movements through temporary traffic control zones and in other temporary traffic control situations shall meet the applicable provisions of OMUTCD Part 4. OMUTCD Section 6F.84 and this Part of the TEM provide additional information on the use of temporary traffic signals in temporary traffic control zones. Part 4 of this Manual should also be reviewed for applicable information.

OMUTCD Figure 6H-12 and SCDs MT-96.11, 96.20 and 96.26 address the use of temporary traffic signals to maintain two-way traffic in a single lane (see Section 641-10). Additional guidance on the design of temporary traffic control signals is provided in Section 605-13.2.

The traffic signal system may either be constructed of standard signal components conforming to SCDs MT-96.11, 96.20 and 96.26 (Section 641-10), or it may be a portable...
traffic signal (PTS) which is essentially self-contained and mounted on trailers (Section 605-13.3)

For common procedures for maintaining traffic signals during construction, see the maintenance of traffic signals and flasher notes found in Chapter 642.

Simple, two-phase traffic signal systems shall not be used for situations where traffic, including contractors’ vehicles, will be entering the traffic stream, from the work site, between signals. Such intermediate access points shall be kept to a minimum, or avoided completely if possible. If traffic must enter the traffic stream at intermediate locations, an additional signal shall be located at each such location. Each such signal shall be traffic actuated.

When temporary traffic control signals are used, conflict monitors typical of traditional traffic control signal operations shall be used.

605-13.2 Duration of Work

For temporary traffic signals which will be in continuous operation for seventy-two hours or less, pavement marking shall be as shown in SCDs MT- 96.11 (see Section 641-10) with the following exceptions and qualifications:

- Temporary pavement markings and temporary raised pavement markers are not required.
- Removal of existing conflicting pavement markings is not required if drums (or cones during daylight hours only) provide continuous positive guidance for vehicles.

605-13.3 Portable Traffic Signal (PTS)

The following shall apply to a Portable Traffic Signal (PTS):

1. A PTS shall conform to all OMUTCD requirements for traffic control signals including Section 4D.20.

2. Each signal head shall have three 12-inch vehicular indications (red, yellow and green) and their candlepower distributions shall not be less than specified for standard 12-inch signal heads in the ITE Standard for Adjustable Face Traffic Signal Heads.

3. The systems may be powered by engine driven generators or by stored battery charge. The systems, including batteries, shall be designed to provide electrical energy which will maintain the above described candlepower distribution for at least twenty-four hours at full output.

   The dimming of a PTS shall be permitted in accordance with the OMUTCD. The unit may include a photocell and circuitry which will permit the yellow lens of the PTS light output to be reduced by up to fifty percent during night hours. The amount of dimming, and the choice of not dimming shall be operator selectable.

4. The signal unit generator battery and electronic controls shall be completely inaccessible to unauthorized access, and protected by a sturdy lockable metal enclosure.

5. Signal supports shall consist of sturdy brackets attached to a trailer. The erected assembly shall be designed to solidly support the roadside signals at the specified heights and be designed for 40 mile per hour wind loads. Signal head configurations for each approach shall be one post-mounted signal at 8 foot minimum height on the right side of the road, plus another signal cantilever mounted over the right-hand traffic lane at a minimum height of 16 feet and maximum height of 18 feet; or two post-mounted signal heads, each erected at 8 foot minimum height on both sides of the road. The lateral...
spacing between signals shall be not less than 8 feet center-to-center.

6. The trailer and supports shall be orange. The signal heads shall be yellow.

7. The control portion of the PTS shall meet NEMA environmental standards. An independent laboratory test report shall be provided to verify compliance with the NEMA environmental standards.

8. The PTS shall be capable of operating in manual, fixed-time and traffic-actuated modes.

9. The controllers for the PTS system shall electronically communicate to each other by cable, radio or other method approved by the Director.

10. It shall not be possible even under manual control: to program the yellow clearance interval for less than three seconds; or for the green interval to be displayed for less than five seconds.

11. All timing intervals shall be set in increments of one second or less.

12. The controller shall provide a variable all red-clearance interval from zero to six hundred seconds.

13. The controller shall provide a method for insuring that the pairs of signal heads cannot display conflicting indications. This shall include at least a system which will identify, as a conflict, the display of a green in one direction while displaying: a green in the conflicting direction; a yellow in the conflicting direction; or the all-red clearance interval for a conflicting approach. Further, a controller will be determined to be in conflict if a displayed green is less than five seconds or a displayed yellow is less than three seconds. Upon determination that a conflict exists, all signal heads shall display flashing red as described in item 15.

14. The controller shall provide a red flash cycle that shall be flashed continuously at a rate of not less than fifty nor more than sixty times per minute. The illuminated period of each flash shall be not less than half, nor more than two-thirds, of the total flash cycle.

15. The controller shall have circuitry which will detect low voltage and prevent the occurrence of an unsafe signal indication. This “brown out” circuit shall hold the signal safe until adequate voltage is resumed. If a microprocessor is utilized, appropriate circuitry shall be included that will reset the processor when needed while holding the signal in an all-red condition. When the processor is removed from the circuitry, the signal shall default to a safe condition.

16. If the PTS utilizes radio transmission equipment:
   a. The transmitter shall be an accepted FCC-type and shall not exceed 1 watt output per FCC Part 90.17. The manufacturer shall also comply with all specific limitations noted in FCC Part 90.17.
   b. In case of radio interference or failure, the PTS shall display all red.
   c. If an FCC license is required, a copy shall be kept on file with the contractor.

17. The contractor shall inspect the PTS at least once each hour for the first eight hours after it is set up or reconfigured. Thereafter, he shall inspect it at least every twenty-four hours, including weekends. The inspections are to determine that it is operating correctly and efficiently, that the signals are properly aimed, and that the battery charge remains sufficient.
18. The contractor or supplier shall submit a letter signed by the manufacturer certifying that the candidate PTS complies with each of the above requirements. The letter shall also convey detailed engineering information, drawings and descriptions which describe how each requirement is satisfied.

Each PTS determined to meet this specification will be shown on an approved list maintained by the Office of Traffic Engineering (OTE) and available on the Office of Materials Management website. The address for the Materials Management website is: http://www.dot.state.oh.us/Divisions/ConstructionMgt/Materials/Pages/default.aspx.

605-14 Temporary Traffic Barriers

605-14.1 General

Temporary traffic barriers are devices designed to help prevent penetration by vehicles while minimizing injuries to vehicle occupants, and designed to protect workers, bicyclists and pedestrians (see OMUTCD Section 6F.85). More specific information on the use of temporary traffic barriers is contained in Chapters 8 and 9 of AASHTO’s Roadside Design Guide (see Section 193-12).

Because the protective requirements of a temporary traffic control situation have priority in determining the need for temporary traffic barriers, their use shall be based on an engineering study.

At a minimum, positive protection devices shall be considered in work zone situations that place workers at increased risk from motorized traffic, and where positive protection devices offer the highest potential for increased safety for workers and road users, such as:

1. The work zone provides no means of escape for workers (e.g., tunnels and bridges).
2. Adjacent lanes, carrying traffic flowing in opposite directions on Interstates, freeways, and other high-speed (>45 miles per hour) multi-lane divided highways (see SCDs MT-95.70 and MT-95.71, and PISs 209572 and 209573).
3. Long-term work zones (e.g., two weeks or more).
4. Workers close to travel lanes open to traffic.
5. Drop-off areas (see MT-101.90).
6. Projects with high operating speeds and high traffic volumes.
7. Bridge decks where the parapet or guardrail is removed (see SCD PCB-91 and the Design Data Sheet PCBDD (Office of Structural Engineering website Standards page: http://www.dot.state.oh.us/Divisions/Operations/Structures/standard/Pages/default.aspx)).

Warning lights or steady-burn electric lamps may also be mounted on temporary traffic barrier installations. When serving the additional function of channelizing vehicular traffic, temporary traffic barriers should be a light color for increased visibility.

605-14.2 Length of Need

The method used to design the length of need and location of barrier for maintenance of traffic applications should be as discussed in L&D Manual Volume One, Sections 602.1.2 and 602.1.3 for determining barrier length.

Length of need typically does not include attenuators, thus work zone design must take this into account.
605-14.3 Movable Barrier

A movable barrier is a linear system of connected barrier segments that can rapidly be shifted laterally by using a specially designed transfer vehicle. The transfer is accomplished in a manner that does not interfere with vehicular traffic in adjacent lanes. Applications of movable barriers include the following:

1. Closing an additional lane during work periods while maintaining the advantage of having the travel way separated from the work space by a barrier.
2. Closing an additional lane during off-peak periods to provide extra space for work activities without adversely impacting vehicular traffic flow; and
3. Creating a temporary reversible lane, thus providing unbalanced capacity favoring the major direction of vehicular traffic flow.

For more information on this device see OMUTCD Section 6F.85 and Figure 6H-45, and Section 606-18.

605-14.4 Temporary Guardrail

All guardrail used as a temporary barrier in maintenance of traffic applications shall conform to the same standards required for permanent guardrail in L&D Manual Volume One, Section 603.1.1.

Guardrail should be as detailed in the current Roadway Standard Construction Drawings. Any variation from these standards shall be submitted for approval by the Office of Roadway Engineering at the design stage, on a case-by-case basis.

Delineation of guardrail shall be by use of barrier reflectors (Section 605-19) mounted at 50-foot spacing.

605-14.5 Portable Barrier (PB)

Portable Barrier (PB) includes both portable concrete barrier (PCB) and portable steel barrier. (It does not include portable water-filled barrier.)

605-14.5.1 Barrier Reflectors, Object Markers and Glare Screens

Delineation of PB shall be provided by use of barrier reflectors and object markers. Barrier reflectors shall be mounted on all PB used for traffic control. Barrier object markers shall be mounted on top of all PB used for traffic control which does not have glare screen. Where glare screen is provided, the glare screen shall be equipped with vertical stripes on paddles. Additionally, object markers shall be provided on top of all permanent concrete barrier located within 5 feet of the edge of the adjacent travel lane.

Maximum spacing for barrier reflectors and object markers shall be 50 feet as shown in SCD MT-101.70. Where both barrier reflectors and object markers are provided on the same device, these items shall be staggered. See Section 605-19 for further information on barrier reflectors and object markers and Section 641-19 for more information about SCD MT-101.70.

Glare screen should be considered for use on PB in accordance with L&D Manual Volume One, Section 604.1. See Section 605-18 for additional information.

605-14.5.2 End Treatment

The exposed end of the PB should be located at a distance from the edge of the traveled
way equal to the clear zone distance for the facility as discussed in L&D Manual Volume One, Section 600.2. When this is not practical, impact attenuators shall be provided on the exposed ends of PB located within the clear zone.

Exposed ends of PB located outside the clear zone shall be tapered. If two PB runs overlap, with the first PB protecting the road user from the leading end of the second, that leading end does not need to be tapered.

For acceptable flare rates for PB, see L&D Manual Volume One, Figure 602-1 and the SCDs.

See Section 620-2 for information on the NCHRP 350 requirements.

605-14.5.3 Anchoring PB

Anchoring of PB may be considered to prevent excessive deflections of the barrier. For example, where a deflection by one vehicle could relocate the PB into the path of opposing traffic, or on bridge decks where a deflection could cause the PB to fall from the deck. Anchoring of PB located on bridges is required as shown in SCD PCB-91. Anchoring drawings of portable steel barrier are shown in the approved products list maintained by Roadway Standards.

605-14.5.4 PB Connections

The hinged connection and J-J Hook connection for PCB currently meet NCHRP Report 350 Test Level 3 (TL-3) crash test criteria. For additional information, see SCD RM 4.1 and RM 4.2. The pin connection used by portable steel barrier also meets NCHRP Report 350 TL-3 crash test criteria. Refer to the shop drawings for portable steel barrier on the approved products list maintained by Roadway Standards.

605-14.5.5 Grading of Cross Slopes

Where PB is located beyond the edge of the paved shoulder, the cross slope within the clear zone, including the surface on which the PB is placed, shall be graded at 10:1 or flatter. If the cross slope is steeper than 10:1, the PB shall be terminated on the paved or graded surface rather than on the cross slope. The PB shall be extended along the paved or graded surface as necessary to satisfy the length of need (L&D Manual Volume One, Section 602.1.2), and then terminated using an impact attenuator.

605-14.6 Plastic Water-Filled Barrier (Used as a Longitudinal Barrier)

A longitudinal barrier provides positive separation and redirective capability in work zones; however, it deflects laterally upon impact. A plastic water-filled barrier (PWFB) deflects significantly more than PB; therefore, it cannot be used as a direct substitute for PB.

For certain types of situations the designer may specify PWFB. For example, PWFBs may have advantages over PB in the following situations:

1. Intermediate-term work zones.
2. Emergency management situations.
3. Moving operations, particularly on low-speed urban roadways.
4. Locations with limited vertical clearance, due to equipment needed to place.
5. Locations requiring restricted dead loads, i.e., bridge decks.
When specifying a PWFB, the designer must consider the following factors:

1. There is assurance adequate clearance exists behind the barrier to accommodate the expected deflections.

2. The PWFB must meet the appropriate NCHRP Report 350 Test Level and have an FHWA acceptance letter for that test level. For example, the Rhino Barrier does not meet TL-3, but it does meet TL-2. A complete listing of accepted devices is found on the FHWA web site at: http://safety.fhwa.dot.gov/roadway_dept/policy_guide/road_hardware/barriers/.

3. Each of the currently approved products have met crash testing criteria by testing their products with a number of interconnected units to achieve the necessary tension needed. Therefore, before a product can be specified, the designer must ensure this minimum length is provided in the plans, even if it greater than the length of need as calculated in Section 605-14.2.

4. The PWFB shall be flared outside the clear zone unless terminated with a crashworthy end treatment.

The designer is encouraged to accommodate all of the products in a generic design. However, if the site has limitations, and only one or two PWFB will work on a project due to the limitations of the other products, the designer is obligated to specify only the appropriate PWFB. Unless the designer specified a particular PWFB, a contractor is free to choose any of the FHWA accepted NCHRP Report 350 PWFB.

The contractor shall install the selected product as per the manufacturer’s recommendations and in accordance with the factors stated above. All Test Level 3 products were crash tested by utilizing some sort of a steel cage, or connectors, so it is imperative the contractor install these “upgrade kits” to match the crash tested design.

605-14.7 Plastic Water-Filled Barrier (Used as a Barricade)

In locations where the water-filled barrier is used primarily as a channelizing device, the length of the barrier is determined in a manner similar to that for drums. They may also provide a higher level of channelization at certain locations where drums would normally be used, such as at exit ramps.

605 -15 Crash Cushions

605-15.1 General

As noted in OMUTCD Section 6F.86, crash cushions are systems that mitigate the effects of errant vehicles that strike obstacles, either by smoothly decelerating the vehicle to a stop when hit head-on, or by redirecting the errant vehicle. The two types of crash cushions that are used in temporary traffic control zones are stationary crash cushions and truck-mounted attenuators. Crash cushions in temporary traffic control zones help protect the drivers from the exposed ends of barriers, fixed objects, shadow vehicles and other obstacles. Specific information on the use of crash cushions can be found in AASHTO’s Roadside Design Guide (see Section 193-12).

Crash cushions shall be crashworthy. They shall also be designed for each application to stop or redirect errant vehicles under prescribed conditions. Crash cushions shall be periodically inspected to verify that they have not been hit or damaged. Damaged crash cushions shall be promptly repaired or replaced.
605-15.2 Stationary Crash Cushions

Stationary crash cushions are used in temporary traffic control zones in the same manner as permanent highway installations to protect drivers from the exposed ends of barriers, fixed objects and other obstacles. Stationary crash cushions shall be designed for the specific application intended.

See Sections 642-30 and 642-31 for related Plan Notes and additional information.

Sand barrel arrays may be used in work zones to provide temporary protection for wide hazards. For ease of moving, they may be mounted on pallets or skids that are 4 inches or less in height. See L&D Manual Volume One, Section 603.4.4 for additional information.

605-15.3 Truck-Mounted Attenuators

Truck-mounted attenuators shall be energy-absorbing devices attached to the rear of shadow trailers or trucks and they should be used in accordance with the manufacturer’s specifications. If used, they shall be located in advance of the work area, workers or equipment to reduce the severity of rear-end crashes from errant vehicles.

Chapter 9 of AASHTO’s Roadside Design Guide (see Section 193-12) and Section 602-8 contain additional information regarding the use of shadow vehicles.

For more detail see L&D Manual Volume One, Section 603.2.

605-16 Vehicle-Arresting Systems

Vehicle-arresting systems are addressed in OMUTCD Section 6F.83.

605-17 Rumble Strips

Rumble strips (see OMUTCD Section 6F.87 and TEM Section 1415) consist of intermittent narrow, transverse areas of rough-textured or slightly raised or depressed road surface that alert drivers to unusual vehicular traffic conditions. Through noise and vibration they attract the drivers attention to such features as unexpected changes in alignment and to conditions requiring a stop.

The first rumble strip pad should be placed before the advance warning devices. The last pad should be placed a minimum of 250 feet in advance of the traffic condition.

A RUMBLE STRIPS sign (W8-H16) warning drivers of the onset of rumble strips may be placed in advance of any rumble strip installation.

Although the intent of the rumble strips is to alert the road user, the noise may also attract the attention of non-road users on adjacent property. This would be unacceptable in residential areas.

605-18 Screens

Screens (see OMUTCD Section 6F.88) are used to block the road users’ view of activities that can be distracting. Screens might improve safety and vehicular traffic flow where volumes approach the roadway capacity because they discourage gawking and reduce headlight glare from oncoming vehicular traffic. They can also help contain the work area and reduce the accumulation of dust and debris on the pavement.

On ODOT-maintained highways a glare screen shall be used at all crossover locations unless a 50-inch portable barrier (PB) is provided.
The upper portion of the 50-inch portable barrier (PB) serves as a glare screen (see SCD RM-4.1 for details).

Paddle, or intermittent, type glare screens may be mounted on the top of 32-inch PB.

See Section 642-21 (Plan Note 642-21), L&D Manual Volume One, Section 604 and SCD MT-95.70 or MT-95.71 for additional guidance.

The choice of 32-inch PB, with screen, or 50-inch is often left to the contractor.

Glare screen can be a maintenance problem. If PB will be in place over the winter during plowing operations, or if the PB is otherwise expected to be hit a lot, the 50-inch PB should be specified. Plowing over the top of a 50-inch PB is possible; however, it is not preferred.

**605-19 Barrier Reflectors and Object Markers**

Barrier reflectors shall be mounted on all portable barrier on ODOT-maintained highways, and barrier object markers shall be mounted on top of all portable barrier which does not have glare screen.

Barrier reflectors and object markers shall also be mounted on top of all permanent concrete barrier and guardrail located within 5 feet of the edge of the adjacent travel lane (see Plan Notes 642-51 and 642-52 in Chapter 642).

The minimum reflective surface area for the reflector portion of a barrier reflector should be 7 square inches.

The reflectors shall be mounted on the face of the barrier with the top of the reflector approximately 26 inches above the base and at a maximum spacing of 50 feet.

Attachment of the reflector shall be by a suitable corrosion resistant fastener, bracket or adhesive. Barrier reflectors shall be the same color as the adjacent edge line. When adjacent to a reversible traffic direction lane, barrier reflectors shall be white on one side and yellow on the other side, such that regardless of the direction of travel of the road user, the yellow barrier reflectors will be visible to road user’s left and white barrier reflectors will be visible to the road user’s right side.

Barrier object markers shall be 6 inches wide and at least 12 inches high. They shall have orange (fluorescent red-orange or fluorescent yellow-orange) retroreflective sheeting. If used with two-way traffic, two-way barrier object markers shall be used.

Spacing for barrier object markers shall be at 50-foot maximum centers midway between the face-mounted reflectors. When adjacent to a reversible traffic direction lane or between opposing traffic flows, they shall be mounted in pairs facing traffic from each direction.

**605-20 Increased Barrier Delineation**

**605-20.1 General**

On freeway and expressway projects, increased barrier delineation shall be installed on all portable barrier and concrete permanent barrier located within 5 feet of the edge of the traveled lane under either of the following conditions: along tapers and transition areas; and along curves (outside only) with degree of curvature greater than or equal to 3 degrees.

**605-20.2 Linear Delineation Panels**

Linear delineation panels shall consist of panels of delineation, approximately 34 inches long and 6 inches wide and shall be “crimped.” Panels shall be provided at the rate of one per
section of portable barrier, or one panel every 10 feet on permanent portable barrier, spaced evenly along the length of the run. The panels shall be mounted such that the tops of the panels are 26 inches above the pavement. See Plan Note 642-50 in Chapter 642 for further details.

605-20.3 Triple Stacking of Barrier Reflectors

Triple stacking of barrier reflectors shall consist of attaching three barrier reflectors, aligned vertically, at locations where a single barrier reflector would be otherwise attached. There shall be no open space between the adjacent barrier reflectors. The top of the middle barrier reflector shall be located 26 inches above the pavement. See Plan Note 642-50 in Chapter 642 for further details.

605-21 Future and Experimental Devices

The States, FHWA, AASHTO, the Transportation Research Board (TRB), and other organizations conduct research and experimentation on new traffic control and safety devices.

The TEM may be used to distribute information on experimental devices that have been approved for use, and on new devices that have yet to be incorporated into the OMUTCD.
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606 TYPE OF TEMPORARY TRAFFIC CONTROL ZONE ACTIVITIES

606-1 General

Each temporary traffic control zone is different. Many variables, such as location of work, road type, geometrics, vertical and horizontal alignment, intersections, interchanges, road user volumes, road vehicle mix (buses, trucks and cars), and road user speeds affect the needs of each zone. The goal of temporary traffic control in work zones is safety with minimum disruption to road users. The key factor in promoting temporary traffic control zone safety is proper judgment.

Previous Chapters in this Part of the TEM have reviewed general policies, standards and guidelines regarding temporary traffic control zones and the related devices. Tables 697-1a through 697-1f provide a review of various options available in choosing the appropriate temporary traffic control. Chapter 606 provides a general discussion about various types of temporary traffic control activities. Chapter 607 and OMTUCD Chapter 6H provide more detailed guidelines about specific typical applications of temporary traffic control. Chapters 640, 641, 642 and 643 include additional information intended to aid in preparing Temporary Traffic Control (Maintenance of Traffic or MOT) Plans.

The discussion in this Chapter regarding types of temporary traffic control activities has been organized into the same general categories used in OMTUCD Chapter 6G:

1. Work Duration.
2. Location of the Work.
4. Work Outside of the Shoulder.
5. Work on the Shoulder with No Encroachment.
7. Work Within the Median.
8. Work Within the Traveled Way of Two-Lane Highways.
10. Work Within the Traveled way of Multi-lane, Nonaccess Controlled Highways.
11. Work Within the Traveled Way at an Intersection.
12. Work Within the Traveled Way of Expressways and Freeways.
13. Two-Lane, Two-Way Traffic on One Roadway of a Normally Divided Highway.
15. Interchanges.
17. Work Affecting Pedestrian and Bicycle Facilities.
18. Temporary Traffic Control During Nighttime Hours.

606-2 Typical Applications

The typical applications of temporary traffic control zones addressed in the OMUTCD and this Chapter are organized according to duration, location, type of work and highway type. OMUTCD Table 6H-1 and the Figures Index for Chapter 698 provide listings of the typical applications shown in these manuals. These typical applications address the use of various temporary traffic control methods, but do not include a layout for every conceivable work situation.

Typical applications for which Traffic SCDS have been prepared are discussed in Chapter 641.

The typical applications should be modified, as necessary, to fit the conditions of a particular temporary traffic control zone. Other devices may be added to supplement the devices shown in the typical applications, while others may be deleted. The sign spacings and taper lengths may be increased to provide additional time or space for driver response.

Decisions regarding the selection of the most appropriate typical application to use as a guide for a specific temporary traffic control zone require an understanding of each situation. Although there are many ways that work zone applications could be categorized, four factors are used to generally characterize the typical applications addressed in Chapter 607 and OMUTCD Chapter 6H. Those four factors are: work duration, work location, work type and highway type.

606-3 Work Duration

As noted in OMUTCD 6G.02, work duration is a major factor in determining the number and types of devices used in temporary traffic control zones. The duration of a temporary traffic control zone is defined relative to the length of time a work operation occupies a spot location.

OMUTCD 6G.02 establishes the following five categories of work duration and discusses each one:

1. **Long-term stationary** is work that occupies a location more than three days.
2. **Intermediate-term stationary** is work that occupies a location more than one daylight period up to three days, or nighttime work lasting more than one hour.
3. **Short-term stationary** is daytime work that occupies a location for more than one hour within a single daytime period.
4. **Short duration** is work that occupies a location up to one hour.
5. **Mobile** is work that moves intermittently or continuously.

606-4 Location of Work

As noted in OMUTCD 6G.03, the choice of temporary traffic control needed for a temporary traffic control zone depends upon where the work is located. As a general rule, the closer the work is to road users, the greater the number of temporary traffic control devices that are needed. Procedures are described in OMUTCD Chapter 6G and herein for establishing temporary traffic control zones in the following locations:

1. Outside the shoulder;
2. On the shoulder with no encroachment;
3. On the shoulder with minor encroachment;
4. Within the median; and
5. Within the traveled way.

606-5 Modifications To Fulfill Special Needs

The typical applications in OMUTCD Chapter 6H and herein illustrate commonly encountered situations in which temporary traffic control devices are employed. Supplemental information provided in this Part of the TEM should also be consulted to insure compliance with ODOT standards. Other devices may be added to supplement the devices indicated in these figures. Device spacing may be adjusted to provide additional reaction time. When conditions are less complex than those depicted in the typical applications, fewer devices may be needed.

When conditions are more complex, typical applications should be modified by incorporating appropriate devices and practices from the list provided in OMUTCD Section 6G.04.

Temporary traffic barriers serving as temporary traffic control devices shall conform to requirements for such devices as set forth throughout Part 6 of the OMUTCD and TEM.

606-6 Work Outside of Shoulder

When work is being performed off the roadway (beyond the shoulders, but within the right-of-way), little or no temporary traffic control may be needed. See OMUTCD Section 6G.06 and Figure 6H-1 for information on this situation.

In these situations, a single Warning Sign, such as SHOULDER WORK AHEAD (W21-H5), should be used. If the equipment travels on the roadway, the equipment should be equipped with appropriate flags, high-intensity rotating, flashing, oscillating, or strobe lights, and/or a SLOW MOVING VEHICLE symbol.

If work vehicles are on the shoulder, a SHOULDER WORK AHEAD sign may be used. For mowing operations, the MOWING AHEAD sign (W21-8) may be used. Where the activity is spread out over a distance of more than 2 miles, the SHOULDER WORK AHEAD sign may be repeated every 1 mile. A supplementary plaque with the message NEXT X MILES plate (W7-3a) may be used.

Caution is advised. The type of work being performed must be considered. If a drop-off is created within the clear zone, additional traffic control may be needed (see Section 640-6).

606-7 Work on the Shoulder with No Encroachment

Generally, when a highway shoulder is occupied or closed a SHOULDER WORK AHEAD sign (W21-H5) or the RIGHT (LEFT) SHOULDER CLOSED sign (W21-5a) is used. See OMUTCD Section 6G.07 and Figures 6H-3, 6H-4 and 6H-5.

When the shoulder is not occupied, but work has adversely affected its condition, the LOW SHOULDER (W8-9) or SOFT SHOULDER (W8-4) sign should be used, as appropriate. Where the condition extends over a distance in excess of 1 mile, the sign should be repeated at 1-mile intervals.

When used for shoulder work, arrow boards shall operate only in the caution mode.

606-8 Work on the Shoulder with Minor Encroachment

OMUTCD Section 6G.08 and Figure 6H-6 address situations where work on the shoulder encroaches slightly into the traveled way.
606-9 Work Within the Median

As noted in OMUTCD Section 6G.09, if work in the median of a divided highway is within 15 feet of the edge of the traveled way for either direction of travel, temporary traffic control should be used through the use of advance Warning Signs and channelizing devices.

606-10 Work Within the Traveled Way of Two-Lane Highways

Techniques for controlling vehicular traffic under one-lane, two-way conditions are described in OMUTCD Section 6G.10 and Section 602-7. For the ODOT-maintained system, the techniques used most often are:

1. Flaggers (see OMUTCD Figure 6H-10 and SCDs MT-97.10, 97.11 and 97.12);
2. Temporary traffic control signal (see OMUTCD Figure 6H-12, Section 607-13, SCDs MT-96.11, 96.20 and 96.26).

However, in low-volume situations STOP/YIELD sign control (see OMUTCD Figure 6H-11 and Section 607-12) may be considered.

Detour signs are used to direct road users onto another roadway. At diversions, road users are directed onto a temporary roadway or alignment placed within or adjacent to the right-of-way. Typical applications for detouring or diverting road users on two-lane highways are shown in OMUTCD Figures 6H-7, 6H-8 and 6H-9.

606-11 Work Within the Traveled Way of Urban Streets

In urban temporary traffic control zones, decisions are needed on how to control vehicular traffic, such as how many lanes are required, whether any turns should be prohibited at intersections, and how to maintain access to business, industrial and residential areas. See OMUTCD 6G.11.

If the temporary traffic control zone affects the movement of pedestrians, adequate pedestrian access and walkways shall be provided. Chapter 603, and OMUTCD Figures 6H-28 and 6H-29 contain additional information regarding controlling pedestrian movements near work zones.

If the temporary traffic control zone affects the movement of bicyclists, adequate access to the roadway or shared-use paths shall be provided. If a designated bicycle route is closed because of the work being done, a signed alternate route should be provided. Bicyclists should not be directed onto the path used by pedestrians. Additional information on bikeways may be found in OMUTCD Part 9, Part 9 of this Manual, the Guide for the Development of Bicycle Facilities and from the Office of Local Projects.

606-12 Work Within the Traveled Way of Multi-lane, Nonaccess Controlled Highways

Work on multi-lane highways can be divided into right-lane closures, left-lane closures, interior-lane closures, multiple-lane closures and closures on five-lane roadways. These situations are addressed in OMUTCD Section 6G.12 and Figures 6H-30, 6H-31, 6H-32, 6H-33, 6H-34, 6H-35 and 6H-37. Related Traffic SCDs are discussed in Chapter 641.

When a roadway must be closed on a divided highway, a median crossover may be used (see Section 606-16).

606-13 Work Within the Traveled Way at an Intersection

The typical applications for intersections are classified according to the location of the work space with respect to the intersection area (as defined by the extension of the curb or edge lines). The three classifications are near side, far side and in-the-intersection. Work spaces often extend into more than one portion of the intersection. For example, work in one quadrant often creates a
near-side work space on one street and a far-side work space on the cross street. In such instances, an appropriate temporary traffic control plan is obtained by combining features shown in two or more of the intersection and pedestrian typical applications. OMUTCD Section 6G.13 and Figures 6H-21 through 6H-27 address work within the traveled way at an intersection.

606-14 Work Within the Traveled Way of Expressways and Freeways

Temporary traffic control problems might occur under the special conditions encountered where vehicular traffic must be moved through or around temporary traffic control zones on high-speed, high-volume roadways. Although the general principles outlined in the OMUTCD and this Manual are applicable to all types of highways, high-speed, access-controlled highways need special attention in order to safely and efficiently accommodate vehicular traffic while also protecting workers. See OMUTCD Section 6G.14 and Figures 6H-33 and 6H-35 through 6H-37 for information on this type of work.

Traffic SCDs have also been developed to address lane closures on freeways and expressways. Lane closure procedures are discussed in Chapter 641.

Also see Policy 516-003 (P) Traffic Management in Work Zones - Interstate and Other Freeways (see Chapter 1599).

OMUTCD Table 6C-3 provides information on the length of the merging and shifting tapers. Taper rates for shifts are also addressed in Section 602-5.3.

606-15 Two-Lane, Two-Way Traffic on One Roadway of a Normally Divided Highway

OMUTCD Section 6G.15 addresses work involving two-lane, two-way traffic on one roadway of a normally divided highway.

OMUTCD Figure 6H-39 addresses the procedure for two-lane, two-way operation. Treatments for entrance and exit ramps within the two-way roadway segment of this type of work are shown in OMUTCD Figures 6H-40 and 6H-41. Related Traffic SCDs are discussed in Chapter 641.

606-16 Crossovers

Crossover construction refers to the concept of maintaining two-way traffic operation on one side of a divided highway while the contractor performs work on the other side of the roadway. See OMUTCD 6G.16 and Figure 6H-39. As noted in Section 641-9.2, design of crossover roadways is also addressed in Section 640-12 and Figures 698-6 through 698-9. There is also additional information on this work in Sections 607-12 and 607-13, SCD MT-95.70, 95.71 and 99.30, and PISs 209572 and 209573.

One disadvantage of crossover construction is that in order to provide entrance and exit ramp access in the direction of travel of the shifted traffic, temporary pavement will be necessary at each interchange. Crossover construction is most beneficial on projects where ramp access is not mandatory. For further information on the advantages and disadvantages of crossover construction, see the compendium of options presented in Tables 697-1a through 697-1f.

606-17 Interchanges

Work in the area of interchanges on limited-access highways is addressed in OMUTCD 6G.17 and Figures 6H-40 through 6H-44. Additional information is also provided in Sections 607-13 through 607-15, Figures 698-4 and 698-5, and the SCD MT-98 series.

606-18 Movable Barriers

OMUTCD Section 6F.85 and Figure 6H-45 address a temporary reversible lane using movable barriers.

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606-19 Work in the Vicinity of Highway-Rail Grade Crossings

OMUTCD Section 6G.18 addresses work in the vicinity of highway-rail grade crossings.

606-20 Control of Traffic Through Incident Areas

OMUTCD Chapter 6I and *Chapter 608* address control of traffic through incident areas.

606-21 Work Affecting Pedestrian and Bicycle Facilities

OMUTCD Section 6G.05 addresses work affecting pedestrian and bicycle facilities. OMUTCD Chapter 6D and Sections 6F.74 and *Chapter 603* provide additional information regarding steps to follow when pedestrian and bicycle facilities are affected by the worksite.

606-22 Temporary Traffic Control Through Nighttime Hours

OMUTCD Section 6G.19 provides additional information regarding temporary traffic control through nighttime hours.
607 TYPICAL APPLICATIONS

607-1 General

Chapter 606 presented a general discussion of typical temporary traffic control activities. Chapter 607 provides more detailed information about typical applications for a variety of situations commonly encountered.

Temporary traffic control applications are presented in OMUTCD Chapter 6H, in this TEM Chapter (and the related figures in Chapter 698), and in the SCD MT series. Applications shown in the OMUTCD present minimum standards permitted within Ohio. Traffic control applications presented in the SCDs are intended for use on ODOT administered projects, and are more restrictive than the applications presented in the OMUTCD. As noted in Section 600-3, applicable SCDs are also recommended for use in ODOT force-account work as much as practical. Additional guidance in proper application of temporary traffic control devices is presented in CMS 614.

In addition to information in the OMUTCD, figures and tables found in this Part of the TEM provide information for the development of temporary traffic control plans. OMUTCD Table 6C-3 is used for the determination of taper lengths, and OMUTCD Table 6C-1 can be used for Warning Sign spacing for various areas and roadway types.

While not every situation is addressed, the information illustrated in the OMUTCD, this Manual and the SCDs can generally be adapted to a broad range of conditions. In many instances, an appropriate temporary traffic control plan is achieved by combining features from various typical applications. For example, work at an intersection might present a near-side work zone for one street and a far-side work zone for the other street. These treatments are found in two different typical applications, while a third typical application shows how to handle pedestrian crosswalk closures.

Procedures for establishing temporary traffic control zones vary with such conditions as road configuration, location of the work, work activity, duration of work, road user volumes, road vehicle mix (buses, trucks and cars) and road user speeds. Examples presented in the OMUTCD are guides showing how to apply principles and standards. Applying these guidelines to actual situations and adjusting to field conditions requires judgment. In general, the procedures illustrated represent minimum solutions for the situations depicted.

Other devices may be added to supplement the devices shown in the various applications presented in these documents. Device spacing may be adjusted to provide additional reaction time or delineation. Fewer devices may be used based on field conditions.

The legend for the symbols used in typical applications presented in the OMUTCD and this Manual is provided in OMUTCD Table 6H-2. In many of the typical applications, sign spacings and other dimensions are indicated by letters using the criteria provided in OMUTCD Table 6C-1. Most of the typical applications show temporary traffic control devices for only one direction.

The following are general comments regarding the use of OMUTCD typical applications for ODOT work:

1. References to “activated rotating, flashing, oscillating or strobe lights” shall be interpreted as “activated yellow rotating, flashing, oscillating, or strobe lights.”

2. The Construction Arrow sign (W1-H11) may be used instead of the arrow board for lane closures on low-volume, low-speed roads and urban streets. The Construction Arrow sign may be used to supplement the arrow board on high-volume roads.
3. Traffic control signing for lane closure on multi-lane highways may be supplemented by Changeable Message Signs.

4. In long-term situations, additional advance Warning Signs may be desirable.

5. Concrete barrier is one method that may be used to close a lane for a long-term project. Use of a barrier should be based on the need determined by an engineering analysis. The layout of the barrier should prevent vehicles from impacting the ends of the barrier. According to the Roadside Design Guide (RDG) (Section 193-12), the barrier should be flared beyond the clear zone. An alternative procedure is to place an impact attenuator to protect traffic from the end of the barrier (see Section 605-14).

6. Where ramps exist within the limits of the project, the EXIT OPEN, EXIT OPEN AHEAD, EXIT CLOSED, and EXIT CLOSED AHEAD signs shall be used, as shown in the SCD MT-98 series.

7. Where entrance ramps are located within the project limits and the mainline gaps are insufficient to provide proper merging, consideration should be given to closing the ramps.

607-2 Blasting Zone (OMUTCD Figure 6H-2)

On a divided highway, the signs should be mounted on both sides of the directional roadways.

607-3 Road Closed with Off-Site Detour (OMUTCD Figure 6H-8)

For unnumbered routes, the M4-9 DETOUR sign may be used instead of the M4-8 DETOUR sign.

607-4 Lane Closures on Low-Volume, Two-Lane Road (OMUTCD Figure 6H-11)

In long-term operations, a double-yellow No-Passing Zone should be added on the approach for the closed lane. The No-Passing Zone shall have a length of “A” as determined from OMUTCD Table 6C-1.

607-5 Lane Closure on Two-Lane Road Using Traffic Signals (OMUTCD Figure 6H-12)

For high-volume applications, consideration should be given to installation of the BE PREPARED TO STOP sign (W3-4) in advance of the Signal Ahead sign (W3-3).

607-6 Temporary Road Closure (OMUTCD Figure 6H-13)

When the temporary road closure occurs at night, Type A flashing lights should be used on advance Warning Signs and the flagger station shall be illuminated, except in an emergency.

607-7 Detour for One Travel Direction (OMUTCD Figure 6H-19)

A DETOUR sign with an advance arrow (M4-H9b) may be used in advance of a turn. On multi-lane streets, a DETOUR sign with an advance turn arrow should be used in advance of a turn.

607-8 Right Lane Closure - Far Side of Intersection (OMUTCD Figure 6H-22)

For long-term operations, pavement markings may be used to highlight the right-only movement.

607-9 Mobile Operation on Multi-lane Road (OMUTCD Figure 6H-35)

Shadow vehicle 2 in this figure may be equipped with a truck-mounted attenuator.
600 TEMPORARY TRAFFIC CONTROL

607-10 Lane Shift on Freeway (OMUTCD Figure 6H-36)

Additional signing should be provided as shown in SCDs MT-102.10, MT-102.20 and MT-102.30. This signing includes the TRUCKS USE LEFT (RIGHT) LANE sign (R-4-5, R-4-H5a) if the use of the shoulder is involved and it cannot adequately accommodate trucks. The Construction Arrow sign (W1-H11) should be used to supplement the drums used along the approaching shift taper.

SCD MT-99.30 addresses additional requirements for delineation along lane shifts of 4 feet or more.

607-11 Interior Lane Closure on Freeway (OMUTCD Figure 6H-38)

OMUTCD Figure 6H-38 cannot be used on ODOT freeways as shown. For work on projects which include ODOT funding or administering, an adjacent lane shall also be closed. This adjacent lane may serve to give the contractor additional work space for equipment and work vehicles transportation, or it may serve as a lateral buffer.

607-12 Median Crossover on Freeway (OMUTCD Figure 6H-39)

OMUTCD Figure 6H-39 shows signing for closure of the right lane in advance of the crossover. A left-lane closing may be used instead. For example, a left-lane closure is shown in SCD MT-95.70 (see Section 641-9).

Additional information regarding crossovers is referenced in Section 606-16.

607-13 Median Crossover for Entrance Ramp (OMUTCD Figure 6H-40)

OMUTCD Figure 6H-40 and Figure 6H-4 address traffic control for a median crossover to maintain access for an entrance ramp. Additional information regarding crossovers is referenced in Section 606-16. The following additional guidelines should be used with this application:

1. This typical application should be used for accessing an entrance ramp across a closed directional roadway of a divided highway.

2. The crossover shall be designed for each specific location and incorporated into the construction plans. A temporary acceleration lane that provides adequate Decision Sight Distance (DSD) for merging traffic should be provided. If the required DSD cannot be provided, consideration should be given to closing the ramp. See Table 697-10 for the required DSD. Additional DSD information is available in Figure 201-6 of the L&D Manual Volume One.

Should physical restrictions exist that preclude these minimums being provided, engineering judgment should be used to determine if a safe merging operation can be provided. Factors such as volumes, gap availability, sight distance, percent trucks, availability of alternate routes, and emergency access should be considered. It may be necessary to statutorily lower the main line speed to accommodate the merging traffic. Documentation should be kept on file supporting the decision to provide a merge with less than the DSD in Table 697-10. The use of the STOP (R1-1) or YIELD (R1-2) signs shown should only be considered when the required distances shown in Table 697-10 cannot be provided and it is impossible or impractical to close the entrance ramp.

3. A broken edge line (dotted line) may be carried across the temporary entrance ramp to assist in defining the through vehicular travel lane.

4. When a temporary traffic barrier is used to separate opposing vehicular traffic, the Two-Way Traffic signs (W6-3) and the DO NOT ENTER signs (R5-1) may be eliminated.
607-14 Partial Exit Ramp Closure (OMUTCD Figure 6H-43)

An additional ROAD WORK AHEAD sign (W20-1) should be added if traffic backs up onto the mainline.

607-15 Work in Vicinity of Entrance Ramp (OMUTCD Figure 6H-44 and Figure 698-5)

OMUTCD Figure 6H-44 provides traffic control information for work in the vicinity of an entrance ramp. **Figure 698-5** depicts an alternative design that has been developed to provide additional geometric information pertaining to the required Decision Sight Distance (DSD) for long-term work zones **(see Table 697-10)**. The following additional guidelines should be used with these figures:

1. The left diagram in **OMUTCD Figure 6H-44** can be used for both short and long-term work zones where it is acceptable to close the outside mainline lane.

2. The right diagram in **OMUTCD Figure 6H-44** should only be used for short-term operations where engineering judgment indicates that a safe merging operation can be provided. Factors such as volumes, gap availability, sight distance, percent trucks, availability of alternate routes and emergency access should be considered when deciding to provide this method of traffic control or closing the entrance ramp. It may be necessary to legally lower the mainline speed to accommodate the merging traffic.

3. When used, the YIELD sign (R1-2) shown in the right diagram of **OMUTCD Figure 6H-44**, should be located so that ramp vehicular traffic has adequate sight distance of oncoming mainline vehicular traffic in order to select a safe gap in the mainline vehicular traffic flow. Also, a longer acceleration lane should be provided beyond the sign to reduce the gap size needed. If insufficient gaps are available, consideration should be given to closing the ramp.

4. Where a mainline lane is closed, the closure should be sufficiently in advance to stabilize vehicular traffic flow before encountering the merge.

5. For **OMUTCD Figure 6H-44** the mainline merging taper with the arrow board at its starting point should be located sufficiently in advance so that the arrow board is not confusing to drivers on the entrance ramp, and so that the mainline merging vehicular traffic from the lane closure has the opportunity to stabilize before encountering the vehicular traffic merging from the ramp.

6. If the ramp curves sharply to the right, Warning Signs with Advisory Speed plaques located in advance of the terminal should be placed in pairs (one on each side of the ramp).

7. Where the acceleration distance is significantly reduced, a supplemental plaque may be placed below the Yield Ahead sign (W3-2a) reading NO MERGE AREA (W23-H2).

8. **Figure 698-5** should typically be used when designing long-term on-ramp merges with a mainline work zone. See **Table 697-10** for the required Decision Sight Distance (DSD). Additional DSD information is available in **Figure 201-6 of the L&D Manual Volume One**. Should physical restrictions exist that preclude these minimums being provided, engineering judgment should be used to determine if a safe merging operation can be provided. Factors such as volumes, gap availability, sight distance, percent trucks, availability of alternate routes, and emergency access should be considered. It may be necessary to legally lower the mainline speed to accommodate the merging traffic. Documentation should be kept on file supporting the decision to provide a merge with less than the DSD in **Table 697-10**. The use of STOP (R1-1) and YIELD (R1-2) signs shown in the **OMUTCD** should only be considered when the required distances shown in **Table 697-10** cannot be provided and it is impossible or impractical to close the entrance ramp.
Section 606-17 and SCDs MT-98.10 and 98.11 provide additional traffic control information for this application.
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608 Incident Management

608-1 General

Traffic incidents are unpredictable, unique occurrences which restrict traffic flow. They are unplanned events such as emergencies and crashes, and each must be addressed individually. Effective incident management can help to increase safety at an incident scene, reduce costs associated with incidents and quickly restore traffic to its original flow.

OMUTCD Chapter 6I and Chapter 608 describe various incident management tools that can be effective in handling different types of incidents. Typically, each incident will require a unique approach and solution.

608-2 Ohio QuickClear Program

The Ohio QuickClear Program is an effort by ODOT, ODPS and various interested organizations to develop a checklist for incident responders and a best practice guide for incident management. The Program is “committed to maintaining the safe and effective flow of traffic during emergencies as to prevent further damage, injury or undue delay of the motoring public.” The idea behind QuickClear is to get traffic moving as safely and quickly as possible, through the timely removal of disabled vehicles from traffic lanes to the shoulder, or, if possible, to the nearest interchange to decrease severe congestion delay and secondary crashes caused by incidents.

QuickClear focuses on the ideas of multiple agency cooperation. Each first response agency has different goals and agendas. For law enforcement the focus is on preserving the scene for the collection of evidence to determine negligence, while the fire department is concerned with protecting the scene including the victims and personnel. Along with these agencies, ODOT and other transportation organizations direct their efforts on traffic management and incident clearance, while towing companies are responsible for the removal of vehicles from the incident scene. It is essential for all of these agencies to work together using QuickClear methods to ensure that everyone can complete their job as safely, quickly and efficiently as possible.

While most of the emphasis about QuickClear in Ohio has been on urban freeways, QuickClear practices can also provide benefits on rural highways as well. These methods can help reopen rural roads in a timely manner, avoiding or minimizing the use of extensive detours or road blocks.

More detailed information on the Ohio QuickClear Program and QuickClear practices can be found on the web using the QuickClear link from the ODOT homepage, or using the link provided in Table 197-3 (www.dot.state.oh.us/quickclear.aspx).

Information about the Ohio QuickClear Program is currently being presented to first responders, Emergency Management Agencies (EMA), local jurisdictions and other groups around the State. This effort is intended to improve awareness of the program and further relationships and dialogue among the various agencies. Presentations can be scheduled through the QuickClear website mentioned above. All first responders are encouraged to use QuickClear methods to provide safer and more efficient roadways.

For effective incident management, including QuickClear procedures, debriefing or after-action meetings should be held after incidents resulting in excessive closures. It is desirable for all agencies involved in the management of the incident to participate in the meeting. These meeting are intended to ensure that continued improvements are being made in regard to incident management techniques and that all parties involved in incident response are aware of new practices by other agencies.
608-3 Incident Logging

To help with overall incident management, it is important to log traffic incidents. These logs can be reviewed at a later date to help improve incident management techniques, or they can be used for secondary crash research purposes. Whatever the reason, all incidents that result in freeway closures should be logged. The route, mile marker, time of closure, time of opening, duration and cause of closure should always be documented in some way.

Eventually, all Freeway Management Systems (FMS) (see Chapter 1303) will have incident logging capabilities. The Ohio Transportation Information System (OTIS) (see Section 1501-3), also has incident logging capabilities which are currently available to all ODOT Districts. In the future, these two may be linked.

608-4 Permitted Lane Closure Schedules (PLCSs)

Permitted Lane Closure Schedules (PLCSs) for freeway and roadway segments should be evaluated for every incident. For more information on ODOT PLCSs see Section 630-4. A complete list of PLCSs is contained on the ODOT website at http://plcm.dot.state.oh.us (Table 197-3). Ideally, such schedules would be established for all highways to manage delays due to incidents and recurring congestion. Additional benefits of using PLCS requirements include reducing exposure of fire personnel, EMAs, law enforcement, and other responders to traffic hazards, and reducing the danger of secondary crashes to the public. Priority should be given to PLCS segments for all types of incidents, including crashes and diesel spills. It may not be possible to expedite the opening of PLCS segments for every incident (for example, some hazardous material (HazMat) incidents and unusual circumstances). However, all agencies should make every effort to follow the protocols and attempt to open lanes as soon as possible, particularly in order to not violate PLCS closure restrictions.

608-5 Reserved for Future Use

This space is reserved for future use.

608-6 Detour Playbook

The ODOT Detour Playbook, usually referred to simply as the Playbook, is a set of predetermined detour routes for PLCS segments across the State. Each detour is referred to as a Play. Originally, the detours were developed by each District individually. The detours for each District were compiled and stored in a variety of ways available in hard copies and/or electronically. These detours or “Plays” were consolidated by Central Office and integrated into the Playbook. Currently, the Playbook can only be accessed by ODOT personnel on the intranet using the link provided in Table 197-3. In the future, the Playbook may be made available to other non-ODOT agencies, but the process for this distribution is still being developed.

For incidents that result in excessive closures, it is suggested that a Play (detour) be enacted. This will help to reduce congestion around the incident scene and will help to protect first responders. It should be noted that only PLCS segments will have Plays available. If a non-PLCS is expected to be closed for an extended amount of time it is recommended that a detour also be established to assist with traffic, but this detour will need to be created and implemented at the incident scene. If an incident results in a Play being used, the various agencies in the area should review the effectiveness of the chosen Play during the debriefing, or after-action meeting. At the debriefing, improvements to the Play and overall incident response should be discussed. See Section 608-2 for more information on debriefings.

When the Districts draft new Plays or revise old ones, the affected local jurisdictions should be consulted to review the plan, provide comment, and exchange or update contact information. Each District should update their Plays prior to each construction season to reflect any necessary revisions that may be caused by construction or changes to the roadways.
Currently, ODOT is developing procedures for HazMat spills. Although HazMat incidents constitute a small percentage of the incidents occurring on Ohio’s roadways, they are responsible for a large portion of the delay. Several endeavors are underway to address these incidents. At this time, ODOT is to contact a contractor or HazMat Team to perform the cleanup. However, a specific HazMat contract may be developed by the OTE to help facilitate this process in the future.

608-8 Diesel Spills

608-8.1 General

The cleanup of diesel spills is a reoccurring problem in Ohio. In the past, small scale spills (less than 300 gallons) have caused roadways to be closed for hours. Through task force discussions, it was estimated by the Ohio Environmental Protection Agency (OEPA) that approximately ninety percent of freeway closures are the result of spilled or leaked diesel fuel from commercial vehicles. After examining these incidents, it was determined that a new set of procedures needed to be established to help facilitate the timely cleanup of diesel spills.

Diesel spills have often resulted in travel lanes remaining closed to motorists for an extended period. These delays are most commonly attributed to the fact that the trucking company responsible for the cleanup cannot be contacted or cannot provide cleaning operations in a timely manner.

ODOT has established a uniform statewide procedure, overseen by the Division of Operations, to provide for removal of small diesel fuel spills from freeway travel lanes by ODOT staff. This procedure shall only apply to those areas covered under the PLCSs (see Sections 608-4 and 630-4) see Section 608-8.9 for guidelines on how to handle diesel spills on Non-PLCS roadways.

608-8.2 For PLCS Segments

608-8.2.1 General

The diesel spill cleanup activities are intended to expedite the opening of freeways and freeway lanes to traffic that are closed due to crashes, where:

1. Only a small quantity of diesel fuel has leaked or been spilled on the roadway surface, and
2. No other reasonable means is available to quickly and safely open the lanes.

These cleanup operations are in addition to performing ODOT’s usual traffic control activities, and will be performed under the supervisor’s direction. It is anticipated that the ODOT Highway Technician (HT) supervisor will be the County Manager and that the Freeway Service Patrol (FSP) operators’ supervisor will be the FSP Manager or the Highway Management Administrator (HMA). Supervisors and managers are required to direct staff to perform activities only within each person’s training capability, in cooperation with the first responders, and within the Incident Command System (ICS). See Section 608-9 for more information on ICS.

The following restrictions and criteria apply to ODOT diesel fuel spill cleanup activities, and are described in further detail later in this Section:

- Only personnel trained for diesel cleanup may participate in the handling of absorbent materials and diesel spill cleanup activities.
• The cleanup is limited to diesel fuel only.
• The cleanup is limited to 300 gallons of diesel fuel or less.
• This is a quick clean and is an expedient measure to quickly and safely open travel lanes to traffic.
• ODOT personnel will not use plugging material on tanks without additional required training.
• Follow the ICS. ODOT will cooperate with first responders and follow the ICS (see Section 608-9).
• Cooperate with first responders and OEPA at the County Manager’s direction.
• No contaminated material may be brought back to an ODOT facility.

608-8.2.2 Diesel Spill Training

Training is required for each ODOT Highway Technician assigned to a county with a PLCS segment of freeway. It is recommended that County Managers and other ODOT staff involved with incident management also attend the diesel spill training. The ODOT Office of Training, in cooperation with the Ohio Fire Academy will provide the diesel spill training, which will be presented in two parts. Part 1 consists of the HazMat and WMD (Weapons of Mass Destruction) Awareness training course provided by the Ohio Fire Academy. Part 2 consists of ODOT training, provided through the ODOT Office of Training. Part 2 will focus on ODOT-specific diesel spill cleanup initiatives and provides hands-on instruction.

Part 1 of the training is complete for all current HTs in counties with PLCS segments, and Part 2 will be implemented within the next several months. Additional training sessions will be provided as necessary for new hires. Questions concerning training and procedures may be referred to the Division of Operations.

It is recommended that County Managers, FSP Managers, and HMAs attend ICS training to help facilitate more effective diesel spill cleanups and incident management in general. HT staff will work under the supervision of their usual supervisors, all working within the ICS approach (Section 608-9).

608-8.2.3 Cleanup Procedures

ODOT’s diesel spill activities include evaluation of the material and quantity spilled or leaked, clearance from first responders and consideration of other options for spill removal. These activities are regulated to provide safety to ODOT staff and criteria for efficient cleanup.

Incident notification is to remain unchanged. Districts will receive notification of an incident in the usual manner. Activities related to diesel spills will be initiated based upon requests from first responders or ODOT incident management staff, when first responders confirm that no other hazardous materials are likely to present a danger to ODOT responders.

HT staff who encounter a leaking fuel tank are to follow the established safety procedures listed below, and will follow the instructions provided during the HazMat and WMD Awareness training course, including evaluating placarding, consulting the Emergency Response Guide (ERG) and exercising appropriate caution. HT staff will not approach a vehicle which appears to contain materials which may endanger them.
Freeway Service Patrol (FSP) operators or other staff may encounter hazardous materials incidents as part of their normal activities, or ODOT may receive a request for assistance from a responding agency. When ODOT receives notification of a fuel spill, the following factors shall be addressed:

1. Is the spill diesel fuel? If the truck is placarded for hazardous materials and first responders are not available or are not able to verify that the only leaking material is diesel, the HT staff will not approach the vehicle. HT staff shall not clean up gasoline and other non-diesel fuel spills. However, HT staff may provide absorbent material and other supplies and equipment to first responders to use in the cleanup of non-diesel spills. Examples of absorbent material include clay (kitty litter), special purpose fuel absorbers (e.g. Floordry or Petesorb), or hydrophobic mat or roll material.

2. Is the spill reportable? A reportable spill is 25 gallons or more or any amount in a waterway. While the party responsible for the spill is required by law to report it to OEPA, ODOT should report a spill to OEPA even if other agencies indicate that it has been reported.

3. Is the spill quantity 300 gallons or less, which is defined as an incidental spill? As an aid in estimating the spill quantity, a typical full saddle tank contains 150 gallons. If both of a semi-tractor trailer’s saddle tanks were full and began leaking, the leak would not be more than 300 gallons. If the incident involved a tanker carrying diesel fuel cargo with a cargo tank leak, it should be assumed that the leak is more than 300 gallons. In that case, ODOT HT staff would not be allowed to participate in cleanup activities. However, once again, HT staff may provide absorbent material and other supplies and equipment to first responders to use in the cleanup of releases larger than 300 gallons.

If a truck’s saddle tank is leaking diesel fuel, in addition to using absorbent material, the HT staff may place a collection pool under the leak to contain it. However, HT staff may not use leak plugging products (referred to as Plug and Dike) without attending the applicable, more extensive training. For more information, contact the ODOT Office of Training. HT staff may provide leak plugging materials or other supplies and equipment to first responders who have been trained to use it in stopping the leak.

608-8.2.4 Removal and Disposal

After the diesel fuel spills have been contained and absorbed, the used absorption material shall be moved to the shoulder or berm, placed in a barrel or placed on and covered with visqueen sheets, as appropriate. Weight shall be placed on the visqueen sheets to prevent wind or water from disturbing the material. After removing the diesel fuel and absorbent material, coarse sand shall be applied to the roadway surface to provide traction. Under no circumstances shall the used absorbent material or other material with diesel fuel to be brought to an ODOT facility. ODOT District personnel shall follow up to ensure that OEPA requires the responsible party to remove the absorbent material and other incident debris.

The ODOT diesel spill cleanup is a statewide initiative to provide a safe and quick option for opening freeway travel lanes to traffic when diesel is involved. This initiative is not intended to replace cleanup by the trucking company, its insurer or a cleanup service for the insurer. This procedure is intended for those situations in which the closure violates the PLCS or the County Manager determines that the closure is excessive due to lack of available cleanup services. The goal is to safely and efficiently restore traffic flows.

608-8.2.5 Documentation

As noted in Section 608-3, it is important to log traffic incidents. The ODOT HT or FSP staff who responds to a diesel spill incident shall document the incident. Some Districts
may choose to use existing documentation for this and some may create a special diesel spill response form. For recommendations, contact the Office of Traffic Engineering (OTE). The information collected shall be as complete as possible for each spill addressed by ODOT and shall be maintained in a District file. The information listed below should be documented for each spill.

- Time/date.
- Location (Roadway, County, milepost location).
- Estimated amount of diesel on roadway.
- Weather conditions.
- Responders on site (ODOT, OEPA, etc.).
- Name of trucking company.
- License plate number.
- Driver’s name.
- Fire/Police incident number.
- Time/Date on and off site.
- Information for cost recovery (material used) – type and amount.

Any reporting and documentation required by OEPA should also be followed. See the OEPA homepage or the web site listed in Table 197-3 for more information.

608-8.2.6 Additional Requirements

It is recommended that a copy of the Emergency Response Guide (ERG) be available to each spill responder. Districts may decide to keep the documents in State vehicles, to require each HT employee to carry them when on duty, or use other means of making them readily available. Training for use of the ERG is provided in the HazMat and WMD Awareness training course (Part 1) and copies are provided to HT staff at the Part 2 training. The ERG provides critical information for isolation zones and other criteria for use by anyone who encounters an incident involving a HazMat.

Each county with PLCSs is expected to have ready access to diesel spill equipment and supplies. Counties with PLCSs segments in which an Emergency Management Agency (EMA) routinely provides hazardous material cleanups may request a waiver from the ODOT Division of Operations Deputy Director, based on a District’s agreements with the local EMA that will exempt them from the storage of diesel spill cleanup material.

608-8.2.7 Program Evaluation

ODOT will use QARs to verify that personnel have current knowledge of policies and procedures, and to share best practices information.

608-8.3 For Non-PLCS Segments

On non-PLCS highway segments, the usual cleanup methods apply. These include response by the trucking company, its agent, the fire department or other responding agency. In some situations, the County Manager or District may decide that traffic volumes or other
circumstances warrant an ODOT response. The various limitations on ODOT response (maximum of 300 gallons of diesel fuel, diesel fuel only, etc.) noted in Section 608 shall also apply under these circumstances.

**608-9 Incident Command System (ICS)/National Incident Management System (NIMS)**

As noted in Subsection 608-8.2.1, all ODOT personnel working on an incident scene will be required to follow the Incident Command System (ICS). In the ICS there is an Incident Commander (IC) who functions as the leader for the incident response. Usually this role is held by the fire chief for large incidents, but other high ranking first responders may hold the position as well. Also, the position may change hands, from one IC to another, based on the stage of the incident clearance. For example, the fire chief may be in charge until all the victims have been removed from the scene. At this point, a police officer may take control to facilitate the vehicle removal process.

The ICS can also be classified under a unified approach. This means that there will be many leaders on the incident scene who will take charge of different tasks that need to be accomplished. All of these leaders will then report to one central IC who will help to facilitate the overall operation and who will not have to worry about the details of individual aspects of the incident response.

Incident management responders should also use the guidelines set forth by the National Incident Management System (NIMS). The address for the NIMS web site can be found in Table 197-3. Training for both the ICS and NIMS can be obtained through ODOT. Contact OTE for more information on these programs.

**608-10 Freeway Service Patrol (FSP)**

**608-10.1 General**

Freeway Service Patrols (FSPs) are another important component of incident management. Incidents have a negative impact on the efficient operation of freeways and FSPs help to minimize this impact. The mission of FSPs is to improve traffic safety and maintain traffic flow by efficiently clearing freeway travel lanes and shoulders of obstructions, and by assisting in traffic control around incidents. FSP services are currently being provided for the following metropolitan areas:

- Toledo District 2
- Akron District 4
- Columbus District 6
- Dayton District 7
- Cincinnati District 8
- Cleveland District 12

FSP operations are generally funded by Districts; however, one District has contracted out their FSP using outside funding. Also, some Districts have elected to provide limited FSP services in work zones in rural areas, particularly during holiday weekends and other peak travel times, to reduce the impacts of crashes and other incidents in areas with reduced capacity.

For any metropolitan area with a Traffic Management Center (TMC) (see Section 1303-1), which included Columbus and Cincinnati as of 2007, the FSP operators interact closely with TMC staff to exchange incident locations and pertinent information.

**608-10.2 FSP Hours of Operation**

The hours of operation for FSPs are anticipated to approximate the hours of peak traffic demand, since the FSP services provide the most benefit during this timeframe. Districts
may elect to provide FSP coverage beyond the hours of the local TMC and beyond the areas covered by a Freeway Management System (FMS.) However, in these cases, **Districts** shall provide a plan for the safety and direction of the FSP operators when they do not have radio communication or direct supervision from the **District**. There shall also be a redundant facility(ies) which will provide limited coordination and assistance to the FSP, during any FSP hours extending beyond TMC hours.

### 608-10.3 Duties of FSP

The FSP operators shall assist motorists, remove debris from travel lanes, assist with traffic control for major incidents, address small diesel spills (with the same restrictions as the HTs; see **Section 608-8**), and tag for future removal abandoned vehicles which are not blocking travel lanes. As noted in **Subsection 608-10.4** the FSP operators shall at times also use the road grip tester while patrolling.

FSP operators also need to be alert to traffic as well as the subject vehicle, maintain cell phone or radio communication with the TMC, record license plates before approaching a vehicle, and use caution and safe operating procedures to ensure their own safety. Communication with law enforcement and other FSP operators is essential, particularly in areas without a TMC or during times without **District** radio communication.

FSP operators shall document their activities. This log information is entered into a database for future use. The logs of incidents, summarized in the database to provide the necessary performance reviews, shall contain at least the following information:

- Driver and vehicle.
- Incident location and type.
- Start time and end time of assistance provided.
- Type of assistance provided.

If a vehicle is blocking a travel lane, the FSP operator should assess the situation by pushing or pulling the vehicle from the travel lanes onto the off ramp, when practical, or the shoulder, and then call for law enforcement assistance, as needed. If a motorist refuses to allow the vehicle to be moved, the FSP operator should explain that they are causing a hazard not only to oncoming motorists, but to themselves as well. If the motorist still refuses, the FSP shall promptly contact law enforcement and wait for them to enforce the removal.

### 608-10.4 Reserved for Future Information

This space is reserved for future use.

### 608-10.5 Evaluation

Each **District**'s FSP program will be evaluated quarterly to review conformance to general **ODOT** policies as well as specific FSP guidelines. The quarterly review will include:

- Conformance to policies, in regard to routes and time per assist. Any assist exceeding 15 minutes duration (unless **ODPS**, the fire department or police are involved) shall be...
documented to evaluate need and appropriateness of time spent.

- Conformance to general ODOT policy regarding employee conduct, safe vehicle operation, FSP operator safety, incident response procedures, correct data entry, etc.

- Review procedures for courteous and safe motorist assistance, distribution of customer response cards, etc.

The response data shall be recorded for evaluation and identification of areas exceeding requirements or needing improvement. The District TMC managers, FSP operators and OTE will work together to further develop minimum and desirable levels of service through the QAR process.

608-11 Buckeye Traffic Website

The Buckeye Traffic website (www.buckeyetraffic.org) offers snapshots of the video provided by CCTV cameras (see Section 1303-2), traffic, construction, weather and incident information. The link for this site is also available in Table 197-3. It is intended that this website will eventually display images from most, if not all, fixed and maneuverable CCTV cameras and webcams with Ohio traffic information.

Currently, the Buckeye Traffic website provides information for current lane closures to the public. Intercity travelers have the benefit of this information in their trip planning and decision making. Advance knowledge of road conditions and incidents may influence travelers to reroute, postpone or cancel a trip. If changes are not an option, the system lets drivers who do not alter their plans know to expect delays and they are able to plan accordingly. Historical information is only available to ODOT personnel at this time.

Districts are required to report all lane closures and enter them into the system. This includes both partial and full highway closures. Knowledge of these closures is critical for improvement. It also provides an essential ability to compare incidents to find similarities, and in turn enhancements, that need to be made to the incident management process. It is ODOT’s goal to keep the roads safe and open to the public, but sometimes, partially or completely closing the roadway is necessary. In these cases, the extent and duration of the closure should be minimized. Events such as this may be identified using Buckeye Traffic.

608-12 Ohio Transportation Information System (OTIS)

The Ohio Transportation Information System (OTIS) provided information on the web about construction, weather and incidents on Ohio highways. In 2008, the information in this system was incorporated into the Buckeye Traffic website.

608-13 Evacuation Plans

Currently, ODOT is developing evacuation route plans for the metropolitan cities in Ohio. It is anticipated that many of the plans will include contraflow operations on freeways in the evacuation areas. These route plans will be combined with procedures from other first response agencies in the future to help build an actual evacuation plan. Emergency plans will be coordinated with local jurisdictions and will be updated as new information becomes available.
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620 MATERIALS AND HARDWARE

620-1 General

Many features along a roadway and particularly within work zones present a hazard to the traveling public. These may be fixed objects, drop-offs, severe slopes, opposing traffic, construction materials and equipment, etc. In these instances, a positive means of separating traffic from these hazards must be employed.

Portable barrier, portable water-filled barrier, and guardrail are appropriate positive barriers for maintenance of traffic applications. However, the use of these positive barriers must be carefully considered on non-freeway / expressway routes due to property access concerns.

620-2 Safety Criteria

620-2.1 National Cooperative Highway Research Program (NCHRP) 350 Criteria

Work zone safety features, including barriers and impact attenuators, installed on the National Highway System (NHS) must demonstrate satisfactory crashworthy performance based on the National Cooperative Highway Research Program (NCHRP) 350 Report, Recommended Procedures for Safety Performance Evaluation of Highway Features, to be accepted by FHWA. The dates for mandatory compliance vary with different types of equipment. Section 620-7 provides a detailed discussion of NCHRP 350 compliance.

ODOT has determined that the NCHRP 350 criteria shall apply to any ODOT-maintained highway regardless of whether or not the highway is on the NHS. The NCHRP safety criteria can be found on the FHWA website under the Programs handled by the Safety Section, see Table 197-3.

620-2.2 Other Safety Criteria

In addition to the NCHRP 350 criteria, any work on ODOT-maintained highway shall meet the requirements of the OMUTCD and TEM.

Materials and equipment used on projects in the State of Ohio which are neither on the NHS nor on the state highway system must meet the criteria of the OMUTCD.

620-3 Sheeting

Faces of construction signs shall be retroreflectorized with Type G or Type H sheeting complying with CMS 730.19 and 730.192. Except for Warning Signs used in incident management areas, the background color of all construction Warning and Guide Signs shall be fluorescent orange as per CMS 614.03. For information regarding sheeting on other signs, see Section 220.

For Warning Signs in incident management areas, the background color may be fluorescent pink.

Guidelines for sheeting quality are provided in ODOT’s Quality Guidelines for Temporary Traffic Control Devices (Section 695-4). This document may be viewed on-line at: www.dot.state.oh.us/Divisions/Operations/Traffic/publications2/qualityguidelines/Pages/default.aspx.

620-4 Temporary Sign Supports

Temporary sign supports shall meet NCHRP 350 guidelines (Sections 620-2 and 620-7) as well as the requirements of SCD MT-105.10.
620-5  Roll-Up Signs

Roll-up signs shall conform to ASTM D 4956 Type VI, and shall be retroreflective fluorescent orange or pink, as appropriate. The wind resistant sign supports shall meet the crash testing requirements in the NCHRP Report 350, and be approved for use by FHWA.

620-6  Pavement Markings

620-6.1  General

Work zone pavement markings shall conform to CMS 614.11. Additional information on pavement markings in temporary traffic control zones is provided in OMUTCD Section 6F.77 and Sections 605-11.10 and 605-11.11.

620-6.2  Materials

Either CMS 642 (temporary paint) or CMS 740.06 (temporary tape) may be used on any surface which will either be removed or covered by another surface in a subsequent maintenance of traffic phase. Temporary pavement marking which would conflict with final traffic lanes shall be removable CMS 740.06 (Type I tape).

620-6.3  Dimensions

The line dimensions shall be as specified in CMS 614.11. Line dimensions wider than those specified may be used in cases where increased delineation is necessary.

620-7  NCHRP 350 Compliance

620-7.1  History of NCHRP Report 350

The Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA) required the Secretary of Transportation to institute measures to enhance the crashworthy performance of roadside features to accommodate vans, mini-vans, pick-up trucks and 4-wheel drive vehicles. In recognition of this requirement, the 1993 National Cooperative Highway Research Program (NCHRP) Report 350, “Recommended Procedures for the Safety Performance Evaluation of Highway Features,” contained guidance for testing highway features with vehicles to access the safety performance of those features. The Federal rule making of 1993 adopted this report as the safety criteria to be used in the evaluation of all new installations of applicable highway features included in projects advertised for bids or installed by State forces or under force account work as the national standard on the National Highway System (NHS). The resulting nominal deadline for full compliance with the recommended guidelines in the NCHRP 350 Report was set at August 16, 1998. The safety criteria established by NCHRP 350 will be implemented on all roadways maintained by ODOT. The local public authorities at their own discretion can adopt NCHRP 350 as the safety standard on their roadways. However, all roadways maintained by local public authorities that are on the NHS must comply with NCHRP 350 requirements.

620-7.2  Categories

The following is a list of the categories, and examples of devices in each category:

1. Category 1 includes those items that are small and lightweight, such as channelizing and delineating devices. Included are items that have been in common use for many years and are known to be crashworthy by crash testing of similar devices or from years of demonstrable, safe performance. These include cones, tubular posts, flexible delineator posts, and plastic drums with or without lights.

2. Category 2 includes devices that are not expected to produce significant vehicular
velocity change but may otherwise be hazardous. Examples of items in this category are barricades, portable sign supports, intrusion alarms, and the following devices with lights mounted on them: vertical panels and cones.

3. **Category 3** includes hardware that is expected to cause significant velocity changes or other potentially harmful reactions to impacting vehicles. Examples are concrete protection barriers, fixed sigh supports (mass > 100 lbs.), crash cushions, and other work zone devices not meeting the definitions of Category 1 or 2.

4. **Category 4** includes portable or trailer-mounted devices such as flashing arrow boards, temporary traffic signals, area lighting supports, and portable changeable message signs.

620-7.3 **Responsibilities**

620-7.3.1 **Office of Roadway Engineering (ORE)**

NCHRP 350 issues relating to roadside barriers, end treatments and impact attenuators come under the responsibility of the Office of Roadway Engineering (on-line at: http://www.dot.state.oh.us/Divisions/ProdMgt/Roadway/Pages/default.aspx).

620-7.3.2 **Office of Structural Engineering (OSE)**

Permanent bridge railing and bridge mounted portable barriers are the responsibility of the Office of Structural Engineering. The implementations of these items have been addressed in their Bridge Design Manual in Sections 304.1, General and 304.3.5, Portable Concrete Barrier – Standard Bridge Drawings PBC-91 (on-line at: http://www.dot.state.oh.us/Divisions/Operations/Structures/standard/Pages/default.aspx).

620-7.3.3 **Office of Construction Administration (OCA)**

The provisions of NCHRP 350 also apply to safety hardware and temporary traffic control devices used on construction projects. This information has been incorporated into the Construction and Materials Specification book in section 614 Maintaining Traffic (on-line at: http://www.dot.state.oh.us/Divisions/ConstructionMgt/Specifications/2008CMS/2008Specbook.aspx).

620-7.3.4 **Office of Traffic Engineering (OTE)**

All work zone traffic control devices listed in Categories 1, 2, 3 and 4 that are not listed as an area of responsibility for the Offices of Roadway Engineering, Structural Engineering and Construction Administration are the responsibility of the Office of Traffic Engineering.

620-7.3.5 **Districts**

All work zone devices purchased for use by maintenance crews after the implementation dates shall be NCHRP 350 compliant. The District should require all suppliers to provide a copy of the acceptance letter for all Category 1, 2, and 3 devices before any purchase is finalized if not on the Office of Materials Management’s website of approved devices.

A listing of NCHRP 350 compliant devices may be found at the following website: http://www.dot.state.oh.us/Divisions/ConstructionMgt/Materials/Pages/TRAFFIC-CONTROL-DEVICES-IN-Work-Zone.aspx.
630-1 General

The information in this Chapter is provided to assist planners and designers in the planning phase of a project or work assignment. For example, Section 1400 of the L&D Manual Volume Three indicates that a Maintenance of Traffic Alternative Analysis (MOTAA) will be performed and that is addressed in Section 630-5. Various tools that are available are also addressed herein and this information is intended to help in making the choice of which tool to use and how.

630-2 Compendium of Traffic Control Options

Tables 697-1a through 697-1f provide a summary of various traffic control strategies/options used to maintain traffic through work zones or to direct traffic around work zones, along with advantages and disadvantages of these strategies. These options should be reviewed in the initial stages of any project.

630-3 Detours

Because temporary traffic control is an essential part of the overall project design and can often affect the design of the facility itself, the decision to either maintain traffic on the existing facility or to utilize a detour must be made early in the planning process. Some of the items that should be considered are:

1. Type of project.
2. Length of project.
3. Duration of project.
4. Volume and type of traffic.
5. Availability of detours or alternate route.
8. Geometric requirements.
10. Effect on local activities and residents.
11. Construction techniques.
12. Pavement types.
13. Economics.
15. Adequacy of adjacent highways for use as detours, and the prohibition of construction and maintenance work along the detours while in use.
16. Railroad Grade Crossings.
In general, projects with detours shorten construction time, are less expensive to construct, and are safer for construction personnel. On the other hand, maintaining traffic generally is more convenient for the road user and has a less detrimental effect on local activities.

630-4 Permitted Lane Closure Schedules (PLCSs)

Lane closures on Interstate and other freeways shall meet the minimum criteria presented in Policy 516-003(P) (see Section 601-2 and Chapter 1511). On the basis of this policy, ODOT has developed a series of lane closure schedules. These schedules indicate the hours of the day in which a lane closure is permitted at a subject work zone location. Maintenance of traffic (MOT) plans shall be in conformance with the permitted lane closure schedule (PLCS). However, as discussed in the policy, exceptions may be permitted, based on results of a queue length study or by waiver from the Multi-lane Coordinator (MLC) (see Section 601-2 and Chapter 1511).

If it is found that lane-closure requirements cannot be met at a reasonable cost at the subject work zone, the District has the option of applying to the Multi-Lane Coordinator (MLC) for a waiver or modification of the lane closure restrictions at the site. If such waiver is not approved, the maintenance of traffic plans shall be revised to meet the requirements of the PLCS.

The PLCS is available on the OTE website at the following address: http://plcm.dot.state.oh.us.

630-5 Maintenance of Traffic Alternative Analysis (MOTAA)

As noted in Section 630-1, Section 1400 of the L&D Manual indicates that a Maintenance of Traffic Alternative Analysis (MOTAA) will be performed. This analysis shall be submitted during the Preliminary Engineering Phase for review and approval for any projects following Paths 4 or 5 of the Project Development Process (PDP). For PDP Path 3 projects, only work zones on the Interstate or Interstate look-alike system need to be analyzed. Like many analyses, the MOTAA may not be applicable to certain projects. Specifically on urban/downtown projects, the consultant should meet with Central Office and District personnel to determine how the MOTAA should be completed.

The purpose of the MOTAA is twofold. First, it provides ODOT with information for use in determining if a part-width construction or crossover construction scenario is better for a given work zone. Secondly, it identifies potential problems, i.e., “constraints” with the various scenarios and allows ODOT to make an informed decision on how to address these problems prior to the actual detailed design of plans.

A Maintenance of Traffic Alternative Analysis (MOTAA) shall address the following requirements:

1. For Non-Interstate and Non-Interstate Look-alike Work Zones (Projects on PDP Paths 4 or 5):
   a. Investigate maintenance of traffic for each alternative.
   b. Include an evaluation of maintenance of traffic for ramps, local roads and cross streets.
   c. For each alternative determine:
      i. Number of lanes to be maintained.
      ii. Type of maintenance of traffic (i.e., signalized, detoured, part-width, runaround, crossover, etc.).
      iii. Lane widths.
iv. Typical sections.

2. For Interstate and Interstate Look-alike Work Zones (Projects on Paths 3, 4, or 5):

Analyze the maintenance of traffic (MOT) for both part-width construction and crossover construction. Should the part-width and crossover alternatives prove to have significant MOT constraints, or prove impractical or otherwise not possible to construct, the analysis should then include the contraflow technique as one of the possible alternatives.

a. Provide a Lane Configuration Diagram (schematic or sketch) covering the entire project length. Include the following information on each Diagram (see Figure 698-10):

i. Arrows showing lane use, including merging and diverging ramps in relation to work areas and barriers.

ii. All bridges.

b. Provide cross sections between every interchange, on every bridge, at merge and diverge points (ramps), where overpass piers are present, and at other “pinch” points. Where bridge widths vary, show the narrowest part of the bridge. Cross sections shall be shown for all phases of all construction alternatives (part-width, crossover, contraflow, etc.) Existing cross sections shall also be included (see Figure 698-10).

The following shall be used to create the above cross sections.

i. The number of lanes to be provided during construction shall satisfy ODOT’s Policy 516-003(P), Traffic Management in Work Zones Interstate and Other Freeways (see Section 601-2 and Chapter 1511).

The number of lanes required by this work zone policy is a starting point for the analysis. It is not meant to imply that a work zone policy exception will never be needed. In fact, ability to meet the work zone policy is one of the constraints that will be specifically examined in 2c. As noted in Sections 601-2 and 630-4, the permitted lane closure schedules (PLCSs) on ODOT’s web page define what hours a lane reduction is allowed on any segment of Ohio’s Interstate and Interstate Look-alike system. Any work zone that violates the PLCS will require a detailed queue analysis per the work zone policy and an exception request, if necessary, depending on the outcome of the queue analysis.

ii. Typically show 11 foot lanes unless a narrower lane(s) provides significant benefits in terms of mitigating maintenance of traffic constraints as discussed in 2c. It is permissible to utilize 10 foot lane(s) on bridges where insufficient space cannot provide for all lanes to be 11 foot; however, the wider lanes are preferred whenever feasible. Show lane widths on cross sections.

iii. All exit and entrance ramps are to be maintained with the same number of lanes during construction as pre-construction.

iv. A minimum 1 foot clearance will be provided between lanes and barrier toes. Show all clearance/buffer widths on cross sections.

v. Show existing beam spacing on bridge decks.

vi. Show bridge deck cut lines in relationship to existing beams. Give the length of cantilevered section of bridge deck after the cut line.

vii. Show a 2 foot paved shoulder where possible; and indicate locations where this is not possible.
c. Provide a table of constraints for the two alternatives (part-width and crossover construction) in the form of a “Constraint Table” (see Form 696-1a). Provide the same information for the contraflow alternative when applicable. In addition to this table, highlight any areas where the cross section required by ODOT’s Policy cannot be provided (e.g., cannot provide a 2 foot paved shoulder in a particular area.)

All of the constraints should be explicitly covered in the analysis. Do not provide general responses such as “no difference between options.” In addition, if a constraint is identified, indicate the magnitude where appropriate.

Providing the required number of lanes, entrance ramp merge distance and maintaining the same number of exit ramps are important emphasis areas. Should it not be feasible or financially prudent to provide them, explain in detail the issues that preclude them from being provided.

The Constraint Table (Form 696-1a) shall include the following categories:

i. Ability to comply with Work Zone Policy 516-003(P) (Chapter 1511).

ii. Ability to maintain all entrance and exit ramps.

iii. Ability to provide required entrance ramp merge decision sight distance (Sections 607-13 and 607-15, and Table 697-10).

iv. Right-of-way impacts.

v. Environmental impacts.

vi. Bridge widths.

vii. Significant impacts for construction duration and construction costs.

viii. Significant impacts to earthwork, retaining walls, pier clearances, profile differences, etc.

ix. Ability to maintain existing drainage and lighting systems.

x. Constructability and construction equipment access.

xi. Location of crossovers.

xii. Access impacts to important traffic generators such as hospitals, fire departments, industries, sports arenas, etc.

xiii. Longitudinal joints for concrete pavement.

xiv. Estimated Maintenance of Traffic costs.

It is not the intent of the MOTAA to require a detailed design of each alternative’s work zone. It is intended to identify and compare major potential constraints of the work zone alternatives.

The MOTAA may be a factor in choosing the preferred alternative and will serve as the basis for scoping the project’s work zone design. The analysis should be a comparison of alternatives that documents maintenance of traffic constraints. It should address the benefits and problems between the alternatives.
The analysis shall be submitted concurrently to the District and the Office of Traffic Engineering. The analysis shall include a project description indicating the type of work. For Non-Interstate and Non-Interstate Look-alike Work Zones (Major Projects only) the information required in Item 1 of this Section shall also be provided. For Interstate and Interstate Look-alike Work Zones, the following shall be included in the submission:

- **Background Information and Description of Alternatives.**

- **Lane Configuration Diagrams and Cross Sections.** Lane Configuration Diagrams (schematic or sketch) for the entire project length as described in 2a of this Section. The cross sections shall be provided for the locations called for in 2b. In the Lane Configuration Diagram, along with each roadway schematic or sketch, the corresponding cross sections shall be displayed on the same sheet. Each cross section location shall have its own identifier, i.e., do not repeat section ‘AA’ at a different location(s). If a cross section is provided at the same location in several phases, it shall be identified the same in each phase to provide easy identification.

- **Form 696-1a, Work Zone Constraints.** This form shall be incorporated into the analysis report. The content of each box in the form should indicate if that work zone constraint will be an issue with each alternative (part-width or crossover, and contraflow when applicable) and the level of impact: Low, Medium or High for Cost, Duration and Constructability. Where a constraint is identified, it should be clear in which phase(s) of construction the constraint will be present. The constraint shall also be explained with sufficient information for ODOT to determine the magnitude of the constraint (see Form 696-1b for an example).

- **Form 696-2a, Bridge Information.** This form shall be incorporated into the analysis report if any bridges are included within the project limits. This includes underpasses and overpasses as well as pedestrian and bicycle bridges. The form shall include the extent of work being completed on the bridge, type of bridge (e.g., overpass, underpass), length of bridge, existing pier spacing, existing bridge widths, bridge widths needed for each MOT alternative, future bridge width, and additional costs associated with the MOT for each bridge in each MOT scheme. Columns may be added to the table as needed (see Form 696-2b for an example).

- **Form 696-3a, Ramp Information.** This form shall be incorporated into the analysis report. The table shall include the ramp designation, number of lanes, ramp volume, ramp truck volume, decision sight distance, whether the ramp will be open or closed (if closed – duration of closure), and detours for closures. Columns may be added to the table as needed (see Form 696-3b for an example).

- **Form 696-4a, Cost Comparison.** A table comparing the cost and project duration for each alternative analyzed shall also be included. The costs are just best available engineering estimates. Major cost differences between alternatives should be noted (e.g. temporary bridge widening, temporary pavement, portable barrier, additional right-of-way, retaining walls, etc. (see Form 696-4b for an example).

- **Rolled Plans for Complex Projects.** For complex projects, ODOT requires a set of rolled plans showing the entire length of the project. Each construction phase with its corresponding traffic phase should be color coded. A legend shall be provided showing different colors for permanent roadway, permanent bridge, temporary roadway, temporary bridge, etc. Cross-hatching shall be shown on each construction area that is critical for the next phase. Other items to be denoted using colors or symbols include ramp closures, structures to be removed or demolished, color coding for traffic routing, and arrows showing direction of traffic flow. A rolled plan shall also be included showing the existing profile and the proposed final profile of the entire project.

Complex projects, for this purpose, are defined as all urban projects, and non-urban projects which involve temporary pavements, significant localized alignment modifications from phase to
phase, etc. Projects which involve significant modifications to interchanges, with a high number of sub-phases, are also considered complex projects. Any project which involves more than two phases and a possible third phase to upgrade the shoulder could also be considered a complex project.

The MOTAA shall include a summary. It is not the responsibility of the design team to determine if one alternative is not feasible and therefore should not be analyzed. The alternatives should be analyzed and the information included in the report. ODOT will determine, based upon the analysis, which is the preferred alternative.

630-6 Conceptual Maintenance of Traffic

As noted in Section 140-7, Section 1400 of the L&D Manual requires that a Maintenance of Traffic (MOT) Conceptual Plan be submitted as part of the project development. This plan shall be based on the preferred alternative determined by ODOT after reviewing the MOTAA (see Section 630-5).

The MOT Conceptual Plan should include a stick drawing (schematic or sketch) of the preferred alternative covering the entire project. The drawing should include some, if not all, of the information listed in Section 630-5(2b). The information in Section 630-5(2c) shall be used to create the cross/transverse sections.
640 DESIGN INFORMATION

640-1 General

The goal of any maintenance of traffic strategy should be to safely route traffic through or around a construction area while providing room for the contractor to work effectively. Ideally this should be done while keeping the geometrics and traffic control as close to those for normal operating conditions as possible. This frequently requires the engineer to balance the needs of the contractor to construct the project with the needs of the traveling public to minimize delay, maintain safety and maximize cost-effectiveness. In order to adequately serve both the contractor and the traveling public, various maintenance of traffic strategies should be analyzed before determining the final strategy. The plans should have some built-in flexibility to accommodate delays or unforeseen changes in the work schedule, field conditions or traffic patterns. The impact on land owners must also be considered.

Per 23 CFR 630.1006, every plan shall have a Traffic Control, or Maintenance of Traffic (MOT), Plan (see Section 602-2) commensurate with the project's scope. This Chapter provides guidelines and references used in designing this MOT Plan. Generally, the Plan should include references to related SCDs and show details, notes, sequences, procedures, limitations, equipment, materials and other items required to maintain traffic. Chapter 641 provides additional design information related to specific typical applications and SCDs. Standard Plan Notes for temporary traffic control items are provided in Chapter 642.

Capacity constraints are vital considerations in preparing MOT Plans. In the following Sections, capacity constraints are discussed for various types of facilities. The traffic volumes used in each discussion of capacity are maximum values for which the corresponding lane closures can be used. Where traffic exceeds the constraining volumes, consideration should be given to limiting work to non-peak hours, establishing alternate routes or using the shoulder as a traffic lane. See other appropriate Sections, including Section 630-4 (Permitted Lane Closure Schedules), for further discussion on these considerations.

The designer must use engineering judgment in combining these guidelines with site-specific conditions to create a safe and efficient work zone environment. L&D Manual Volume Three, Section 1306 also provides the designer some guidance in developing MOT plans.

640-2 Geometrics

The following discussion of geometrics should be used as a guide where maintenance of traffic is to be accomplished using the existing facility. Geometric criteria to be used in designing and utilizing temporary roads are discussed in Section 640-11.

It is desirable to maintain lane widths equal to those on the existing facility. A reduction in the lane width will result in a reduction in lane capacity. The desired lane width on freeways and expressways is 12 feet. A 1.5 foot clearance from the edge line to the channelizing devices is also desirable. Where longitudinal concrete barrier is provided, a minimum clearance of 1.0 foot between the barrier and the adjacent travel lane shall be provided.

If lane width reduction on freeways and expressways is necessary, it is desirable to maintain a minimum width of 11 feet. Widths should not be less than 10 feet on any highway unless the lane widths on the existing facility are less than 10 feet. In no case shall the lane width be less than 9 feet. See Table 697-4 for required lane widths when the degree of curvature exceeds 10 degrees (horizontal curve radius is less than or equal to 500 feet). These lane width criteria shall also apply to freeway and expressway ramps. See the SCD MT-98 series.

Although the above criteria are considered to be desirable minimums, any additional pavement width should be made use of to provide 12 foot lanes and additional shoulder width, if possible, to maximize road-user safety.
On freeways and expressways, the lengths of acceleration lanes should be maximized to provide safe merging. See Section 641.12 and SCDs MT-98.10 and 98.11.

See Section 630-5 for guidance in determining appropriate geometric criteria during the Project Development Process.

Channelizing device offsets, discussed in Sections 605-11.2, should be provided in addition to lane widths. Attempts to provide larger offsets should be made whenever possible.

On spot improvement locations of very short length, such as bridge replacements or bridge reconstruction, (excluding Interstates and other freeways) where the clear roadway width (face to face of barrier or channelizing device) criteria stated above cannot be provided and a detour is not feasible, lateral clearance requirements to barriers and channelizing devices may be reduced. However, at no time on such a project shall the distance face-to-face of barrier and/or channelizing devices be less than 10 feet. See Table 697-4 for requirements on sharp curves (curve radius is less than or equal to 500 feet).

Where the horizontal alignment is to be altered from that of the existing roadway, the maintenance of traffic horizontal alignment shall conform to the criteria in L&D Manual Volume One, Sections 202.1 and 202.2. The designer should also ensure that the minimum stopping sight distance criteria in L&D Manual Volume One, Section 201.2 and the vertical clearances from L&D Manual Volume One, Section 302.1 are satisfied.

640-3 Sequence of Operation

The maintenance of traffic notes should include a sequence of construction activities to coordinate the maintenance of traffic details, especially on complex projects. The sequence should include any planned stages, phases or steps as well as particular procedures if appropriate.

A stage typically identifies a period in which work is concentrated in one section of the project site. Each stage may appear as a separate construction project, as the work in one section of the project site is completed before the work in another section of the site is begun. Consideration should be given to relocating advance Warning Signs with each stage change. Stages of construction may be separated by periods of inactivity. For example, this would be the case if the contractor is required to complete one stage by the end of one construction season, and is not permitted to begin the next stage until the beginning of the next construction season. Implementation of multi-stage construction is typically limited to large projects.

A phase typically identifies the duration of a specific traffic control set up. That is, at the point in time when one phase is ended and another phase is begun, a change in traffic control set up is involved. On freeway upgrading or resurfacing projects, the first phase often calls for traffic to be maintained on existing pavement while the shoulder is being improved for use as a travel lane in later phases. The final phase often calls for traffic to be maintained on the final pavement surface while miscellaneous work is being completed beyond the shoulder.

A step typically identifies a sub-phase. Often it becomes necessary to make modifications to the traffic control set up in one location within the project while the set up in general remains unchanged. There may be a small change in the construction activity taking place in one location, there may be a change in the location of the activity or the change in traffic control set up might be temporary. Any of these could be considered as an individual step if the designer finds a need for specifically identifying the set up.

On complex, multi-year Maintenance of Traffic (MOT) Plans consideration may be given to identifying project stages, phases and/or steps.
640-4  **Lane Closure**

Roadway construction often requires a reduction in the number of available lanes. This may require only a reduction in lane width or it may require complete lane closure. Lane closure may be required not only of the lane in which the activity is taking place, but also an adjacent lane in order to provide a barrier or a buffer between the workers and the vehicular traffic.

When there is a need to perform roadway maintenance or reconstruction in the interior lane of a freeway, an adjacent lane shall be closed in addition to the lane in which the maintenance or reconstruction is necessary. This additional lane may serve to provide access to construction traffic or equipment, or it may serve as a lateral buffer, see OMUTCD Figures 6H-37 and 6H-38. Caution is advised in the use of Figure 6H-38. Although this figure may be used to determine proper signing for splitting directional through movement, it does not provide for closure of the additional lane. Interior lane closure on ODOT projects shall be modified accordingly.

Before incorporating lane closures into the design of the MOT Plan, the effect of the lane closure on the traffic flow must be analyzed to insure that delay to the road users is kept within an acceptable range (see Section 640-13).

A minimum distance between adjacent lane closures should be provided. Suggested minimum distances are 2 miles in high-volume locations and 1 mile in low-volume locations. If the suggested distance cannot be provided, it is suggested that the lane closure be extended between the adjacent locations to form one continuous lane closure.

640-5  **Use of Shoulders**

640-5.1  **General**

Many maintenance of traffic situations require the use of either the full width or part-width of the paved shoulder as a traffic lane. Capacity, traffic characteristics, bridge width, work area location and existing shoulder characteristics all play a role in determining the extent of modifications and use of paved shoulders.

Any shoulder use for maintaining traffic requires evaluating the integrity of the shoulder pavement. Engineering judgment should be used in making this evaluation. The designer should consider the percentage of truck traffic and the existing pavement condition, including the composition.

SCDs MT-102.10, 102.20 and 102.30 are examples of use of the shoulder as a traffic lane.

640-5.2  **Provisions for Use of Shoulders**

When a shoulder is to be used as a traffic lane certain provisions shall be made:

1. Lane width, in accordance with Section 640-2, shall be maintained. This may require widening the existing shoulder.

2. The designer shall evaluate the strength of the shoulder and consider strengthening it or replacing it with temporary pavement.

   a. Shoulders used for maintaining traffic, which are determined to be of insufficient strength, should be completely removed and replaced in accordance with the requirements of L&D Manual Volume 1, Section 301.2 and the Pavement Design Manual (Section 194-11).

   b. Shoulders used for maintaining traffic, which are determined to be structurally sufficient, should also provide smooth travel. Provisions should be made to recondition shoulder surfaces that are rutted, raveled or otherwise insufficient.
3. The designer shall examine structures to ensure that sufficient width and height are maintained.

4. The designer should evaluate the roadside for obstacles which may require protection. Temporary protection may be required at obstructions that were not previously protected. In such a situation the clear zone values for the facility under normal conditions (L&D Manual Volume One, Figure 601-1) may be reduced by 12 feet, but shall never be reduced to less than 2 feet.

During any sequence of operations where traffic is to be maintained within 2 feet of the edge of the paved shoulder, the graded shoulder area adjacent to the paved shoulder should be considered for strengthening. A bituminous aggregate base placed 8 inches deep, or a composition with similar structural characteristics, should be specified for 2 feet beyond the edge of the temporary traveled lane. This treatment should be placed in conjunction with final graded shoulder treatments when such shoulder use is required on final surface course pavements. This treatment may be left in place.

Part-width use of shoulders may be required when either work or channelizing devices encroach upon the traveled lane adjacent to the shoulder.

Minimum clearance from existing obstructions may be reduced by 12 feet when traffic is shifted onto the shoulder.

640-5.3 Emergency Pull-Offs

When shoulders are used to maintain traffic over long distances, consideration should be given to providing emergency pull-offs in an attempt to minimize capacity reduction due to vehicle malfunction. This is particularly important when traffic is limited to only one lane in each direction. Signing for such pull-offs shall be erected in order to provide advance notice to the road user of the emergency pull-offs. These signs should be rectangular in shape, with black legend on orange background.

640-5.4 Existing Rumble Strips on Shoulders

Permanent, longitudinal rumble strips are often provided on freeway shoulders to alert the road user who diverts from the travel lane. Longitudinal rumble strips create a dilemma when providing lane-shifts in temporary traffic control zones. It may be necessary to remove or resurface longitudinal rumble strips when providing lane shifts. Or, if the temporary lanes can be aligned such that the wheels of the vehicles can straddle the rumble strip, it may be adequate to limit the rumble strip removal to the shift tapers.

640-6 Work Zone Drop-Offs

A pavement edge drop-off occurs when there is a vertical difference in height between adjacent road surfaces. Treatments for pavement edge drop-offs in construction work zones are shown on SCD MT-101.90. The drawing may be used as a designer's tool for determining the appropriate measures to specify in the plans for treatment or protection of drop-off conditions. The designer may also use it to develop designs or sequences of operations that would avoid or minimize drop-offs.

The treatments indicated on the SCD are intended for high-volume projects. For low-volume situations, a one-level drop in protection may be used, e.g., use drums instead of PB. For low-speed situations, protection may not be needed. In all situations, engineering judgment should be used to select the most appropriate treatment for each work zone.

Maintenance of traffic Plan Notes should address the treatment of any anticipated open trench areas. Whenever possible, it should be stipulated that trench excavating operations will not remove any more material than can be replaced by the end of each day's work. In areas where
this is not possible, or where adverse conditions prevent it, overnight trench openings shall be temporarily backfilled. See Plan Notes 642-14 and 642-15 in Chapter 642 for additional information.

640-7 Ramp Closure

640-7.1 Volume Considerations

In urban areas, consideration may be given to closing some entrance ramps. This can reduce the volume of traffic using the highway and minimize the negative effect on mainline traffic capacity caused by the ramp traffic merging onto the highway. Such closures could significantly improve traffic flow on the freeway; however, detours must be provided on the surface street system to handle the diverted traffic volume.

640-7.2 Geometric Considerations

Geometric conditions on ramps often make it difficult to perform work on the ramp while maintaining traffic. Consideration should be given to temporarily closing ramps and providing detours in such cases.

640-8 Detours

When a detour has been designated for a project (see Section 602-6), provisions must be made for erecting adequate Detour signing along with other appropriate traffic control devices. The plans shall specify all necessary detour traffic control in accordance with the O MUTCD and this Manual (also see related typical applications in Chapters 607 and 698). The plans shall provide the appropriate traffic control information, for installation by ODOT. On local or other projects where detour traffic control cannot be provided by the maintaining agency, the plans shall provide for installation by the contractor.

Reassurance Detour signing in rural areas should be erected at intervals not to exceed 2 miles. In urban areas, Detour signing should be spaced no more than two blocks apart.

640-9 Contractor Access

The traffic control plan shall address the need for access to the work zone. This is a particularly critical issue on freeways and expressways where concrete barrier protection is used. The designer must address the question of how to get equipment and material into and out of the work zone safely. The following should be considered:

1. Type of work zones likely to create ingress/egress problems (e.g., median work spaces that will require vehicles to merge into and out of high-speed traffic, work activities that require frequent delivery of materials such as paving projects.

2. Temporary acceleration and deceleration lanes for work vehicles should be provided.

3. The location of the access opening should provide good sight distance for oncoming traffic.

4. In extreme conditions – lane closures may need to be considered.

5. Openings in barrier walls should be planned to ensure the ends are properly protected and that the wall does not create sight distance issues.

6. Special warning signs may be necessary.

7. The use of Portable Changeable Message Signs should be considered.

On freeways and expressways using concrete barrier protection, the access points shall be laid
600 TEMPORARY TRAFFIC CONTROL

out as directed in PIS 209563.

640-10 Private Driveway Access

Except as noted herein, where private drives exist within the work area, access to the drives shall be maintained. It may be necessary to adjust the work procedures to work around the drives as much as possible and to provide temporary access to the drives when normal access cannot be provided.

At urban residential locations, access to residential driveways may be denied for a few hours at a time after adequate advance notice of closure has been provided to the residents of the property involved.

640-11 Temporary Roads

640-11.1 General

A temporary road is any crossover, runaround, ramp, roadway, etc., whose sole purpose is to temporarily maintain traffic during construction. After construction is complete, temporary roads are typically removed.

Temporary roads are required when the existing roadway is inadequate to properly accommodate both the work and the traffic. They may also be required in certain cases where bridge construction or reconstruction does not facilitate part-width construction or realignment to the extent that the existing facility can serve as the temporary road. The use of runarounds and temporary structures in such cases shall be evaluated by the designer for cost-effectiveness and public service.

640-11.2 Design Speed

The design speed used in designing temporary roads shall be that which is discussed in Section 640-18.1.

640-11.3 Geometrics

The geometric design of temporary roads should be commensurate with the chosen design speed. Pavement design criteria are provided under CMS 615. Typical roadway plans for temporary roadway are provided in L&D Manual Volume Three, Figures 1306-6s and 1306-7s.

The horizontal alignment of temporary roads shall comply with the criteria discussed in L&D Manual Volume One, Sections 202.1 and 202.2. Superelevation of temporary roads is discussed in the following Section. Spirals are not required.

Crest and sag vertical curves on temporary roads should comply with L&D Manual Volume One, Section 203.3 using minimum criteria. Maximum allowable grades are the values shown in L&D Manual Volume One, Figure 203-1 under hilly terrain for the appropriate design speed.

Stopping sight distances shall meet or exceed the minimum criteria discussed in L&D Manual Volume One, Section 201.1 and pavement cross slopes shall be as discussed in L&D Manual Volume One, Section 301.1.5.

The designer shall also ensure that vertical clearances in conformance with L&D Manual Volume One, Section 302.1 (existing structures to remain) are provided.

Additional general information regarding geometric design is provided in Section 640-2.
640-11.4 Superelevation

Except as noted in Section 640-12, superelevation on temporary roads should conform to the requirements shown in L&D Manual Volume One, Figure 202-8 for design speeds greater than or equal to 50 miles per hour and L&D Manual Volume One, Figure 202-9 for design speeds less than 50 miles per hour.

640-11.5 Lane Width

Lane widths of temporary roads should conform to the requirements discussed in Section 640-2.

Where horizontal curve geometrics are less than adequate for the temporary road conditions (Dc > 10 degrees), curve widening should be provided as called for in Table 697-4.

640-11.6 Guardrail Offset and Sideslopes

CMS 615.04, permits a minimum guardrail offset of 1.5 feet and a maximum side slope of 1.5:1. These dimensions are appropriate for absolute minimum design, but design above these values should be provided when feasible. For design speeds over 40 miles per hour, a minimum shoulder width and guardrail offset of 6 feet is desired and 4:1 side slopes are desired where right-of-way is available.

Barrier placement along temporary roads shall conform to the appropriate requirements of L&D Manual Volume One, Section 600.

640-11.7 Pavement

CMS 615.05, provides Class A and Class B pavement designs for temporary roads. These designs are intended to be specified on projects with large traffic volumes where the proposed project pavement design is stronger than either of these two designs. A temporary road pavement should not normally be stronger than the permanent pavement design of the project.

For a temporary road pavement design that is weaker than Class A or B, the design should be based on the anticipated total equivalent 18-kip single axle-load applications and determined from information contained in the Pavement Design Manual published by the Office of Materials Management.

For temporary road pavement that is to be used for a short time (less than two months) by moderate traffic volumes (2000 ADT or less), CMS Item 410 Traffic Compacted Surface, stabilized with CMS Item 616, may be provided.

640-12 Crossover Construction

640-12.1 General

For general information regarding crossover construction, see OMUTCD Section 6G.16 and Section 606-16. Further detail information on traffic control for crossovers is provided in the following Sections and in OMUTCD Figures 6H-39 and 6H-40, TEM Sections 607-12 and 607-13, Figure 698-4 and SCDs MT-95.70 and MT-95.71.

All temporary crossover areas shall be illuminated as shown on SCD MT-100.00, and the transition areas for temporary crossovers shall be delineated in accordance with SCD MT-99.30.

All temporary crossovers shall be removed at the completion of the current proposed work unless retention for future use is recommended and justified by the District. Any crossover
which is to remain for future use or left in place without use between construction seasons shall be camouflaged with an earth overlay so that the crossover area appears as part of the normal median.

640-12.2 Traffic Separation

The use of breaks in the traffic separation runs, to permit access, should not normally be allowed. For unusual circumstances where breaks are necessary, each end of the barrier shall be protected by a temporary impact attenuator.

640-12.3 Considerations for Reversed Flow

When a traffic diversion requires that two-way operation be maintained on a roadway which normally carries one-directional traffic, as is the case in crossover construction, the designer shall provide temporary barrier protection from hazards that are in the clear zone of the reversed movement. The designer should evaluate the project to ensure the proper barriers, bridge terminal assemblies, and guardrail end treatments, and to specify the appropriate changes or additions to barrier protection (see SCD MT-95.82). It is not necessary to change the lap in the existing guardrail.

640-12.4 Crossover Geometric Design

For guidance on traffic control for crossovers, see Section 640-12.1 and SCDs MT-95.70 and MT-95.71 and PISs 209572 and 209573. Figures 698-6 through 698-9 provide geometric detail information for two-lane crossovers. For single-lane crossovers, decrease all pavement widths by 12 feet, providing one 12-foot lane with 3-foot paved shoulders. The 3-degree reverse curves are appropriate for rural temporary crossovers. In urban areas the curvatures may be increased to 5 degrees provided the posted speed is reduced to 45 miles per hour. Superelevation for these curves shall be limited to 0.016 sloped toward the inside of the curves. Variations in design due to mainline curvature will be considered on a case-by-case basis.

The plans should detail temporary crossovers, including locations, horizontal alignment, typical sections, profiles, and pavement transitions to the existing pavement.

Crossover locations should be very carefully selected with traffic needs being the primary consideration. A tangent section on flat terrain is the most desirable location for constructing a crossover. The designer should field check possible crossover locations to select the optimum site and not necessarily choose the project limits as their location.

Regarding lane width on single-lane crossovers, there has been some debate in the past as to the proper width of the single lane. In discussion between OTE and the Office of Roadway Engineering, it was determined that this lane is to be 12-foot, with 3 feet of paved shoulder and 2 feet of aggregate shoulder on each side. This provides for the same typical section as does the two-lane crossover design provided in Figures 698-6 through 698-9, except that the pavement width is decreased by 12 feet. In the past, this drawing called for a 16-foot lane, as is typical of a permanent single-lane ramp, with a 1-foot shoulder on each side. However, a 12-foot lane width is adequate for a properly designed single-lane median crossover and will contribute to providing uniformity in temporary work zone geometrics among ODOT work zones.

640-13 Capacity

640-13.1 General

The following capacity restrictions should be evaluated for each project. The values have been developed to assist in identifying when traffic volumes may cause delays and/or backups during construction phases.
When traffic volumes exceed these values, other steps should be considered in preparing Maintenance of Traffic Plans. These include re-sequencing construction to allow additional lanes to be used, use of shoulders as traffic lanes, providing additional advance Warning Signs, use of alternate routes and corresponding signing, use of Portable Changeable Message signs or detours, and night work.

The above steps should be considered when the following conditions exist:

1. On two-lane highways where the ADT is greater than 6,000 (two-way) or where the peak hour traffic is greater than 600 vph (two-way).

2. On multi-lane non-freeway highways (more than two lanes, divided or undivided) where the directional ADT is greater than 14,000 per lane of traffic being maintained, or where the peak hour traffic is greater than 1,400 vph per lane of traffic being maintained.

On Interstate and other freeways, lane closures shall meet the minimum criteria presented in the Permitted Lane Closure Schedules (PLCSs), discussed in Sections 601-2 and 630-4. Development of the PLCSs is based on queue length analysis, in accordance with the criteria set forth in Section 640-13.2. If there is any question as to the validity of the lane closure schedule provided for a specific location, a queue analysis may be performed for the project site in an attempt to override the schedule provided in the PLCS.

640-13.2 Queue Length Predictions for Freeways

Except by waiver approval from the Maintenance of Traffic Exception Committee (MOTEC), queue lengths on freeways shall not exceed the maximum thresholds set forth in ODOT Policy 516-003(P) (see Chapter 1511). An analysis of traffic patterns within freeway sections shall be performed in order to develop maintenance of traffic strategies which attempt to meet these queuing thresholds. The queuing thresholds set forth in the Policy are as follows:

<table>
<thead>
<tr>
<th>Queue Length</th>
<th>Maximum Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 0.75 miles</td>
<td>Unlimited</td>
</tr>
<tr>
<td>0.75 - 1.5 miles</td>
<td>2 hours</td>
</tr>
<tr>
<td>&gt;1.5 miles</td>
<td>Not acceptable</td>
</tr>
</tbody>
</table>

ODOT has adopted the following procedure for predicting queue lengths in construction zones. The calculation is in two parts:

1. The first part requires use of the QUEWZ92 or QUEWZ98 software program to calculate the expected capacity through a given construction zone.

2. The second part requires the application of the calculated capacity to a spreadsheet program developed by ODOT for calculating potential queue lengths at a given construction site.

QUEWZ92 or QUEWZ98, which is an acronym for Queue and User Cost Evaluation of Work Zones, was developed by the Texas Transportation Institute (TTI) to calculate queue lengths in work zones and the associated costs of delay attributed to the reduction in available lanes. This program shall be used to calculate capacity, an intermediate output. Copies of the program may be purchased from McTrans Center (see Table 197-3).

Input requirements for the program are:

1. Number of directions in which lanes are closed (one or two);
2. Number of existing lanes for each direction;

3. Number of open lanes in work zone for each direction;

4. Length of the closure;

5. Time of the lane closure and work zone activity;

6. Traffic volumes (AADT or directional hourly counts);

7. Cost update factor, based on the Consumer Price Index (in today’s dollars expressed as a percent of 1990 dollars):
   
   Cost Update Factor, December 2000 = 133%; and any future cost update factors can be calculated as: Cost Update Factor = Consumer Price Index / 130.7;

8. Percentage of trucks; and

9. Design speed, work zone speeds (default values provided).

QUEWZ-98 allows for adding the excess emissions estimates to the road user cost output option.

It should be noted that no compensation for grade is called for in this software. However, based on field observations, it appears that truck traffic has a greater effect in decreasing capacity on a positive grade than on a negative grade. The designer should consider the potential effect of grade on projects by calling for shorter lane closures in areas of high truck volumes on single-lane uphill grades than would otherwise be specified.

The Intermediate Output provided by this program is expected capacity in vehicles per hour of day.

The program’s Final Output provides:

1. Length of queue by hour of day. This is not used for ODOT queue calculation; ODOT’s spreadsheet is used instead.

2. Cost of delay to the traveling public as a result of the traffic queue caused by a reduction in the number of traffic lanes. Since this is not relevant to the calculation of queue length, it is used only to determine an appropriate disincentive (see Section 640-24).

The capacity calculation provided by the QUEWZ92 or QUEWZ98 program as an Intermediate Output is used in the spreadsheet program to calculate the expected queue length. This spreadsheet program can be obtained by contacting the OTE Traffic Control Section. This volume is entered as both the free-flow work zone capacity and the queued work zone capacity.

The number of lanes of queued vehicles must also be entered. The designer should take into consideration the need for including the lane being closed in queue development. Observations have found locations in which there was very little volume stored in the lane being closed. At other locations the queue in the closed lane was the same length as the queue in the open lanes. In other cases, the closed lane carried only a fraction of the volume carried by the open lanes. The designer must determine individually how to account for the volume carried by the closed lane of a specific project.
640-14 Considering Holidays and Special Events

The designer should, in conjunction with the District Work Zone Traffic Manager, investigate the use of lane closure restrictions on Interstates and other freeways during holiday and other significant events.

The plan shall require the contractor to have all existing lanes (a number of traffic lanes equal to the existing highway) open to traffic during specifically designated periods. These requirements are in addition to the requirements identified in the Permitted Lane Closure Schedules discussed in Section 630-4 and the requirements identified in ODOT Policy 516-003(P) (Section 1511).

Lane closure restriction schedules for urban locations may differ from schedules for rural locations. Where rural location would be expected to carry high traffic volumes during holiday weekends, some urban routes, such as radial freeway segments leading to a central business district, may be found to carry less traffic during holiday weekends. An analysis of traffic patterns shall be made to determine whether or not it is appropriate to restrict lane closures for designated periods including holiday weekends.

The designated "lane closure restriction" periods shall be identified in the plan and may include, but are not limited to:

1. National holidays and holiday weekends:
   - New Years,
   - Memorial Day,
   - Fourth of July,
   - Labor Day,
   - Thanksgiving, and
   - Christmas.

2. Weekends with greater than normal travel:
   - Easter,
   - Mother's Day, and
   - Other weekends, or periods, when regional travel is significant.

3. Periods involving local events having attendance greater than 75,000 persons per day or event, or a lesser attendance for events producing mass arrivals or departures, such as football games.

4. Periods when snow accumulation is probable. During these periods daily isolated lane closures may be used during non-peak hours, weather permitting.

A "holiday weekend," for traffic maintenance purposes, begins at noon on the last normal weekday preceding the weekend. Traditionally, the “holiday weekend” has been considered to end at noon on the first normal weekday following the holiday; however, the designer should review the traffic patterns at the specific location. Traffic data shows that at many locations, the traffic on the following weekday morning is not significantly different from a typical weekday morning. In such cases it is suggested that the holiday weekend be considered to end at 6:00 AM or earlier to allow the contractor a full day of normal operation. A day between the holiday and Saturday or Sunday is considered part of the weekend.

Section 630-4 contains information regarding Permitted Lane-Closure Schedules (PLCSs) which are intended for use in the scheduling of part-time lane closures.

640-15 Project Length Restrictions

Although ODOT has no written policy limiting the length of lane closures, consideration should be given to potential effects on traffic flow, and the potential negative public reaction to closures of
extensive length. These factors are of concern primarily where only a single lane remains open in each direction of travel. In rolling to hilly terrain where underpowered vehicles tend to slow traffic flow, the length of one-lane operations should be minimized. In flat terrain, the length of reduced-lane operations is less critical; however, the designer should give consideration to the type of activities to be performed, and what effect these activities might have on traffic movement. Access to accident sites by tow trucks and emergency vehicles on one-lane operations may become especially difficult if concrete barrier is present on both sides of the lane. Sections of open roadway between adjacent lane closures should meet the lengths suggested in Section 640-4.

The public reacts negatively to seeing lane closures in areas of no activity. To avoid such situations on projects of considerable length, it may be desirable to concentrate activity in one section of the project at a time, and to minimize the lengths of lane closures accordingly. On multi-year projects, concentrating work in a portion of the project each construction season may allow an added benefit of opening the entire highway during the inactive winter months.

The designer should not overlook the advantage of scheduling adjacent corridor improvements simultaneously, if this would minimize the time period for inconveniencing motor vehicle traffic. For example, two adjacent projects, requiring only one season each to construct, could be constructed in the same construction season (rather than in consecutive seasons) to minimize the inconvenience to one season rather than two.

640-16 Work on Detour and Alternate Routes

Work along designated detours and alternate routes is strongly discouraged. These routes carry volumes which may be significantly increased over the volumes carried under normal conditions. The potential for traffic queue development would be greater than if the work were performed prior to implementation, or following elimination, of the detour or alternate route.

Work along a designated detour or alternate route can also create a negative public response. Under such conditions the road user would be directed around one construction project, only to be directed through another one. See Section 640-17 regarding project coordination.

640-17 Coordination With Adjacent Projects

Coordination of signing between adjacent projects is recommended in order to minimize presenting misleading information to the road user. If proper location of advance signing for one project results in this signing being located within the limits of another construction project, then consideration should be given to treating the two projects as one project for the purpose of signing.

For more information about coordinating speed reductions and increased fines policies, see Section 600-2 and 640-18.2.5.

640-18 Speeds in Work Zones

640-18.1 Design and Advisory Speeds

The design speed for maintaining traffic through a construction zone should remain the posted legal speed limit, except as indicated in Section 640-18.2. If necessary, reductions in design speed should be accomplished gradually, in increments of 10 miles per hour or less. Sudden changes in design speed and the related geometrics should be avoided.

Advisory speed signing should be provided in accordance with OMUTCD Sections 2C.08 and 6F.52 and TEM Chapter 641.

Where design speed becomes an issue on ramps in relation to maintenance of traffic in work zones, a reduced speed limit can be used as provided in L&D Manual Volume 1 Figure 503-
1. Speeds used from this table shall be limited to those classified as Upper Range speeds.

640-18.2 Speed Limit Reductions

640-18.2.1 General

As noted in Section 1203-2.9, research has shown that regardless of Speed Limit signs, the speed of drivers within work zones will decrease from the speed upstream from the work zone. Although speed zoning might be an effective tool in reducing speeds in work zones in some situations, there are also other work zone speed control methods available, such as Advisory Speed signs, dynamic signs, and design geometrics that should be considered. Unnecessarily reducing the speed limit can introduce additional, and undesirable, speed variance into the traffic flow through the work zone.

If it is determined that a speed limit reduction is needed in a temporary traffic control zone, research also indicates that a 10-mph reduction is likely to provide the best results (maximize compliance and minimize speed variances), rather than a 5-, 15- or 20-mph reduction. However, circumstances may occasionally require an overall reduction greater than 10 mph. A 20-mph reduction should only be accomplished using 10-mph increments; however, for a 15-mph reduction, a direct reduction of 15 miles per hour is allowed.

640-18.2.2 Process

The overall process for Speed Zoning is addressed in Chapter 1203. Section 1203-2.9, Figure 1298-1 and Table 1297-7 address the specific process, guidelines and forms used for review and approval of a Work Zone Speed Zone (WZSZ).

All ODOT construction projects (and all operations/maintenance work projected to take more than 3 hours to complete) involving high-speed (≥55 mph) multi-lane highways should be reviewed for possibly using a speed limit reduction. Requests for work zone speed zones may also be initiated during the construction phase if the need for one was not determined during the design phase or if additional, or new, conditions have been identified that subsequently warrant their implementation (see Figure 1298-1b).

When a WZSZ is required, Plan Note 642-24 (Section 642-24) shall be included in the plans. The Plan Note shall document the WZSZ Revision Number and indicate the locations and applicable conditions and factors (from Table 1297-7) that warrant the indicated WZSZ. The Note shall also require that the revised Speed Limit signs be erected or uncovered no earlier than four hours prior to the actual start of work causing the warranting condition(s) to occur, and removed or covered no later than four hours following removal of the warranting condition(s).

When the need for the Work Zone Speed Zone has ended, it shall be withdrawn in accordance with the procedures described in Section 1203-4 for Speed Zones.

640-18.2.3 Guidelines

Table 1297-7 provides guidelines for determining if a work zone speed zone might be warranted. Form 1296-16, WSZS Justification Report is used to document background information needed about the project/work, and Form 1296-17, WZSZ Evaluation Sheet for High-Speed (≥55 mph) Multi-lane Highways is used to calculate the recommended speed limit for a WZSZ. Sections 1203-2.9.5 through 1203-2.9.7 describe how to complete the forms.

Whenever a speed reduction is to be used, the design speed for maintenance of traffic (MOT) items shall remain at the original posted speed limit on approaches to the work zone. Within the work zone, the design speed should match whichever speed limit is in
effect at the time and location. If the zone will have the work zone speed limit signs put up and taken down intermittently, then the MOT elements shall either be adjusted each time to accommodate the different speed limits, or the more conservative design speed parameters must be used (i.e. higher speed for taper rates, buffers, clear zone, etc and the lower speed for device spacing, etc.)

The speed limit reduction shall be limited to only the portion of the project and the work that warranted the work zone speed limit reduction. When the warranting conditions are no longer present, the speed limit shall return to the original posted speed, and the temporary Speed Limit signs shall be removed or covered no later than four hours following the time in which the warranting conditions resolve. Temporary WZSZ Speed Limit signs may be re-erected or uncovered no earlier than four hours prior to resumption of warranting conditions.

When the work that justified the work zone speed zone is complete, the Speed Limit signs shall be removed and the related speed limit reduction shall be withdrawn (see Section 1203-4).

The two directions of a divided highway are considered separate highway sections (see CMS Item 614.02(B)). Therefore, if the work on a multi-lane divided highway is limited to only one direction, a speed reduction in the direction of the work does not automatically constitute a speed reduction in the opposite direction. A speed limit reduction in the opposite direction, in such case, is appropriate only if conditions are expected to have an impact of the directional traffic flow.

640-18.2.4 Signing

The work zone speed zone is not in affect and enforceable until the existing conflicting Speed Limit signs are removed or covered and the reduced Speed Limit signs are in place, and the signs should only be in place during the time of the activity or condition that warranted the speed limit reduction.

For divided highways, the first dual-mounted Work Zone Speed Limit sign (R2-1) shall be placed approximately 500 feet in advance of the lane reduction or shift taper or other roadway or shoulder restriction that warranted the work zone speed zone. On undivided highways, the sign shall be mounted on the right side approximately 250 feet in advance of such restrictions. The sign(s) shall be repeated every 1 mile for 55 mph zones, and every one-half mile for 50 or 45 mph zones. These signs shall also be erected immediately after each open entrance ramp (or intersection) within the zone. See Plan Note 642-24 in Chapter 642 for additional information on locating Work Zone Speed Limit signs.

Work Zone Speed Limit signs shall be mounted on two Item 630, Ground Mounted Supports, No. 3 posts, unless mounted on a temporary sign support per SCD MT 105.10.

Work Zone Speed Limit and related sign sizes, placement, supports, etc shall be per the OMUTCD, with two exceptions: 1) expressway size Speed Limit signs may be used on freeways and expressways, if necessary; 2) the height of signs mounted on portable supports should be the height required for ground-mounted signs but shall not be more than 1 foot lower than the height required by the OMUTCD, or as directed by the engineer. Portable supports should not be used for a duration of more than 3 days.

The Speed Reduction sign (W3-5) shall be placed in advance of the beginning point of the work zone speed zone; approximately 1,250 feet in advance of the first Work Zone Speed Limit sign on freeways and expressways and at 500 feet on other high-speed (≥255 mph) multi-lane highways. On divided highways, Speed Reduction signs should be dual-mounted.
A Speed Limit sign indicating resumption of the original posted speed limit (applicable R2-1, R2-H2a, etc.) shall be erected at the end of the work zone speed zone.

640-18.2.5 Adjacent Projects and Speed Zones

Whenever a lowered speed limit is to be used within a section that has more than one original posted speed, the areas should be evaluated as separate sections. If there is not enough room (lengthwise) to implement the separate speed zones, consideration may be given to lowering consecutive work zone speed zones to the lower approved work zone speed limit.

Where adjacent projects exist, any speed reductions should be coordinated. The project engineer, or other responsible ODOT representative, shall resolve potential differences between the zones implemented on the individual projects to ensure: they match each other to form one continuous zone; are separated by enough distance to function as separate zones (e.g., more than 1 mile); or are otherwise signed appropriately to step from one zone to the next.

640-18.3 Work Zone Increased Penalty Signs (R11-H5a)

The Work Zone Increased Penalty sign can be used to address speeding concerns on projects independent of reduced work zone speed zones. See Section 605-4.3 for details on the use of these signs. When these signs are used on a project Plan Note 642-27 (Section 642-27) shall be included.

640-19 Law Enforcement Officers (LEOs)

640-19.1 Law Enforcement Officers (LEOs) for Assistance During Construction Operations

Law enforcement officers (LEOs) with patrol cars are effective for slowing traffic speed through work zones. Their use shall be specifically identified in the construction plans. Their primary purpose is to ensure the safe, efficient and orderly movement of traffic. They are not to be used for the convenience of the contractor at project cost.

In general, LEOs should be positioned to direct traffic at the point of lane restriction or road closure and to manually control traffic movements through intersections in work zones.

For lane closures, the use of LEOs should be required during initial set up periods, tear down periods, substantial shifts of a closure point or when new lane closure arrangements are initiated. LEOs should also be required when construction vehicles are entering/exiting the zone directly from/to an open lane of traffic. If a lane has been closed to provide an acceleration/deceleration lane for the vehicles, then the LEO is not required. Use of LEOs is required during the entire advance preparation and closure sequence where complete blockage of traffic is required, and during traffic signal installation when impacting the normal function of the signal or the flow of traffic or when traffic needs to be directed through an energized traffic signal contrary to the signal display. LEOs should not be used where the OMUTCD intends that flaggers be used.

Use of LEOs by contractors other than the uses specified above shall not be permitted at project cost. LEOs may be used to circulate through the work area, with flashing lights off, to provide a general slowing of traffic.

State Highway Patrol Officers may be specified on rural Interstate projects.

For additional information, see Plan Note 642-55 in Chapter 642.
Excessive speeds in roadway work zones adversely affect the safety of the traveling motorists and the roadway construction workers. The use of law enforcement officers (LEOs) in work zones is effective in reducing speeds through the work area. Law enforcement officers can be used in the form of:

- Stationary patrol car.
- Circulating patrol car.
- Air enforcement in combination with ground patrol car.

On construction projects that meet the criteria set forth, the need, ability and method of law enforcement shall be resolved early in the Project Development Process (PDP).

The following is the procedure to follow when incorporating law enforcement hours for enforcement purposes into projects:

1. Designer shall evaluate projects (Preliminary Engineering Phase of PDP Paths 3, 4, or 5) to determine which will require additional law enforcement efforts during construction. (Is the project over $20 million in construction costs, or have a complex work zone configuration?)

2. Office of Traffic Engineering (OTE) in coordination with the District shall review the proposal and modify, approve and/or disapprove.

3. Designer shall note the needed additional enforcement during plan development (Environmental Engineering Phase of PDP Paths 3, 4, or 5) and determine the type of enforcement (circulating, stationary, air, etc.), location of enforcement, amount of enforcement, and when the enforcement should be used. All shall be shown or noted in the plans. Aggressive enforcement should be used during the opening days of the project and following major changes in work zone conditions. This will include determining need for enforcement pullout areas, air enforcement striping, etc.

   a. When considering air enforcement, check with nearby airport restrictions.

   b. Enforcement pullout areas should be spaced throughout long work zones. The pullout areas need to be approximately 0.25 miles long.

4. OTE in coordination with the District shall review the plans and modify, approve and/or disapprove. OTE will send the plans to the Ohio Traffic Safety Office (a Division of ODPS).

5. Ohio Traffic Safety Office (a Division of ODPS) will provide back to OTE, within three weeks, any law enforcement agency comments. They will take the lead in determining the appropriate law enforcement agencies to review each set of plans they receive. These comments will assist in development of the enforcement plan and provide input on the type, amount, location, etc. of enforcement.

6. Designer shall finalize plans and incorporate comments received (Final Engineering Phase of PDP Paths 3, 4 or 5).

7. OTE shall compile pre work zone crash statistics and update the work zone crash tracking database. Prior to the beginning of the project – meet with project personnel and law enforcement agencies and provide work zone safety and mobility training on a project specific level.
8. OTE, the District, and law enforcement agencies will monitor/collect work zone crashes, speeds, etc. and implement countermeasures to improve the safety for motorists and workers as needed.

These guidelines are intended for long-term contractual type projects and are not to take the place of the "Law Enforcement Officers (LEOs) for Assistance During Construction Operations" described in Subsection 640-19.1.

For additional information, see Plan Note 642-56 in Chapter 642.

640-20 Temporary Traffic Control Devices

The design and application of standard traffic control devices for temporary traffic control zones are addressed in OMUTCD Part 6, Chapters 605, 607, 641 and 642, in the Traffic SCDs and in CMS 614.04.

640-21 Removal of Logo Signs

The Ohio Business Logo Sign Program established by ODOT, also known as the Specific Service Sign Program, permits eligible businesses which provide fuel, food, lodging, camping or attraction services to road users to have their Logo Sign Panels placed on Specific Service Signs. Mainline Logo Sign Panels are placed in advance of eligible interchanges, and directional Logo Sign Panels are placed along the exit ramps. The Logo Sign Program is operated by a private company (Program Manager) under contract with ODOT.

Information regarding removal and temporary re-erection of Logo Signs due to construction activity is addressed in Sections 207-2.

640-22 Temporary Lighting

For guidance in the use of temporary lighting for crossovers, see SCD MT-100.00 and Plan Note 642-35 (Section 642-35 in Chapter 642). For floodlighting see Plan Note 642-29 in Chapter 642. Part 11 of the Manual provides additional guidance for general lighting design principles.

See Plan Note 642-39 in Chapter 642 for when temporary traffic signals are provided for closing one lane of a two-lane highway.

If a project requires illumination for special situations, the Office of Traffic Engineering should be contacted for design guidance.

On contract work, the contractor is responsible for obtaining power for temporary lighting. Power shall not be obtained from an existing nearby highway lighting system.

640-23 Reserved for Future Information

The information in this Section has been incorporated into other Sections; however, the number has been reserved for future use.

640-24 Disincentives

640-24.1 Requirements/Guidelines

Disincentives may be assessed against the contractor for failure to complete his work on schedule. They may also be assessed for failing to reopen a closed lane within an allowable timeframe. The disincentives should be based upon costs incurred by the public as a result of the contractor’s delay in completing the project. Various methodologies are available for analyzing the cost incurred by the public depending on the specific circumstances.
640-24.2 Calculating Costs of Delay (QUEWZ Software)

One methodology, which is frequently used on Interstate and other freeway reconstruction projects where the number of existing traffic lanes is reduced for maintenance of traffic purposes during construction, is to determine the cost of the additional delay to the road user as a result of the reduction in the number of available traffic lanes. As an aid, several computer programs known as QUEWZ-92 or QUEWZ-98 (see Section 640-13.2), can be used to calculate queue lengths in work zones and the associated costs of delay attributed to the reduction in available lanes. QUEWZ-98 (see Section 640-13.2) is the program that is most commonly used by ODOT personnel.

The cost of delay calculated by the QUEWZ program, or some lesser amount, may be used as the disincentive. Also, Section 642-6 contains a table of acceptable disincentive amounts that may be applied to lane closures on Interstates and Interstate look-alikes.

640-24.3 Other Considerations

Additional methods available to encourage the contractor to complete his work on schedule include Lane Rental, Incentive/Disincentives, and A + B Bidding. Guidelines on use of these concepts is presented in the Compendium of Traffic Control Options in Section 630-2 and Tables 697-1a through 697-1f.

The Lane Rental concept calls for the contractor to be charged for keeping a lane closed longer than called for in the plans.

The incentive/disincentive concept is typically applied to the completion of a phase of a project.

With A + B Bidding, the contractor bids on the cost of the project and on the time required to complete the project.

The Innovative Contracting Manual contains additional information on all of these methods. This manual is maintained by the Office of Construction Administration and is available for viewing online from their homepage at http://www.dot.state.oh.us/Divisions/ConstructionMgt/Admin/Pages/default.aspx.

640-25 Pedestrian Considerations

Planning and design for maintaining pedestrian traffic should consider both the characteristics of that traffic and the type of construction activities. An analysis of trip origins, destinations and travel paths is useful for providing adequate temporary facilities. Also see O MUTCD Chapter 6D for additional information about accommodating pedestrians in temporary traffic control zones.

Pedestrian accommodations within work zones should be provided: where sidewalks existed prior to construction; where the work zone is located along a route to a school or park; where there is evidence of pedestrian usage (where well-worn paths exist, for example); or where existing land use generates pedestrian traffic.

In residential and commercial areas, adequate pedestrian access should be provided to properties abutting a work zone.

Use of increased pedestrian crossing times at signalized intersections (based on a walking speed of 3 feet per second) may be necessary, particularly in locations where the percentage of elderly pedestrians is expected to be significant. See Section 603-2 for additional information on pedestrian issues that should be considered.

The following general principles should be followed when designing pedestrian facilities:
1. If a sidewalk or bridge that carries pedestrians is closed, provide a temporary walkway (concrete or asphalt) around the work area or direct the pedestrians to an alternate route. Do not force pedestrians to walk through the work area or into traveled lanes.

2. Passageways for pedestrians, especially elderly and disabled, should be well defined and safe for use by these groups. Ramps should be provided for access to streets.

3. All signs or devices should be set up so that they do not cause a hazard for pedestrians. All signs mounted near or over sidewalks should have a minimum 7 foot vertical clearance.

4. Minimum width of walkway shall be 5 feet. Wider walkways are required in areas of high pedestrian activity.

5. Pedestrian walkways shall be free of any obstructions or hazards (holes, debris, mud, etc.). It is especially important to cover or repair any holes and to have broken or damaged sidewalks repaired quickly.

6. Lighting should be provided for temporary walkways if the existing facility was lighted.

7. Fixed walkway and canopy-type pedestrian protection should be provided in the case of long-duration building projects involving construction, demolition and repair activities located close to the street.

8. The design of a temporary pedestrian structure shall be approved by the Office of Structural Engineering. The following criteria shall be used:
   a. Live Loading - 85 psf
      Maximum Allowable Live Load Deflection - 1/800 of the span with no allowable increase for temporary structure.
   b. Minimum Width - 5 feet face to face of railing.
      Railing - 5 feet high with chain link fence fabric.

SCD MT-110.10 provides detail for maintaining or detouring pedestrian traffic. However, it is the responsibility of the designer to provide site-specific detail when necessary. For example, although MT-110.10 (in Note 5B) calls for a maximum grade of 5 percent and a maximum cross slope of 2 percent for temporary walkways, there could be specific locations where the profile of the existing street and sidewalk are at 5 percent or greater. In such a case, the designer should specify in the plans the appropriate criteria to be applied at the specific site. It is suggested that under conditions where pedestrians are detoured into the curb lane, the elevation of the temporary walkway be raised to that of the sidewalk in order to eliminate the need for ramps between the sidewalk and the roadway elevations.

640-26 Advance Work Zone Information Signs

Advance work zone information signs may be required as part of the maintenance of traffic plan for major construction projects. Their need is usually determined by the Corridor Traffic Management Team during their review of the project. These signs are fixed message types and advise the road user of alternate routes, possible delays, etc. The signs are generally located at extreme distances from the work area.

To ensure uniformity in the design and application of these signs, the following guidelines will apply:

1. These signs shall be shown in the plans whether supplied by the contractor or by others. This choice shall be clearly indicated in the plans. The normal procedure is for the contractor to provide the signs.
2. The location of the signs shall be field checked by the designer to ensure that there are no conflicts with existing features or with other signs in the area. The designer will assure that signs are not blocked by being too close to other signs and that the motorist has sufficient time to read, understand and act on the information provided by all the signs.

3. The plans shall indicate the legend, level and size of the signs. The signs shall be considered Supplemental Guide Signs as described in the OMUTCD Section 2E.35 and Tables 2E-2 and 2E-4.

4. The signs shall be black on orange, including a black border. The layout shall conform to the OMUTCD and SDM Appendix C.

5. Where appropriate, advance work zone information signs shall make use of the same exit numbers, route numbers, directions and destinations as shown on the permanent Guide Signs.

6. In some instances, instead of providing separate installations, it may be desirable to modify existing overhead Guide Signs. These changes are accomplished by providing black-on-orange overlays to cover portions of the existing signs. Letter size on these overlays should be the same as on the existing signs. When lane arrows are to be covered, a blank overlay should be placed over each of the affected arrows. When a ramp is being closed, rather than using a blank overlay to cover the entire sign, the legend “EXIT CLOSED” should be used on a diagonal overlay (lower left to upper right) on the sign. The size of lettering on overlays and the size of the overlay shall be indicated in the plans. The minimum letter size for the diagonal “EXIT CLOSED” overlay shall be 12” C.

7. When regulatory information is provided, it shall be displayed separately as a standard black-on-white sign. Mixing of black-on-white regulatory information on a black-on-orange information sign is prohibited.

8. If the road user is being detoured or if an alternate route is provided, the route should be signed with assemblies consisting of the appropriate black-on-orange (DETOUR or ALT) marker with a standard Route sign and arrow plate. If more target value is desired, this trail blazer information may be shown on an orange panel, M2-H3 type. See OMUTCD Section 2D.32.

9. Route Sign assemblies shall be sized according to the type of road on which they are located in accordance with the OMUTCD.

10. Supports for sign installations shall conform to all existing standards for permanent signs. These signs should not be attached to existing supports.

11. All advance work zone information sign installations located outside of the project work limits shall be paid for under appropriate CMS 630 items (signs, supports, concrete, breakaway connection, overlay, removal, etc.). This requirement does not apply to advance Warning Signs or to sign installations within the work limits.

640-27 Retiming of Existing Traffic Signals

Modifications to the normal traffic flow often create a need to retime existing traffic signals within the work zone and/or around the work zone along detours, alternate routes, or parallel arterial streets. The plans shall include revised signal timing where necessary. The District will determine whether it will be the responsibility of the consultant to determine the timing or whether the timing will be provided by the District or local agency, to be included in the plans by the consultant.

Where work zones are located on freeways, signal timing revisions may be found necessary in...
order to accommodate increased volumes at exit ramps where it is expected that there will be a significant increase in volume due to work on the mainline or due to closure of a ramp at an adjacent interchange.

Where signals are located within a work zone, signal retiming may be found necessary to improve capacity on the legs of the intersection where lane reductions are in effect.

In addition to retiming of signals at exit ramps and within work zones, it may also be necessary to retime additional signals as follows:

1. At nearby signals which are coordinated with the signal at the exit ramp or within the work limits.
2. Along routes which are designated as detour or alternate routes.
3. Along parallel arterial streets which are expected to carry additional volumes due to closure of entrance ramps or due to increased exit ramp volumes.
4. Closed loop systems at locations where a series of entrance ramps is closed to reduce mainline volumes.

It may be necessary to retime the signals with each phase of construction. Where traffic is detoured in only one direction per construction phase, signal timing along detours should be timed to allow progression in the direction of the detoured traffic.

**640-28 Freeway/Expressway Termination (“Permanent”)**

Occasionally there may be a need for “permanent” termination of a freeway/expressway. Such termination will be located at an interchange, forcing all traffic to exit at that point. This is not a work zone. Such a condition differs from that which is discussed in Section 641-17 in that this termination point would be somewhat “permanent.” Construction of a section of new roadway may have been built and open to traffic while the adjacent section of roadway is not yet built and may not be built for several years, if at all.

If it is expected that the construction of a section of new highway will create such a condition upon completion, it will be the responsibility of the designer to address this condition in the permanent traffic control plans for the project.

The designer may use SCD MT-99.50 as a guide to develop the permanent traffic control plan at such location. Taper rates for lane closures and shifts shall be as shown in MT-99.50. Advance signing shall be by use of extrusheet Guide Signs as shown in MT-99.50. However, the arrow boards and portable changeable message signs shown in MT-99.50 will not be appropriate for use in this or any other permanent traffic control condition.

Use of drums in permanent situations is not appropriate. A section of pavement which is to be permanently closed shall be separated from the open traveled lanes by use of PB. The PB shall be located parallel to and offset approximately 4 feet from, the edge line along the shifting taper. Upstream from the shifting taper, the PB shall be continued at the same taper rate as the shifting taper.

Where the PB is located parallel to and within 5 feet of the traveled lane, object markers shall be provided on the PB at 50 foot spacing.

Any pavement between the edge line and the PB shall be marked with transverse lines at 100 foot spacing. It is recommended that raised pavement markers be provided along the edge line where the PB does not run parallel to the edge line.

The designer should keep in mind that, as this is not a work zone, orange is not generally an
appropriate color for any traffic control devices under such conditions. For example, barricades, under such conditions, shall contain red and white diagonal stripes rather than orange and white.

641  PLAN PREPARATION / PRODUCTION

641-1  General

The L&D Manual Volume Three describes ODOT plan preparation and production guidelines and standards. Maintenance of Traffic (MOT) plans are addressed in Chapter 1306 of that manual. Additional information specific to MOT plans is provided in this Chapter and Chapter 640. The detail needed in MOT plans depends on the complexity of the project. Adjustments in the field may be necessary when unforeseen circumstances arise.

The following sections provide information about various components of the Temporary Traffic Control (or MOT) Plan, including detail information about Traffic SCDs and PISs.

641-2  Temporary Traffic Control / Maintenance of Traffic (MOT) Plans

641-2.1  General

As noted in Section 602-2, Temporary Traffic Control (or MOT) Plans are used to describe the temporary traffic control measures that are to be used for facilitating the road users through a work zone. These plans play a vital role in assuring a continuity of safe and efficient traffic flow through the work zone.

641-2.2  Plan Sheets

The traffic control plan may include plan sheets for each sequence of operation, to show all temporary signing and pavement marking applicable to the phase. Additionally, removal or covering of non-applicable signs should be indicated on the plan.

641-2.3  Plan Notes

Standard maintenance of traffic Plan Notes are in Chapter 642. Additionally, the designer must provide notes to explain any requirements of the contractor which are not covered in the standard notes or elsewhere in the plans or the specifications.

641-2.4  Sequence of Operation Notes

The designer should also provide sequence of operation notes in order to insure that the traffic is maintained as may have been agreed upon by ODOT and the public. For additional information regarding development of a sequence of operation, see Section 640-3.

641-2.5  Designer Notes

In addition to the information found throughout this Part of the TEM, Designer Notes specifically related to the Standard Construction Drawings (SCDs) have been included in this Chapter. Designer Notes have also been included with the Plan Notes in Chapter 642.

641-2.6  Quantities

As shown in CMS 614 and in the Item Master, many of the traffic control quantities should be itemized, including signing, pavement marking and concrete barriers. (The Item Master and the Summary of Contracts Awarded are both available from the Office of Estimating.) Non-itemized quantities will be paid for as Item 614 Maintaining Traffic.

641-2.7  Plan Reviews

The MOT plan for all projects on Interstates and Interstate Look-alikes with construction cost expected to exceed $10,000,000 shall be submitted to the Multi-Lane Coordinator (MLC) at
each stage of development as per Policy 516-003(P), Section II B1(c). This policy is included in Chapter 1511.

Other MOT plans may be submitted to the Office of Traffic Engineering (OTE) Traffic Control Section for review/advice.

641-2.8 Waiver Approval

Lane closures shall meet the requirements of the permitted lane-closure schedule provided in Section 630-4. Any request for exception to this lane-closure schedule shall be submitted for waiver approval to the MLC. Any waiver request, if not submitted for review and approval during the planning stage, should be submitted as soon as possible during the design stage so that the MOT plan can be developed accordingly.

641-3 Traffic Plan Insert Sheets (PISs)

Traffic PISs are addressed in general in Chapter 104. They are addressed as appropriate throughout the text of this Manual; and this Chapter provides specific information about the application of most of the traffic-related Traffic PISs. Traffic PISs are used in a plan as a plan sheet. They can be used as is or modified as needed. They are available from the OTE website (http://www.dot.state.oh.us/Divisions/Operations/Traffic/publications2/PISs/Pages/) and from the Design Reference Resource Center (DRRC) (http://www.dot.state.oh.us/drrc/Pages/).

641-4 Standard Construction Drawings (SCDs)

SCDs are addressed in general in Chapter 103. They are addressed as appropriate throughout the text of this Manual; and this Chapter also provides specific information about the application of most of the traffic-related SCDs. A list of applicable SCDs is to be included on the title sheet. The Traffic SCDs are available from the ODOT website from the Design Reference Resource Center (DRRC) (http://www.dot.state.oh.us/drrc/Pages/default.aspx) and from the OTE website (http://www.dot.state.oh.us/Divisions/Operations/Traffic/publications2/SCD/Pages/).

641-5 Closing Right or Left Lane of a Multi-lane Divided Highway (MT-95.30, 95.40 and 95.50)

641-5.1 General

SCD MT-95.30 depicts traffic control for closing the right or left lane of a multi-lane divided highway using drums. MT-95.40 is used when construction procedure or the condition requires that the work area be protected by portable barrier (PB) in accordance with Section 605-14. MT-95.50 incorporates Speed Limit signing and Increased Penalty signing with the lane-reduction signing called for in MT-95.30 and MT-95.40. MT-95.50 also provides additional Advance Warning Sign Groups. These sign groups, when used, are in addition to the advance signing provided in MT-95.30 and MT-95.40.

The designer should check the existing median width to determine if sufficient width exists for erection of the median signs. If not, a smaller size median sign should be specified in CMS 614 Maintaining Traffic.

For some work area locations, it may be desirable to provide additional safety devices such as portable changeable message signs (PCMSs), and truck-mounted or self-contained impact attenuators. When required, these units must be specifically identified in the plans. When included, these items shall have separate notes and/or details as well as separate pay items.

641-5.2 Advance Warning Sign Groups

SCD MT-95.50 allows the designer to require extra Advance Warning Sign Groups (AWSGs)
when traffic is expected to back-up beyond the standard advance Warning Signs. Whenever this SCD is specified in a plan, the designer should analyze the anticipated traffic demand, peaking characteristics, capacity and expected queue lengths, and include this analysis with the preliminary Maintenance of Traffic submission. If the queue is expected to extend beyond the normal ROAD WORK AHEAD sign (W20-1), extra AWSGs should be specified in the Item 614 Maintaining Traffic Plan Note (see Sections 642-2 and 642-33). The first extra AWSG should be located a distance, in whole miles, in advance of the lane taper which is at least equal to the longest anticipated queue length. Additional AWSGs should be located at 1 to 2 mile intervals between the first AWSG and the normal Warning Signs location. AWSGs would typically be specified for 2 miles, 3 miles, 5 miles and 8 miles up to the distance needed to deal with the anticipated queue.

If the construction will extend over a holiday period, or any other anticipated period of unusually high traffic demand, a separate queue length analysis should also be made for that period. This condition may require more AWSGs and Plan Note 642-34 (Section 642-34) would be used.

The Plan Note (Section 642-33 or 642-34) added within Item 614 Maintaining Traffic should specify the distance (in whole miles) on the W16-3a Distance plaque which is placed below the RIGHT/LEFT LANE CLOSED AHEAD sign (W20-5, W20-5a). This sign should be located approximately 1 mile in advance of the calculated end of the queue. The distance shown on the plate should be the distance to the beginning of the lane taper.

641-5.3 Advisory Speed Plaque (W13-1)

Advisory Speed Plaques are described in OMUTCD Sections 2C.08 and 6F.52. The designer may specify the use of the Advisory Speed plaque (W13-1) by a Plan Note in Item 614 Maintaining Traffic. Unless specified, this plaque would only be used when directed by the project engineer. The designer may also specify the speed to be shown. An advisory speed reduction, if any, would normally be 10 miles per hour. If the speed is not specified, the speed is as directed by the project engineer. If the statutory speed limit has been altered by establishment of a lower legal speed limit for the construction activity, the Advisory Speed plaque should not be used.

641-5.4 Pavement Markings

The work zone edge line parallel to the roadway (i.e., beyond the taper edge line) is used only when specified by the plans. The use should be specified in the Item 614 Maintaining Traffic Plan Note with an estimated quantity carried to the General Summary. See the notes on SCD MT-95.30 or MT-95.40, and CMS 614.11 for the type of work zone line to specify. Use of this line should be based on engineering judgment and include consideration of the length of the work, time of the closure, sequence of the work, including any need to remove the line in subsequent phases, encroachment on other lanes or the shoulder, the type of work, the geometrics in the area, and the relative cost of paint and work zone tape.

641-5.5 Illumination

In cases of unusual horizontal/vertical curvature, the designer may want to provide illumination of the taper area(s) depending on traffic volumes, accident history or patterns (particularly those involving crossing of the center line). See Part 11 of this Manual for general lighting design principles. For guidance in unusual situations, the Office of Traffic Engineering should be contacted.

For guidance in use of temporary lighting for crossovers, see SCD MT-100.00 and Plan Note 642-35 in Chapter 642. For floodlighting see Plan Note 642-29 in Chapter 642.
641-5.6 Bid Items

The following items would normally be included with the lump sum bid for Item 614 Maintaining Traffic: Signs, Cones, Drums, Flashing Arrow Board, Warning Lights and Shadow Vehicle.

The following items will be shown as separate quantities in the plans, when required:

- Item 614, Work Zone Edge Line, Class 1 (By Type) Mile
- Item 622, Portable Concrete Barrier, ____” Foot
- Item 614, Barrier Reflector Each
- Item 614, Work Zone Impact Attenuator Each
- Item 614, Object marker, _____-way Each

641-6 Closing Right or Left Lane of a Multi-lane Undivided Highway (MT-95.31, 95.32 and 95.41)

641-6.1 General

SCDs MT-95.31 and 95.32 depict traffic control for closing the right and left lane, respectively, of a multi-lane undivided highway using drums. MT-95.41 is used to close the right or left lane on a multi-lane undivided highway when construction procedure or the condition requires that the work area be protected by portable barrier (PB) in accordance with Section 605-14.

The designer should evaluate the possibility or extent of encroachment into open traffic lanes. This evaluation should include consideration of the existing geometrics (including lane and shoulder widths), the type of work being performed during the various construction stages and any additional width required for location of drums or cones and for work zone edge line when used. Depending upon the available lane width of the right lane, for the left-lane closing in SCD MT-95.32, it may be necessary to shift traffic onto the shoulder using drums or cones and/or work zone edge line. In this case, consideration should be given to removal of the existing right edge line.

For the right and left-lane closings shown in SCDs MT-95.31 and 95.32, if the traffic or any of the traffic control devices are expected to encroach on or over the center line, it may be necessary to close the left lane of opposing traffic, in accordance with MT-95.32. For short-term daylight closures, it may be possible to narrow the opposing lanes or shift them onto the shoulder using cones for guidance. Engineering judgment is necessary to determine the best solution. This evaluation should include consideration of the geometrics, traffic volumes and speeds, traffic composition and duration of the work.

For some work area locations, it may be desirable to provide additional safety devices such as portable changeable message signs (PCMSs), and truck-mounted or self-contained impact attenuators. These units when required must be specifically itemized in the plans. When included, these items shall have separate notes and/or details as well as separate pay items.

641-6.2 Advance Warning Sign Groups

Additional Advance Warning Sign Groups (AWSGs) should not normally be required. If an analysis should indicate the need for this group, see Section 641-5.2. In this case, SCD MT-95.50 shall be included in the plan with a reference in the Item 614 Maintaining Traffic Plan Note requiring additional AWSGs as shown on MT-95.50, except that median-mounted signs would not be used.
641-6.3 Advisory Speed Plaque (W13-1)

Advisory Speed plaques are described in OMUTCD Sections 2C.08 and 6F.48. The designer may specify the use of the Advisory Speed plaque (W13-1) by a note in Item 614 Maintaining Traffic (Section 642-2). Unless specified, this plaque would only be used when directed by the project engineer. The designer may also specify the speed shown (see OMUTCD Section 6F.48). An advisory speed reduction, if any, would normally be 10 miles per hour. If the speed is not specified, the speed would be as directed by the project engineer. If the statutory speed limit has been altered by establishment of a lower legal speed limit for the construction activity, the Advisory Speed plaque should not be used.

641-6.4 Pavement Markings

The work zone edge line parallel to the roadway (i.e., beyond the taper edge line) is used only when specified by the plans. The use should be specified in the Item 614 Maintaining Traffic Plan Note (Section 642-2) with an estimated quantity carried to the General Summary. See the notes on SCD MT-95.31, MT-95.32 or MT-95.41, and CMS 614.11 for the type of work zone line to specify. Use of this line should be based on engineering judgment and include consideration of the length of the work, time of the closure, sequence of the work, including any need to remove the line in subsequent phases, encroachment on other lanes or the shoulder, the type of work, the geometrics in the area, and the relative cost of paint and work zone tape.

641-6.5 Bid Items

The following items would normally be included with the lump sum bid for 614 Maintaining Traffic: Signs, Cones, Drums, Flashing Arrow Board, Warning Lights and Shadow Vehicle.

The following items will be shown as separate quantities in the plans, when required:

- Item 614, Work Zone Edge Line, Class 1 (By Type) Miles
- Item 622, Portable Concrete Barrier, ____” Foot
- Item 614, Barrier Reflector Each
- Item 614, Work Zone Impact Attenuator Each
- Item 614, Object marker, ____-way Each

641-7 Closure of a Two-Way Left Turn Lane (MT-95.60)

641-7.1 General

For some work area locations, it may be desirable to provide additional safety devices such as portable changeable message signs (PCMSs), and truck-mounted or self-contained impact attenuators. When required, these units shall have separate notes and/or details as well as separate pay items.

The designer should evaluate the possibility or extent of encroachment into open traffic lanes. This evaluation should include consideration of the existing geometrics (including lane and shoulder widths), the type of work being performed during the various construction stages and any additional width required for the location of drums or cones and temporary edge lines when used. Depending upon the available lane width of the right lane, it may be necessary to shift traffic onto the shoulder using drums or cones and/or a temporary edge line. In this case, consideration should be given to removal of the existing right edge line.

641-7.2 Advance Warning Signs Groups

Additional Advance Warning Sign Groups (AWSGs) should not normally be required. If an analysis indicates the need for this group, it would have to be included in the plan with a reference in Item 614 Maintaining Traffic that the additional AWSG(s) shall be included as
641-7.3 Advisory Speed Plaque (W13-1)

Advisory Speed plaques are described in OMUTCD Sections 2C.08 and 6F.52. The designer may specify the use of the Advisory Speed plaque (W13-1) by a Plan Note in Item 614 Maintaining Traffic. Unless specified, this plaque would only be used when directed by the project engineer. The designer may also specify the speed to be shown (see OMUTCD Section 6F.52). A speed reduction would normally be 10 miles per hour. If the speed is not specified, the speed would be as directed by the project engineer.

641-7.4 Bid Items

The following items would normally be included with the lump sum bid for Item 614 Maintaining Traffic: Signs, Cones, Drums, Warning Lights and Shadow Vehicles.

641-8 Closure of Right Lane of Three-Lane Section with Two-Way Left-Turn Lane (MT-95.61)

641-8.1 General

For some work area locations, it may be desirable to provide additional safety devices such as portable changeable message signs (PCMSs), and truck-mounted or self-contained impact attenuators. When required, these units shall have separate notes and/or details as well as separate pay items.

The designer should evaluate the possibility or extent of encroachment into open traffic lanes. This evaluation should include consideration of the existing geometrics, including lane and shoulder widths, the type of work being performed during the various construction stages, and any additional width required for the location of drums or cones and work zone edge lines, when used. Depending upon the available lane width of the lane, it may be necessary to shift traffic onto the shoulder using drums or cones and/or work zone edge line. In this case, consideration should be given to removal of the existing right edge line.

641-8.2 Advance Warning Signs Groups

Additional Advance Warning Sign Groups (AWSGs) should not normally be required. If an analysis indicates the need for this group, it would have to be included in the plan with a reference in 614 Maintaining Traffic that the additional AWSG(s) shall be included as part of the signing required for SCD MT-95.61 (see Section 641-5.2).

641-8.3 Advisory Speed Plaque (W13-1)

Advisory Speed Plaques are described in OMUTCD Sections 2C.08 and 6F.52. The designer may specify the use of the Advisory Speed plaque (W13-1) by a Plan Note in 614 Maintaining Traffic. Unless specified, this plaque would only be used when directed by the project engineer. The designer may also specify the speed to be shown (see OMUTCD Section 6F.52). A speed reduction would normally be 10 miles per hour. If the speed is not specified, the speed would be as directed by the project engineer.

641-8.4 Pavement Markings

The work zone edge line parallel to the roadway (i.e., beyond the taper edge line) is used only when specified by the plans. The use should be specified in the Item 614 Maintaining Traffic Plan Note with an estimated quality carried to the General Summary. See the notes in SCD MT 95.61 and CMS 614.11 for the type of work zone line to specify. Use of this line should be based on engineering judgment and include consideration of the length of the work, time of the closure, sequence of the work, including any need to remove the line in
subsequent phases, encroachment on other lanes or the shoulder, type of work, geometrics in the area, and the relative cost of paint and work zone tape.

641-8.5  Bid Items

The following items would normally be included with the lump sum bid for Item 614 Maintaining Traffic: Signs, Cones, Drums, Warning Lights and Shadow Vehicle.

The following item will be shown as a separate quantity in the plans, when required:

Item 614,  Work Zone Edge Line, Class I (By Type)  Mile

641-9  Median Crossover Operation (MT-95.70, 95.71, 95.82 and 100.00; PIS 209572 and 209573)

641-9.1  General

Median crossover operation using continuous PB, as shown in SCDs MT-95.70 and MT-95.71 and PISs 209572 and 209573, is a relatively sophisticated method of traffic control which is only suited to certain types of construction activities. Median crossovers shall be lighted, either by an existing lighting system or by provision of a temporary lighting system (MT-100.00). SCD MT-95.82 also provides additional information for this operation. These traffic control and lighting drawings supplement the temporary roadway plans for the crossovers.

Portable barrier (PB) details shall be included in the plan by reference to SCDs RM 4.1 and RM-4.2.

Median crossover operations shall be designed with the number of lanes necessary to provide adequate traffic capacity in each direction.

MT-95.70 presents the appropriate design for a single-lane crossover; and MT-95.71 presents the appropriate design for a multi-lane crossover. These designs are basically identical except that along single-lane operations greater than 3 miles in length the SINGLE LANE (W6-H3b) sign is to be erected at 1 mile intervals to keep the road users informed as to the distance remaining to the point where multi-lane operation will be resumed. Additionally, MT 95.70 provides for lane reduction prior to the crossover by closing the left lane. ODOT’s practice is to close the left lane when a lane reduction is necessary in advance of a crossover. MT-95.71 assumes that there is no lane reduction; however, if a lane reduction is provided in advance of a multi-lane crossover, both drawings should be included in the plans.

PISs 209572 and 209573 present a hybrid design, where one lane is detoured across the median while the remaining lanes are maintained to the right of the median through an area of part-width construction. This method of traffic control may have limited uses, but may be appropriate where bridge widths are not adequate to provide the minimum capacity by implementing standard part-width or standard crossover traffic control. As shown in PIS 209573, if exit ramps are located within a section of highway where the hybrid design is in use, it will be necessary to include appropriate signing in the plans to provide adequate guidance to these exit ramps. If no exit ramps are located within the highway section, the signing shown in PIS 209572 should be provided.

Operations which are forced to include a ramp or other complicating factor should usually result in the use of a Plan Insert Sheet specifically modified to show the individual situation.

Normally, the need for a median crossover operation will be determined from the Maintenance of Traffic Alternative Analysis (MOTAA).
641-9.2 Crossover Design

The design of crossover roadways is addressed in Sections 606-16 and 640-12. Careful choice of crossover locations is extremely important to the safe and efficient operation of this system. They should be located in tangent, level sections with both roadways on about the same profile elevations. They should avoid bridges, other structures and should be well spaced from interchanges, rest areas or other ramps. Existing signs in the area may have to be relocated, covered or overlayed. All crossover sites should be field checked to the extent that crossovers, tapers and advance signing are approximately located in the field.

Crossovers are normally located as a pair to facilitate their use on adjacent construction sections, but they may be separated in order to provide improved operational locations. Consideration should be given at this time to the extent of backups expected and any extra advanced warning which may be necessary due to queues of slow moving traffic.

641-9.3 Advisory Speed Plaque (W13-1)

Advisory Speed plaques are described in OMUTCD Sections 2C.08 and 6F.52. The Advisory Speed plaques (W13-1) shown in SCD MT-95.70 and PISs 209572 and 209573 will not normally be used on a project. Current practices, as discussed in Section 640-18, make a strong effort to assure that the design (i.e., speed of the crossover) is comparable to the statutory or revised legal speed of the highway. Careful choice of crossover locations, as discussed in Subsection 641-9.2, should eliminate any need to display the W13-1. However, in exceptional cases, where a local speed reduction may become necessary, Advisory Speed plaques may be added to the W1-4, W1-4b or W1-4c sign to warn the road users of the appropriate travel speed for the local conditions.

641-9.4 Pavement Markings

Notes in the drawing address the need to maintain appropriate pavement markings and eliminate conflicting ones. See Sections 605-11.10 and 605-11.11 and CMS Item 614.11 for additional information on work zone pavement markings. Also, see Section 605-11.12 and CMS Item 614.115 for information about work zone raised pavement markers.

641-9.5 Illumination

SCD MT-100.00 is intended for use to provide a lighting system for work zone median crossovers. The system is designed to light the entire width of the divided highway, from outside edge to outside edge of the permanent pavement, including the median in the vicinity of the temporary crossover.

SCD MT-100.00 provides for non-breakaway poles to be located beyond the clear zone, preferably 40 feet from the edge of pavement. This is acceptable only if fill slopes do not exceed 8:1, which they do not on most Interstate and other divided highways. If side slopes of greater than 8:1 are encountered without existing guardrail, see L&D Manual Volume One for increased setback.

The designer shall review the probable location of crossover lighting units in the field to assure reasonable placement with respect to ditches or other features. A work zone crossover lighting system shall be provided when an existing lighting system is not present. When a work zone crossover lighting system is to be provided, Plan Note 642-35 (Section 642-35) should be used.

The designer may develop a site-specific lighting plan for the crossover; however, the lighting plan must be approved by the Office of Traffic Engineering (OTE).
641-9.6 Provisions for Reverse Flow and Use of the Shoulder

The reverse traffic flow will be exposed to obstacles which do not affect the normal traffic flow direction (see SCD MT-95.82). Downstream bridge parapet ends, guardrail ends, etc. must be treated. Normally, additional lengths of temporary guardrail, turn-down anchors and appropriate guardrail to bridge parapet connections will be needed and should be provided separately in the plans. Normally temporary guardrail of this type will be removed to minimize future guardrail maintenance costs. Keep in mind that some existing guardrail-to-bridge parapet connections which are suitable for normal traffic flow direction are unsafe when traffic flow is reversed. The new approach end of the guardrail needs to be refit with an approved end treatment. Turn-down end treatments are not allowed in the clear zone.

Where traffic flow is reversed, additional Type 3 Object Markers (OM-3) and barrier reflectors should be provided to guide this traffic. Type 3 Object Markers, also known as Bridge End Markers, are addressed in OMFUTCD Section 2C.63; and barrier reflectors are addressed in more detail in Chapter 307, Section 605-19 and CMS 626 and 720.04.

The designer shall field review the section of road since traffic will be flowing in the opposite direction from normal, and if a paved shoulder will be used as a traffic lane, the review should determine:

1. If any bridge parapets, safety curbs, etc. restrict the width available for the lane throughout the remainder. If this construction would bring the available lane width to less than 10 feet, the shoulder should not normally be used. Even if 10-foot or more lanes are still provided, the obstruction should be well delineated. Bridge End Markers (OM-3) and barrier reflectors on guardrail or parapets will usually be desirable and may be reduced to 25 foot spacing when very close to the traffic lane. When old style safety curbs are encountered, they should be painted (retroreflective curb markings) on the approach ends and trailing ends, and barrier reflectors should be applied to the top of the curb to delineate it.

2. If existing signs need to be moved. Existing signs within 12 feet of the temporary lane should be reviewed.
   a. Signs behind guardrail: Those at least 4 feet behind face of guardrail will not be a problem, and probably as little as 2 feet behind rail will be acceptable. Signs closer than 1 or 2 feet to face of rail and less than 6 feet from the temporary lane are likely to be damaged and, if possible, should be moved further from the road.
   b. Signs not behind guardrail: Major signs on breakaway supports (not behind guardrail) are usually located 30 feet or more from the edge of the through lane and will not normally be a problem. Any major sign which is closer than 12 feet to a temporary lane should be considered for moving back to 30 feet or more from the permanent lane if conditions permit. Since moving signs back enhances overall safety, this work should not be considered incidental to maintaining traffic but should be defined with normal permanent sign plan requirements (elevation views, bid items, removal of sign, removal of support, (new) sign support, signs, breakaway connections, etc.).
   c. Major signs in the median: Major signs on breakaway supports located in the median will not function properly if struck by counter-flow traffic. When these signs are within 30 feet of traffic lanes and not otherwise shielded from counter-flow traffic the following steps should be considered:
      i. In many cases, the legend may not be considered essential during construction (County or City Limit signs, etc.) and the sign can be removed, safely stored and later re-erected
      ii. Some breakaways can be modified by replacing the hinge plates with additional
fuse plates (fuse plates on both sides of beam).

d. Minor signs (on drive posts) are normally located 6 feet from edge of shoulder and this is considered adequate. Any found to be less than 6 feet from the paved shoulder should be considered for relocation.

In some cases, signs can be relocated longitudinally to put them behind guardrail provided for other purposes.

3. If the shoulders are adequate. Shoulders which will be used for traffic flow should be checked to determine if they will support the anticipated loads without becoming too rough to be serviceable. Overlays, and possibly full-depth shoulder replacement, may be needed.

When two lanes will be provided in one direction by using the shoulder, the line separating them will be coincidental with the permanent edge line. Rather than require a contractor to remove parts of an existing white edge line to convert it to a standard dashed lane line, it is permissible to allow it to remain as a solid white lane line (OMUTCD Section 3B.04).

641-9.7 Bid Items

It is intended that separate bid items be included for the following items:

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Item 614</td>
<td>Object Marker, ____-way</td>
<td>Each</td>
</tr>
<tr>
<td>Item 614</td>
<td>Work Zone Pavement Markings (by type)</td>
<td>Foot</td>
</tr>
<tr>
<td>Item 614</td>
<td>Work Zone Raised Pavement Marker</td>
<td>Each</td>
</tr>
<tr>
<td>Item 614</td>
<td>Temporary Impact Attenuator</td>
<td>Each</td>
</tr>
<tr>
<td>Item 622</td>
<td>Portable Concrete Barrier, ____&quot;</td>
<td>Foot</td>
</tr>
<tr>
<td>Item 622</td>
<td>Portable Concrete Barrier, with Glare Shield or 50&quot;</td>
<td></td>
</tr>
<tr>
<td></td>
<td>high</td>
<td>Foot</td>
</tr>
<tr>
<td>Item 614</td>
<td>Work Zone Crossover Lighting System</td>
<td>Each</td>
</tr>
<tr>
<td>Item 614</td>
<td>Barrier Reflectors (by type)</td>
<td>Each</td>
</tr>
<tr>
<td>Item 630</td>
<td>Signs (Permanent)</td>
<td></td>
</tr>
<tr>
<td>Item 630</td>
<td>Supports (Permanent)</td>
<td></td>
</tr>
</tbody>
</table>

The lump sum for Item 614 Maintaining Traffic will cover all other work needed to place, maintain and remove the TLTWO including the following items:

Temporary Signs and Supports
Drums and other channelizing devices
Flashers and lights on signs
Flashing arrow boards
Removal and replacement of raised pavement marker reflectors
Removal of conflicting existing or work zone pavement markings (this is specifically incidental to Item 614 Work Zone Pavement Markings)
Temporary Guardrail, Type 5
Temporary Bridge Terminal Assemblies

641-10 Signalized Closing, One-Lane of a Two-Lane Highway (MT-96.11, 96.20 and 96.26)

641-10.1 General

This standard drawing is to be used where it is necessary to close one lane of a two-lane highway and where the longer length of time of the closure would not lend itself to the use of a flagger. Hazards under these conditions are typically protected by concrete barrier as shown in the drawing. A typical application of this drawing would be part-width bridge construction. However, if the work does not result in the development of significant drop-offs or other significant hazards to the workers or the road users, the designer may consider
calling for drums to be used.

The end of a concrete barrier, if not treated properly, can represent the most hazardous part of the installation. Therefore, wherever practical, the exposed end of the PB should be terminated outside the clear zone. When the design speed is greater than 40 miles per hour and the barrier is located within the clear zone, consideration should be given to terminating the barrier with a work zone impact attenuator.

Where PB is located beyond the edge of the paved shoulder, the cross slope within the clear zone, including the surface on which the PB is place, shall be graded at 10:1 or flatter. If the cross slope is steeper than 10:1, the PB shall be terminated on the paved or graded surface rather than on the cross slope. The PB shall be extended along the paved or graded surface as necessary to satisfy the length of need (see L&D Manual Volume One, Section 602.1.2), and then terminated using an impact attenuator.

In the majority of the cases, it will be necessary to construct temporary pavement or rebuild the shoulders to maintain a minimum desirable lane width. This lane width should be the width of the approach lane, but in no case less than 10 feet. Wherever possible the lane width shall be in addition to a 1 foot offset (preferably 2 feet) from any guardrail or concrete barrier. A separate sheet will be required in the plan to show the details necessary to construct the temporary pavement, as well as the actual width of the pavement to be closed.

These signalized closing treatments provide high visibility of one side of the single lane (PB with reflective panels, barrier reflectors and object markers, or retroreflectorized drums). However, similar night visibility is not assured for the roadside away from the work. If a hazard beyond the shoulder, or a constriction such as a bridge parapet or guardrail, exists on that side, additional devices (retroreflective panels, barrier reflectors, etc.) should also be specified on that side to provide a more balanced outline of the maintained lane.

If adequate room is not available to set up the zone because of driveways or intersections, revision will be required as a separate Maintenance of Traffic Plan Sheet, with the provisions of the SCD being adhered to wherever possible.

Where pedestrians are likely to try to pass through the construction area, reasonable provision shall be made for them. If pedestrian traffic is significant, a designated path may be necessary. See Sections 603-2 and 640-25 for further information on accommodating pedestrians.

Simple, two-phase traffic signal systems shall not be used for situations where traffic, including contractors’ vehicles, will be entering the traffic stream, from the work site, between signals. Such intermediate access points shall be kept to a minimum, or avoided completely if possible. If traffic must enter the traffic stream at intermediate locations, an additional signal shall be located at each such location. Each such signal shall be traffic actuated.

The traffic signal system may either be constructed of standard signal components conforming to SCDs MT-96.11, 96.20 and 96.26, or it may be a portable traffic signal (PTS) which is essentially self-contained and mounted on trailers (see Section 605-13.3).

641-10.2 Duration of Work

As noted in Section 605-13.2 for temporary traffic signals which will be in continuous operation for seventy-two hours or less, pavement marking shall be as shown in SCD MT-96.11 (see Section 641-10) with the following exceptions:

1. Temporary pavement markings are not required.

2. Removal of existing conflicting pavement markings is not required if drums (or cones during daylight hours only) provide continuous positive guidance for vehicles.
641-10.3 Capacity and Flow Rates

The maximum length of one-lane operation for one-way traffic signal control is determined by the capacity required to handle the peak-hour demand. Table 697-2 summarizes these conditions.

The hourly rate of flow figures shown in Table 697-2 may not be readily available during the initial analysis of signal timing. In those cases, ADT data from readily available reports published by the Office of Innovation, Partnerships and Energy may be used to develop hourly rates of flow. Two factors should be used in this conversion: the peak hour factor (PHF) and “K.”

The peak hour factor (PHF) relates the average peak hourly flow to the peak 15-minute flow during the peak hour. If other information is not available, PHF = .90 may be assumed.

“K” relates the peak hour volume to the average daily traffic. If other information is not available, K = 0.10 may be assumed.

Using these factors, an approximate hourly rate flow can be determined:

Approximate Hourly Rate of Flow = ADT x K/PHF

EXAMPLE: 9000 (ADT) x 0.1(k)/0.9 (PHF) = 1000 vehicles per hour

This flow rate can then be used in Table 697-2 by finding the approximate hourly rate of flow in the proper column which defines the length of the one-lane operation (from Stop Line to Stop Line). Moving to the left in the table, the total signal cycle length is determined. If the cycle length is considered acceptable, it can be used to help determine the individual signal interval times.

A more accurate method of determining hourly rates of flow is necessary when the closure length is long or traffic volumes are high. When the estimated traffic ADT and closure length exceeds that shown in Table 697-8, collection of more detailed traffic data and more refined analysis of signal timing is recommended.

In these cases, actual current traffic counts should be obtained and analyzed to identify various peak periods for weekdays and weekends, noting particularly any directional imbalances occurring during the peaks. Where traffic patterns are determined to be repetitious and there is significant disparity between peak and off-peak traffic, or there are major differences between various peak periods, then a signal controller capable of adjusting timing to suit the anticipated traffic flows should be selected.

This can be accomplished in either of two ways:

1. Use of a multi-plan, time-of-day (TOD) controller and time clock to provide preselected timing patterns to suit the various peaks and off-peak times. As compared to the following alternate, this system is less expensive in terms of hardware and installation, but it requires more accurate (and expensive) traffic data collection and analysis to choose appropriate timing patterns and their hours of operation. One, or perhaps two weeks of hourly, directional counts may be needed to develop reasonably reliable timing plans. Once implemented, this system will usually be relatively maintenance free, but if traffic patterns change during construction, additional data collection and retiming may be necessary. The District should be prepared to monitor the system operation and provide data collection and timing changes when warranted.

2. A traffic-actuated controller with detectors in advance of each end of the work zone will also compensate for changing traffic patterns. Fully traffic-actuated operation is normally employed once carefully selected controller timing is implemented. The units should
adapt to most changes in traffic volume and provide good operation. When compared to
the first alternate above, the hardware and installation costs for detection will increase
initial installation costs. Also, detectors can be expected to fail or require readjustment
during construction, thus increasing maintenance costs. On the other hand, unexpected
changes in peak-period demand or timing will usually be accommodated automatically,
thus negating the need for signal retiming. The District should still be prepared to
monitor the signal operation for failure or inappropriate timing.

Where analysis of the traffic data shows that peak periods are not predictable in terms of
magnitude, predominant direction of flow or time of occurrence, actuated operation will be the
most appropriate choice.

Any existing traffic signals within one-half mile must be taken into account when determining
the effect of signal operation. Coordination, or modification of the existing signal, may be
appropriate in cases where queues from one signal may interfere with the operation of the
other.

Analysis of signal timing and traffic capacity should assure that the anticipated traffic can be
accommodated, or signalized operation of this sort should not be included in the project.

Plan Notes 642-36 and 642-37 (Sections 642-36 and 642-37) should be included in the
plans to obtain multi-plan, time-of-day or an actuated controller when appropriate.

641-10.4 Traffic Signal Details

SCDs MT-96.20 and 96.26 will be required when MT-96.11 is used. Supplemental
Specification 961 and Supplement 1050 for portable traffic signals will also be required.

Under light traffic the signal will normally operate in a pretimed mode using a simple pretimed
controller, or using an actuated control in a pretimed mode (no detectors, recalls on). However, under certain conditions it may be desirable/necessary to use actuated control with
detection or to require a multi-plan pretimed control (see SCD MT-96.20).

The plan shall show necessary signal timing (see Tables 697-3 and 697-5).

Sheet 2 of MT-96.11 provides information regarding signalization of intermediate side-road
approaches located within the limits of the two-way operation of the single lane. Two
locations are shown for the side-approach signal heads; a near-side location “A,” and a far-
side location “B”; the far-side location being the preferred location. At least one of the signal
heads per side approach shall be located as per MUTCD Figure 4D-4. The stop line shall
be located accordingly.

The detection on the side approach should be set in the lock mode. For the mainline
approaches to the single-lane operation, consideration should be given to setting these
approaches on recall.

At special locations, such as where an intersection is located immediately in advance of the
lane reduction, as shown at the left side on Sheet 2 of MT-96.11, a special site-specific detail
should be provided in the plans. A conventional simple span might be appropriate at such
locations. It is the responsibility of the designer to design an appropriate signal for such sight-
specific locations.

641-10.5 Pavement Markings

Work Zone pavement markings are required in all cases, except as noted otherwise in
Section 641-10.2, as follows:

1. Work Zone Stop Lines, Class I: at each end of the work.
2. Work Zone Center Lines, Class I: double solid for 150 feet from each Stop Line.

3. Work Zone Edge Lines, Class I: 740.06, Type I tape, white, along the merge tapers.

4. Work Zone Edge Lines, Class I, white, along the single-lane, two-way operation. Paint may be used if not on the final surface course. Type I tape, 740.06, shall be used if on the final surface course.

The requirements for work zone pavement markings are contained in CMS 614.11.

641-10.6 Driveways and Side Roads

Driveways and side roads intersecting within or close to the one-lane portion of the temporary traffic control zone should be considered and treated uniformly. The following alternatives should be considered, with the earlier being considered more desirable than those later on the list:

1. If the drive or street is very close to one end of the one-lane, two-way segment, determine if the signals and Stop Line can be relocated sufficiently to place the intersection outside of the one-lane area.

2. Where drives or streets have low to moderate traffic volumes, consider erecting signs (a STOP sign plus a No Left/Right Turn sign) to allow traffic to only turn away from the central area of the work zone. This treatment is only feasible if cross-corner sight distance in both directions is good and if the near-end of the one-lane segment can be easily seen.

3. Where a residential drive or minor commercial drive is involved, if the work length is very short (perhaps less than 200 feet) and a driver stopped on the drive has good visibility to both ends of the work and both approaches, it may be reasonable to impose only stop control on the drive traffic.

4. Where a public road or alley is involved, consider closing that approach to the intersection, or possibly making it one way away from the work area. This will require discussion with the local agency responsible for the side road. Provisions shall be made for additional ROAD CLOSED signs, Detour signs, ONE WAY signs, DO NOT ENTER signs and other Regulatory Signs.

5. If a driveway serves a business, group or property which also has another usable drive, close the drive in question, after informing owners and tenants of the intended action. Minor widening or improvement of the alternate drive may be considered to provide similar access and to avoid major complaints or litigation.

6. Provide a temporary driveway or minor relocation of the side street to move the entering traffic away from the one-lane segment.

7. If less intrusive methods are not feasible, consider providing another actuated signal phase, complete with at least two signal heads, for the side street or drive. Prior to approval of this method, the designer must obtain projected hourly traffic data for a typical weekday (and weekend if traffic is critical) in order to perform capacity analysis for critical periods. Capacity analysis resulting in poor levels or service will normally preclude use of this treatment.

8. Provision of flagger or control by law enforcement officers.

641-10.7 Lighting

Typically lighting will not be required for signalized closings 1 lane or a 2-lane highway.
However there may be some locations where the designer may find a special need to provide lighting. Examples of need for such lighting might be the existence of an intersection at the point of the lane closure, or poor geometrics or poor sight distance at the point of the lane closure.

The Plan Note for Work Zones Lighting System, found in Section 642-39, shall be included in the plans when lighting is required at the points of lane closure.

When lighting is called for, it shall be paid for as Work Zone Lighting System. Quantities shall be provided in the sub-summary for each phase of maintenance of traffic. If it is expected that lighting will be of the conventional type, the lighting shall be paid for per Each.

641-10.8 Field Reviews

A field review, by the designer, is required to verify the proposed locations of PB, drums, pavement markings, signal heads, signs and other features for each phase of the project. Each element shall be tentatively located according to the requirements of the SCD and plans to assure adequate visibility and to assure that the controls will be effective. Signal heads shall be visible no less than 215 feet in advance for 25 mile per hour approaches, 325 feet for 35 mile per hour; 460 feet for 45 mile per hour and 625 feet for 55 mile per hour approaches. Signs shall be visible at least 250 feet in advance. Reviews should consider the effects of summer foliage. Any existing traffic controls or other physical features which will detract from safe and efficient operation should be dealt with in the plans. The field check shall also verify that there will be adequate room to perform construction behind barriers or channelizing devices, and that available pavement widths will be sufficient to maintain traffic. The need for temporary pavement or pavement strengthening to carry maintained traffic shall be considered. Changes deemed necessary as a result of this field check shall be incorporated into the MOT Plans by providing details or descriptive notes in the plans. These may include revised locations for signs, signals, pavement markings, PB or other devices. They may also include requirements to use overhead-mounted signals or additional signals or other control devices and could include requirements to remove foliage on the right-of-way.

When actuated signals are necessary, Plan Note 642-37 (Section 642-37) should be included in the plans.

When overhead-mounted signals are necessary, Plan Note 642-38 (Section 642-38) should be included in the plans.

641-10.9 Bid Items

In an effort to obtain consistency in the bidding procedure the following pay items should be used, as required:

- Item 615, Pavement for Maintaining Traffic, Class _____ Sq. Yd.
- Item 614, Work Zone Edge Line, Class I Mile
- Item 614, Work Zone Center Line, Class I Mile
- Item 614, Work Zone Stop Line, Class I Foot
- Item 622, Portable Concrete Barrier, _____” Foot
- Item 614, Barrier Reflector Each
- Item 614, Object Marker, _____-way Each
- Item 614, Work Zone Lighting System Each

All other items will be included in Item 614 Maintaining Traffic.

641-11 Flagger Closing One Lane of a Two-Lane Highway (MT-97.10, 97.11 and 97.12)

SCD MT-97.10 depicts a typical application using a flagger to close one lane of a two-lane highway for a stationary operation. The distance (“A”) provided from the Flagger Ahead sign...
(W20-7a) to the flagger assumes light to moderate traffic with no substantial back-up, thus the
distance allows for a typical back-up of cars plus adequate distance to slow from the approach
speed to a stop at the end of the queue. Other locations with heavier traffic or a longer work area
will increase the queue length build-up just before traffic is released. The designer should
increase distance \textit{A} by \textit{Plan Note} when calculations show the need. Further, MT-97.10, allows
the project engineer to increase sign spacing based on expected or actual field conditions at any
time.

SCDs MT-97.11 and 97.12 were developed specifically for use during a paving operation on a
two-lane road. Therefore, one shall be included with each two-lane resurfacing plan. SCD
MT-97.11 should be used with all non-Federal two-lane resurfacing projects. MT-97.12 shall be
used with all Federal two-lane resurfacing projects.

MT-97.11 and 97.12 provide guidance for traffic going through a paving operation by the use of
flaggers and traffic cones. They provide for the use of cones placed laterally across the lane
being paved at roads intersecting the closure, and attempt to keep the work area length to a
minimum and keep the advance signing and the flagger grouped together.

All items shown on these drawings will be included in the lump sum bid for \textit{Item 614 Maintaining
Traffic}.

641-12 Lane Closure at Entrance Ramp (MT-98.10 and 98.11)

SCDs MT-98.10 and 98.11 generally address lane closures in the vicinity of entrance ramps.
SCD MT-98.10 applies primarily to major reconstruction work, where the work extends beyond
the acceleration lane, upstream and downstream on the main line and upstream on the ramp.
SCD MT-98.11 applies to isolated work areas located primarily on the mainline, in the through
lane adjacent to the acceleration lane of the entrance ramp.

Each of these SCDs includes separate details drawings. Work location determines which detail is
used.

SCD MT-95.30, which pertains to lane closures on the mainline, shall be used as a companion
drawing whenever MT-98.10 or 98.11 is used. Figure 698-5 should be consulted to ensure that
adequate acceleration length and merge taper length are provided.

The designer should exercise care when using SCD MT-95.30 in the area of an entrance ramp.
The placement of signs for closing the right lane contained in MT-95.30 may overlap an upstream
ramp and confuse road users as to whether the ramp is open or closed. When this condition
exists, the designer shall provide positive guidance for the road user. This may involve showing
the exact placement of all signs and tapers noted in MT-95.30 within both interchanges on a
separate drawing, rather than relying on the SCD.

If the paved shoulder must be used to achieve minimum lane width, it may require that the
shoulder be reconstructed or strengthened to accommodate the additional load. A separate sheet
would be required in the plan detailing the shoulder work.

In order to work on an entire entrance-ramp, it will be necessary to use both detail drawings from
the applicable SCD. Traffic operation under the detail shown on the second page of each of these
drawings may be significantly restricted, and poorer operation can be anticipated. Therefore, the
design and project implementation should attempt to do as much of the work as possible using
the detail shown on the first page of each of these SCDs. This should minimize the time and
traffic restrictions involved when the work area is as shown in the detail on the second page of
the drawing. Consideration should be given to providing temporary pavement to locate the
merge/shift area in the first detail shown at a point downstream, which will then allow for
adequate acceleration distance to be provided when the work area shifts and the second detail is
used.
Adequate decision sight distance should be provided where possible. See Section 607-15, Table 697-10 and Figure 698-5. If adequate decision sight distance cannot be provided, this should be documented, explaining the reason for non-compliance. Consideration should also be given to closing the ramp.

Quantities for work zone pavement markings shall be provided in the plans. If the markings are to remain for three days or longer, all Item 614 Class I markings shall be provided. If the markings are to remain for less than three days, consideration may be given to eliminating edge lines if the lines are represented by drums or other acceptable forms of channelization. Additional reduced marking at specific locations may also be appropriate. See OMITCD Section 6F.78 and TEM Subsection 605-11.11.

The following items would normally be included with the lump sum bid for Item 614 Maintaining Traffic: Signs, Cones, Drums and Warning Lights.

The following items shall be shown as separate quantities in the plans, when required:

Item 614, Work Zone Edge Line, Class I (By Type) Mile
Item 614, Work Zone Lane Line, Class I (By Type) Mile
Item 614, Work Zone Dotted Line, Class I (By Type) Feet

641-13 Lane Closure at Exit Ramp (MT-98.20 and 98.21)

SCDs MT-98.20 and 98.21 generally address lane closures in the vicinity of exit ramps. SCD MT-98.20 addresses lane closures using drums. SCD MT-98.21 addresses lane closures using portable barrier (PB). SCD MT-98.21 also addresses the use of impact attenuators in the exit gore. Otherwise, both drawings are basically the same.

Each of these SCDs includes separate details drawings. Work location determines which detail is used.

Where the impact attenuator is intended to apply to two barriers within the gore, one from the mainline and one from the ramp, the two barriers shall be joined to form one unit using a PCB “Y” connector segment. See the Office of Roadway Engineering’s Plan Insert Sheet for details on this PCB “Y” connector segment. This insert sheet shall be provided in the plans. When using steel barrier, a double wide attenuator shall be used instead of a “Y” connector.

SCDs MT-95.30 and 95.40, which pertain to lane closures on the mainline, shall be used as companion drawings to SCD MT-98.20 or 98.21, respectively.

The designer should exercise care when using SCD MT-95.30 or MT-95.40 in the area of an interchange immediately upstream of the work site. The placement of signs shown in MT 95.30 or MT-95.40 for closing the right lane may overlap an upstream ramp and confuse road users as to whether the ramp is open or closed. When this condition exists, the designer shall provide positive guidance for the exiting road user. This may include showing the exact placement of all signs and tapers noted in MT-95.30 or MT-95.40 within both interchanges on a separate drawing, rather than relying on the SCD.

Advisory Exit or Ramp Speed signs may exist at interchanges along the deceleration lanes or across from the exit gores. The designer should check the speed of any proposed Advisory Exit or Ramp Speed signs to avoid contradictory speed postings with existing signs. Where conflicts exist, the existing signs should be covered or removed. The proposed signs, when compared to the existing signs, should always provide a lower or equal advisory speed.

The opening to the ramp shall have a minimum length of 200 feet. Within this space, the exiting vehicle must shift laterally to enter the exit ramp. Based on the 1985 Highway Capacity Manual, maximum capacity, regardless of design speed, occurs at a speed of 30 to 35 miles per hour. Below this speed, the freeway/expressway will experience unstable flow and capacity will
decrease. Therefore, to avoid premature unstable flow and keep the facility at maximum capacity, all design elements on the freeway/expressway must meet or exceed an operating speed of 30 to 35 miles per hour. Consideration should be given to providing temporary pavement at the upstream end of the deceleration lane for use in the second detail of each of these SCDs if necessary in order to provide adequate ramp openings.

SCDs MT-98.20 and 98.21 show an opening of 390 feet each, which is associated with a 65 miles per hour exiting speed. Openings longer than 390 feet should be used whenever conditions permit. When conditions will not allow a 390 foot opening, shorter values (but not less than 200 feet) may be used. When shorter openings (associated with a speed at least 10 miles per hour less than the posted speed) are used, Advisory Speed signs (W13-1) shall be provided. See OMUTCD Section 6C.08 and Section 602-5 for a discussion of taper rates.

If the paved shoulder must be used to achieve minimum lane width on the ramp, as noted in SCDs MT-98.20 and 98.21, it may be necessary to reconstruct or strengthen the shoulder to accommodate the additional load. A separate sheet would be required in the plan detailing this shoulder work.

Quantities for work zone pavement markings shall be provided in the plans. If the markings are to remain for three days or longer, all Item 614 Class I markings shall be provided. If the markings are to remain for less than three days, consideration may be given to eliminating edge lines if the lines are represented by drums or other acceptable forms of channelization. Additional reduced marking at specific locations may also be appropriate. See OMUTCD Section 6F.78 and TEM Subsection 605-11.11.

The following items would normally be included with the lump sum bid for Item 614 Maintaining Traffic: Signs, Cones, Drums and Warning Lights.

The following items shall be shown as separate quantities in the plans, when required:

- Item 614, Work Zone Edge Line, Class I (By Type) Mile
- Item 614, Work Zone Channelizing Line, Class I (By Type) Foot
- Item 614, Work Zone Dotted Line, Class I (By Type) Foot

641-14 Lane Closure in Deceleration Lane (MT-98.22)

SCD MT-98.22 addresses closure of the deceleration lane, with an opening located near the gore to provide access from the freeway/expressway to the ramp.

The opening to the ramp shall have a minimum length of 200 feet. Within this space, the exiting vehicle must shift laterally to enter the exit ramp. Based on the 1985 Highway Capacity Manual, maximum capacity, regardless of design speed, occurs at a speed of 30 to 35 miles per hour. Below this speed, the freeway/expressway will experience unstable flow and capacity will decrease. Therefore, to avoid premature unstable flow and keep the facility at maximum capacity, all design elements on the freeway/expressway must meet or exceed an operating speed of 30 to 35 miles per hour.

SCD MT-98.22 shows an opening of 390 feet each, which is associated with a 65 miles per hour exiting speed. Openings longer than 390 feet should be used whenever conditions permit. When conditions will not allow a 390 foot opening, shorter values (but not less than 200 feet) may be used. When shorter openings (associated with a speed at least 10 miles per hour less than the posted speed) are used, Advisory Speed signs (W13-1) shall be provided. See OMUTCD Section 6C.08 and Section 602-5 for a discussion of taper rates.

Advisory Exit or Ramp Speed signs may exist at interchanges along the deceleration lanes or across from the exit gores. The designer should check the speed of any proposed advisory Exit or Ramp Speed signs to avoid contradictory speed postings with existing signs. Where conflicts exist, the existing signs should be covered or removed. The proposed signs, when compared to
the existing signs, should always provide a lower or equal advisory speed.

Advance Warning Signs should be placed in locations that provide adequate sight distance for the existing vertical and horizontal roadway alignment. Use OMUTCD Table 6C-1 to determine dimensions A, B and C.

The following items would normally be included with the lump sum bid for Item 614 Maintaining Traffic: Signs, Cones, Drums and Warning Lights.

Quantities for work zone pavement markings shall be provided in the plans. If the markings are to remain for three days or longer, all Item 614 Class I markings shall be provided. If the markings are to remain for less than three days, consideration may be given to eliminating edge lines if the lines are represented by drums or other acceptable forms of channelization. Additional reduced marking at specific locations may also be appropriate. See OMUTCD Section 6F.78 and TEM Subsection 605-11.11.

The following items shall be shown as separate quantities in the plans, when required:

- Item 614, Work Zone Edge Line, Class I (By Type) Mile
- Item 614, Work Zone Dotted Line, Class I (By Type) Foot

641-15 Typical Lane Closures for Ramps (MT-98.28 and 98.29)

SCD MT-98.28 shall be used when work along an exit ramp leaves at least one lane open to ramp traffic.

The SCD includes two separate details drawings. Work location determines which detail is used. The first is intended for use when the work is in the inside portion of the ramp curve, with traffic to be routed along the outside portion of the curve. The second is intended for use when the work is in the outside portion of the ramp curve, with traffic to be routed along the inside portion of the curve.

SCD MT-98.29 shall be used when work requires that the exit ramp be entirely closed.

Advisory Exit or Ramp Speed signs may exist at interchanges along the deceleration lanes or across from the exit gores. When the ramp will remain open, the designer should check the speed of any proposed advisory exit or ramp speed signs to avoid contradictory speed posting with existing signs. Where conflicts exist, the existing signs should be covered or removed. The proposed signs, when compared to the existing signs, should always provide a lower or equal advisory speed.

When SCD MT-98.29 is included in plans, treatment of the permanent Guide Signs in accordance with the guidelines for Advance Work Zone Information Signs shall be considered. The need for a detour and related signing must also be addressed.

Advance Warning Signs should be placed in such locations that provide adequate sight distance for the existing vertical and horizontal roadway alignment. Use OMUTCD Table 6C-1 to determine dimensions A, B and C.

The following items would normally be included with the lump sum bid for Item 614 Maintaining Traffic: Signs, Cones, Drums and Warning Lights.

Quantities for work zone pavement markings shall be provided in the plans. If the markings are to remain for three days or longer, all Item 614 Class I markings shall be provided. If the markings are to remain for less than three days, consideration may be given to eliminating edge lines if the lines are represented by drums or other acceptable forms of channelization. Additional reduced marking at specific locations may also be appropriate. See OMUTCD Section 6F.78 and TEM Subsection 605-11.11.
The following items shall be shown as separate quantities in the plans, when required:

Item 614, Work Zone Edge Line, Class I, (By Type) Mile
Item 614, Work Zone Dotted Line, Class I (By Type) Foot

641-16 Traffic Control for Long Line Pavement Marking Operations (MT-99.20)

**SCD MT-99.20** is applicable to all projects with long line markings (center, edge or lane line except in the following situations:

1. Where the markings will be applied while the area is closed to traffic for other reasons;

2. Where the work area is so short (+/- one-half mile) that the required sequence of vehicles cannot be assembled while the marking vehicle travels the length of the project; or

3. Where the plans require another form of protection.

Also see **CMS 614.11** for additional traffic control requirements for long line pavement marking operations.

If the work will require a lane closure as designated in the table on **SCD MT-99.20**, the plans should include the appropriate lane closure details.

The 18-inch cones are permissible only to protect a wet painted line. The larger, 28-inch cones shall be provided if they will be used to close off a lane (in daylight), either in the closure transition or through the work area.

641-17 Freeway/Expressway Closure in Work Zones (MT-99.50)

641-17.1 General

**SCD MT-99.50** is intended for use where a freeway or expressway is closed within a work zone or in an emergency. It is not intended for use in conjunction with “permanent” closures which remain upon completion of the contract. For “permanent” closures see **Section 640-28**.

**MT-99.50** may be appropriate for “weekend” closures, particularly at diamond interchanges for painting or other work within an interchange. In such situations, all traffic will be required to exit at the exit ramp and then re-enter at the entrance ramp. The cross highway shall be closed in order to allow continuous movement from the exit ramp to the entrance ramp. Appropriate signing and channelization shall be provided in order to maintain traffic flow along the ramps and to designate a detour for the cross-highway traffic. This additional traffic control should be detailed in the plans.

**MT-99.50** may also be appropriate for emergency situations. Additional site-specific message boards may be appropriate in order to provide detour signing, directing traffic back to the freeway/expressway.

641-17.2 Signing

Signing used for this type of work will typically consist of flatsheet Warning Signs and arrow boards. Use of existing extrusheet major Guide Signs, with overlays, in lieu of the flatsheet signing may be used. The designer shall specify which type of signing is to be used. If existing extrusheet Guide Signs are to be overlaid, the designer shall locate these signs in the field and show the signs in the plans accordingly.

If existing supports are not available, breakaway supports or supports behind guardrail shall be individually designed.
Portable Changeable Message Signs (PCMSs) may also be used to supplement the flatsheet or extrusheet signs. If PCMSs are to be used, the designer shall specify the quantity of signs and provide the appropriate legends to be displayed.

### 641-17.3 Channelization Devices

Typically, the closure is identified by use of drums; however, PB is shown in **MT-99.50** for use when called for in the plans. A drop-off condition is an example of a situation that might constitute a need for PB (see Subsection 605-5.13 and MT-101.90). The designer shall determine whether or not the additional protection provided by PB is necessary and shall provide the appropriate quantity.

Taper rates of drums shall be as called for in Table II in **MT-99.50**. These taper rates are intended to be similar to those shown in OMUTCD Figure 6H-32.

The flare rate of the PB shall also be as called for in Table II of **MT-99.50**. The flare rate may be applied at the exit gore; however, if the contractor will be working in the vicinity of the provided shift taper, the designer should consider specifying in the plans that the PB shall be located parallel to the edge line.

The drum/PB combination is intended to be similar to that shown in **MT-95.40** and in OMUTCD Figure 6H-34.

### 641-17.4 Multiple Lane Closures

If a freeway/expressway has three or more directional lanes and it is necessary to close more than one lane, insert a tangent section (equal in length to twice the taper) between the end of the first lane closure and the beginning of the second. Dual ground-mounted W4-2-28 signs (W9-H4-144 signs if using extrusheet signing) shall be placed along the tangent, in advance of the taper for the second lane closure, at approximately a distance equal to the length of the taper (also see OMUTCD Figure 6H-37). If additional lanes are closed, the same process shall be repeated.

If the signs shown as dashed at the ramps do not exist, the designer may require them or similar signs as a part of the work.

### 641-17.5 Portable Barriers and Impact Attenuators

1. The impact attenuator treatment will typically not require any additional grading of the median; however, foreslopes of 10:1 or flatter from the edge of the shoulder to the PB shall be required. This may require drainage changes.

2. The impact attenuator treatment should typically be more economical.

3. The offset “E” to the beginning of the PB may not always be sufficient (see L&D Manual Volume One, Section 307). If the roadway curves to the right, and the curvature exceeds 2.5 degrees (radius is less than 4100 feet), the offset shall be increased in accordance with Table 697-9.

The length of PB beyond the shoulder shall also be increased proportionately to maintain the flare rate relative to the edge of pavement, per Table II.

The designer, not the contractor, must determine when to use each type of end treatment and note this in the MOT Plan.

### 641-17.6 Bid Items

For **SCD MT-99.50**, all items will be included for payment under Item 614 Maintaining
Traffic, except the following:

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>630</td>
<td>Sign, Extrusheet</td>
<td>Square Foot</td>
</tr>
<tr>
<td>630</td>
<td>Sign, Overlay</td>
<td>Square Foot</td>
</tr>
<tr>
<td>630</td>
<td>Ground Mounted Supports, _______ Beam</td>
<td>Foot</td>
</tr>
<tr>
<td>630</td>
<td>Breakaway Beam Connection</td>
<td>Each</td>
</tr>
<tr>
<td>630</td>
<td>Ground Mounted Beam Support Foundation</td>
<td>Each</td>
</tr>
<tr>
<td>614</td>
<td>Work Zone Edge Line, Class I (By Type)</td>
<td>Mile</td>
</tr>
<tr>
<td>614</td>
<td>Work Zone Raised Pavement Marker</td>
<td>Each</td>
</tr>
<tr>
<td>622</td>
<td>Portable Concrete Barrier, _____”</td>
<td>Foot</td>
</tr>
</tbody>
</table>

641-18 Road Closure Using Type III Barricades (MT-101.60)

The type of closure shown in SCD MT-101.60 will typically be used in two different situations:

1. The closure seals off a road from which through traffic has been detoured upstream. In this case, only local traffic is expected on the approach to the closure, although this traffic might still be appreciable if the detour begins some distance upstream. Any traffic approaching the closure must be adequately warned and given ample opportunity to stop. The minimum advance warning treatment is three signs. They are supplemented with Type A flasher warning lights. The signs will be dual installations on a four-lane divided road and the designer may insert a Plan Note requiring dual installations on other roads.

2. The closure is accompanied by some form of a runaround, directing traffic away from the barricade closure. The runaround may be any one of several types: it may be a true runaround as provided in OMUTCD Figure 6H-7; it may be a median crossover as provided in SCD MT-95.70; or, it may be a complete closure of a limited-access highway, requiring all of the traffic to exit upstream of the barricade closure, such as is shown on SCD MT-99.50.

All elements of the barricade closure, including any advance Warning Signs, will be included in the lump sum of Item 614 Maintaining Traffic.

641-19 Portable Barrier and Impact Attenuator Delineation (MT-101.70)

SCD MT-101.70 shall be used when PB is specified in the plans. The drawing presents several methods for delineating PB as well as an impact attenuator nose cone delineation detail. Typically, PB is delineated using object markers and barrier reflectors at 50 foot intervals, with the object markers and the barrier reflectors offset at 25 feet. This method of delineation is applicable to 32-inch PB as well as to 50-inch PB. Plan Note 642-26 (Section 642-26) shall be included in the plans when this method of delineation is to be provided. (See Sections 605-14.5 and 605-19 for more information on PB delineation.)

Where glare screen is provided, the use of object markers is not practical. In such cases, the traditional method for delineating the glare screen is to provide reflective sheeting stripes on glare screen panels. The stripes shall be placed in sets of three, on consecutive glare screen panels, at 50 foot intervals, center-to-center.

The delineation methods typically used are presented in the upper half of the detail drawing. In the bottom half of the drawing, two alternative delineation methods are presented for the purpose of providing an increased level of delineation of the side of the PB. For the top of the PB, only the typical methods of delineation, as discussed above, are presented.

One alternative delineation method is to provide linear delineation panels (3M™ Scotchlite™ Linear Delineation System (LDS) or approved equal). The linear delineation panels shall be provided in 6 x 34 inch sections, with one panel section centered on each PB section.

Another alternative is to provide the barrier reflectors at intervals of 50 foot spacing as is the normal practice, except that the barrier reflectors are to be stacked vertically in sets of three,
rather than singly.

Either the linear delineation panel or the triple stack method of delineation shall be used within freeway and expressway work zones on all concrete barrier, permanent or temporary, located within 5 feet of the edge of the traveled lane under either of the following conditions:

- Along tapers and transition areas;
- Along curves (outside only) with degree of curvature greater than or equal to 3 degrees.

Plan Note 642-50 (Section 642-50) shall be included in the plans where such conditions exist.

These alternative methods of increased delineation may also be specified in the plans for additional use.

The nose cones of impact attenuators shall have a retroreflective surface as specified in SCD MT-101.70.

641-20 Drop-Offs in Work Zones (MT-101.90)

Where drop-offs occur in work zones, adequate protection shall be provided to protect the road user. Typically the method of protection to be used will be specified in the plans in accordance with Section 605-14. However, occasionally drop-offs that are not addressed in the plans will develop in the field. The purpose of this drawing is to provide instruction to the contractor regarding appropriate methods for protection from drop-offs within work zones where specific instructions have not been provided in the plans.

This drawing is intended primarily for use with work on freeways and expressways, as described under Conditions I and II; however, Conditions I and II may also be applied to other multi-lane highways with speed limits of 45 miles per hour or greater with minimal driveways. Methods of drop-off protection provided in the table for Condition II are to be considered as minimums.

Use of portable barrier (PB) may be appropriate in locations where Table II calls for a lesser form of drop-off protection, as the PB serves not only as protection from drop-offs, but also provides protections from the contractor’s activities and from fixed objects such as utility poles and stored equipment. The designer may want to consider the expected duration of the maintenance of traffic stage as an additional factor in determining the need for providing a higher level of protection.

Also included in the drawing is Condition III, which is applicable to locations behind curb where the legal speed is 40 miles per hour or less. At such speeds, curbs of adequate height, typically 6 inches, have an effect on the lateral placement of moving vehicles. Therefore, the need for channelizing devices to protect the road user from the drop-off is reduced (see the table in the drawing under Condition III). Also see Location and Design Manual Sections 305.3.1 and 601.1.4.

For conditions other than those described in this drawing, engineering judgment shall be used to determine the appropriate method of drop-off protection to be provided. Examples of such conditions are highways where driveway access is a major concern, or low-speed highways where curb is not provided (see the Location and Design Manual Section 601.1.4). The time period during which such drop-offs remain in existence should be minimized. Consideration should be given to providing fill material at the end of the work day to create a desirable foreslope of 3:1 or flatter, with 2:1 as maximum. However, if engineering judgment indicates that use of PB is appropriate, then the maintenance of traffic should be designed based on use of PB.

641-21 Transition Plans for Use of Shoulder (MT-102.10, 102.20 and 102.30)

When the work involves closing a lane(s) and a capacity analysis indicated that it is necessary to maintain more lanes of traffic than would remain after closing the lane(s), this drawing provides
for use of the shoulder to maintain traffic. If the encroachment into the traveled lane is 2 feet or less, use a lane width reduction.

Lane use cross sections should be shown in the plan indicating the number of lanes and the width of each. Normally, all lanes should be shifted.

To help keep the traffic in the proper lanes, Work Zone Solid Lane Lines are used through the transition area, and extended 300 feet in each direction beyond the transition area. Dashed lines may be provided within the tangent sections beyond these points if the length of dashed line would be 600 feet or greater. However if the length of the dashed line section would be less than 600 feet in length, the solid lane line shall be continued through the tangent section. Pavement marking and delineation details shall be provided in the plans (see SCD MT-99.30 and Section 641-25).

SCD MT-102.10 addresses the use of this shoulder transition to maintain traffic when portable barrier (PB) is used, and SCD MT-102.20 addresses the use of this traffic control when drums are used to close off the work area. The choice between using PB or drums should be based on the drop-off policy as well as consideration of traffic volumes, truck volumes, speed, duration of work and consideration of the degree of hazard. SCD MT-102.30 incorporates Speed Limit signing and Increased Penalty signing with the shift signing called for in MT-102.10 and MT-102.20.

The transition should be designed to maintain the legal speed or reduced speed as discussed in Section 640-18. However in exceptional cases, where a local speed reduction may become necessary, advisory speed plaques should be added to the W1-4, W1-4b or W1-4c sign to warn the road users of the appropriate travel speed for the local conditions.

The existing shoulders must be checked for smoothness, structural adequacy and clearance to structures. Reconstruction may be necessary to assure that they are adequate for the traffic. Plans should provide details of the shoulder work needed. Appropriate bid items shall be included in the plan.

Truck lane-use signs R4-5 and R4-H5a are shown in the SCD MT-102 series. As indicated in the notes for MT-102.10, 102.20 and 102.30, use of these signs should not be automatic. The stability of the shoulder on the specific project should be reviewed to determine whether it is adequate to carry the truck loads which travel on the specific roadway segment. If the shoulder stability is adequate, it should be clearly specified in the plans that the signs are not required. It should be general practice to keep signing to a minimum, as over-signing may create clutter. Use of these signs may be appropriate during one Maintenance of Traffic phase, but may not be appropriate in another phase of the job. For example, such might be the case where a rather unstable existing shoulder is used to carry traffic in Phase 1 while a stable new shoulder is used to carry traffic in Phase 2.

It is intended that separate bid items be included for the following items:

- Item 614, Work Zone Solid Lane Lines, Class I, (By Type) Mile
- Item 614, Work Zone Edge Lines, Class I, (By Type) Mile
- Item 622, Portable Concrete Barrier, ____", Foot
- Item 614, Work Zone Lighting System Each
- Item 614, Barrier Reflector (By Type) Each
- Item 614, Work Zone Curb Marking
- Item 614, Object Marker Each

The lump sum for Item 614 Maintaining Traffic will cover all other work needed to place, maintain and remove the shoulder transitions including:

- Temporary signs and supports
- Drum and other channelizing devices
- Flashers and lights on signs
- Removal and replacement of raised pavement marker reflectors
- Removal of conflicting existing or work zone pavement markings
  (this is specifically incidental to Item 614 Work Zone Pavement Markings)

When traffic will be on a shoulder near structure parapets or guardrail, plan quantities may also be needed for Bridge End Markers and additional barrier reflectors (spacings of 25 feet when traffic is close to these barriers).

641-22 Temporary Sign Support (MT-105.10)

SCD MT-105.10 provides requirements for temporary sign supports. This drawing shall be used on all projects.

Normally, all temporary sign support items will be incidental to the lump sum bid for Item 614 Maintaining Traffic.

The designer should field check proposed sign locations which may be required to implement the various traffic control schemes shown in the plans. The check should determine if the site will be adequate for an appropriate temporary support and should consider any potential conflicts with existing signs. The plans may require the removal, covering or modification of the legend of existing signs, particularly overhead signs which establish lane use.

641-23 Detour of Pedestrians (MT-110.10)

Pedestrian considerations are addressed in Section 603-2 and 640-25. When it has been determined that a detour should be provided for pedestrian traffic, SCD MT-110.10 shall be used.

SCD MT-110.10 provides detail for maintaining or detouring pedestrian traffic. However, it is the responsibility of the designer to provide site-specific detail when necessary. For example, although MT-110.10 (in Note 5B on Sheet 2 of 2) calls for a maximum grade of 5 percent and a maximum cross slope of 2 percent for temporary walkways, there could be specific locations where the profile of the existing street and sidewalk are at 5 percent or greater. In such a case, the designer should specify in the plans the appropriate criteria to be applied at the specific site. It is suggested that under such conditions where pedestrians are detoured into the curb lane, that the elevation of the temporary walkway be raised to that of the sidewalk in order to eliminate the need for ramps between the sidewalk and the roadway elevations.

641-24 New or Revised Traffic Control Signals (MT-120.00)

Prior to activating a new traffic signal, the public shall be given advance notice of the activation by use of special signing. This signing is shown in SCD MT-120.00. MT-120.00 is to be provided in all plans which require the activation of a new traffic signal.

641-25 Work Zone Delineation (MT-99.30)

641-25.1 General

SCD MT-99.30 addresses ODOT’s procedures for providing raised pavement marking in work zones located on freeway and expressway projects. Although this standard drawing is intended for maintenance of traffic schemes expected to remain in place for at least thirty days, consideration should also be given to including this drawing for all long-term work (greater than three days). MT-99.30 specifies the use of raised pavement markings as appropriate for a specific surface type, asphalt or concrete.

Specifications are provided for delineation within transition areas and also for delineation beyond transition areas (within tangent areas). Transition areas are applicable to lane-shifts tapers of ≥ 4 feet and to median crossovers. Lane-shifts of less than 4 feet shall be treated as...
The transition area for a lane shift is generally considered to begin 300 feet in advance of the beginning of the shift taper and to end 300 feet beyond the termination of the shift taper. The transition area for a crossover is generally considered to begin 300 feet in advance of the beginning of the crossover geometrics and to end 300 feet beyond the termination of the crossover geometrics. If it is necessary to revise the lengths of these approach distances, the revisions shall be specified in the plans. If the approach distances vary among the several approach distances within the plans, the limits of each transition area within the plans shall be specified individually.

Raised pavement markers used in work zones shall conform to CMS 614 or to CMS 621 as specified in Sections 641-25.2 and 641-25.3. As specified in Sections 641-25.2 and 641-25.3, use of Work Zone Raised Pavement Markers conforming to CMS 614 is not permitted during the snow-plowing season. The limits of the snow-plowing season at the project site should be determined by the District and specified in the Plans. If dates are not specified, the default dates of snow-plowing season shall be as per CMS 614.115C (October 15 to April 1) regarding installation of WZRPMs.

641-25.2 Asphalt Surfaces

Within transition areas, the plans shall call for Raised Pavement Markers (RPMs) to be provided along edge lines and channelizing lines. Spacing shall be at 20-foot increments. Beyond transition areas, the plans shall call for RPMs to be provided along the lane lines at 120-foot spacing. The plans should specify that RPMs intended to be in place during the snow-plowing season shall conform to CMS 621. During other times of the year, the contractor should be permitted to provide RPMs which conform to either CMS 621 or CMS 614. Plan Note 642-48 or 642-49 shall be included in the plans.

Upon removal of RPMs complying with CMS 621, the resulting holes shall be filled as per CMS 621.08. Prior to application of the surface course on the project, the existing pavement within the transition area shall be removed to a depth equivalent to a depth necessary to reach the level of the intermediate course of the proposed pavement, as determined by the Engineer. Resurfacing of the transition area shall be performed at the time that the surface course is being applied to the entire project.

The following bid items should be included in the plans:

<table>
<thead>
<tr>
<th>Item 254</th>
<th>Pavement Planing, Asphalt Concrete</th>
<th>Square Yards</th>
</tr>
</thead>
<tbody>
<tr>
<td>Item 614</td>
<td>Work Zone Raised Pavement Marker, as per plan</td>
<td>Each</td>
</tr>
</tbody>
</table>

The appropriate quantity of surface course material for resurfacing the transition area should also be provided.

Temporary work zone marking (edge lines, lane lines, etc.) shall be paid for under the appropriate Item 614 pavement marking item.

<table>
<thead>
<tr>
<th>Item 614</th>
<th>Work Zone Solid Lane Lines, Class I, (By Type)</th>
<th>Mile</th>
</tr>
</thead>
<tbody>
<tr>
<td>Item 614</td>
<td>Work Zone Edge Lines, Class I, (By Type)</td>
<td>Mile</td>
</tr>
</tbody>
</table>

641-25.3 Concrete Surfaces

RPMs applied to concrete surfaces shall conform to CMS 614. The plans shall specify that PRMs shall not be provided during the snow-plowing season. During other times of the year, the contractor shall provide Item 614 Work Zone Raised Pavement Markers. Within transition areas, RPMs shall be provided along edge lines and channelizing lines. Spacing shall be at 20-foot increments. Beyond transition areas, RPMs shall be provided along the lane lines at 120-foot spacing. The appropriate Plan Note from Chapter 642, for installation of RPMs in
work zones on concrete surfaces, shall be included in the plans.

Work Zone Raised Pavement Marking shall be paid for as follows:

Item 614  Work Zone Raised Pavement Marker Each

Temporary work zone marking (edge lines, lane lines, etc.) shall be paid for under the appropriate Item 614 pavement marking item.

Item 614  Work Zone Solid Lane Lines, Class I, (By Type) Mile
Item 614  Work Zone Edge Lines, Class I, (By Type) Mile

641-26 Longitudinal Channelizer (PIS 2010180)

The design of the longitudinal channelizer may vary from manufacturer to manufacturer. It shall consist of two main components: a base component consisting of interlocking units and a vertical reboundable marker/channelizer component. The shape of the vertical component may vary from manufacturer to manufacturer. The width shall be approximately 8 to 9 inches for elliptical designs and 4 to 6 inches for round (tubular) designs. The height of the vertical component shall be within the range of 36 inches minimum to 48 inches maximum.

The vertical component shall be equipped with retroreflective sheeting or with retroreflective stripes. Where stripes are used, the stripes shall consist of two 3-inch wide bands placed a maximum of 2 inches from the top with a maximum of 6 inches between the bands. The base component shall be equipped with reflectors.

The longitudinal channelizer may be useful at entrance ramp merges, either to help direct traffic into its designated lane(s) around curves, or to maximize sight distance at the merge. Use of the longitudinal channelizer in a set of plans should be determined, based on engineering judgment, during the design stage of project development. However, occasionally the need for implementing the longitudinal channelizer may be determined in the field during construction. In such a case, it may be appropriate to add the longitudinal channelizer to the plans by change order.

When the longitudinal channelizer is to be used PIS 2010180 and Plan Note 642-53 shall be included in the plans.

Where the longitudinal channelizer is used, its use should be monitored to determine whether there is significant damage from errant vehicles.
Intentionally blank.
642 PLAN NOTES

642-1 General

Typical Plan Notes have been consolidated here for convenience in preparing plans. The number used for the Plan Note will be the same as the Section number. When a Plan Note revises the material or contractor requirements from that which is specified in the CMS, both the note and the bid items 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. Each note is accompanied by a “Designer Note” in an attempt to give some guidance as to when the note should be used.

In keeping with the 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.

642-2 Item 614, Maintaining Traffic

The text of this note will depend on specifics of the project.

Designer Note: Most traffic control plans should include an “Item 614, Maintaining Traffic note that contains the following:

1. A description of how traffic will be maintained throughout the construction life of the project, including any limitations or restrictions.

2. Descriptions of all items that are to be performed under CMS Item 614.

3. A closing paragraph indicating the method of payment (see Plan Note 642-12).

642-3 Item 614, Maintaining Traffic (At All Times)

A minimum of ___ lane(s) of traffic in each direction shall be maintained at all times by use of the existing pavement, the completed pavement, Item 502 Structure for Maintaining Traffic, Item 615 Pavement for Maintaining Traffic, Item 615 Roads for Maintaining Traffic, and temporary surfaces using Items 410 and 614.

Designer Note: This note should be edited to include only items pertinent to each specific project.

642-4 Item 614, Maintaining Traffic (Time Limitation on a Detour)

A minimum of one lane of traffic in each direction shall be maintained at all times, except for a period not to exceed ______ consecutive calendar days, when through traffic may be detoured as shown on sheet _____. A disincentive shall be assessed in the amount of $ _______ per day for each calendar day the roadway remains closed to traffic beyond the specified limit.

Designer Note: This note shall be used if there is a time limitation placed on the detour. The dollar amount of the disincentive shall be calculated as directed by the Innovative Contracting Manual. The Innovative Contracting Manual is available for download at: http://www.dot.state.oh.us/Divisions/ConstructionMgt/Admin/Pages/default.aspx. The official detour route should be used in the calculation of road user costs.

642-5 Item 614, Maintaining Traffic (Winter Time Limitations)

All existing lanes shall be open to traffic between November _____ and April ____. November _____ shall be considered to constitute an interim completion date and liquidated
damages shall be assessed in accordance with CMS 108.07 for each calendar day that all lanes are not open and available to traffic.

**Designer Note:** This note shall be used when winter traffic limitations are required.

642-6  **Item 614, Maintaining Traffic (Lanes Open During Holidays or Special Events)**

No work shall be performed and all existing lanes shall be open to traffic during the following designated holidays or events:

- Christmas
- New Years
- Memorial Day
- Thanksgiving
- Fourth of July
- Labor Day
- (Other Holiday or Event)

The period of time that the lanes are to be open depends on the day of the week on which the holiday or event falls. The following schedule shall be used to determine this period:

<table>
<thead>
<tr>
<th>Day of holiday or event</th>
<th>Time all lanes must be open to traffic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sunday</td>
<td>12:00N Friday through (6:00 AM or 12:00N) Monday</td>
</tr>
<tr>
<td>Monday</td>
<td>12:00N Friday through (6:00 AM or 12:00N) Tuesday</td>
</tr>
<tr>
<td>Tuesday</td>
<td>12:00N Monday through (6:00 AM or 12:00N) Wednesday</td>
</tr>
<tr>
<td>Wednesday</td>
<td>12:00N Tuesday through (6:00 AM or 12:00N) Thursday</td>
</tr>
<tr>
<td>Thursday (Thanksgiving only)</td>
<td>12:00N Wednesday through (6:00 AM or 12:00N) Friday</td>
</tr>
<tr>
<td>Friday</td>
<td>12:00N Thursday through (6:00 AM or 12:00N) Monday</td>
</tr>
<tr>
<td>Saturday</td>
<td>12:00N Friday through (6:00 AM or 12:00N) Monday</td>
</tr>
</tbody>
</table>

No extensions of time shall be granted for delays in material deliveries, unless such delays are industry-wide, or for labor strikes, unless such strikes are area-wide.

Should the Contractor fail to meet any of these requirements, the Contractor shall be assessed a disincentive in the amount of $_______ for each minute the above described lane closure restrictions are violated.

**Designer Note:** This note shall be used when lanes must be open to traffic during holidays or special events. The dollar amount of the disincentive should be based on the hourly rates specified in the below table:

<table>
<thead>
<tr>
<th>ADT in most heavily traveled segment of project</th>
<th>0-50,000</th>
<th>50,000-75,000</th>
<th>75,000-100,000</th>
<th>&gt;100,000</th>
</tr>
</thead>
<tbody>
<tr>
<td>$50/min</td>
<td>$75/min</td>
<td>$100/min</td>
<td>$125/min</td>
<td></td>
</tr>
</tbody>
</table>

If a larger disincentive is desired, written documentation of the reason and justification for the disincentive shall be submitted to **OTE’s Traffic Control Section**.

642-7  **Item 614, Maintaining Traffic (Lane Closure/Reduction Required)**

Length and duration of lane closures and restrictions shall be at the approval of the Engineer. It is the intent to minimize the impact to the traveling public. Lane closures or restrictions over segments of the project in which no work is anticipated within a reasonable time frame, as determined by the Engineer, shall not be permitted. The level of utilization of maintenance of traffic devices shall be commensurate with the work in progress.

**Designer Note:** This note shall be added to the **Item 614 Maintaining Traffic** note (**Section 642-2**) if lane closures, or restrictions are required.
Item 614, Maintaining Traffic (Notice of Closure Sign)

Notice of Closure signs, as detailed in these plans, shall be erected by the Contractor at least one week in advance of the scheduled road or ramp closure. The signs shall be erected on the right-hand side of the road/ramp facing traffic. They shall be placed so as not to interfere with the visibility of any other traffic control signs. On roadways, they should be erected at the point of closure. The signs may be erected anywhere on ramps as long as they are visible to the motorists using the ramp. On entrance ramps, the sign shall be erected well in advance of the merge area to avoid distracting motorists.

**Designer Note:** The use of Notice of Closure signs in the plan and this note is at the discretion of the designer. Details of these closure signs must be in conformance with the O MUTCD and be included in the plans. The last line of the sign shall list a phone number which a motorist may call for additional information. This is to be a specific office within the District (or municipality) rather than the general switch board number. The person answering this phone should have a one-page summary of critical project data, and possibly a portion of a map showing the closure and planned detour route. Information shown would normally include such information as: contract identification, scheduled completion, type of improvement, why the closure is necessary, other closures or lane reductions planned as a part of the project and their timing and other data which would help a motorist deal with the construction period.

Item 614, Maintaining Traffic (Estimated Quantities)

The following estimated quantities have been included in the General Summary for use as determined by the Engineer for the maintenance of traffic.

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Item 410, Traffic Compacted Surface, Type A or B</td>
<td>Cu. Yd.</td>
<td></td>
</tr>
<tr>
<td>Item 410, Traffic Compacted Surface, Type C</td>
<td>Cu. Yd.</td>
<td></td>
</tr>
<tr>
<td>Item 614, Asphalt Concrete for Maintaining Traffic</td>
<td>Cu. Yd.</td>
<td></td>
</tr>
<tr>
<td>Item 616, Water</td>
<td>M. Gal.</td>
<td></td>
</tr>
</tbody>
</table>

**Designer Note:** This note shall be used when quantities of CMS Items 410, 614, 616, or other items, are added to the plan to be used as directed by the Engineer. Such estimated quantities for maintaining traffic are normally required when through or local traffic is being maintained on a facility during construction. Quantities of CMS Item 614 Asphalt Concrete or CMS Item 410 will depend on the number of drives and pavement cuts required because of drainage or utilities. Generally, every 50 cubic yards of CMS Item 410 will require 1 M. Gal. of CMS Item 616, Water (minimum of 50 M. Gal.).

Item 614, Maintaining Traffic (ROAD CLOSED Sign)

The Contractor shall provide, erect and maintain standard 48 x 30 inch ROAD CLOSED signs, sign supports, barricades and lights, as detailed in SCD MT-101.60 at the following locations during periods in which the affected roads are closed to traffic.

(List locations, example - Loyal Road just west of SR 1000 intersection.)

**Designer Note:** Unless shown in a detail elsewhere in the plan, this note should be included in the Item 614 Maintaining Traffic note (Section 642-2) on projects where ROAD CLOSED signs are to be used on major relocation projects in rural areas where crossroads are located an appreciable distance from the project. Normally, these signs are positioned at the first crossroad on each side of the relocation.
642-11 Item 614, Maintaining Traffic (Signs and Barricades)

The Contractor shall provide, erect and maintain signs and sign supports, as detailed in the Ohio Manual of Uniform Traffic Control Devices, and Type III barricades of the type and location as follows:

(List the type and locations.)

**Designer Note:** Unless shown in a detail elsewhere in the plan, this note should be included in the Item 614 Maintaining Traffic note *(Section 642-2)* on projects where signs and barricades are to be provided.

642-12 Item 614, Maintaining Traffic (Closing Paragraph for Note)

All work and traffic control devices shall be in accordance with CMS 614 and other applicable portions of the specifications, as well as the Ohio Manual of Uniform Traffic Control Devices. Payment for all labor, equipment and materials shall be included in the lump sum contract price for Item 614, Maintaining Traffic, unless separately itemized in the plan.

**Designer Note:** This note should be used as a closing for the Item 614 Maintaining Traffic note *(Section 642-2)*.

642-13 Placement of Asphalt Concrete

Two-way traffic shall be maintained at all times except that one-way traffic will be permitted for minimum periods of time consistent with the requirements of the specifications for protection of completed asphalt concrete courses.

**Designer Note:** This note shall be used on projects involving resurfacing while traffic is maintained.

642-14 Trench for Widening

Trench excavation for base widening shall be only on one side of the pavement at a time. The open trench shall be adequately maintained and protected with drums or barricades at all times. Placement of proposed subbase and base material shall follow as closely as possible behind excavation operations. The length of widening trench which is open at any one time shall be held to a minimum and shall at all times be subject to approval of the Engineer.

**Designer Note:** This note shall be used on widening projects where traffic is maintained. The designer should refer to SCD MT-101.90, Drop-offs in Work Zones, to determine the necessary treatment or protection to be specified in the plan.

642-15 Overnight Trench Closing

The base widening shall be completed to a depth of no more than _____ inches below the existing pavement by the end of each work day. No trench shall be left open overnight except for a short length (25 feet or less) of a work section at the end of the trench. In case work must be suspended because of inclement weather or other reasons, the trench for the uncompleted base widening shall be backfilled at the direction of the Engineer.

**Designer Note:** This note shall be used for projects involving base widening where traffic is maintained. The allowable depth is calculated to the bottom of the first surfacing course. The designer should refer to SCD MT-101.90, Drop-offs in Work Zones, to determine the necessary treatment or protection to be specified in the plan.
642-16 Concrete Median Barrier Replacement

Removing, grading and installing the replacement barrier in a continuous operation shall be limited to _____ linear feet and shall at all times be subject to the approval of the Engineer. The Engineer shall be satisfied that all installations will afford maximum protection for traffic.

**Designer Note:** This note shall be used when replacing existing concrete median barrier. The length of this operation should be decided in conjunction with the District Highway Management Administrator.

642-17 Drum Requirements

In addition to the requirements of the plans, specification and proposal, drums furnished by the Contractor shall be new and unused at the time of arrival on the project. Any drums brought on the project, which have previously been used elsewhere, will not be accepted.

Payment for drums shall be included in the lump sum price bid for maintaining traffic unless separately itemized.

**Designer Note:** This note may be included in the plans for multi-year projects on Interstate and Interstate Look-alike projects at the discretion of the District. The note shall not be used on other projects. The intent of this note is to minimize the need to replace drums within the duration of the project.

Payment for drums called for in this note shall be included in the lump sum price bid for maintaining traffic.

When included in the plans, this note shall be in addition to Plan Note 642-23, Replacement Drums.

642-18 Reserved for Future Information

See Plan Notes 642-55 and 642-56 (Sections 642-55 and 642-56) for information regarding Law Enforcement Officers (LEOs) used in work zones (formerly addressed in this Section).

642-19 Dust Control

The Contractor shall furnish and apply water for dust control as directed by the Engineer. The following estimated quantities have been included for dust control purposes:

Item 616, Water _______ M. Gal.

**Designer Note:** For every cubic yard of earthwork (embankment plus excavation), use between 0.002 M. Gallon and 0.004 M. Gal of water. The lower rate should be used for small and/or rural projects and the larger rate should be used for large and/or urban projects.

642-20 Work Zone Markings and Signs

The following estimated quantities have been carried to the General Summary for use at locations identified by the Engineer for work zone pavement markings and signs per the requirements of CMS 614.04 and 614.11.

**Designer Note:** A breakdown of the various types of signs and pavement markings should be included (examples: Item 614, Work Zone Marking Sign; Item 614, Work Zone Lane Line, Class ____, ____, Item 614, Work Zone Stop line, Class ____, ____, etc.).
642-21 **Item 622, Portable Concrete Barrier, 50\textup{"}**, As Per Plan

This work shall consist of furnishing, maintaining, and subsequently removing a 50-inch Portable Concrete Barrier (PCB) at the locations shown on the plans. For details, see SCD RM-4.1. Please note that SCD RM-4.1 was updated 10-20-06 to provide a PCB which is compatible with NCHRP 350 criteria.

Portable steel barrier is an approved alternative to PCB. For information on approved vendors, see the Approved Products List maintained by Roadway Standards.

Portable Concrete Barrier, 32 inches high with an 18-inch minimum height glare screen may be used at the option of the Contractor. The glare screen shall be constructed using one of the screens provided on the approved list, available on the Office of Materials Management web page.

Paddle or intermittent type glare screens shall be designed using a 20 degree cut-off angle based on tangent alignment. That spacing shall be used throughout the barrier length without regard to barrier curvature.

The glare screen system shall be securely fastened to the 32-inch Portable Concrete Barrier using the hardware and procedures specified by the manufacturer.

For directions on how to install the glare screen and the barrier, see the manufacturer’s instructions.

Payment shall include all labor, material, and equipment necessary to perform the work and shall be paid for at the contract price per foot for Item 622, Portable Concrete Barrier, 50 inch, as per plan.

**Designer Note:** A plan detail will be required for this item.

642-22 **Item 614, Replacement Sign**

Flatsheet signs furnished by the Contractor in accordance with the requirements of the plans, specifications and proposal which become damaged by traffic for reasons beyond the control of the Contractor shall be replaced in kind when ordered by the Engineer. Replacement signs shall be new. Other materials may be in used, but good, condition subject to approval by the Engineer.

Payment for the new signs shall be made at the contract price per Each for Item 614, Replacement Sign, and shall include the cost of removing and disposing of damaged signs, hardware and supports, and providing the necessary replacement hardware, supports, etc.

An estimated quantity of _____ Each has been provided in the General Summary.

**Designer Note:** This note shall be used on all four-lane, high-speed projects which will last longer than six months, and on other projects where there is a high probability that a number of signs will be damaged during construction.

642-23 **Item 614, Replacement Drum**

Drums furnished by the Contractor in accordance with the requirements of the plans, specifications and proposal which become damaged by traffic for reasons beyond the control of the Contractor shall be replaced in kind when ordered by the Engineer. Replacement drums shall be new.
Payment for the new drums shall be made at the contract price per each for Item 614, Replacement Drum, and shall include the cost of removing and disposing of the damaged drum, and providing and maintaining the replacement drum in accordance with the contract requirements for the original drum.

An estimated quantity of ____ each has been provided in the General Summary.

**Designer Note:** This note shall be used on all four-lane high-speed projects which will last longer than six months, and on other projects where there is a high probability that a number of drums will be damaged during construction.

**642-24 Item 614, Work Zone Speed Limit Sign**

The Contractor shall furnish, install, maintain, cover during suspension of work, and subsequently remove Work Zone Speed Limit (R2-1) (_____ speed limit) signs and supports within the work limits in accordance with the following requirements:

- The Contractor shall cover or remove any existing Speed Limit signs within the reduced Speed Zone(s). These signs shall be restored during suspension or termination of the reduced speed limit. The expense of covering or removal and restoration of existing Speed Limit or Minimum Speed Limit signs shall be included in the pay item for the Work Zone Speed Limit signs.

- The Work Zone Speed Limit signs may be erected or uncovered no more than four hours before the actual start of work that causes the warranting condition(s) to occur. The signs shall be removed or covered no later than four hours following removal of the warranting condition(s), or sooner as directed by the Engineer. Temporary sign covering and uncovering due to temporary removal of warranting condition(s) shall be guided by the four-hour limitations stated above.

- Construction and Material Specifications Item 614, Paragraph 614.02(B), indicates that the two directions of a divided highway are considered separate highway sections. Therefore, if the work on a multi-lane divided highway is limited to only one direction, a speed reduction in the direction of the work does not automatically constitute a speed reduction in the opposite direction. A speed limit reduction in the opposite direction, in such case, is appropriate only if conditions are expected to have an impact on the directional traffic flow, as directed by the Engineer.

- The Contractor shall erect a Work Zone Speed Limit sign in advance of the warranting condition, as detailed in the plans or as directed by the Engineer. The sign shall be mounted on both sides of a directional roadway of divided highways. The first Work Zone Speed Limit sign shall be placed approximately 500 feet in advance of the lane reduction, shift taper, or other roadway or shoulder restriction that warranted the work zone speed zone. On undivided highways the sign shall be mounted on the right side, approximately 250 feet in advance of such restrictions. The sign shall be repeated every 1 mile for 55 mph zones and every one-half mile for 50 mph and 45 mph zones. These signs shall also be erected immediately after each open entrance ramp within the zone.

- The speed limit reduction shall be limited to only the portion of the project and the work that warranted the work zone speed limit reduction.

- Speed Reduction (Speed Zone Ahead symbol) signs (W3-5) shall be erected in advance of the speed reduction, approximately 1250 feet on multi-lane highways and 500 feet on two-lane highways.

- A sign(s) to indicate the resumption of the statutory speed limit shall be erected at the end of any reduced Speed Zone. The Contractor may use signs and supports in used, but good
condition, provided the signs meet current ODOT specifications. Sign faces shall be retroreflectORIZED with Type G sheeting complying with the requirements of CMS 730.19.

Work Zone Speed Limit signs shall be mounted on two Item 630, Ground Mounted Supports, No. 3 posts, unless mounted on a temporary sign support per SCD MT 105.10.

Work Zone Speed Limit and related sign sizes, placement, supports, etc shall be per the OMUTCD, with two exceptions: 1) expressway size Speed Limit signs may be used on freeways and expressways, if necessary; 2) the height of signs mounted on portable supports should be the height required for ground-mounted signs but shall not be more than 1 foot lower than the height required by the OMUTCD, or as directed by the Engineer. Portable supports should not be used for a duration of more than 3 days.

Work Zone Speed Limit signs and supports will be measured as the number of sign installations, including the signs and necessary supports. If a sign and support combination is removed and reerected at another location within the project due to changes in the Speed Zone as detailed in the plans or as directed by the Engineer, it shall be considered another unit.

Payment for accepted quantities, complete in place, will be made at the contract unit price. Payment shall be full compensation for all materials, labor, incidentals and equipment for furnishing, erecting, maintaining, covering during suspension of work, and removing the signs and supports. Speed limit signing for the point of resumption of the statutory speed limit shall be paid for as Work Zone Speed Limit signs. The following estimated quantity has been carried to the General Summary.

| Item 614, Work Zone Speed Limit Sign | ______ Each |
| Item 614, Speed Zone Ahead symbol sign | ______ Each |

The following table provides details on Work Zone Speed Zones approved for use on this project:

<table>
<thead>
<tr>
<th>WZSZ Revision Number</th>
<th>County &amp; Route</th>
<th>SLM Phase/Part &amp; Direction</th>
<th>Approved Speed Limit (mph)</th>
<th>Specific Warranting Conditions and Factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>WZ-</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WZ-</td>
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<tr>
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<td></td>
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</tr>
<tr>
<td>WZ-</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Designer Note:** This note shall be included in projects where speed limits are reduced in accordance with Section 640-18.2.

Sufficient numbers of the Work Zone Speed Limit signs shall be included to cover all approved work zone speed zones within the entire project at the spacing required by the note plus the sign(s) for each entrance ramp, for each applicable direction as well as the necessary quantity of signs for posting the resumption of the statutory speed limit at the end of the posted work zone speed zone. For example, for a 2.33 mile work zone speed zone (EB only; reduced to 55 mph) on a 6 mile project on an Interstate freeway with 2 open entrance ramps, what is the number of signs needed for this approved speed zone?

Spacing = 1.0 miles
2.33/1.0 = 2.33 signs or 3 signs
Both sides of roadway (dual mounted) = 3 x 2 = 6 signs
One direction of roadway (e.g. EB only) = 6 x 1 = 6 signs
Plus two open entrance ramps (assuming dual mounted necessary) = 6 + 4 = 10 signs
Plus sign for resumption of statutory speed limit = 10 + 1 = 11 signs
Number of Work Zone Speed Limit signs for this work zone speed zone = 11

Repeat for each approved work zone speed zone to calculate a total number of Work Zone Speed Limit signs needed for the project.

642-25 Designated Local Detour Route

In addition to the official, signed Detour Route, a local route has been determined to be the secondary, unsigned Detour Route or “designated local Detour Route.” This route is shown on Sheet No. ____. During the time that traffic is detoured, the Contractor shall maintain this route in a condition which is reasonably smooth and free from holes, ruts, ridges, bumps, dust and standing water. Once the detour is removed and traffic returned to its normal pattern, the designated local Detour Route shall be restored to a condition that is equivalent to that which existed prior to its use for this purpose. All such work shall be performed when and as determined by the Engineer.

The following estimated quantities are provided for use as determined by the Engineer to maintain and subsequently restore the designated local Detour Route.

<table>
<thead>
<tr>
<th>Item</th>
<th>Estimated Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Item 301, Asphalt Concrete Base, PG 64-22</td>
<td>Cu. Yd.</td>
</tr>
<tr>
<td>Item 304, Aggregate Base</td>
<td>Cu. Yd.</td>
</tr>
<tr>
<td>Item 448, Asphalt Concrete Surface Course, Type 1, PG 64-22</td>
<td>Cu. Yd.</td>
</tr>
<tr>
<td>Item 407, Tack Coat</td>
<td>Gal.</td>
</tr>
<tr>
<td>Item 408, Prime Coat</td>
<td>Gal.</td>
</tr>
<tr>
<td>Item 614, Asphalt Concrete for Maintaining Traffic</td>
<td>Cu. Yd.</td>
</tr>
<tr>
<td>Item 616, Water</td>
<td>M. Gal.</td>
</tr>
<tr>
<td>Item 617, Compacted Aggregate, Type A</td>
<td>Cu. Yd.</td>
</tr>
<tr>
<td>Item 617, Water</td>
<td>M. Gal.</td>
</tr>
<tr>
<td>Item 642, Center Line</td>
<td>Mile</td>
</tr>
</tbody>
</table>

Designer Notes:

1. Procedures relative to Detours and designated local Detour Routes are set forth in **SOP OPS-103**, Detours and **SOP OPS-104**, Maintenance & Repair of Local Roads and Streets Used as Official Detour Routes, Designated Local Detour Routes, or Haul Roads. These documents are available on the Maintenance Administration website via the Intranet.

2. The list of payment items is included for example purposes only. It is not meant to be all-inclusive of the Items that might be required. The designer must provide items for each individual project as may be appropriate for the work involved.

3. All pay items listed in the above note should be carried to the General Summary under the Maintenance of Traffic heading.

642-26 Item 614, Barrier Reflectors And/Or Object Markers

Barrier Reflectors and/or Object Markers shall be installed on all Portable Barrier (PB) used for traffic control. Barrier Reflectors, Object Markers and their installation shall conform to CMS 626, except that the spacing shall be 50 feet. An estimated quantity of _____ each of Item 614 Barrier Reflector, Type B and _____ each of Item 614 Object Marker, ____-way have been provided and carried to the General Summary.

**Designer Note:** This note shall be added when Item 614, Barrier Reflectors and/or Object Markers are specified on portable barrier. Each time portable barrier is moved to a new location a new quantity of barrier reflectors and/or object markers shall be provided in the plans.
642-27 Work Zone Increased Penalties Sign (R11-H5a)

R11-H5a-48 signs shall be furnished, erected, and maintained in good condition and/or replaced as necessary and subsequently removed by the Contractor. Signs shall be mounted at the appropriate offsets and elevations as prescribed by the Ohio Manual of Uniform Traffic Control Devices. They shall be maintained on supports meeting current safety criteria.

The signs may be erected or uncovered no more than four hours before the actual start of work. The signs shall be removed or covered no later than four hours following restoration of all lanes to traffic with no restrictions, or sooner as directed by the Engineer. Temporary sign covering and uncovering due to temporary lane restorations shall be guided by the four-hour limitations stated above. Such lane restorations should be expected to remain in effect for 30 or more consecutive calendar days, such as during winter shut-downs.

(The signs on the mainline shall be dual mounted unless not physically possible. The first sign shall be placed between the ROAD WORK AHEAD (W20-1) sign and the next sign in the sequence. Signs shall be erected on each entrance ramp and every 2 miles through the construction work limits. Signs on the mainline shall be R11-H5a-48. Signs used on the ramps shall be R11-H5a-24. R11-H5a-24 signs may be used in the median in lieu of R11-H5a-48 signs if it is not physically possible to provide R11-H5a-48 signs in the median.)

The Contractor may use signs and supports in used, but good, condition provided the signs meet current ODOT specifications. Sign faces shall be retroreflectorized with Type G sheeting complying with the requirements of CMS 730.19.

Work Zone Increased Penalties signs and supports will be measured as the number of sign installations, including the sign and necessary supports. If a sign and support combination is removed and reerected at another location as directed by the Engineer, it shall be considered another unit.

Payment for accepted quantities, complete, in place will be made at the contract unit price. Payment shall be full compensation for all materials, labor, incidentals and equipment for furnishing, erecting, maintaining, covering during suspension of work, and removal of the sign and support.

Item 614, Work Zone Increased Penalties Sign ______ Each

Work Zone Increased Penalties signs will be placed at the following locations:

**Designer Note:** As noted in **Section 605-4.3**, this sign shall be used for construction zones on multi-lane divided highways where the work is expected to last thirty days or more, the work length is at least 0.50 miles, and the work is stationary. See **Section 605-4.3** for other information about the use of this signing.

The third paragraph shall only be used when the sign locations are not itemized in note.

642-28 Earthwork for Maintaining Traffic

The following quantities have been included in the plan for information only.

- Excavation for Maintaining Traffic ______ Cu. Yd.
- Embankment for Maintaining Traffic ______ Cu. Yd.

When undercuts are necessary for mainline pavement or embankment construction, evaluate the need for temporary road undercuts if within a close proximity to the mainline undercuts. A geotechnical evaluation should be considered to determine if the existing soil conditions are adequate to support the temporary road. Additional soil borings along the temporary road are not normally required.
**Designer Note:** This note should be used in conjunction with CMS Item 615, Roads for Maintaining Traffic. The calculations for the above quantities may be shown on the cross-sections or on a separate letter-size sheet that is attached to the LD-4 form.

**642-29 Floodlighting**

Floodlighting of the work site for operations conducted during nighttime periods shall be accomplished so that the lights do not cause glare to the drivers on the roadway. To ensure the adequacy of the floodlight placement, the Contractor and the Engineer shall drive through the work site each night when the lighting is in place and operative prior to commencing any work. If glare is detected, the light placement and shielding shall be adjusted to the satisfaction of the Engineer before work proceeds.

Payment for all labor, equipment and materials shall be included in the lump sum contract price for Item 614, Maintaining Traffic (Section 642-2).

**Designer Note:** The note shall be used on projects that will have work performed during the nighttime hours.

**642-30 Item 614, Work Zone Impact Attenuator for 24" Wide Hazards (Unidirectional or Bidirectional)**

This item shall consist of furnishing and installing a non-gating impact attenuator. Furnish an impact attenuator from the Office of Roadway Engineering approved list for Work Zone Impact Attenuators. The approved list is available at the “Roadway Standards: Proprietary Roadside Safety Devices” web page on the Office of Roadway Engineering website.

Installation shall be at the locations specified in the plans in accordance with the manufacturer’s specifications.

The Contractor shall repair or replace a damaged unit within 24 hours of a damaging impact.

When bidirectional designs are specified, the Contractor shall supply appropriate transitions.

When gating impact attenuators are desired, the Contractor shall submit documentation to the Engineer for acceptance.

The cost for the additional barrier required for a gating impact attenuator shall be included in the cost of the gating impact attenuator.

Payment for the above work shall be made at the unit price bid and shall include all labor, tools, equipment and materials necessary to construct and maintain a complete and functional impact attenuator system, including all related backups, transitions, leveling pads, hardware and grading, not separately specified, as required by the manufacturer.

**Designer Notes:**

1. This note should be used for temporary protection of Type 5 Barrier Design Guardrail, Concrete Median Barrier, Temporary Traffic Barrier and other narrow hazards (24 inches or less in width) When a work zone impact attenuator is needed to protect wider hazards, the designer should specify Item 614 Work Zone Impact Attenuator for Hazards Over 24” and Less Than 36” Wide, (Unidirectional or Bidirectional) and add the corresponding note to the plans (see Section 642-31).

2. A minimum 75 x 20 foot recovery area shall be provided behind each impact attenuator. The recovery area shall be free of workers or any other hazards. Additional work area
may be required beyond the recovery area. The designer should refer to PIS 2010175, Impact Attenuator Placement for further guidance.

3. The length of need point is at the nose of the system; therefore, the entire length of the non-gating impact attenuator can be deducted from the calculated length of need for the barrier.

4. Any of the attenuators can be installed on a concrete pad or asphalt pavement. Consult the manufacturer's specifications for minimum pavement thicknesses and anchoring requirements.

5. Pre-approved shop drawings are reviewed and kept on file. Contact the Office of Roadway Engineering for the current Drawing/Revision.

6. If cross slopes are steeper than 8 percent (12:1), or if the cross slope varies by more than 2 percent (1 degree) over the length of the unit, a leveling pad may be used.

7. Provisions shall be made for the rear fender panels to slide 30 inches rearward upon impact.

8. Bidirectional impact attenuators should be specified for locations where traffic is expected to be in opposing directions on either side of the attenuator. Unidirectional shall be specified when traffic is expected in the same direction on both sides of the attenuator.

9. For gating impact attenuators, the following shall apply:
   a. The recovery area described in note 2 shall be provided from the start of the temporary traffic barrier. The area behind the gating impact attenuator shall be an extension of the recovery area.
   b. The length of need for a gating impact attenuator is at the back of the attenuator; therefore, the impact attenuator shall not be included as part of the calculated length of need.
   c. Gating impact attenuators shall not be used as a bidirectional attenuator.

642-31 Item 614, Work Zone Impact Attenuator for Hazards Over 24" and Less than 36" Wide (Unidirectional or Bidirectional)

This item shall consist of furnishing and installing a non-gating impact attenuator. Furnish an impact attenuator from the Office of Roadway Engineering approved list for Work Zone Impact Attenuators.

Installation shall be at the locations specified in the plans, in accordance with the manufacturer's specifications.

The Contractor shall repair or replace a damaged unit within 24 hours of a damaging impact.

When bidirectional designs are specified, the Contractor shall supply appropriate transitions.

Payment for the above work shall be made at the unit price bid and shall include all labor, tools, equipment and materials necessary to construct and maintain a complete and functional impact attenuator system, including all related backups, transitions, leveling pads, hardware and grading, not separately specified, as required by the manufacturer.

Designer Notes:

1. This note should be used for temporary protection of Type 5 Barrier Design Guardrail, Concrete Median Barrier, Temporary Traffic Barrier, and other fixed objects located in
work zones where hazards are wider than 24 inches, but less than 36 inches.

2. The designer should refer to PIS 2010175, Impact Attenuator Placement for further guidance.

3. The length of need point is at the nose of the system; therefore, the entire length of the unit can be deducted from the calculated length of need for the barrier.

4. Any of the attenuators can be installed on a concrete pad or asphalt pavement. Consult the manufacturer’s specifications for the minimum pavement thicknesses.

5. Pre-approved shop drawings are reviewed and kept on file. Contact the Office of Roadway Engineering for the current Drawing/Revision.

6. If cross slopes are steeper than 8 percent (12:1), or if the cross slope varies by more than 2 percent (1 degree) over the length of the unit, a leveling pad may be used.

7. Provisions shall be made for the rear fender panels to slide 30 inches rearward upon impact.

8. Bidirectional should be specified for locations where traffic is expected to be in opposing directions on either side of the attenuator. Unidirectional shall be specified when traffic is expected to move in the same direction on both sides of the attenuator.

642-32 Reserved for Future Information.

This Plan Note has been deleted; however, the Section (and Plan Note) number has been reserved for future information.

642-33 Extra Advance Warning Signs (Note A)

An Extra Advance Warning Sign Group consists of two W20-1 (ROAD WORK AHEAD) signs, two W20-5 (RIGHT /LEFT LANE CLOSED AHEAD) signs with W16-3a Distance plates, and two W3-H7 (WATCH FOR STOPPED TRAFFIC) signs and required warning lights.

The Contractor shall provide, erect, maintain and remove Extra Advance Warning Sign Groups as shown on SCD MT-95.50 at the following distances in advance of the lane tapers with the appropriate W16-3a distance plates:

1) Lane Taper No. ______, Station ________, Phases _____ & _______; provide sign groups at ______ miles ______ miles and ______ miles.

2) Lane Taper No. ______, Station ________, Phases _____ & _______; provide sign groups at ______ miles, ________ miles, _______ miles, and _______ miles.

(Optional paragraph - The Contractor shall have an additional Extra Advance Warning Sign Group (6 signs and 2 distance plates) available for use when directed by the Engineer. The distance plates for this group shall be able to be modified in the field to show appropriate whole miles to the lane taper.)

Payment for providing, erecting, maintaining and removing Extra Advance Warning Sign Groups shall be included in the lump sum bid for Item 614, Maintaining Traffic.

Designer Note: As noted in Section 641-5.2, this note should be used to require extra Advance Warning Sign Groups if the queue resulting from a lane closure on a multi-lane divided highway is expected to extend beyond the normal ROAD WORK AHEAD sign (W20-1). See Section 641-5.2 for further information.
642-34 Extra Advance Warning Signs (Note B)

An Advance Warning Sign Group consists of two W20-1 (Road Work Ahead) signs, two W20-5 (Right/Left Lane Closed Ahead) signs with W16-3a Distance plates, and two W3-H7 (Watch for Stopped Traffic) signs and required flashing lights.

The Contractor shall provide, erect, maintain and remove an Extra Advance Warning Sign Group as shown on SCD MT-95.50. The W16-3 Distance plates shall read "________ MILES". The Right (Left) Lane Closed Ahead signs shall be located ________ miles from the beginning of the lane taper. Spacing of the other signs shall be as shown on SCD MT-95.40.

The Contractor shall provide, erect, maintain and remove an additional Extra Advance Warning Sign Group to provide additional warning for the anticipated traffic increase during the following national holidays: (appropriate holidays to be filled in as defined by policy and the specific needs of the project). These signs shall be erected no later than 1:00 p.m. the third day preceding the holiday or holiday weekend and not removed before 9:00 a.m. the third day subsequent to the holiday or holiday weekend. The signs shall be removed during the periods between holidays. The W16-3a Distance plates shall read "_______ MILES" with the W20-5 signs located ______ miles from the beginning of the lane taper. Spacing of the other signs shall be as shown on SCD MT 95.30 or 95.40.

(Optional paragraph - The contractor shall have a third Extra Advance Warning Sign Group (6 signs and 2 distance plates) available for use when directed by the Engineer. The distance plates for this group shall read "________ MILES.")

Payment for providing, erecting, maintaining and removing Extra Advance Warning Sign Groups shall be included in the lump sum bid for Item 614, Maintaining Traffic.

Designer Note: As noted in Section 641-5.2, this note should be used to require extra Advance Warning Sign Groups in situations involving work that will extend over a holiday or any other anticipated period of unusually high traffic demand, if the queue resulting from a lane closure on a multi-lane divided highway is expected to extend beyond the normal ROAD WORK AHEAD sign. See Section 641-5.2 for further information.

642-35 Item 614, Work Zone Crossover Lighting System

This work shall consist of furnishing, erecting, operating, maintaining and removing a work zone lighting system for a single crossover, or overlapping a pair of crossovers. The system shall be as shown on SCD MT-100.00. The Contractor shall arrange for and pay for power. All materials and construction shall comply with applicable portions of 625 and 725 except: The Performance test of 625.19F, and certified drawing requirement of 625.04, are waived and used materials in good condition are acceptable.

Poles which are not protected by guardrail or portable barrier shall be located outside the clear zone, and should be located at least 30 ft (preferably 40 ft) from the edge of pavement when possible. Additional pole lines, cables and appurtenances necessary to furnish power to the lighting system shall be included in this item. Service poles shall be positioned with the same constraints as the lighting poles as a minimum.

Payment will be made at the unit price per each for Item 614, Work Zone Crossover Lighting System throughout all phases of work when the crossover roadways are used.

Designer Note: As noted in Section 641-9.5, this note should be included in the plan when a work zone crossover lighting system is provided.

642-36 Multi-Plan, Time-of-Day Operation of Work Zone Signal

The work zone signal control required for this project and shown on sheets __________ and
SCDs MT-96.11, 96.20, and 96.26 shall be capable of providing multiple timing patterns chosen on a time-of-day basis.

Traffic control equipment shall be capable of time-of-day/day-of-week programming; with a minimum of three-dial, three offsets and three splits, or a minimum of fifteen separate timing plans.

<table>
<thead>
<tr>
<th>Approach</th>
<th>A</th>
<th>B</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Northbound Green</td>
<td>31.0*</td>
<td>41.0</td>
<td>16.0*</td>
</tr>
<tr>
<td>Northbound Yellow</td>
<td>3.5</td>
<td>3.5</td>
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<tr>
<td>Northbound All Red (Internal Clearance)</td>
<td>18.0</td>
<td>18.0</td>
<td>18.0</td>
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<tr>
<td>Southbound Green</td>
<td>30.0</td>
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<td>Southbound All Red (Internal Clearance)</td>
<td>19.0</td>
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<td><strong>Total Cycle Length</strong></td>
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<td>105.0</td>
<td>75.0*</td>
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* Provide Timing Appropriate for the Signal Location Under Consideration

<table>
<thead>
<tr>
<th>Time of Day</th>
<th>SUN</th>
<th>MON</th>
<th>TUE</th>
<th>WED</th>
<th>THUR</th>
<th>FRI</th>
<th>SAT</th>
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<tbody>
<tr>
<td>Midnight - 7:00 a.m.</td>
<td>C*</td>
<td>C</td>
<td>C</td>
<td>C</td>
<td>C</td>
<td>C*</td>
<td>C</td>
</tr>
<tr>
<td>7:00 a.m. - 9:00 a.m.</td>
<td>C</td>
<td>A</td>
<td>A</td>
<td>A</td>
<td>A</td>
<td>A</td>
<td>C</td>
</tr>
<tr>
<td>9:00 a.m. - 4:00 p.m.</td>
<td>A</td>
<td>C</td>
<td>C</td>
<td>C</td>
<td>C</td>
<td>C</td>
<td>A</td>
</tr>
<tr>
<td>4:00 p.m. - 6:00 p.m.</td>
<td>C</td>
<td>B</td>
<td>B</td>
<td>B</td>
<td>B</td>
<td>B</td>
<td>A</td>
</tr>
<tr>
<td>6:00 p.m. - Midnight</td>
<td>C*</td>
<td>C</td>
<td>C</td>
<td>C</td>
<td>C</td>
<td>C</td>
<td>C*</td>
</tr>
</tbody>
</table>

Payment is incidental to the lump sum bid for Item 614, Maintaining Traffic.

**Designer Note:** This note should be included in the plan when a signalized one-lane, two-way closing is used.

**642-37 Fully-Actuated Operation of Work Zone Traffic Signal**

The work zone signal control required for this project and shown on sheets ______________ and SCDs MT- 96.11, 96.20 and 96.26 shall be fully traffic-actuated and operate in a manner similar to that described in Section 733.02 of the Construction and Material Specifications.

The initial controller timing shall be as follows:

<table>
<thead>
<tr>
<th>Phase *</th>
<th>1 (All Red Dummy Phase)</th>
<th>2 Mainline (direction)¹</th>
<th>3 (All Red Dummy Phase)</th>
<th>4 Mainline (direction)¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>Min. Green</td>
<td>T_{IC1} = 6+/−</td>
<td>10</td>
<td>T_{IC3} = 6+/−</td>
<td>10</td>
</tr>
<tr>
<td>Extension</td>
<td>n/a</td>
<td>4</td>
<td>n/a</td>
<td>4</td>
</tr>
<tr>
<td>Max. Green</td>
<td>T_{IC1} = 5+/−</td>
<td>30</td>
<td>T_{IC3} = 5+/−</td>
<td>30</td>
</tr>
<tr>
<td>Yellow</td>
<td>3</td>
<td>3.5</td>
<td>3</td>
<td>3.5</td>
</tr>
<tr>
<td>All Red</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Recall</td>
<td>Max.</td>
<td>Min.</td>
<td>Max.</td>
<td>Min.</td>
</tr>
</tbody>
</table>

¹Phases as shown on SCD MT-96.20 for Actuated Control. Add more phases as needed to accommodate side streets, driveways, etc.  
²Plus/minus provide timing for the signal location under consideration.
IC1 is the desired Internal Clearance time for phase 1. T_{IC2} is the desired Internal Clearance time for phase 3. Usually, T_{IC1} = T_{IC3}.

Indicate direction of green.

The Contractor shall also design, furnish, install and maintain a traffic detector on each traffic approach which will reliably detect all legal traffic approaching (but not leaving) the signal as it passes or waits in the designated detector zone shown in the plans. Detector designs which do not provide reliable detection, free from false calls, shall be immediately replaced by the Contractor.

**Designer Note:** This note should be included in the plan when a signalized one-lane, two-way closing is used.

### 642-38 Overhead-Mounted Work Zone Signals

Signals shall be overhead mounted in accordance with the details shown on SCD MT-96.20.

**Designer Note:** This note shall be provided if there is a reason to prohibit side-mounted signal heads.

### 642-39 Lighting

Lighting shall be provided at each end of the lane closure for the closing of one lane of a two-lane highway.

Lighting shall be by conventional methods, with luminaire arms attached to the signal supports. Area illumination shall be provided by using 150 watt minimum high pressure sodium luminaries or 250 watt minimum mercury luminaries. The minimum height of the luminaire shall be 27 ft from the ground surface.

Payment for lighting shall include delivery, erection, maintenance and removal as called for in the plans. Payment shall be per Each.

**Designer Note:** This note may be included in the plans if the designer finds that there is a special need for the lighting at the project location. Examples of need for such lighting might be the existence of an intersection at the point of the lane closure, or poor geometrics or poor sight distance at the point of the lane closure.

Item 614 Work Zone Lighting System Each

### 642-40 Maintenance of Canoe Traffic

Canoe traffic shall be maintained throughout construction of the project either through existing river channel or through portage trail approved by the Engineer.

Adequate signing both upstream and downstream shall be installed and maintained by the Contractor. The following type signs are considered to be minimum treatment:

1. Approximately one-quarter mile upstream, advanced warning type signs on both banks;
2. Approximately 300 feet upstream, signs specifying actions required of canoeist on both banks;
3. Approximately one-quarter mile downstream, advance warning type signs on both banks; and
4. Approximately 300 feet downstream, signs specifying actions required of canoeist of both banks.
The above signing shall be mounted in such a way as to be a minimum of 4 feet above the water level, unobstructed by tree branches, and properly angled for maximum visibility from the main clear channel. The method of supporting the signs shall be approved by the engineer prior to installation. Upon completion of the project, the signs and support systems shall be completely removed from the river channel. The Contractor shall notify local canoe liveries using this portion of the river at least 10 days prior to any changes affecting canoe traffic.

Portage trails if used shall be constructed and maintained by the Contractor with the least possible disturbance to the surrounding area. The trail shall be adequately marked in both directions. The Contractor shall be responsible for obtaining the right-of-way for the portage trails if required.

In the event pipes are used to divert or carry river water, both the inlet and outlet ends shall be adequately protected by grates or fence so that people or canoes are not drawn through or held by them.

642-41 **Item 614, Portable Changeable Message Signs, As Per Plan**

The Contractor shall furnish, install, maintain and remove, when no longer needed, a changeable message sign. The sign shall be of a type shown on a list of approved PCMS units available on the Office of Materials Management web page. The list contains Class A and B units with minimum legibility distances of 650 feet and 475 feet, respectively.

Each sign shall be trailer-mounted and equipped with a functional dimming mechanism, to dim the sign during darkness, and a tamper and vandal proof enclosure. Each sign shall be provided with appropriate training and operation instructions to enable on-site personnel to operate and troubleshoot the unit. The sign shall also be capable of being powered by an electrical service drop from a local utility company. PCMS trailers shall be delineated on a permanent basis by affixing conspicuity tape conforming to CMS 614.03, in a continuous line on the face of the trailer as seen by oncoming road users.

The probable PCMS locations and work limits for those locations are shown on sheet(s) of the plan. Placement, operation, maintenance and all activation of the signs by the Contractor shall be as directed by the Engineer. The PCMS shall be located in a highly visible position yet protected from traffic. The Contractor shall, at the direction of the Engineer, relocate the PCMS to improve visibility or accommodate changed conditions. When not in use, the PCMS shall be turned off. Additionally, when not in use for extended periods of time, the PCMS shall be turned, facing away from all traffic, and shall display one or more Type G yellow retroreflective sheeting surfaces of 9-inch by 15-inch minimum size facing traffic.

The Engineer shall be provided access to each sign unit and shall be provided with appropriate training and operation instructions to enable ODOT personnel to operate and troubleshoot the unit, and to revise sign messages, if necessary.

(The Contractor shall implement a system whereby changeable messages will be implemented within ______ hours following telephone notification from the Project Engineer to a designated phone.)

All messages to be displayed on the sign will be provided by the Engineer. A list of all required pre-programmed messages will be given to the Contractor at the project preconstruction conference. The sign shall have the capability to store up to 99 messages. Message memory or pre-programmed displays shall not be lost as a result of power failures to the on-board computer. The sign legend shall be capable of being changed in the field. Three-line presentation formats with up to six message phases shall be supported. PCMS format shall permit the complete message for each phase to be read at least twice.
The PCMS shall contain an accurate clock and programming logic which will allow the sign to be activated, deactivated or messages changed automatically at different times of the day for different days of the week.

(The PCMS shall contain a cellular telephone data link which will (in active cellular phone areas) allow remote sign activation, message changes, message additions and revisions to time of day programs. The system shall also permit verification of current and programmed messages. One remote data input device (laptop computer plus modem or equivalent) shall be furnished for use by the District Traffic Engineer, or equivalent, and shall be insured against theft.)

The PCMS unit shall be maintained in good working order by the Contractor in accordance with the provisions of CMS 614.07. The Contractor shall, prior to activating the unit, make arrangements, with an authorized service agent for the PCMS, to assure prompt service in the event of failure. Any failure shall not result in the sign being out of service for more than 12 hours, including weekends. Failure to comply may result in an order to stop work and open all traffic lanes and/or in the Department taking appropriate action to safely control traffic. The entire cost to control traffic, accrued by the Department due to the Contractor’s noncompliance, will be deducted from moneys due, or to become due the Contractor on his contract.

The Contractor shall be responsible for 24-hour-per-day operation and maintenance of these signs on the project for the duration of the phases when the plan requires their use.

Payment for the above described item shall be at the contract unit price. Payment shall include all labor, materials, equipment, fuels, lubricating oils, software, hardware and incidentals to perform the above described work.

Item 614,  Portable Changeable Message Sign, as per plan __________ Sign Month

Designer Note: Portable changeable message signs (PCMSs) are trailer-mounted programmable message units which can be utilized to provide advance information about upcoming traffic conditions or diversion routing schemes to road users (see Section 605-9). PCMS units are supplemental information devices and shall not be utilized as alternates to standard fixed signing or flashing arrow boards.

On major construction projects, PCMS units can provide real benefits to road users. These benefits include increased work zone capacity resulting from advance warning of lane closures, and improved corridor capacity resulting from diversion schemes implemented in reduced capacity situations.

PCMSs are intended to have a high impact on the motorist and to convey timely, pertinent, driver oriented information which could not be provided by fixed-message signs. For this reason, if no important message needs to be displayed, the sign shall be turned off. The display of non-priority messages is discouraged as drivers tend to become familiar with these and overlook priority messages displayed later.

The use of PCMS should be reserved for situations where signs must be changed frequently and/or where the next required message cannot be predicted in advance. When a message is known in advance or when it could be determined before there is a need to display it, then a fixed-message sign is appropriate. Certainly, messages such as LEFT/RIGHT LANE CLOSED AHEAD should not be considered for PCMS display because there are standard signs readily available for this purpose and emphasis can be added with flashers or flags at a nominal cost. Similarly, non-standard messages such as ROAD WORK WILL CLOSE TWO (2) LANES BEGINNING APRIL 20, 2012 can normally be determined well in advance of need and included in the plans as fixed-message signs. Even where sign messages must change periodically, a fixed-message sign with flip-up panel may be more appropriate.
Sign messages shall be limited to a maximum of two sequential displays or phases, each consisting of a maximum of three, eight-character lines.

The Approved List of Portable Changeable Message Signs can be found on the Office of Materials Management website. This list contains the PCMS approved for use on ODOT projects. The pre-qualified list currently contains two classes of PCMS, Class A and Class B. The Class A unit, with legibility distance of 650 feet is intended for use on roadways where the speed limit is 45 mph or greater. The Class B unit, with legibility of 475 feet is intended for use on roadways where the speed limit is 40 mph or less.

The fifth paragraph in this Plan Note is optional. This paragraph is to be included in the plans when it is intended that time-of-day/day-of-week programming capability is to be provided. This feature allows for certain messages to be pre-selected for anticipated critical times, and also allows the unit to be automatically turned off when there is no significant message to convey.

The eighth paragraph in this Plan Note is also optional. This paragraph is to be used when it is necessary to require cellular phone data link programming of PCMS operation and messages. This should be included only when potential maintenance of traffic problems justify its use; and only when procedures have been developed to assess travel problems on a current basis and an operating agency (e.g., District Traffic Department, City Traffic Department, OSHP or City Police Department) is prepared to monitor and operate the system on a real-time basis with current information. Further, the cellular phone option should not be invoked unless the designer has assured that cellular phone services are available in the proposed sign area. Generally, PCMS units should be located well in advance of the situation to which they relate. In the case of diversion schemes, the PCMS units should be located well in advance of the upstream interchange where the alternate route begins. The desired location(s) for deployment of PCMS units shall be established by means of a Plan Note listing the specific locations where the contractor is to install, maintain and remove the PCMS units(s) and the duration the PCMS unit is to function. Designers should field review potential sites to find those with good visibility and a level, accessible area, preferably behind existing guardrail. The Plan Note also permits the project engineer to relocate the sign to improve visibility or to accommodate changing conditions.

642-42 Maintenance of Traffic Signal/Flasher Installation

The Contractor shall be responsible for maintaining traffic signal/flasher installations within the project under the following conditions:

1. Existing signal/flasher installations which the plans require the Contractor to adjust, modify, add onto or remove, or which the Contractor actually adjusts, modifies or otherwise disturbs. The Contractor shall be responsible for the entire installation (at an intersection) from the time his operations first disturb the installation until the installation has been subsequently removed or modified and the work is accepted.

2. New or reused signal/flasher installations or devices, installed by the Contractor. The Contractor shall be responsible for maintenance of these from the time of installation until the work is accepted.

The Contractor shall correct as quickly as possible all outages or malfunctions. He shall provide the maintaining agency and the Engineer such addresses and phone numbers where his maintenance forces can be contacted. The Contractor shall provide one or more persons to receive all calls and dispatch the necessary maintenance forces to correct outages. Such a person or persons may be used to perform other duties as long as prompt attention is given to these calls and a person is readily available continuously 24 hours a day, 7 days a week. All lamp outages, cable outages, electrical failures, equipment malfunctions and misaligned
signal heads shall be corrected to the satisfaction of the Engineer with the signal back to service within four hours after the Contractor has been notified of the outage.

In the event new signals are damaged prior to acceptance, all damaged equipment except poles and control equipment shall be replaced by the Contractor to the satisfaction of the Engineer with the signal back in service within 8 hours after the Contractor's notification of the outage. The Contractor shall arrange for full traffic control until the signal is back in operation.

If poles and/or control equipment are damaged and must be replaced, the Contractor shall make temporary repairs as necessary to bring the signal back into full operation within the allowed 8-hour period, and shall make permanent repairs or replacement as soon thereafter as possible.

None of the above shall be construed as collective or consecutive outage time periods at any one location. That is, where more than one outage occurs at any one location then the allotted time limit shall be for the worst single outage.

Where outages are the direct result of a vehicle accident the response of the Contractor shall be as outlined above. The Contractor shall be responsible for collection of any compensation for this work from those parties responsible for the damage.

Where the Contractor has failed to, or cannot respond to, an outage or signal equipment malfunction, at these locations within his responsibility, within periods as specified above, the Engineer may invoke the provisions of Section 105.15 and any subsequent billings to the State or the City of __________ for Police Services and maintenance services by City forces shall be deducted from monies due or to become due the contractor in accordance with provisions of Section 105.15.

The Contractor shall provide the maintenance service entirely with his forces or he may choose to enter into a cooperative understanding with the local maintaining agency to provide the maintenance. The Contractor shall inform the Engineer, in writing, of the maintenance method selected.

The Contractor shall be responsible for any damage to any traffic signal components required to be handled during the relocation of poles and revisions to the signal system. When a traffic signal must be taken out of service by the Contractor, due to construction procedures, this outage shall not exceed ___ hours and shall not include the hours of ___ to ___. Any signalized intersection, where the signal is out of service due to construction procedures, or due to an outage or malfunction of equipment as described above, shall be protected, by the Contractor, by the installation of temporary "STOP" signs, except for the following intersections which shall be protected by off-duty City of __________ Police, hired by the Contractor:

1. 
2. 
3. 

Any vehicular traffic signal head, either new or existing which will be out of operation shall be covered in the manner described in 632.25.

The Contractor shall maintain complete records of malfunctions including:

1. Time of notification of malfunction;
2. Time of work crews arrival to correct the malfunction;
3. Actions taken to correct the malfunction, including a list of parts repaired or replaced;

4. A diagnosis of reason for the malfunction and probability of reoccurrence;

5. Time of completion of the repair and system restored to full service.

A copy of these records shall be provided to the Engineer within three (3) working days following completion of each repair.

All costs resulting from the above requirements shall be considered to be included in the lump sum price bid for Item 614, Maintaining Traffic.

**Designer Note:** This note may be used when existing signals are to be maintained.

### 642-43 Advance Work Zone Information

Advance work zone information signs, as used in this note, are fixed message types. The signs are to be located at extreme distance from the work area, as shown in the plans.

The signs shall be black on orange (including a black border). The layout shall be in conformance with TEM Section 211.

When regulatory information is provided, it shall be displayed separately as a standard black-on-white sign. Mixing of black-on-white regulatory information on a black-on-orange information sign is prohibited.

If the motorist is being detoured or if an alternate route is provided, the route should be signed with assemblies consisting of the appropriate black-on-orange DETOUR or ALT marker with a standard route marker and arrow plate. If more target value is desired, this trail blazer information may be shown on an orange panel (OMUTCD Section 2D.32).

Route Sign assemblies shall be sized according to the type of road on which they are located in accordance with the OMUTCD.

Supports for sign installations shall conform to all existing standards for permanent signs. These signs should not be attached to existing supports.

Where the plans call for an overlay to cover a portion of an existing sign, the overlay shall be black-on-orange. Letter sizes should be the same as on the existing signs. When lane arrows are to be covered, rather than using a blank overlay, the legend “LANE CLOSED” shall be used. When a ramp is being closed, rather than using a blank overlay to cover the entire sign, the legend “CLOSED” shall be used on a diagonal overlay (lower left to upper right) on the sign. The size of lettering on overlays and the size of the overlay are indicated in the plans. The minimum letter size for “LANE CLOSED” shall be 10” E. The minimum letter size for the diagonal “CLOSED” overlay shall be 12” E.

All advance work zone information sign installations located outside of the project work limits shall be paid for under appropriate 630 items (signs, supports, concrete, breakaway connection, overlays, removals, etc.).

**Designer Note:** This note may be used when it is necessary to provide advance information on fixed signs, as discussed in **Section 640-26**.

### 642-44 Worksite Traffic Supervisor

Subject to approval of the Engineer, the Contractor shall employ and identify (someone other than the superintendent) a certified Worksite Traffic Supervisor (WTS) before starting work in the field. The WTS may be certified from one of the following organizations:
1. American Traffic Safety Service Association (ATSSA), phone number 1-800-272-8772, certified Traffic Control Supervisor (TCS).

2. National Highway Institute, Design and Operation of Work Zone Traffic Control, phone number 1-703-235-0528.

3. The Ohio Contractors Association, Traffic Control Supervisor (OCA/TCS) work zone class, only if taken after May 5, 2004, phone number 1-800-229-1388.


A copy of each WTSs certification and 24-hour contact information shall be provided to the Engineer at the preconstruction conference. If the designated WTS will not be available full time (24/7) the Contractor may designate an alternate WTS to be available when the primary is off duty. Each WTS shall have a current WTS certification (with an expiration date no more than 5 years from the date of issue) from any of the approved organizations.

The WTS position has the responsibility of monitoring traffic control deficiencies for the entire work zone. The duties of the WTS are as follows:

1. Be available on a 24-hour per day basis, and be able to be on site for all emergency traffic control needs within one hour of notification by police or project staff and be prepared to effect corrective measures immediately on existing work zone traffic control devices.

2. Attend preconstruction meeting and all project meetings where traffic control management is discussed.

3. Be available for meetings or discussions with the Engineer upon request or within 36 hours.

4. Be aware of, and coordinate if necessary, all traffic control operations, including those of subcontractors and suppliers.

5. Coordinate project activities with all Law Enforcement Officers (LEOs). A WTS shall also be the main contact person with the LEOs while they are on the project.

6. Coordinate meetings with ODOT personnel, LEOs and other applicable entities before each plan phase switch to discuss work zone traffic control.

7. Ensure compliance with the contract documents for signs, barricades, temporary concrete barrier, pavement markings, portable message signs, and other traffic control devices on a daily basis; and facilitate any corrective action necessary.

8. Notify the Contractor of the need for cleaning and maintenance of all traffic control devices, including the covering and removal of inapplicable signs.

9. Inspect, evaluate, propose necessary modifications to, and document the effectiveness of, the traffic control devices and/or traffic operations on a DAILY BASIS (7 days a week). In addition, a weekly night inspection of the work zone setup for daytime work operations; and one daytime inspection per week for nighttime projects. This shall include (but not be limited to) documentation on the following project events:

   a. Initial traffic control setup (day and night review).

   b. Daily traffic control setup and removal.
c. When construction staging causes a change in the traffic control setup.

d. Crash occurrences within the construction area.

e. Removal of traffic control devices at the end of a phase or project.

f. All other emergency traffic control needs.

10. Complete the Department approved Long Term Inspection form (CA-D-8) after each inspection as required in # 9 and submit it to the Engineer the following work day. These reports shall include a checklist of all traffic control maintenance items to be reviewed. A copy of the form will be provided at the pre-construction meeting. Any deficiencies observed shall be noted, along with recommended corrective actions and the dates by which such corrections were, or will be, completed. A copy of this document can be found in the Department of Transportation Construction Inspection Forms Manual dated 10/15/06 or current revision.

11. Verify that all flagging operations are being conducted per the Ohio Manual of Uniform Traffic Control Devices.

12. Have copies of the ODOT Temporary Traffic Control Manual and applicable standards and specifications included in the contract documents available at all times on the project.

The Department will not pay the unit price bid for the WTS for any day on which the Contractor fails to perform the duties set forth above. Should the Contractor’s failure to perform any of the duties described above result in a maintenance of traffic safety issue, the Department will deduct the prorated daily amount for Item 614 Maintenance of Traffic from the Contractor’s next scheduled estimate.

If three or more failures to perform the duties set forth above occur, the WTS shall be immediately removed from the work in accordance with C&MS 108.05.

The following estimated quantity has been included for the Worksite Traffic Supervisor:

| Item 614 | Worksite Traffic Supervisor | _______ Months |

**Designer Note:** The Worksite Traffic Supervisor note is intended for use on long-term Interstate or Interstate look-alike projects.

642-45 **Item 614 - Maintaining Traffic**

The Contractor shall be responsible for designing and maintaining safe and effective traffic control 24 hours a day for the duration of this project. All traffic control devices shall be furnished, erected, maintained, and removed by the Contractor.

The Contractor shall devise a maintenance of traffic scheme which shall be stamped by a professional engineer, and present it to the Engineer for approval. The maintenance of traffic scheme shall present, in general, the method for conducting the required work in a safe and efficient manner.

The plans shall include the following components:

- Plan view at an appropriate scale to show:
  - Work area
  - Begin/end stationing of tapers, temporary markings, etc.
  - Temporary Pavement
  - Locations of signs (existing overhead signs and all proposed, covered, or modified...
signs)
Locations of typical sections
References to applicable standard drawings
Typical sections showing:
Lane widths, pavement markings, drums, PB, etc.
Limiting stations
Work area and drop-offs
Sign details for proposed signs and overlays/modifications

The maintenance of traffic scheme shall be in conformance with the Ohio Manual of Uniform Traffic Control Devices, latest revision, the referenced standard construction drawings including designer notes, the construction and material specifications (CMS), Policy No. 516-003(P) Traffic Management in Work Zones Interstate and Other Freeways, ODOT Location and Design Manual, Volume 1, and all requirements detailed in these plans.

This submittal shall consist of three copies of the plans for review and distribution. No work shall begin at the location until the maintenance of traffic plans have been approved by Ohio Department of Transportation.

The progress schedule will be required to approve the maintenance of traffic plans. This schedule of operations shall detail the Contractor’s work activities and his methods of maintaining traffic during these activities. Maintenance of traffic plans shall be prepared and submitted to the district for approval. These plans shall be sealed by a registered professional engineer. The District shall have 14 calendar days to review and comment on these plans. The Contractor shall not begin any work requiring traffic control until the Engineer has given approval of the Contractor’s sequence of operations and maintenance of traffic plans.

The maintenance of traffic scheme shall take into consideration snow and ice operations from December 1 through March 31. Lane shifts, restrictions, and closures may not be approved if they adversely affect snow removal operations.

If in the opinion of the Engineer, the Contractor fails to comply with these requirements and the provisions of the approved maintenance of traffic plan, the Engineer shall suspend work until all requirements are met. Any costs or delays incurred as a result of the failure shall be the full responsibility of the Contractor.

Payment for all the items required to maintain traffic in accordance with these requirements shall be included in the lump sum price for Item 614 - Maintaining Traffic, as per plan.

**Designer Note:** This note is intended for use with plans calling for contractor-developed maintenance of traffic plans.

**642-46 SpeedInfo Devices within Project Limits**

The Contractor shall take measures to maintain the proper operation of any SpeedInfo devices within the project limits. The devices are Doppler radar units which look like cylindrical tubes with solar panels attached to them. The sensors are implemented on all Interstates statewide and other major US and State Routes in urban areas, generally spaced between 1 to 2 miles apart, and installed on any existing ODOT infrastructure (typically overhead trusses, cantilevers, ground-mounted sign supports, or light poles). ODOT will coordinate the relocation of any devices that may be affected by the Contractor’s operation. The Contractor shall NOT remove the devices themselves. The Contractor shall notify the Project Engineer a minimum of ten calendar days prior to performing any work which requires device relocation. The Project Engineer shall then notify SpeedInfo, Inc. and the ODOT Office of Traffic Engineering of any devices that require relocation. The Contractor should be aware that since speed data is still desirable to ODOT, the Project Engineer will attempt to inform SpeedInfo, Inc. of newly available install locations for the sensors to be relocated to, with minimal downtime.
If immediate attention to a SpeedInfo sensor is required, the Contractor may directly contact the regional installer for SpeedInfo, Inc. from the provided contact information. The regional installer would be able to provide the quickest possible attention to the situation. If the regional installer cannot be reached, the list of statewide contacts should be used in the order it is presented. An email informing all parties of the situation should also be sent at the earliest convenience.

(Provide appropriate regional contacts as well as statewide contacts.)

(Optional) The SpeedInfo devices within the project limits are located at the below locations. The Contractor shall be advised that these locations may have changed by the time of construction and shall use the above procedure for any other speed detection devices.

(Provide table with existing locations of SpeedInfo sensors, obtainable from Bryan Comer in the Office of Traffic Engineering (OTE) or the ODOT Office of Traffic Engineering ITS intranet website.)

**Designer Note:** This note shall be used on any construction project which includes SpeedInfo sensor(s) located within the project limits. The sensors are installed on all Interstates statewide spaced at approximately 1 mile increments within urban areas and 2 mile increments in rural areas, and also implemented on some US and State Routes which are Interstate look-a-likes. A list of existing locations can be found on the ODOT Office of Traffic Engineering ITS intranet website (see Traffic Signals/ITS, ITS, Shared Documents, SpeedInfo). For any questions about the existing or future planned locations, contact Bryan Comer. Regional and statewide contacts are given below. Include the appropriate contacts within the note in the plans.

1. **Regional Contacts**

   **ODOT D01, Western D05, D06, D07, D08 (also Northern KY), D09**

   Matt Slusher, Capital Electric  
   (937) 531-7518  
   mslash@capitalelectric.com

   Joe Hutsell, Capital Electric  
   (937) 604-5838  
   jhutsell@capitalelectric.com

   **ODOT D02, D03, D04, Eastern D05, D10, D11, D12**

   Jeff Chase, A+A Safety  
   Work: (216) 283-8040  
   Cell: (216) 854-6531  
   jeffc@aasafetyinc.com

2. **Statewide Contacts**

   Charlie Armiger, SpeedInfo  
   Office: (408) 333-9960  
   Cell: (408) 425-4684  
   carmiger@speedinfo.com

   Bryan Comer, ODOT  
   (614) 387-1253  
   bryan.comer@dot.state.oh.us

   George Saylor, ODOT  
   (614) 752-8099  
   george.saylor@dot.state.oh.us

   Jason Yeray, ODOT  
   (614) 466-2168  
   jason.yeray@dot.state.oh.us

**642-47 Speed Measurement Markings**

The Contractor shall place a series of Speed Measurement markings on the roadway to assist in the enforcement of speed regulations within the work zone. Each Speed Measurement Marking shall consist of one white transverse 24-inch line, 4 foot in length. The markings shall be placed at one-quarter mile intervals over a 1 mile length of roadway, at locations as shown in the plans or as directed by the Engineer. Speed Measurement Markings shall not be located within 0.5 mile of a taper, shift, crossover, entrance or exit ramp. Speed Measurement Markings are typically located such that they extend 2 feet on either side of the center line or the edge line, or are located entirely on the shoulder;
however, in work zones it may be necessary to center these markings within a lane.

The markings shall be laid out by a registered surveyor.

The following quantity has been carried to the General Summary to be used as directed by the Engineer:

Item 614  Special - Air Speed Zone Marking  _______ Each

**Designer Note:** This note shall be used when it is intended that an Air Speed Check Zone be provided within a work zone.

The following procedure should be followed for installing Air Speed Check Zones in work areas:

**ODOT** and the Local **Ohio State Highway Patrol (OSHP) Posts** shall discuss desires for placing Air Speed Check Zones in the work zone. When it has been agreed that there will be an Air Speed Check Zone within the work zone, the **OSHP Aviation Section Headquarters** shall be contacted for their assistance in enforcing the Air Speed Check Zone.

The agreement to assist by the **Aviation Section Headquarters** shall be forwarded to the appropriate **ODOT District Highway Management Administrator**.

Upon termination of the work zone, any Speed Measurement Marking which is not eliminated by pavement removal or resurfacing shall be allowed to wear out.

**642-48  Item 614 - Work Zone Raised Pavement Marker, As Per Plan**

Work Zone Raised Pavement Markers, As Per Plan, and their installation shall conform to CMS 614 or CMS 621 as specified herein.

- Raised Pavement Markers in use during the snow-plowing season shall conform to 621.
- Raised Pavement Markers in use during the non-snow-plow season shall conform to either 614 or to 621.

The snow-plowing season shall run from ________________ through ________________.

If project delays, not the fault of ODOT, cause the work to extend into the snow-plowing season, the contractor shall be responsible for replacing Work Zone Raised Pavement Markers (WZRPMs) conforming to CMS 614, with Raised Pavement Markers conforming to 621, as determined by the Engineer, at the contractor’s expense.

This item shall include purchase, installation and removal of Item 614 Work Zone Raised Pavement Marker, As per Plan, including filling of any depressions created in the pavement as per CMS 621.08.

Resurfacing of the transition areas shall be performed at the time that the surface course is being applied to the entire project. Prior to application of the surface course on the project, the existing pavement within the transition area shall be removed to a depth necessary to reach the level of the intermediate course of the pavement, as determined by the Engineer.

The following bid items should be included in the plans:

Item 254  Pavement Planing, Asphalt Concrete  Square Yards
Item 614  Work Zone Raised Pavement Marker, as per plan  Each

Payment for resurfacing within the transition area shall be paid for under the appropriate bid
items for the work required, as provided for in the plans.

**Designer Note:** This note shall be included in the plans on freeway and expressway projects when raised pavement marking is to be provided on asphalt surfaces in temporary traffic control zones. Snow-plowing season at the project site should be as determined by the District. If dates specific to the project site cannot be determined, the default dates of snow-plowing season shall be as per CMS 614.115C (October 15 to April 1) regarding installation of WZRPMs.

The appropriate quantity of surface course material for resurfacing the transition area shall also be provided.

**642-49 Item 614 - Work Zone Raised Pavement Markers on Concrete Surfaces**

Raised pavement markers in work zones, installed on to concrete surfaces, shall be Item 614 Work Zone Raised Pavement Markers. WZRPMs are intended for use only during the non-snow-plowing season. WZRPMs shall not be provided during the snow-plowing season.

The snow-plowing season shall run from ______________ through ______________.

Where a temporary alignment will remain in use through the winter, the WZRPMs shall be removed prior to the beginning of the snow-plowing season and replaced approximately April 1, or as otherwise determined by the Engineer.

This item shall include purchase, installation and removal of Item 614 Work Zone Raised Pavement Markers

An estimated quantity of ______ Each of Item 614 Work Zone Raised Pavement Marker has been provided and carried to the General Summary.

**Designer Note:** This note shall be included in the plans when raised pavement marking is to be provided on concrete surfaces in temporary traffic control zones. Snow-plowing season at the project site should be as determined by the District. If dates specific to the project site cannot be determined, the default dates of snow-plowing season shall be as per CMS 614.115C (October 15 to April 1) regarding installation of WZRPMs.

**642-50 Barrier Delineation, As Per Plan**

Increased delineation, as specified herein, shall be installed on all portable barrier and concrete permanent barrier located within 5 feet of the edge of the traveled lane under either of the following conditions:

- Along tapers and transition areas
- Along curves (outside only) with degree of curvature greater than or equal to 3 degrees

The increased delineation shall consist of either linear delineation panels or the triple stacking of work zone barrier reflectors.

The linear delineation panels shall consist of panels of delineation, approximately 34 inches long and 6 inches wide and shall be “crimped.” Panels shall be provided at the rate of one panel every 10 feet on portable barrier and permanent concrete barrier, spaced evenly along the length of the run. The panels shall be mounted such that the tops of the panels are 26 inches above the pavement.

Triple stacked barrier reflectors shall consist of three barrier reflectors stacked vertically in their attachment to portable barrier. There shall be no open space between the adjacent barrier reflectors. The top of the middle barrier reflector shall be located 26 in above the pavement.
pavement.

Payment shall be full compensation for all material, labor, incidentals and equipment necessary for furnishing, installing, maintaining and removing Linear Delineation. The following estimated quantity has been included in the plans:
614  Linear Delineation    Foot

Along runs of portable barrier where this item is provided, the quantity shall be measured as the entire length of the run being delineated, including the spaces between the individual panels or stacks of barrier reflectors.

**Designer Note:** This note shall be added to freeway and expressway projects when portable barrier or permanent concrete barrier is located within 5 feet of the edge of the traveled lane.

It is intended that either the linear delineation panels or the triple stacking of barrier reflectors be provided, at the Contractor’s discretion.

642-51 Barrier Delineation

Barrier reflectors and object markers shall be installed on all permanent concrete barrier located within 5 feet of the edge of the adjacent travel lane. Barrier reflector and object marker spacing shall be as per MT-101.70.

Payment shall be full compensation for all material, labor, incidentals and equipment necessary for furnishing, installing, maintaining and removing barrier reflectors and object markers.

An estimated quantity of foot of Item 614 Linear Delineation and Each of Item 614 Object Marker, -way has been provided and carried to the General Summary.

**Designer Note:** This note shall be included in the plans when permanent concrete barrier is located within 5 feet of the edge of the travel lane for projects located on freeways (Interstate and Interstate look-alike) or expressways.

642-52 Guardrail Delineation

Object Markers shall be installed on all Guardrail located within 5 feet of the edge of the adjacent travel lane. Guardrail-mounting of Object Markers shall be made by installing the object markers on the extension blocks rather than directly onto the guardrail itself. Object marker spacing shall be approximately 50 feet.

Payment shall be full compensation for all material, labor, incidentals and equipment necessary for furnishing, installing, maintaining and removing Object Markers.

An estimated quantity of each of Item 614 Object Markers, -way has been provided and carried to the General Summary.

**Designer Note:** This note shall be included in the plans when guardrail is located within 5 feet of the edge of the travel lane for projects located on freeways (Interstate or Interstate look-alike) or expressways.

642-53 Item 614, Longitudinal Channelizer

Longitudinal Channelizers shall be provided as called for in the plans. A Longitudinal Channelizer consists of a combination of vertical components and longitudinal base components, fit together to create a continuous channelizing device, as detailed in PIS 2010180. Use of tubular markers, as identified in the OMUTCD, Figure 6F-7, shall not qualify for use as a longitudinal channelizer.
The vertical component shall be equipped with two 3-inch wide retroreflective bands, placed a maximum of 2 inches from the top, with a maximum of 6 inches between the bands. The longitudinal base components shall be equipped with reflectors.

The Longitudinal Channelizer shall be NCHRP 350 compliant.

For installation procedures, follow the manufacturer’s instructions.

Payment for providing, installing and removing this channelizer will be made at the unit price per foot for:

Item 614, Longitudinal Channelizer Foot

Designer Note: This note shall be included in the plans when Longitudinal Channelizer is called for in the plans.

642-54 Item 614 – Business Entrance (M4-H15) Sign, As Per Plan

The Business Entrance (M4-H15) sign should be provided at each temporarily relocated commercial Driveway for which the relocation is not obvious to the motorist. The project Engineer shall determine whether or not the driveway relocation is, or is not, obvious and whether or not a sign should be provided. Only one sign per Business shall be permitted. The sign shall be 36 inch X 48 inch in size with Type G or Type H orange retroreflective sheeting. The sign legend shall be placed on both sides of the sign (back to back). The sign shall have the standard M4-H15 legend with the word “BUSINESS” on the top line, except under unusual circumstances where it may not be intuitive that a driveway serves a specific business. In such unusual cases, the actual business name may be substituted for the word “BUSINESS”.

The sign shall be mounted on two #3 posts or on temporary posts in accordance with SCD MT-105.10 and in accordance with the Ohio Manual of Uniform Traffic Control Devices, latest edition. The sign shall be clearly visible and shall clearly identify the location of the driveway. The sign should be positioned at 90° to the direction(s) of traffic. The sign may need to be moved for each Phase of the Maintenance of Traffic operations.

Payment for all costs associated with manufacturing, mounting, relocating, and removing the sign, including all labor, materials and equipment shall be included in the contract price per Each for Item 614-Business Entrance sign.

The following estimated quantity has been carried to the general summary for this item.

Item 614, Business Entrance Sign Each

Designer Note: This note may be included in the plans when business entrances are temporarily relocated. It is intended that this note be used on projects where there are isolated business locations.

The sign should be the standard M4-H15 legend with the word “BUSINESS” on the top line. Under unusual circumstances where it may not be intuitive that a driveway serves a specific business, the actual business name may be substituted for the word “BUSINESS.”

642-55 Item 614 - Law Enforcement Officer (With Patrol Car) for Assistance During Construction Operations

Use of Law Enforcement Officers (LEOs) by contractors other than the uses specified below will not be permitted at project cost. LEOs should not be used where the OMUTCD intends that flaggers be used.
In addition to the requirements of CMS 614 and the OMUTCD, a uniformed LEO with an official patrol car (car with top-mounted emergency flashing lights and complete markings of the appropriate law enforcement agency) shall be provided for the following traffic control tasks:

- During the entire advance preparation and closure sequence where complete blockage of traffic is required.

- During a traffic signal installation when impacting the normal function of the signal or the flow of traffic or when traffic needs to be directed through an energized traffic signal contrary to the signal display (e.g., directing motorists through a red light).

In addition to the requirement of CMS 614 and the OMUTCD, a uniformed LEO with an official patrol car (car with top-mounted emergency flashing lights and complete markings of the appropriate law enforcement agency) should be provided for the following traffic control tasks:

- For lane closures: during initial set-up periods, tear down periods, substantial shifts of a closure point or when new lane closure arrangements are initiated for long-term lane closures/shifts (for the first and last day of major changes in traffic control setup). In general, LEOs should be positioned at the point of lane restriction or road closure and to manually control traffic movements through intersections in work zones.

- When construction vehicles are entering/exiting the zone directly from/into an open lane of traffic. If a lane has been closed to provide an acceleration/deceleration lane for the vehicle, the LEO will not be required.

LEOs should not forgo their traffic control responsibilities to apprehend motorists for routine traffic violations. However, if a motorist’s actions are considered to be reckless, then pursuit of the motorist is appropriate.

The LEOs work at the direction of the Contractor. The Contractor is responsible for securing the services of the LEOs with the appropriate agencies and communicating the intentions of the plans with respect to duties of the LEOs. The Engineer shall have final control over the LEOs’ duties and placement, and will resolve any issues that may arise between the two parties.

The LEO shall report in to the Contractor prior to the start of the shift, in order to receive instructions regarding specific work assignments during his/her shift. The LEO is expected to stay at the project site for the entire duration of his/her shift. The LEO shall report to the Contractor at the end of his/her shift. Once the LEO has completed the duties described above and still has time remaining on his/her shift, the LEO may be asked to patrol through the work zone (with flashing lights off) or be placed at a location to deter motorists from speeding. Should it be necessary to leave the project site, the LEO shall notify the Engineer. The Contractor shall provide the LEO with a two-way communication device which shall be returned to the Contractor at the end of his/her shift.

LEOs (with patrol car) required by the traffic maintenance tasks above shall be paid for on a unit price (hourly) basis under Item 614, Law Enforcement Officer (With Patrol Car) for Assistance. The following estimated quantities have been carried to the General Summary.

Item 614, Law Enforcement Officer With Patrol Car for Assistance _____ Hours

The hours paid shall include any minimum show-up time required by the law enforcement agency involved.

Any additional costs (administrative or otherwise) incurred by the Contractor to obtain the
services of an LEO are included with the bid unit price for Item 614, Law Enforcement Officer With Patrol Car for Assistance.

**Designer Note:** See Section 640-19 for additional information. The plans shall clearly specify when and where the LEO is to be utilized. This note should be edited to conform to the project requirements.

**642-56 Item 614 - Law Enforcement Officer (With Patrol Car) for Enforcement in Work Zones**

When Law Enforcement Officers (LEOs) are used as a speed control measure in stationary work zones, they shall be used as shown in these plans. LEOs can be used in the form of: stationary patrol car, circulating patrol car, and/or air enforcement in combination with ground patrol car.

The LEO works at the direction of the Contractor. The Contractor is responsible for arranging the services of the LEO with an official patrol car (car with top-mounted emergency flashing lights and complete markings of the appropriate law enforcement agency). The Contractor should schedule the LEO a minimum of one week in advance and shall include any minimum show-up time required by the law enforcement agency involved. The Engineer shall resolve any issues that may arise between the two parties.

The LEO shall report to the Contractor prior to the start of the shift, in order to receive instructions regarding specific work assignments as shown in the plans. The LEO is expected to stay at the project site for the entire duration of his/her shift. The LEO shall report to the Contractor at the end if his/her shift. Should it be necessary to leave the project site, the LEO shall notify the Engineer. The Contractor shall provide the LEO with a two-way communications device which shall be returned to the Contractor at the end of his/her shift.

A meeting with district personnel, central office personnel, work zone traffic supervisor (if applicable) and appropriate law enforcement agencies shall take place prior to the beginning of the project. Work Zone Safety and Mobility training specific to the project will take place at this time along with distribution of pre-work zone crash analyses. During this meeting, duties and responsibilities of the LEO will be discussed.

LEOs (with patrol cars) required by these plans shall be paid for on a unit price (hourly) basis under Item 614, Law Enforcement Officer (with Patrol Car) for Enforcement. The following estimated quantities have been carried to the General Summary.

**Item 614, Law Enforcement Officer with Patrol Car for Enforcement**  
_________ Hrs

The hours paid shall include any minimum show-up time required by the law enforcement agency involved.

Any additional costs (administrative or otherwise) incurred by the Contractor to obtain the services of a LEO are included with the bid unit price for Item 614, Law Enforcement Officer With Patrol Car for Enforcement.

**Designer Note:** See Section 640-19 for additional information. The plans shall clearly specify when and where the LEO is to be utilized. This note should be edited to conform to the project requirements.
Intentionally blank.

643 SPECIFICATIONS

ODOT specifications discussed in this Part of the TEM for furnishing and installing temporary traffic control devices and material for work zones are contained in the following CMS sections:

108 Prosecution and Progress
410 Traffic Compacted Surface
614 Maintaining Traffic
615 Roads and Pavements for Maintaining Traffic
622 Concrete Barrier
641 Pavement Marking - General

630 and 730 Traffic Sign and Support Material
631 and 731 Sign Lighting and Electrical Signs

Supplemental Specifications 821 and 921 address arrow boards.
Supplement 1021 addresses the prequalification procedure for arrow boards.

Supplemental Specifications 830 and 930 address automated flagger assistance devices (AFADs).

Supplement 1030 addresses the prequalification procedure for AFADs.

650 CONSTRUCTION

650-1 General

This Chapter is intended to provide additional information on temporary traffic control that would be helpful particularly to construction personnel. However, it may also be useful for maintenance personnel performing the same functions. Inspection procedures for temporary traffic control devices will be addressed in this Chapter. Inspection procedures for other types of traffic control devices are outlined in the other Chapters related to the various types of traffic control devices.

650-2 Removal of Logo or Tourist Oriented Directional Signs (TODS)

Information regarding removal and temporary re-erection of Logo Signs or TODS due to construction activity is addressed in Sections 207-2 and 207-3.

650-3 Quality Standards for Temporary Traffic Control Devices

The ODOT publication Quality Standards for Temporary Traffic Control Devices and Acceptable Delineation Methods for Vehicles (Section 695-4) shall be used to determine the acceptability of work zone traffic control devices. This document may be viewed on-line at: www.dot.state.oh.us/Divisions/Operations/Traffic/publications2/qualityguidelines/Pages/default.aspx.

650-4 Acceptable Delineation Methods for Vehicles

The ODOT publication Quality Standards for Temporary Traffic Control Devices and Acceptable Delineation Methods for Vehicles (Section 695-4) addresses acceptable delineation methods for work vehicles and supply vehicles. As noted in Section 650-3, this document may be viewed on-line at: www.dot.state.oh.us/Divisions/Operations/Traffic/publications2/qualityguidelines/Pages/default.aspx.
660 MAINTENANCE / OPERATIONS

660-1 General

The consequence of poor maintenance practices are a reduction in safety to road users and an unnecessarily large exposure to liability claims. District Roadway Services personnel are responsible for establishing and maintaining temporary traffic control zones for District maintenance work and force account operations projects. Additional information is provided separately in this Manual regarding maintenance activities related to signing, markings, traffic signals, lighting and temporary traffic control.

660-2 Work Zone Set-up Reviews (OPIs and QARs)

ODOT has developed a program to review maintenance of traffic set-up in temporary traffic control zones. The program has basically two parts, the Operation Performance Index (OPI) and the Quality Assurance Review (QAR).

The OPI applies to work zones on Interstate and Interstate Look-alike highways. Representatives from the Office of Traffic Engineering will travel the Interstate highway system twice per construction season to evaluate temporary traffic control zone set-ups throughout the State. A representative from the District being evaluated, as well as a representative from FHWA, will be welcome to come along for the field review. It is expected that each District review will require one-half to 1 full day time period. Work zone set-ups along Interstate Look-alikes will also be evaluated at that time. It will be the responsibility of the District to correct any inadequacies reported regarding set-ups in temporary traffic control zones and to determine the cause of the inadequacies, e.g., contractor, designer or management error. Items subject to review include:

1. Fixed signs, condition and usage;
2. Channelizing devices.
3. Portable barrier (PB) and unprotected hazards;
4. Portable changeable message signs and arrow boards;
5. Pavement marking;
6. Tapers; and
7. Entrance and exit ramps.

The QAR applies to work on all highways on the state highway system, other than those covered in the OPI, including two-lane and multi-lane controlled or uncontrolled access. These reviews apply to both contract work and to maintenance work. Sites to be reviewed will be chosen at random. The field trips will include personnel from the Office of Traffic Engineering and personnel from other Districts. Items subject to review will be the same as with the OPI evaluations. If inadequacies persist, the QAR review team will review the situation in further detail to determine the cause of the inadequacies and to recommend solutions.

660-3 Removal of Logo Signs

The Ohio Business Logo Sign Program established by ODOT, also known as the Specific Service Sign Program, permits eligible businesses which provide fuel, food, lodging, camping or attraction services to road users to have their Logo Sign Panels placed on Specific Service Signs. The program is operated by a private company (Program Manager) under contract with ODOT.

Section 207-2 addresses Logo Signs issues that arise due to maintenance activities.
660-4  Temporary Traffic Control (TTC) for Pothole Patching

660-4.1 General

As noted in Section 600-3, ODOT maintenance work zones shall “comply with the requirements in the OUMUTCD and this Manual.” While recognizing that the ODOT “SCDs and CMS do not necessarily provide the only method to achieve a given objective,” Section 600-3 indicates that Districts should “also follow the provisions in applicable SCDs and Construction and Materials Specifications (CMS) sections.”

As noted in Section 606-1, the general goal in work zone TTC is “safety with minimum disruption to road users.” However, as noted in OUMUTCD Section 6A.01 another goal of TTC is to provide for the efficient construction and maintenance of the highway, as well as efficient resolution of traffic incidents that may occur. Judgment is a key factor in balancing these goals, and determining what control is needed/appropriate. OUMUTCD Chapter 6B provides a review of the fundamental principles of TTC.

OUMUTCD Section 6G.02 and Chapter 606 address work duration as a factor in determining the devices used in TTC zones.

For pothole patching, it may take longer to set up and remove the TTC zone than to perform the work. This can significantly increase the delay for road users and increase workers’ exposure to road hazards. Therefore, simplified control procedures may be warranted. The OUMUTCD allows a highway agency some discretion in determining the TTC to provide. However, the agency’s application of these devices should be consistent and commensurate with the conditions present in order to minimize risk to workers and the traveling public.

Permitted lane closure schedules (PLCS) have been established for Interstates and Interstate look-a-likes as well as other multi-lane roads deemed to be major or important by the District (see Section 630-4). The PLCS designates hours where volumes are low enough that work can be performed in a closed lane and still provide sufficient capacity for the lower traffic volumes. Whenever possible, any work hours should conform to the restrictions of the PLCS. However, it is recognized that this is not always possible (e.g., emergencies).

For pothole patching on ODOT-maintained highways, the TTC procedures described in this Section should be followed to the extent practical.

660-4.2 Incident Management/Emergency Work Zones

Emergencies affecting the health and safety of the traveling public can occur that necessitate action on ODOT’s part before all the necessary equipment and personnel can be gathered to establish TTC per the OUMUTCD, SCDs and TEM (see OUMUTCD Chapter 6I and TEM Chapter 608). Circumstances such as these call for judgment in regards to the initial TTC devices deployed (based on availability) when using less than what is desirable. For emergency pothole patching on ODOT-maintained highways, the TTC procedures described in this Section should be followed to the extent practical.

660-4.3 Pothole Patching on Multi-Lane Facilities that Will Violate the Permitted Lane Closure Schedule (PLCS)

The following procedure is for pothole patching that occupies one location up to an hour (Short Duration per OUMUTCD Section 6G.02 and Section 606-3) on multi-lane facilities during times that are in violation of the PLCS.

Below is a hierarchy list of preferred methods for addressing TTC needs while pothole patching under these conditions:
1. Schedule the work to be completed during times that do not violate the PLCS (see Section 660-4.4). All non-emergency work should be scheduled for times that will not violate the PLCS.

2. Dispatch workers and equipment to close the lane in which work will be performed per OMUTCD Figure 6H-33 (and/or the appropriate lane closure SCD).

3. Dispatch workers and equipment to close the lane in which work will be performed per Figure 698-11.

When working in the interior lane(s) of a directional roadway with three or more lanes, multiple lanes should be closed per OMUTCD Figure 6H-37 to remove the unique safety hazards to workers and motorist that are created by an interior-lane only closure. For emergency pothole patching necessitating an interior-lane closure, the District should use the resources available and LEOs to comply with OMUTCD Figure 6H-37 to the extent practical.

Refer to OMUTCD Chapter 6G, OMUTCD Figure 6H-35 and Chapter 606 for other pothole patching work durations such as Mobile, etc., and the associated TTC for these work conditions.

660-4.4 Pothole Patching on Multi-Lane Facilities that Will Not Violate the Permitted Lane Closure Schedule (PLCS)

The following procedure is for pothole patching that occupies one location up to an hour (Short Duration per OMUTCD Section 6G.02 and Section 606-3) on multi-lane facilities during times that are not in violation of the PLCS. For locations where the roadway facility is not addressed by the PLCS, non-emergency pothole patching work should be scheduled to occur during non-peak/lower volume hours.

Below is a hierarchy list of preferred methods for addressing TTC needs while pothole patching under these conditions:

1. Dispatch workers and equipment to close the lane in which work will be performed per OMUTCD Figure 6H-33 (and/or the appropriate lane closure SCD).

2. If the OMUTCD Figure 6H-33 cannot be achieved during emergency pothole patching work, or to close a lane using this application is not practical due to the very short work duration, dispatch workers and equipment to close the lane in which work will be performed per Figure 698-12, Detail A. (This lane closure method is not intended to be used for Mobile Operations (see OMUTCD 6G.02, OMUTCD Figure 6H-35 and Section 606-3). Factors such as volume, terrain or lack of shoulder should be considered when deciding on the use of truck-mounted attenuators and/or the need to request the presence of a law enforcement vehicle with flashing lights.

3. If factors such as volume, terrain or lack of shoulder do not necessitate the need for a shadow vehicle (or the need for a LEO) as in Figure 698-12, Detail A, then dispatch workers and equipment per Figure 698-12, Detail B.

4. On non-interstate multi-lane roads where there are very low volumes, providing sufficient gaps to perform very short duration work, the use of high-intensity rotating, flashing, oscillating or strobe lights only may suffice. The work vehicle would be positioned on the shoulder. This method of TTC is only intended for use on very low-volume multi-lane highways (e.g., rural US 30, Appalachian highways, etc.) where the pothole patching work duration is very short and the roadway geometry and terrain do not necessitate additional measures (shadow vehicle, TMA, LEO, etc.).

When working in the interior lane(s) of a directional roadway with three or more lanes,
multiple lanes should be closed per **OMUTCD Figure 6H-37** to remove the unique safety hazards to workers and motorist that are created by an interior-lane only closure. For emergency pothole patching work necessitating an interior-lane closure, the District should use the resources available and LEOs to comply with **OMUTCD Figure 6H-37** to the extent practical.

Refer to **OMUTCD Chapter 6G, OMUTCD Figure 6H-35** and **Chapter 606** for other pothole patching work durations such as Mobile, etc., and the associated TTC for these work conditions.

### 660-4.5 Pothole Patching on Two-Lane/Other Facilities

The following procedure is for pothole patching that occupies one location up to an hour (Short Duration per **OMUTCD Section 6G.02 and TEM Section 606-3**) on two-lane/other facilities. Non-emergency pothole patching work should be scheduled to occur during non-peak/lower volume hours.

Below is a hierarchy list of preferred methods for addressing TTC needs while pothole patching under these conditions:

1. Dispatch workers and equipment to close the lane in which work will be performed per **OMUTCD Figure 6H-10** (see also **OMUTCD Sections 6C.10 and 6G.10**, and **Section 606-10**) OR for low-speed, low-volume facilities per **OMUTCD Figure 6H-18** (see also **OMUTCD Sections 6C.10 and 6G.10**, and **Section 606-10**).

2. On two-lane/other facilities where there are very low volumes, providing sufficient gaps to perform very short duration work, the use of high-intensity rotating, flashing, oscillating or strobe lights only may suffice. The work vehicle would be positioned on the shoulder or as far off the roadway as possible. This method of TTC is only intended for use on very low-volume two-lane/other facilities where the pothole patching work duration is very short and the roadway geometry and terrain do not necessitate additional measures (shadow vehicle, TMA, LEO, lane closure, etc.).

Refer to **OMUTCD Chapter 6G, OMUTCD Figure 6H-17** and **Chapter 606** for other pothole patching work durations such as Mobile, etc., and the associated TTC for these work conditions.
670 OTHER CONSIDERATIONS

670-1 General

This Chapter has been reserved for information on other considerations that should be noted, but for various reasons have not been addressed in the other Chapters. For example, it may at times be used to expedite incorporating information that will later be consolidated into other Chapters.

670-2 Bikeways

As noted in Section 606-11, if the temporary traffic control zone affects the movement of bicyclists, adequate access to the roadway or shared-use paths shall be provided. Additional information on bikeways may be found in MUTCD Part 9, Part 9 of this Manual, and the Guide to the Development of A Bicycle Facility.

670-3 Waterways

On projects involving construction or major reconstruction of structures over navigable waterways, provisions should be made to inform and/or guide watercraft traffic through the construction area.

Projects that close rivers or streams for construction purposes should provide a safe portage for light watercraft along with appropriate Guide and Warning Signs in each direction.

Projects that do not close rivers or streams, but alter existing portages or create otherwise hazardous conditions for watercraft passage, should provide adequate Guide and Warning Signs and protection, where appropriate, along the waterway.

Additional information on watercraft traffic and navigable waters can be obtained through the Ohio Department of Natural Resources, Division of Watercraft. ODNR’s website for the Division of Watercraft is http://ohiodnr.com/watercraft/Watercraft/tabid/2062/Default.aspx.

670-4 Motorcycles

Motorcycles are more susceptible to variations or obstacles in the road surface than are other vehicles. If a potential hazard cannot be eliminated, it is vital that motorcyclists receive a warning of the hazard well in advance. Warning Signs should be considered for potential hazards, especially for pavements that are heavily grooved (Section 202-12), or contain rumble strips (Section 605-17), loose gravel (MUTCD Figure 2C-4) or pavement edge drop offs.

670-5 Towing Operations

Towing operations shall be performed in a safe manner. Short-duration towing operations shall follow the guidelines applicable to short-duration maintenance operations (see Section 606-3.5).

All towing vehicles shall display a yellow high-intensity flashing, rotating, oscillating or strobe light, regardless of any other devices that may be mounted on the vehicles.

670-6 Rest Areas

670-6.1 General

When rest areas exist within a temporary traffic control zone, a decision must be made at an early stage as to whether the rest area will remain open or whether it will be closed during the work. Rest area closures will simplify the traffic control plan.
When rest areas remain open during construction, traffic control at the rest area entrance and exit ramps should be implemented as shown in MT-98 series of SCDs.

670-6.2 Rest Area Closures

Rest areas shall not be closed to the public without approval of the District Deputy Director. Approvals of temporary rest area closures called for within construction projects become effective with the District Deputy Director's signature on the title sheet.

All advance Rest Area signs (D5-1, D5-2, D5-H2a, D5-H6) shall have the action message covered by an overlay bearing the legend “CLOSED.” This panel shall have a black legend on a retroreflective orange background. The overlay for the D5-1 and D5-H2a signs shall be 8 x 1.5 feet. The overlay for the D5-2 and D5-H6 signs shall be 4 x 1.5 feet. Supplemental panels (TELEPHONE, TOURIST INFO, Handicapped symbol, etc.) located under mainline Rest Area signs shall be removed or covered when the rest area is closed. On conventional highways, the overlay panel size shall be 28 x 10 inches.

Distance information provided on the NEXT REST AREA XX MILES sign (D5-H7), located in advance of the upstream rest area, shall be modified to provide the distance to the next open downstream rest area. This modification shall be accomplished by providing a black on orange overlay to cover the distance provided on the sign.

As shown in SCD MT-98.29, the entrance ramp to the rest area shall be closed by use of drums. The exit ramp from the rest area shall be closed in a similar manner. On major standard highways where a median opening may exist to permit access to and from the rest area, this opening shall also be closed in a similar manner.

Where rest area lighting exists, it shall be maintained in proper condition to provide optimum illumination.

670-6.3 Restroom Closures

Rest areas shall not be closed because of restroom failure. If restrooms are closed because of mechanical failure or any other reason except routine maintenance, the REST ROOMS CLOSED sign (D5-H33), black legend on retroreflective orange background, shall be used to inform the road user of the closure. On freeways and expressways the D5-H33, 48 x 48 inches sign shall be installed below the Advance Rest Area sign (D5-1), and may be installed below the (D5-2) and D5-H2a signs; however, it shall not be installed at the D5-H6 gore sign. On conventional highways, the D5-H33-24 sign, 24 x 24 inches, shall be installed below the Advance Rest Area sign (D5-H1) and may be installed below the D5-H2 sign.

670-7 Railroad Crossings

An important design consideration in the development of temporary traffic control plans involving railroad grade crossings is the potential for vehicles queuing onto the railroad tracks. Adjusting the transition area and/or buffer space might be appropriate so that downstream congestion caused by a lane drop, for example, does not reach the railroad crossing.

When the grade crossing is equipped with an active traffic control system, the normal sequence of highway intersection signal indications should be preempted upon approach of trains to avoid entrapment of vehicles on the crossing by conflicting aspects of the highway traffic signals and the grade crossing signals. Temporary traffic control signals near grade crossings should be operated so that vehicles are not required to stop on the tracks. See OMUTCD Part 8 and Part 8 of this Manual for additional information.

Guidance on traffic control near railroad crossings is provided in OMUTCD Part 8, Section 6G.18 and Figure 6H-46 and TEM Section 606-19 and Part 8.
670-8 Transit Considerations

Provision for effective continuity of transit service needs to be incorporated into the temporary traffic control planning process. Oftentimes, public transit buses cannot efficiently be detoured in the same manner as other vehicles (particularly for short-term maintenance projects). On transit routes, the traffic control plan (Section 602-2) should provide for features such as temporary bus stops, pull-outs and waiting areas for transit patrons.
Intentionally blank.
695  REFERENCE RESOURCES

695-1  General

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

695-2  Temporary Traffic Control Manual (reprint of OMUTCD Parts 1, 5 and 6)

OMUTCD Parts 1, 5 and 6 have been reprinted as a separate document for use in the field. The book is titled the “Temporary Traffic Control Manual”; however, it is also known as the Construction Manual or the Orange book, since it has an orange cover. This manual is available for purchase from the Office of Contracts or on-line at: http://www.dot.state.oh.us/Divisions/Operations/Traffic/publications2/TTCM/Pages/default.aspx.

695-3  Flagger Handbook

As noted in Section 614-5, the Flagger Handbook published by ATSSA is a pocket-size booklet, intended for use by field staff for easy reference to proper flagging procedures.

695-4  Quality Standards for Temporary Traffic Control Devices and Acceptable Delineation Methods for Vehicles

This document sets standards for acceptability of conditions of temporary traffic control devices. It is intended to provide uniformity in condition of traffic control devices on the public highway system. These standards are intended to address the day-to-day needs of traffic control within a work zone and are not meant to cover needs of emergency situations. This document is directly referenced in CMS 614. This quality standard is available on-line at: http://www.dot.state.oh.us/Divisions/Operations/Traffic/publications2/qualityguidelines/Pages/default.aspx.

This document also addresses acceptable delineation methods for work vehicles and supply vehicles.

695-5  Guidelines for the Use of Portable Changeable Message Signs

The ATSSA publication, Guidelines for the Use of Portable Changeable Message Signs, is recommended as guidance for use in determining how to make use of PCMSs to inform road users of traffic conditions due to construction activity.

695-6  Reserved for Future Use

For now, this space and Section number will be reserved for future use.

695-7  Guidelines for Traffic Control in Work Zones

As noted in Section 195-6, the Guidelines for Traffic Control in Work Zones is a pocket-sized consolidation of information regarding temporary traffic control. The information is based on that in the Ohio Manual of Uniform Traffic Control Devices (OMUTCD), but some additional guidelines/handbook information is included. It can be purchased for $2.50 plus tax and shipping (based on the quantity ordered) from the LTAP Office or the Office of Contracts. This publication is available on the OTE website at: http://www.dot.state.oh.us/Divisions/Operations/Traffic/publications2/pocketguide/Pages/default.aspx.
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696 FORMS INDEX

696-1a Work Zone Constraints

*Form 696-1a* is submitted as part of the Maintenance of Traffic Alternative Analysis (MOTAA) described in *Section 630-5* for projects involving Interstates and Interstate Look-alikes. A paper or electronic (.pdf and Excel formats) copy of this form is available from OTE upon request. It will also be posted on the OTE Forms web page.

696-1b Example of a Completed Work Zone Constraints Form

*Form 696-1b* is an example of a completed *Form 696-1a*. A paper or electronic (.pdf and Excel formats) copy of this example is available from OTE upon request. It will also be posted on the OTE Forms web page.

696-2a Bridge Information

*Form 696-2a* is submitted as part of the MOTAA described in *Section 630-5*. A paper or electronic (.pdf and Excel formats) copy of this form is available from OTE upon request. It will also be posted on the OTE Forms web page.

696-2b Example of a Completed Bridge Information Form

*Form 696-2b* is an example of a completed *Form 696-2a*. A paper or electronic (.pdf and Excel formats) copy of this example is available from OTE upon request. It will also be posted on the OTE Forms web page.

696-3a Ramp Information

*Form 696-3a* is submitted as part of the MOTAA described in *Section 630-5*. A paper or electronic (.pdf and Excel formats) copy of this form is available from OTE upon request. It will also be posted on the OTE Forms web page.

696-3b Example of a Completed Ramp Information Form

*Form 696-3b* is an example of a completed *Form 696-3a*. A paper or electronic (.pdf and Excel formats) copy of this example is available from OTE upon request. It will also be posted on the OTE Forms web page.

696-4a Cost Comparison

*Form 696-4a* is submitted as part of the MOTAA described in *Section 630-5*. A paper or electronic (.pdf and Excel formats) copy of this form is available from OTE upon request. It will also be posted on the OTE Forms web page.

696-4b Example of a Completed Cost Comparison

*Form 696-4b* is an example of a completed *Form 696-4a*. A paper or electronic (.pdf and Excel formats) copy of this example is available from OTE upon request. It will also be posted on the OTE Forms web page.

696-5 WTS Daily Inspection Report

*Form 696-5* is the daily inspection form noted in item 10 of the list of Worksite Traffic Supervisor duties outlined in *Plan Note 642-44 (Section 642-44)*.
Intentionally blank.
## Work Zone Constraints

<table>
<thead>
<tr>
<th>Constraint</th>
<th>Work Zone Alternatives</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Part-Width</td>
<td>Crossover</td>
</tr>
<tr>
<td>Ability to meet Work Zone Policy</td>
<td>Indicate areas where the policy (# lanes, widths of lanes/shoulders, etc.) can and cannot be maintained. Include information on what is needed to meet the policy and associated costs.</td>
<td></td>
</tr>
<tr>
<td>Ability to maintain all accesses</td>
<td>Include a Ramp Table. This table shall include ramp designation, number of lanes, ramp volume, ramp truck volume, decision sight distance, whether the ramp will be closed or open for each phase of construction, duration of closure, and detour for closure. If the ramp operates with more than one lane and this will be reduced in any phases of MOT, include this information as well. If a detour is noted - can ramps being used handle additional traffic or will modifications be needed such as widening on the ramp and/or signal work at ramp termini.</td>
<td></td>
</tr>
<tr>
<td>Ability to provide required on-ramp merge decision sight distance.</td>
<td>Provide the proposed decision sight distance at each entrance ramp for each phase in the ramp table. If it does not meet the required DSD in the TEM, how much does it not meet by or what will it take to meet it? This information should be included in the ramp table described above.</td>
<td></td>
</tr>
<tr>
<td>Right-of-way impacts</td>
<td>Explain the project ramifications of overcoming this constraint (e.g. cost of additional ROW, cost of retaining walls used). Include associated impacts to the schedule.</td>
<td></td>
</tr>
<tr>
<td>Environmental impacts</td>
<td>Indicate areas where additional widening, bridge widening, etc. would cause impacts to streams, rivers, etc. Cost impacts and schedule impacts shall be included.</td>
<td></td>
</tr>
<tr>
<td>Bridge widths</td>
<td>Include a Bridge Table. This table shall include extent of work being completed, length of bridge, type of bridge, existing pier spacing, existing bridge width, bridge width needed for each phase of MOT, future bridge width, and additional cost of width needed for each MOT scheme.</td>
<td></td>
</tr>
<tr>
<td>Significant impacts for construction duration and/or construction costs</td>
<td>Include an estimated time of construction for each alternative. Describe additional costs for each alternative.</td>
<td></td>
</tr>
<tr>
<td>Significant impacts to earthwork, retaining walls, pier clearances, profile differences, etc.</td>
<td>Include information such as amount of retaining wall needed, cost of retaining wall, significant fills or cuts and associated costs, etc.</td>
<td></td>
</tr>
<tr>
<td>Ability to maintain existing drainage and lighting systems</td>
<td>Include information such as removal of median lighting, temporary wedging to allow for drainage, etc. Include any additional costs associated with concerns.</td>
<td></td>
</tr>
<tr>
<td>Constructability; and construction equipment access</td>
<td>Discuss issues and costs associated with contractor access and ability to construct the project. If alternatives vary greatly in cost or time describe why.</td>
<td></td>
</tr>
<tr>
<td>Location of crossovers (e.g., Can crossovers be located near the project?)</td>
<td>How do the locations of the crossovers on each end of the project affect existing ramps? Are bridge structures going to be constraints in areas of crossovers?</td>
<td></td>
</tr>
</tbody>
</table>
### Table 696-1a. Work Zone Constraints (Continued)

<table>
<thead>
<tr>
<th>What are the access impacts to important traffic generators such as hospitals, fire departments, industries, sports arenas, etc.</th>
<th>Indicate if any ramp closures impact major traffic generators or emergency services in the area. If so, how may this be handled during closure.</th>
</tr>
</thead>
<tbody>
<tr>
<td>For concrete pavements, the longitudinal joints must be located at the lane lines.</td>
<td></td>
</tr>
<tr>
<td>Exit ramps - Can the existing number of ramp lanes be maintained?</td>
<td>Include a Cost Comparison Table with the major costs differences between the alternatives analyzed. A total cost for each alternative shall also be included.</td>
</tr>
</tbody>
</table>

Note: All constraints that require any additions need to have a cost estimate associated with the alternative.
Form 696-1b. Example of a Completed Work Zone Constraint Form
### Form 696-1b. Example of a Completed Work Zone Constraint Form (Continued)

<table>
<thead>
<tr>
<th>Constraint</th>
<th>Work Area/Activity</th>
<th>Location of constraint</th>
<th>Confinement</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- **Confinement**: All work activity shall be contained within the identified area.
- **Location of constraint**: The constraint shall be placed at the north, south, east, or west side of the work area.
- **Details of work area/activity**: The details of the work area/activity shall be clearly identified.
- **Estimated duration of time**: The estimated duration of the time shall be provided.

**Note**: All work area/activities shall be identified with appropriate signs and barriers.

---

**Section 1**: General Information

- **Project Name**: [Project Name]
- **Contractor Name**: [Contractor Name]
- **Date**: [Date]

**Section 2**: Work Area/Activity

- **Description**: [Description]
- **Confinement**: [Confinement Details]

**Section 3**: Location of Constraint

- **North**: [North Details]
- **South**: [South Details]
- **East**: [East Details]
- **West**: [West Details]

**Section 4**: Estimated Duration of Time

- **Start Date**: [Start Date]
- **End Date**: [End Date]
| BRIDGE NAME | STATION | EXTENT OF WORK | COST OF TEMPORARY TRAFFIC CONTROL | COST OF TEMPORARY TRAFFIC CONTROL FOR COMMERCIAL VEHICLES | COST OF TEMPORARY TRAFFIC CONTROL FOR PASSENGER CARS | COST OF TEMPORARY TRAFFIC CONTROL FOR MOTORCYCLES | COST OF TEMPORARY TRAFFIC CONTROL FOR BICYCLES | COST OF TEMPORARY TRAFFIC CONTROL FOR PEDESTRIANS | WIDTH NEEDED FOR TEMPORARY TRAFFIC CONTROL | WIDTH NEEDED FOR TEMPORARY TRAFFIC CONTROL FOR COMMERCIAL VEHICLES | WIDTH NEEDED FOR TEMPORARY TRAFFIC CONTROL FOR PASSENGER CARS | WIDTH NEEDED FOR TEMPORARY TRAFFIC CONTROL FOR MOTORCYCLES | WIDTH NEEDED FOR TEMPORARY TRAFFIC CONTROL FOR BICYCLES | WIDTH NEEDED FOR TEMPORARY TRAFFIC CONTROL FOR PEDESTRIANS | FUTURE BRIDGE WIDTH | CURRENT BRIDGE WIDTH | EXISTING BRIDGE WIDTH | EXISTING PER SPACING | LENGTH OF BRIDGE | TYPE OF BRIDGE |
| BRIDGE NAME     | STATION | EXTENT OF WORK | TYPE OF BRIDGE | LENGTH OF BRIDGE (R.) | EXISTING PIER SPACING | EXISTING BRIDGE WIDTH (R.) | FUTURE BRIDGE WIDTH (R.) | WIDTH NEEDED FOR Maintain WIDTH | COST OF 30' PCB BRIDGE MOUNTED | COST OF ADDITIONAL BRIDGE WIDENING | WIDTH NEEDED FOR CROSSOVER | COST OF 32' PCB BRIDGE MOUNTED | COST OF ADDITIONAL BRIDGE WIDENING | WIDTH NEEDED FOR CONTRA FLOW (Peak Flow Rate) | COST OF 32' PCB BRIDGE MOUNTED | COST OF ADDITIONAL BRIDGE WIDENING |
|----------------|---------|----------------|----------------|-----------------------|-----------------------|----------------------------|---------------------------|-------------------------------|--------------------------------|---------------------------------|--------------------------------|--------------------------------|---------------------------------|--------------------------------|--------------------------------|
| Cincinnati St (L) | 299-75  | Deck Replacement | Overpass       | 160                  | 4.5-64-48             | 54                         | 69                        | 80                             | $9,344                          | $520,000                        | 74                             | $4,672                          | $11,622                         | 74                             | $5,811                          | $11,622                        |
| Cincinnati St (R) | 299-75  | Deck Replacement | Overpass       | 160                  | 4.5-64-48             | 53.5                      | 57                        | 80                             | $9,344                          | $530,000                        | 74                             | $4,672                          | $11,622                         | 74                             | $5,811                          | $11,622                        |
| Stewart St (L)   | 247-25  | Replace substructure and superstructure | Overpass     | 199                  | 4-1/2-100-44           | 54                         | 69                        | 80                             | $11,622                         | $64,930,220                     | 74                             | $5,811                          | $11,622                         | 74                             | $5,811                          | $11,622                        |
| Stewart St (R)   | 247-25  | Replace substructure and superstructure | Overpass     | 199                  | 4-1/2-100-44           | 53.5                       | 57                        | 80                             | $11,622                         | $659,168                        | 74                             | $5,811                          | $606,938                        | 74                             | $5,811                          | $11,622                        |
| Abandoned RR Crossing (L) | 262-25  | Eliminated | Overpass       | 145                  | 4-1/2-53-44            | 84                         | Bridge Eliminated          | 80.5                           | $5,848                          | $706,875                        | 74                             | $4,204                          | $599,063                        | 74                             | $4,204                          | $8,468                         |
| Abandoned RR Crossing (R) | 262-25  | Eliminated | Overpass       | 145                  | 4-1/2-53-44            | 41.5                       | Bridge Eliminated          | 80.5                           | $5,848                          | $706,875                        | 74                             | $4,204                          | $599,063                        | 74                             | $4,204                          | $8,468                         |
| Albany St (L)    | 264-75  | Replace substructure and superstructure | Overpass     | 125                  | 55-50-35-53            | 40                         | 57                        | 69                             | $7,300                          | $296,875                        | 52                             | $3,650                          | $536,938                        | 52                             | $3,650                          | $8,468                         |
| Albany St (R)    | 264-75  | Replace substructure and superstructure | Overpass     | 125                  | 55-50-35-53            | 40                         | 57                        | 69                             | $7,300                          | $296,875                        | 52                             | $3,650                          | $536,938                        | 52                             | $3,650                          | $8,468                         |
| US 28 (L)       | 273-35  | Replace substructure | Overpass     | 97                   | 46-46-64              | 50                         | 54.5                      | 56.5                           | $5,666                          | $66,668                         | 52                             | $2,832                          | $8,668                          | 52                             | $2,832                          | $5,666                         |
| US 28 (R)       | 273-35  | Replace substructure | Overpass     | 97                   | 46-46-64              | 54.5                       | 54.5                      | 56.5                           | $5,666                          | $66,668                         | 52                             | $2,832                          | $8,668                          | 52                             | $2,832                          | $5,666                         |
| Washington BIC SX (L) | 285-00  | Replace substructure and superstructure | Overpass     | 686                  | 51-64-72-104-104-104-57-62-57-62 | 41                             | 60                        | 58                             | $40,062                         | $1,457,760                      | 52                             | $20,031                         | $1,029,000                      | 47/18                         | $40,062                         | $25,392                        |
| Washington BIC SX (R) | 285-00  | Replace substructure and superstructure | Overpass     | 686                  | 51-64-72-104-104-104-57-62-57-62 | 40                             | 60                        | 58                             | $40,062                         | $1,543,900                      | 52                             | $20,031                         | $1,029,000                      | 47/18                         | $40,062                         | $25,392                        |
| Washington BIC SX (L) | 286-00  | Replace substructure and superstructure | Overpass     | 686                  | 51-64-72-104-104-104-57-62-57-62 | 64                             | 54                        | 58                             | $40,062                         | $0                             | 96                             | $20,031                         | $1,029,000                      | 67/38                         | $40,062                         | $25,392                        |
| Washington BIC SX (R) | 286-00  | Replace substructure and superstructure | Overpass     | 686                  | 51-64-72-104-104-104-57-62-57-62 | 64                             | 54                        | 58                             | $40,062                         | $0                             | 96                             | $20,031                         | $2,744,000                      | 67/41                         | $40,062                         | $35,352                        |
| Edain C. Moses (L) | 294-75  | Replace substructure and superstructure | Overpass     | 605                  | 77-117-69-69-117-117-69-69 | 64                             | 84                        | 80                             | $35,332                         | $1,210,000                      | 96                             | $17,666                         | $907,500                        | 67/41                         | $35,352                         | $35,352                        |
| Edain C. Moses (R) | 294-75  | Replace substructure and superstructure | Overpass     | 605                  | 77-117-69-69-117-117-69-69 | 64                             | 84                        | 80                             | $35,332                         | $1,210,000                      | 96                             | $17,666                         | $907,500                        | 67/41                         | $35,352                         | $35,352                        |
Form 696-3b. Example of a Completed Ramp Information Form

<table>
<thead>
<tr>
<th>Phase</th>
<th>Duration of Closure of Ramp</th>
<th>Part of Ramp Width</th>
<th>Part of Cross Street or Overpass</th>
<th>Number of Lanes</th>
<th>Ramp Designation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phase 1</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>1</td>
<td>US 35 NB to US 35</td>
</tr>
<tr>
<td>Phase 2</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>2</td>
<td>US 35 SB to US 35</td>
</tr>
<tr>
<td>Phase 3</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>1</td>
<td>US 35 NB to US 35</td>
</tr>
<tr>
<td>Phase 4</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>1</td>
<td>US 35 SB to US 35</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Phase</th>
<th>Duration of Closure of Road</th>
<th>Part of Road Width</th>
<th>Part of Cross Street or Overpass</th>
<th>Number of Lanes</th>
<th>Road Designation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phase 1</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>1</td>
<td>US 35 NB to US 35</td>
</tr>
<tr>
<td>Phase 2</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>2</td>
<td>US 35 SB to US 35</td>
</tr>
<tr>
<td>Phase 3</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>1</td>
<td>US 35 NB to US 35</td>
</tr>
<tr>
<td>Phase 4</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>1</td>
<td>US 35 SB to US 35</td>
</tr>
</tbody>
</table>

Notes:
- NA: Not Available
- Y: Yes
- N: No
<table>
<thead>
<tr>
<th></th>
<th>Contra Flow Construction</th>
<th>Crossover Construction</th>
<th>Part-Width Construction</th>
<th>Additional Right-of-Way</th>
<th>Retaining Walls</th>
<th>Additional Bridge Structure</th>
<th>Cut/Fill/Shoring</th>
<th>Lighting</th>
<th>Grillage</th>
<th>Temporary Pavement</th>
<th>Portable Concrete Barrier</th>
<th>Subtotal:</th>
<th>15% Contingency</th>
<th>MOT Related Cost</th>
<th>Project Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cost</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Form 696-4a. Cost Comparison
Form 696-4b. Example of a Completed Cost Comparison Form

<table>
<thead>
<tr>
<th></th>
<th>Cost</th>
<th>Cost</th>
<th>Cost</th>
<th>Cost</th>
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<th>Cost</th>
<th>Cost</th>
<th>Cost</th>
<th>Cost</th>
<th>Cost</th>
<th>Mot Related Cost</th>
<th>Project Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Part-Width Construction</td>
<td>$20,000</td>
<td>$150,000</td>
<td>$14,800,000</td>
<td>$1,300,000</td>
<td>$4,000,000</td>
<td>$20,000</td>
<td>$30,000</td>
<td>$2,000,000</td>
<td>$3,100,000</td>
<td>$16% Contingency</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>$3,000,000</td>
<td>$1,824,000</td>
<td>$274,000</td>
<td>$22,008,000</td>
<td>$23,600,000</td>
<td>$26 months</td>
<td>$30 months</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Additional Right-of-Way</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>$2,184,000</td>
<td>32 months</td>
</tr>
<tr>
<td></td>
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<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>$3,224,000</td>
<td></td>
</tr>
<tr>
<td>Crossover Construction</td>
<td>$20,000</td>
<td>$175,000</td>
<td>$13,200,000</td>
<td>$1,000,000</td>
<td>$411,000</td>
<td>$20,000</td>
<td>$114,000</td>
<td>$1,824,000</td>
<td>$274,000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>$3,000,000</td>
<td>$1,824,000</td>
<td>$274,000</td>
<td>$22,008,000</td>
<td>$23,600,000</td>
<td>$26 months</td>
<td>$30 months</td>
<td></td>
<td></td>
<td>$19,108,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Contra Flow Construction</td>
<td>$0</td>
<td>$0</td>
<td>$1,400,000</td>
<td>$0</td>
<td>$0</td>
<td>$0</td>
<td>$0</td>
<td>$0</td>
<td>$0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>$3,000,000</td>
<td>$1,824,000</td>
<td>$274,000</td>
<td>$22,008,000</td>
<td>$23,600,000</td>
<td>$26 months</td>
<td>$30 months</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Form 696-4b: Example of a Completed Cost Comparison Form
Form 696-5. WTS Daily Inspection Report

WORKSITE TRAFFIC SUPERVISOR (WTS)
DAILY INSPECTION REPORT
rev Jan ’08

<table>
<thead>
<tr>
<th>ODOT PROJECT NO:</th>
<th>CONTRACTOR:</th>
<th>DATE:</th>
<th>TIME:</th>
</tr>
</thead>
</table>

RECEIVED BY: (ODOT) DATE: |

A. DRIVE THRU TRAFFIC
- Work zone free of difficult or unexpected maneuvers? | YES | NO | N/A |
- Adequate warning of hazards? |
- Signing clear/uncrowded and properly spaced? |
- Traffic control devices sufficiently visible? |
- Is project free of traffic accidents? |
- If no, list Accident Report Number and describe on Page 2
- Equipment/materials properly stored off roadway? |
- Are congestion points absent from within project limits? |
- Work vehicles properly interacting with traffic? |

B. SIGNS/LIGHTS
- Working properly/visible? |
- Are all permanent/temporary signs consistent with one another? |
- Proper Size? |

C. PORTABLE CHANGING MESS/ARROW PANEL
- Application meets guidelines? |
- Correct Placement? |
- Delineated with cones/drum? |
- Dimmed at night? |
- All boards/signs working properly (bulbs correctly aligned, no bulbs out, etc.)? |

D. DRUMS/BARRICADES/PCB/IMPACT ATTENUATORS
- Acceptable taper length? |
- Spacing acceptable? |
- Properly aligned/cleaned/secured? |
- Adequate number of devices? |
- Object markers/barrier reflectors in-place/visible? |
- Attenuators in place? |
- Attenuators secured and in good condition? |

E. PAVEMENT MARKINGS / RAISED PAVEMENT MARKERS (RPM)
- Pavement markings visible and in good condition? |
- Is striping free of conflict? |
- RPMs in good condition, proper number and correspond to pavement markings? |

NOTES/COMMENTS FROM CHECKLIST:  

VIDEOS/PHOTOS OF WORKZONE: YES | NO | N/A |

NAME OF PHOTOGRAPHER/VIDEOGRAPHER:  

CORRECTIVE ACTION NEEDED? YES | NO |

Revised July 20, 2012          October 23, 2002          6-199
WORKSITE TRAFFIC SUPERVISOR (WTS)  
DAILY INSPECTION REPORT  
rev Jan '08

DESCRIPT TRAFFIC ACCIDENTS (IF ANY):

__________________________________________________________________________
__________________________________________________________________________
__________________________________________________________________________
__________________________________________________________________________
__________________________________________________________________________

DAMAGED OR MISSING MOT ITEMS:

__________________________________________________________________________
__________________________________________________________________________
__________________________________________________________________________
__________________________________________________________________________
__________________________________________________________________________

LANE CLOSURES/ROLLING ROAD BLOCKS:

__________________________________________________________________________
__________________________________________________________________________
__________________________________________________________________________
__________________________________________________________________________
__________________________________________________________________________

NO. OF LEO’S: ____________________ TOTAL LEO HOURS ____________________

LEO ACTIVITIES

__________________________________________________________________________
__________________________________________________________________________
__________________________________________________________________________
__________________________________________________________________________

I certify that this document and all attachments submitted are, to the best of my knowledge and belief, true, accurate and complete. I am aware that there are significant penalties for submitting false information.

INSPECTED BY: ____________________ (CONTRACTOR) DATE: ____________

Page 2 of 2
697-1a Construction / Traffic Maintenance Strategies

As noted in Sections 606-16, 630-2 and 640-25.3, Tables 697-1a through 697-1f present a Compendium of Traffic Control Options of various traffic control strategies and traffic control options. Table 697-1a addresses construction and traffic maintenance strategies in general.

697-1b Corridor Options Outside Work Zones

As noted in Sections 606-16, 630-2 and 640-25.3, Tables 697-1a through 697-1f present a Compendium of Traffic Control Options of various traffic control strategies and traffic control options. Table 697-1b addresses corridor options outside the work zone.

697-1c Traffic Flow Options Inside Work Zones

As noted in Sections 606-16, 630-2 and 640-25.3, Tables 697-1a through 697-1f present a Compendium of Traffic Control Options of various traffic control strategies and traffic control options. Table 697-1c addresses traffic flow options inside work zones.

697-1d Time Limitations With Disincentive Option

As noted in Sections 606-16, 630-2 and 640-24.3, Tables 697-1a through 697-1f present a Compendium of Traffic Control Options of various traffic control strategies and traffic control options. Table 697-1d addresses time limitations with a disincentive option.

697-1e Contracting Procedure Options

As noted in Sections 606-16, 630-2 and 640-25.3, Tables 697-1a through 697-1f present a Compendium of Traffic Control Options of various traffic control strategies and traffic control options. Table 697-1e addresses contracting procedures options.

697-1f Administrative Options

As noted in Sections 606-16, 630-2 and 640-25.3, Tables 697-1a through 697-1f present a Compendium of Traffic Control Options of various traffic control strategies and traffic control options. Table 697-1f addresses various administrative options.

697-2 Rate of Flow (Two-Way) for a Signalized One-Lane, Two-Way Closing

As noted in Sections 641-12.2, Table 697-2 provides rate of flow (two-way) information for use in designing a signalized one-lane, two-way closing related to the length of the one-lane operation.

697-3 Initial Timing Chart

As noted in Sections 641-12 and 641-13, Table 697-3 presents an example of a timing chart that could be used in a plan involving a signalized one-lane, two-way closing to indicate specified signal timing.

697-4 Minimum Lane Widths for Maintaining Traffic on Curves (Where D>10 degrees)

As noted in Section 640-2, Table 697-4 establishes minimum lane widths for maintaining traffic on sharp curves (degree of curvature exceeds 10 degrees).
697-5  **Sample Phasing Chart for Actuated Signal Control**

As noted in *Sections 641-12.3 and 641-13.3, Table 697-5* presents a sample phasing table that can be used in the plan.

697-6  **Reserved for Future Information**

The table “Selection of Crash Cushions and Barriers - TRACC and Triton” has been deleted, but the number/space has been reserved for future information.

697-7  **Reserved for Future Information**

The table “Selection of Crash Cushions - QuadGuard” has been deleted, but the number/space has been reserved for future information.

697-8  **Maximum Closure Lengths**

As noted in *Section 641-12.2, Table 697-8* provides guidance in designing a signalized one-lane, two-way closing. These values are used as a guide as to when a more detailed analysis of the traffic is needed.

697-9  **Barrier Offset on Curved Roadways**

As noted in *Section 641-17, Table 697-9* summarizes required offsets for barriers on curved roadways.

697-10  **Decision Sight Distance for Entrance Ramp Applications**

As noted in *Sections 607-13 and 607-15, Table 697-10* provides the decision sight distance information used in the applications addressed in those Sections.
Table 697-1a. Construction / Traffic Maintenance Strategies  
Compendium of Traffic Control Options

<table>
<thead>
<tr>
<th>Strategy &amp; Objectives</th>
<th>Pros</th>
<th>Cons</th>
<th>Restrictions</th>
<th>When to Use</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Part Width Construction</td>
<td>Easier design.</td>
<td>Contractor access interference.</td>
<td>Minimum lane widths sometimes tough to obtain.</td>
<td>When existing two lanes can remain with use of</td>
<td>This is the basis of</td>
</tr>
<tr>
<td></td>
<td>Cheaper MOT cost.</td>
<td>May sacrifice quality.</td>
<td>Conflict between width of roadway and width</td>
<td>shoulder.</td>
<td>comparison for alternate</td>
</tr>
<tr>
<td></td>
<td>No detour to follow.</td>
<td>More difficult to construct.</td>
<td>needed for work.</td>
<td>Minor work with short duration.</td>
<td>strategies, the “defacto”</td>
</tr>
<tr>
<td></td>
<td>Ramps can remain open.</td>
<td>Narrow lanes and less safe.</td>
<td></td>
<td>One lane may handle only 20,000 ADT with normal</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Longer to construct.</td>
<td></td>
<td>backup.</td>
<td>standard.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Barrier could still be required for some</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>dropoffs.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Close &amp; Detour (Unusual on</td>
<td>Safety/ speeds up construction with full</td>
<td>Public can’t get there the “usual” way.</td>
<td>Short distance and ramp access.</td>
<td>If it produces accelerated construction,</td>
<td>CC↓, MTC↑, RUC↑</td>
</tr>
<tr>
<td>Interstates and expressway</td>
<td>access.</td>
<td>Access to businesses.</td>
<td>Local agencies must accept detour and public</td>
<td>alternates are available and drivers are</td>
<td>Cheap if only signs are</td>
</tr>
<tr>
<td>routes)</td>
<td></td>
<td>Cost to motorist (time &amp; fuel).</td>
<td>information is emphasized (i.e., by TMP in</td>
<td>fairly warned.</td>
<td>used; but will cost more</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td>Signing.</td>
<td>urban area).</td>
<td></td>
<td>if alternate route</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Lost road users complaints.</td>
<td>Locations of ramps and intersections.</td>
<td></td>
<td>modifications are</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Damage of local roads.</td>
<td>Detour must be adequately signed and may require</td>
<td></td>
<td>required.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>capacity improvements.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Legend:
- Objectives: 1 = Reduce Complaints; 2 = Maximize Corridor Capacity; 3 = Minimize duration of motorist inconvenience; 4 = Maximize motorist / worker safety
- Cost: CC = Construction Cost; MTC = Maintenance of Traffic Cost; RUC = Road User Cost; ↑ = Cost Increase; ↓ = Cost Decrease; CC + MTC = Contract Cost
### Table 697-1a. Construction / Traffic Maintenance Strategies - Compendium of Traffic Control Options (continued, 2 of 3)

<table>
<thead>
<tr>
<th>Strategy &amp; Objectives</th>
<th>Pros</th>
<th>Cons</th>
<th>Restrictions</th>
<th>When to Use</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Crossover Construction 3, 4</strong></td>
<td>Safety for workers, familiarity of road user. Easier and better construction. Wider traveled lanes. If left in place, useful in emergency. Should increase contractor productivity. Should increase quality. Could reduce traffic interference as a result of increased contractor productivity leading to shorter phase. Completion dates are mandated.</td>
<td>Ramp interference. Cost. Requires time for crossover construction and removal. Long crossovers less acceptable in rolling to hilly terrain.</td>
<td>Duration of project. Location of crossover depends on ramps, lighting, structure and grade. Phasing limits may impact use. Length of work zone may affect acceptability.</td>
<td>Whenever possible, especially where not many ramps interfere. Long stretches of pavement reconstruction or rehabilitation. Bridge work not conducive to keeping one lane open. One lane each direction should handle about 30,000 ADT with limited backups.</td>
<td><strong>CC↓, MTC↑, RUC↓</strong> Minimum $3 to 2 million per pair.</td>
</tr>
<tr>
<td><strong>Temporary Pavements (Runaround) 1, 2, 3, 4</strong></td>
<td>Separates work from traffic. Expensive and time consuming while constructing. Inefficient use of materials.</td>
<td>Must have sufficient right-of-way.</td>
<td>No adequate detour is available.</td>
<td>None stated, aside from the minimum cost requirement.</td>
<td></td>
</tr>
</tbody>
</table>

**Legend:**
- Objectives: 1 = Reduce Complaints; 2 = Maximize Corridor Capacity; 3 = Minimize duration of motorist inconvenience; 4 = Maximize motorist / worker safety
- Cost: **CC** = Construction Cost; **MTC** = Maintenance of Traffic Cost; **RUC** = Road User Cost; ↑ = Cost Increase; ↓ = Cost Decrease; **CC + MTC** = Contract Cost
Table 697-1a. Construction / Traffic Maintenance Strategies - Compendium of Traffic Control Options (continued, 3 of 3)

<table>
<thead>
<tr>
<th>Strategy &amp; Objectives</th>
<th>Pros</th>
<th>Cons</th>
<th>Restrictions</th>
<th>When to Use</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Temporary Structures</strong> (Allows closure of structure, but no detour for the public)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1, 2</td>
<td>Traffic remains on routes.</td>
<td>Cost. Time to design and construct. Inefficient use of materials.</td>
<td>Right-of-Way.</td>
<td>When volumes warrant. No detour available.</td>
<td>MTC↑, RUC↓</td>
</tr>
<tr>
<td><strong>Detour of One Direction of Mainline</strong> (Assumes detour for closed direction)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3, 4</td>
<td>Work moves faster. Only half of the traffic detoured at anytime. Improves safety of project personnel.</td>
<td>Detour maintenance. Short distance and ramp access. Local agencies must accept detour routes and public information is emphasized (i.e., by TMP in urban area). Locations of ramps and intersections. Detour must be adequately signed and may require capacity improvements.</td>
<td></td>
<td>Often. Urban/suburban freeway is amenable to this when suitable detour is available.</td>
<td>MTC↑ Could require detour improvements.</td>
</tr>
</tbody>
</table>

Legend:
Objectives: 1 = Reduce Complaints; 2 = Maximize Corridor Capacity; 3 = Minimize duration of motorist inconvenience; 4 = Maximize motorist / worker safety
Cost: CC = Construction Cost; MTC = Maintenance of Traffic Cost; RUC = Road User Cost; ↑ = Cost Increase; ↓= Cost Decrease; CC + MTC = Contract Cost
### Table 697-1b. Corridor Options Outside Work Zone
#### Compendium of Traffic Control Options

<table>
<thead>
<tr>
<th>Option &amp; Objectives</th>
<th>Pros</th>
<th>Cons</th>
<th>Restrictions</th>
<th>When to Use</th>
<th>Cost</th>
</tr>
</thead>
</table>
| **Temporary Signals**  
(At ramps and on expressways, includes construction vehicle crossing and ramp metering)  
1, 2, 4 | Helps maintain ramp and detour capacity. | Change traffic patterns on cross roads. | Should be warranted. | When additional capacity is needed for the short term. | Low. |
| **Reversible Lanes**  
(May use movable barriers)  
2 | Flexible to accommodate fluctuations in traffic peak flow direction. | Confusing to infrequent user. Labor intensive. | Need majority commuting traffic. | Large variances in directional volumes between AM & PM; and number of lanes limited. | MTC↑, RUC↓ |
| **Movable Barrier Systems**  
2, 3, 4 | Ability to provide for peak flow capacity. | More costly than drums and fixed barriers. | Shift distance must be a constant. Must determine appropriate end treatment. | When you have a need for repeated barrier shifts. | CC↑, RUC↓ |
| **Signed Alternate Routes**  
(Eligible for Federal money)  
1, 2, 4 | Reduces congestion. Lessens congestion on mainline. | Hard to get people to use. Signing. Not always used by public. | Must be just as quick or close. Shouldn’t go through other construction zones. Local officials must approve. | With good arterials (parallel). When construction expected to backups. Project is of long duration. | Low cost unless alternate route improvements are required. |

**Legend:**
- Objectives: 1 = Reduce Complaints; 2 = Maximize Corridor Capacity; 3 = Minimize duration of motorist inconvenience; 4 = Maximize motorist / worker safety
- Cost: CC = Construction Cost; MTC = Maintenance of Traffic Cost; RUC = Road User Cost; ↑ = Cost Increase; ↓ = Cost Decrease; CC + MTC = Contract Cost
### Table 697-1b. Corridor Options Outside Work Zone - Compendium of Traffic Control Options (continued, 2 of 2)

<table>
<thead>
<tr>
<th>Option &amp; Objectives</th>
<th>Pros</th>
<th>Cons</th>
<th>Restrictions</th>
<th>When to Use</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Unsigned Alternate Routes</strong> <em>(Not eligible for Federal money)</em> <em>(Logical unsigned alternate may be eligible for State money)</em></td>
<td>Reduces congestion. Lessens congestion on mainline.</td>
<td>Difficult to get people to use.</td>
<td>Alternate routes shouldn’t go through other construction zones.</td>
<td>When construction expected to produce backups and good parallel arterials are available.</td>
<td><strong>High cost.</strong></td>
</tr>
<tr>
<td><strong>Highway Advisory Radio</strong></td>
<td>Provides real time information to motorists. Low usage rate due to difficulty tuning in station.</td>
<td>Limited ranges. Information needs to be current.</td>
<td>When alternate routes are available. Long duration of construction.</td>
<td>Low cost.</td>
<td></td>
</tr>
<tr>
<td><strong>Advanced Signing (Time or Distance)</strong></td>
<td>A great tool for information to motorists. Gives public advance warning to make decisions.</td>
<td>If project is delayed, sign is wrong.</td>
<td>Need to keep information up to date.</td>
<td>Anytime. Advanced warning/PR is great always. Low cost for fixed signs. Higher cost for PCMS.</td>
<td><strong>Low cost.</strong></td>
</tr>
</tbody>
</table>

Legend:
Objectives: 1 = Reduce Complaints; 2 = Maximize Corridor Capacity; 3 = Minimize duration of motorist inconvenience; 4 = Maximize motorist / worker safety
Cost: CC = Construction Cost; MTC = Maintenance of Traffic Cost; RUC = Road User Cost; ↑ = Cost Increase; ↓ = Cost Decrease; CC + MTC = Contract Cost
Table 697-1c. Traffic Flow Options Inside Work Zones
Compendium of Traffic Control Options

<table>
<thead>
<tr>
<th>Option &amp; Objectives</th>
<th>Pros</th>
<th>Cons</th>
<th>Restrictions</th>
<th>When to Use</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Temporary Pavements (Widen)</strong> 1, 2, 4</td>
<td>Allows for more lanes to stay open. Creates greater capacity through the construction zone - less backups.</td>
<td>Expensive and time consuming while constructing. Bridges and other roadway items.</td>
<td>When volumes warrant keeping all lanes open. When construction is expected to produce backups. When project is of long duration.</td>
<td>MTC↑, RUC↓</td>
<td></td>
</tr>
<tr>
<td><strong>Use Existing Shoulders</strong> 1, 2</td>
<td>Keeps flow normal. Allows wider work space or increases capacity. Low cost. Quick.</td>
<td>Requires more maintenance. Trucks may damage weak shoulders. No room for breakdowns/ emergency stops unless parking lots created. Closer to guardrail, embankment and piers.</td>
<td>Must have full shoulder widths, level bridges. Bridges must be able to accommodate. Put trucks in left lane if possible. Must evaluate shoulders during design. Should have full width approach slabs.</td>
<td>High volume. When backups expected. Moving projects.</td>
<td></td>
</tr>
</tbody>
</table>

Legend:
Objectives: 1 = Reduce Complaints; 2 = Maximize Corridor Capacity; 3 = Minimize duration of motorist inconvenience; 4 = Maximize motorist / worker safety
Cost: CC = Construction Cost; MTC = Maintenance of Traffic Cost; RUC = Road User Cost; ↑ = Cost Increase; ↓ = Cost Decrease; CC + MTC = Contract Cost
Table 697-1c. Traffic Flow Options Inside Work Zones - Compendium of Traffic Control Options (continued, 2 of 4)

<table>
<thead>
<tr>
<th>Option &amp; Objectives</th>
<th>Pros</th>
<th>Cons</th>
<th>Restrictions</th>
<th>When to Use</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Temporary Signals</strong> (At ramps and on expressways includes construction vehicle crossing and ramp metering)</td>
<td>Helps maintain ramp and detour capacity.</td>
<td>Change traffic patterns on cross roads.</td>
<td>Should be warranted.</td>
<td>When additional capacity is needed for the short term.</td>
<td>Low.</td>
</tr>
<tr>
<td>1, 2, 4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Reversible Lanes</strong> (May use movable barriers)</td>
<td>Flexible to accommodate fluctuations in traffic peak flow direction.</td>
<td>Confusing to infrequent user.</td>
<td>Need majority commuting traffic.</td>
<td>Large variances in directional volumes between AM and PM; and number of lanes limited.</td>
<td>MTC↑, RUC↓</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Movable Barrier Systems</strong></td>
<td>Ability to provide for peak flow capacity.</td>
<td>More costly than drums and fixed barriers.</td>
<td>Shift distance must be a constant.</td>
<td>When you have a need for repeated barrier shifts.</td>
<td>MTC↑, RUC↓</td>
</tr>
<tr>
<td>2, 3, 4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Legend:
Objectives: 1 = Reduce Complaints; 2 = Maximize Corridor Capacity; 3 = Minimize duration of motorist inconvenience; 4 = Maximize motorist / worker safety

Cost: CC = Construction Cost; MTC = Maintenance of Traffic Cost; RUC = Road User Cost; ↑ = Cost Increase; ↓ = Cost Decrease; CC + MTC = Contract Cost
<table>
<thead>
<tr>
<th>Option &amp; Objectives</th>
<th>Pros</th>
<th>Cons</th>
<th>Restrictions</th>
<th>When to Use</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Ramp Closures</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2, 3, 4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Can pave/repair ramp full width.</td>
<td>Blocks traffic pattern.</td>
<td>Should give definite time limit.</td>
<td>When other ramps are close by, or when bridges on mainline are too close to utilize exit and/or entrance ramps.</td>
<td>Relatively cheap.</td>
<td></td>
</tr>
<tr>
<td>See “Close &amp; Detour.”</td>
<td>Forces new traffic pattern.</td>
<td>Best if only two ramps at a time (to and from directional pairs).</td>
<td></td>
<td>Use when you have high-traffic volumes.</td>
<td></td>
</tr>
<tr>
<td>Reduces mainline congestion.</td>
<td>Moves congestion elsewhere.</td>
<td>In urban area, may have negative impact on next intersection.</td>
<td></td>
<td>In areas where alternate routes exists.</td>
<td></td>
</tr>
<tr>
<td>Reduces cross road congestion.</td>
<td>Easy to sign in rural area.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| **Glare/Gawk Screens** |      |      |              | When view of intense construction is likely to reduce capacity. |      |
| 2, 4                  |      |      |              | With all part-width construction at restricted areas to control headlight glare. | MTC↑ |
| Effective way to separate work and keep traffic moving. | Longer to set up than drums. | Widths in certain areas. | | | |
| Safer for work. | Higher cost than 32 inches. | Sight restrictions at intersections and ramps. | | | |
| Reduce rubber-necking. | Maintenance of glare screen, if used. | | | | |
| If present on both sides, may reduce drive speed. | Barrier can interfere with wide loads. | | | | |

Legend:
Objectives: 1 = Reduce Complaints; 2 = Maximize Corridor Capacity; 3 = Minimize duration of motorist inconvenience; 4 = Maximize motorist / worker safety
Cost: CC = Construction Cost; MTC = Maintenance of Traffic Cost; RUC = Road User Cost; ↑ = Cost Increase; ↓ = Cost Decrease; CC + MTC = Contract Cost
### Table 697-1c. Traffic Flow Options Inside Work Zones - Compendium of Traffic Control Options (continued, 4 of 4)

<table>
<thead>
<tr>
<th>Option &amp; Objectives</th>
<th>Pros</th>
<th>Cons</th>
<th>Restrictions</th>
<th>When to Use</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Highway Advisory Radio</strong></td>
<td>Provides real time information to motorists.</td>
<td>Limited ranges. Low usage rate by motorists due to difficulty tuning in station. Information needs to be current. May work best with repeat drivers. Should be limited to project specific information.</td>
<td></td>
<td>When alternate routes are available. Long duration of construction.</td>
<td>RUC↓</td>
</tr>
<tr>
<td><strong>Owner Imposed Design Restrictions</strong></td>
<td>Can reduce actual construction duration.</td>
<td>Requires advance planning during design. Could increase cost.</td>
<td></td>
<td>For certain time critical phases.</td>
<td></td>
</tr>
<tr>
<td><strong>Use of Owner Supplied or Stockpiled Materials</strong></td>
<td>Can reduce actual construction duration.</td>
<td>Requires advance planning.</td>
<td></td>
<td>For time-critical phases to shorten duration.</td>
<td>Inexpensive.</td>
</tr>
<tr>
<td><strong>Control of Contractor=s Access to the Work</strong> (By location or time of day.)</td>
<td>Eliminates potential conflicts between construction traffic and motorists. Improves through put of motorists.</td>
<td>May reduce contractor productivity. Must provide reasonable access for contractor.</td>
<td></td>
<td>Where capacity is critical. Where conflicts between contractor’s equipment and motorists is expected to impact capacity and safety, possibly on grades or locations with poor sight distances.</td>
<td>CC↑, RUC↓</td>
</tr>
</tbody>
</table>

Legend:
- Objectives: 1 = Reduce Complaints; 2 = Maximize Corridor Capacity; 3 = Minimize duration of motorist inconvenience; 4 = Maximize motorist / worker safety
- Cost: CC = Construction Cost; MTC = Maintenance of Traffic Cost; RUC = Road User Cost; ↑ = Cost Increase; ↓ = Cost Decrease; CC + MTC = Contract Cost
### Table 697-1d. Time Limitations with Disincentive Options
#### Compendium of Traffic Control Options

<table>
<thead>
<tr>
<th>Option &amp; Objectives</th>
<th>Pros</th>
<th>Cons</th>
<th>Restrictions</th>
<th>When to Use</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temporary Lane Closures or Restrictions 1, 2</td>
<td>Prevents contractor from keeping lanes closed longer than necessary. Prevents work during specified hour.</td>
<td>May surprise repeat drivers. May be more expensive. More setups and take downs which can reduce construction time.</td>
<td>Rush hour considerations. Use only if work will allow. Give public notices.</td>
<td>Mainline paving on basic freeway lanes. When desired to prohibit closures during specified times.</td>
<td>CC↑, MTC↑, RUC↓ Cheap (cone in daylight; drums at night). Possibly higher cost than permanent closure.</td>
</tr>
</tbody>
</table>

#### Night Work (Hours of day a specific phase of work is or required to be performed) 2, 3 | Good PR. Lower cost to motorist. May shorten project duration. | Costly for labor. Lower efficiency. Personnel are isolated. Possibly poorer quality work and inspection difficulty. Difficult to get some materials at night. Increased hazard potential. Difficult to access management or supervision for problem solution. | Residential areas. Work must be able to be accomplished in this time. Urban noise ordinances. | High-volume areas. When extensive backups expected to be created. | CC↑, MTC↑, RUC↓ |

---

Legend:

Objectives: 1 = Reduce Complaints; 2 = Maximize Corridor Capacity; 3 = Minimize duration of motorist inconvenience; 4 = Maximize motorist / worker safety

Cost: CC = Construction Cost; MTC = Maintenance of Traffic Cost; RUC = Road User Cost; ↑ = Cost Increase; ↓ = Cost Decrease; CC + MTC = Contract Cost
<table>
<thead>
<tr>
<th>Option &amp; Objectives</th>
<th>Pros</th>
<th>Cons</th>
<th>Restrictions</th>
<th>When to Use</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weekend Work (Only)</td>
<td>Lower cost to motorist.</td>
<td>Costly - needs inspection on overtime also. Impacts traveler who is less familiar with alternate routes. Difficult to get some materials on weekends.</td>
<td>Work must be able to be accomplished in this time.</td>
<td>More amenable in urban areas. High volume of commuter traffic expected to be delayed.</td>
<td>CC↑, RUC↓</td>
</tr>
<tr>
<td>Lane Rental</td>
<td>Work done in the most cost effective and timely manner. Should minimize construction time. Provides incentive to minimize use of road space.</td>
<td>Expect disagreements. New application in Ohio.</td>
<td>Requires careful timekeeping. Too many variables.</td>
<td>Paving freeways.</td>
<td>CC↑, RUC↓</td>
</tr>
<tr>
<td>Interim Completion Dates, By Phase</td>
<td>A good tool for timeliness. Prevents contractor from having lanes closed or restricted when not desired.</td>
<td>Only works if enforced by increased disincentives. Schools, weather, plowing, etc. Must require early consideration and follow-up. Must be updated when a sale date is established or revised.</td>
<td>To open roads before winter, specified events.</td>
<td>Cheap.</td>
<td></td>
</tr>
</tbody>
</table>
### Table 697-1e. Contracting Procedure Options
Compendium of Traffic Control Options

<table>
<thead>
<tr>
<th>Option &amp; Objectives</th>
<th>Pros</th>
<th>Cons</th>
<th>Restrictions</th>
<th>When to Use</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Incentives/ Disincentives</strong>&lt;br&gt;(Usually applies to a phase of a project)</td>
<td>Timeliness. Quicker construction.</td>
<td>More arguments on time extension. Our people must resolve issues quickly. Requires CPM schedule.</td>
<td>None known. Need good plans and a project with the work well defined in advance. Work must be able to be accomplished in allotted time, must follow the incentive/disincentives guidelines.</td>
<td>High volume that truly impacts motorists without good detour or alternate route.</td>
<td>CC↑, RUC↓ Must budget for maximum incentive.</td>
</tr>
<tr>
<td><strong>A + B Bidding</strong>&lt;br&gt;(Construction cost plus construction time)</td>
<td>Work done in the most cost effective and timely manner. Should minimize construction time.</td>
<td>May pay more for the work. Expect disagreements.</td>
<td>Limit to high impact projects. Currently limited to test projects. Need very good plans and no expected changes. Need reasonable completion times.</td>
<td>High volume that truly impacts motorists without good detour or alternate route.</td>
<td>CC↑, RUC↓</td>
</tr>
</tbody>
</table>

Legend:
Objectives: 1 = Reduce Complaints; 2 = Maximize Corridor Capacity; 3 = Minimize duration of motorist inconvenience; 4 = Maximize motorist / worker safety
Cost: CC = Construction Cost; MTC = Maintenance of Traffic Cost; RUC = Road User Cost; ↑ = Cost Increase; ↓ = Cost Decrease; CC + MTC = Contract Cost
<table>
<thead>
<tr>
<th>Option &amp; Objectives</th>
<th>Pros</th>
<th>Cons</th>
<th>Restrictions</th>
<th>When to Use</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Lane Rental</strong></td>
<td>Work done in the most cost effective and timely manner.</td>
<td>Expect disagreements.</td>
<td>Requires careful timekeeping.</td>
<td>Paving freeways.</td>
<td><strong>CC↑, RUC↓</strong></td>
</tr>
<tr>
<td>(Many variations)</td>
<td>Should minimize construction time.</td>
<td>New application in Ohio.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(May be combined with A+B Bidding)</td>
<td>Provides incentive to minimize use of road space.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Contractor loses money for duration of specific lane closures)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1, 2, 3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Legend:
- Objectives: 1 = Reduce Complaints; 2 = Maximize Corridor Capacity; 3 = Minimize duration of motorist inconvenience; 4 = Maximize motorist / worker safety
- Cost: CC = Construction Cost; MTC = Maintenance of Traffic Cost; RUC = Road User Cost; ↑ = Cost Increase; ↓ = Cost Decrease; CC + MTC = Contract Cost
# Table 697-1f. Administrative Options
## Compendium of Traffic Control Options

<table>
<thead>
<tr>
<th>Option &amp; Objectives</th>
<th>Pros</th>
<th>Cons</th>
<th>Restrictions</th>
<th>When to Use</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Traffic Management Program (Area, corridor or project) (May include enforcement, demand management, public information, public perception adjustment)</td>
<td>Keeps checks on conflicts. Helps with consistency. Coordinates all projects, develops a forum for discussion of construction problems.</td>
<td>Not welcomed by some. Takes extra time and planning. Tends to be expensive. Additional funding required from Districts and Locals. Project outside area boundaries may cause public relation problems. Requires more staff time.</td>
<td>Takes extra time and planning. Area must be large enough to make worthwhile.</td>
<td>Anytime. Most often used in larger urban areas and particularly (eight MPO’s) with large projects.</td>
<td>CC↑, MTC↑, RUC↓ Personnel only (mainly). Typical program is $500,000 to $1 million per year.</td>
</tr>
<tr>
<td>Enforcement</td>
<td>Expedited, orderly traffic flow, incident support.</td>
<td>Cost.</td>
<td>When incident support is required, or enforcement presence is desired.</td>
<td>Medium high.</td>
<td></td>
</tr>
<tr>
<td>Incident Management</td>
<td>Minimizes effect incidents have on traffic flow.</td>
<td>Cost of standby incident response personnel and vehicles; administrative cost.</td>
<td>Freeway sections with high v/c ratio and high likelihood of incidents.</td>
<td>High.</td>
<td></td>
</tr>
</tbody>
</table>

Legend:
- Objectives: 1 = Reduce Complaints; 2 = Maximize Corridor Capacity; 3 = Minimize duration of motorist inconvenience; 4 = Maximize motorist / worker safety
- Cost: CC = Construction Cost; MTC = Maintenance of Traffic Cost; RUC = Road User Cost; ↑ = Cost Increase; ↓ = Cost Decrease; CC + MTC = Contract Cost
<table>
<thead>
<tr>
<th>Option &amp; Objectives</th>
<th>Pros</th>
<th>Cons</th>
<th>Restrictions</th>
<th>When to Use</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Demand Management</strong>&lt;br&gt;1, 2, 3, 4</td>
<td>Shifts some demand from highway under construction.&lt;br&gt;Good PR.</td>
<td>Requires advance planning and coordination.&lt;br&gt;Cost.</td>
<td>Alternative routes and modes must be available.</td>
<td>Large urban and suburban projects in congested corridor.</td>
<td>High.</td>
</tr>
<tr>
<td><strong>Contractor Proposed Options</strong>&lt;br&gt;3</td>
<td>May result in shorter construction duration.</td>
<td>Contractor may not be as familiar with recommended procedure as claimed.&lt;br&gt;Usually requires rush reviews by ODOT.</td>
<td>Requires adequate lead time for PR and permits.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Legend:
Objectives: 1 = Reduce Complaints; 2 = Maximize Corridor Capacity; 3 = Minimize duration of motorist inconvenience; 4 = Maximize motorist / worker safety
Cost: CC = Construction Cost; MTC = Maintenance of Traffic Cost; RUC = Road User Cost; \( \downarrow \) = Cost Increase; \( \downarrow \) = Cost Decrease; CC + MTC = Contract Cost
### Table 697-2. Rate of Flow (Two-Way) for a Signalized One-Lane, Two-Way Closing

<table>
<thead>
<tr>
<th>Total cycle length</th>
<th>400</th>
<th>500</th>
<th>600</th>
<th>700</th>
<th>800*</th>
<th>900*</th>
<th>1000*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minutes</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.0</td>
<td>60</td>
<td>450</td>
<td>310</td>
<td>170</td>
<td>35</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>70</td>
<td>570</td>
<td>445</td>
<td>320</td>
<td>200</td>
<td>80</td>
<td></td>
</tr>
<tr>
<td>1.5</td>
<td>80</td>
<td>690</td>
<td>579</td>
<td>475</td>
<td>365</td>
<td>260</td>
<td>155</td>
</tr>
<tr>
<td></td>
<td>90</td>
<td>810</td>
<td>715</td>
<td>625</td>
<td>530</td>
<td>440</td>
<td>350</td>
</tr>
<tr>
<td></td>
<td>100</td>
<td>870</td>
<td>780</td>
<td>700</td>
<td>615</td>
<td>530</td>
<td>445</td>
</tr>
<tr>
<td>2.0</td>
<td>120</td>
<td>990</td>
<td>915</td>
<td>844</td>
<td>788</td>
<td>712</td>
<td>638</td>
</tr>
<tr>
<td>3.0</td>
<td>180*</td>
<td>1154</td>
<td>1117</td>
<td>1075</td>
<td>1027</td>
<td>983</td>
<td>934</td>
</tr>
<tr>
<td>4.0</td>
<td>240*</td>
<td>1247</td>
<td>1215</td>
<td>1184</td>
<td>1151</td>
<td>1118</td>
<td>1081</td>
</tr>
<tr>
<td>5.0</td>
<td>300*</td>
<td>1302</td>
<td>1276</td>
<td>1253</td>
<td>1226</td>
<td>1200</td>
<td>1170</td>
</tr>
</tbody>
</table>

This table assumes a 12 foot lane width. If the lane width is 11 feet, reduce the rate of flow by using a factor of 0.97 and for a 10 foot lane width, reduce the rate of flow by using a factor of 0.93.

* Cycle lengths greater than three minutes should be considered only in unusual cases. It is important to remember that a road user encountering a signal staying red for more than two minutes is very likely to become impatient and/or assume the signal is malfunctioning. This is particularly true if the motorist cannot see that opposing traffic is using the open lane. For the same reasons, closure lengths greater than about 800 feet should not be used until carefully evaluated. Where relatively short closure lengths are involved but high peak traffic volumes tend to support the need for a longer cycle length, it will probably be appropriate to employ a technique which will allow a shorter cycle length to be used during lower traffic periods. Traffic actuated operation and/or multi-plan time-of-day operation should be considered.
### Table 697-3. Initial Timing Chart

<table>
<thead>
<tr>
<th>Approach</th>
<th>A</th>
<th>B</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Northbound Green</td>
<td>31.0*</td>
<td>41.0</td>
<td>16.0*</td>
</tr>
<tr>
<td>Northbound Yellow</td>
<td>3.5</td>
<td>3.5</td>
<td>3.5</td>
</tr>
<tr>
<td>Northbound All Red (Internal Clearance)</td>
<td>18.0</td>
<td>18.0</td>
<td>18.0</td>
</tr>
<tr>
<td>Southbound Green</td>
<td>30.0</td>
<td>20.0</td>
<td>15.0</td>
</tr>
<tr>
<td>Southbound Yellow</td>
<td>3.5</td>
<td>3.5</td>
<td>3.5</td>
</tr>
<tr>
<td>Southbound All Red (Internal Clearance)</td>
<td>19.0</td>
<td>19.0</td>
<td>19.0</td>
</tr>
</tbody>
</table>

| Total Cycle Length                           | 105.0* | 105.0 | 75.0* |

* Provide timing appropriate for the signal location under consideration.

<table>
<thead>
<tr>
<th>Time of Day</th>
<th>SUN</th>
<th>MON</th>
<th>TUE</th>
<th>WED</th>
<th>THUR</th>
<th>FRI</th>
<th>SAT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Midnight - 7:00 a.m.</td>
<td>C*</td>
<td>C</td>
<td>C</td>
<td>C</td>
<td>C</td>
<td>C</td>
<td>C*</td>
</tr>
<tr>
<td>7:00 a.m. - 9:00 a.m.</td>
<td>C</td>
<td>A</td>
<td>A</td>
<td>A</td>
<td>A</td>
<td>A</td>
<td>C</td>
</tr>
<tr>
<td>9:00 a.m. - 4:00 p.m.</td>
<td>A</td>
<td>C</td>
<td>C</td>
<td>C</td>
<td>C</td>
<td>C</td>
<td>A</td>
</tr>
<tr>
<td>4:00 p.m. - 6:00 p.m.</td>
<td>C</td>
<td>B</td>
<td>B</td>
<td>B</td>
<td>B</td>
<td>B</td>
<td>A</td>
</tr>
<tr>
<td>6:00 p.m. - Midnight</td>
<td>C*</td>
<td>C</td>
<td>C</td>
<td>C</td>
<td>C</td>
<td>C</td>
<td>C*</td>
</tr>
</tbody>
</table>
Table 697-4. Minimum Lane Widths for Maintaining Traffic on Curves  
(Where D >10 degrees)

<table>
<thead>
<tr>
<th>RADIUS feet</th>
<th>Type A feet</th>
<th>Type B feet</th>
<th>Type C feet</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt; 500</td>
<td>10</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>500</td>
<td>10</td>
<td>10.5 *</td>
<td>11.5 *</td>
</tr>
<tr>
<td>300</td>
<td>10</td>
<td>11.0 *</td>
<td>12.5 *</td>
</tr>
<tr>
<td>200</td>
<td>10</td>
<td>11.5 *</td>
<td>13.5 *</td>
</tr>
<tr>
<td>150</td>
<td>10 *</td>
<td>12.0 *</td>
<td>14.5 *</td>
</tr>
<tr>
<td>100</td>
<td>10 *</td>
<td>13.5 *</td>
<td>17.0 *</td>
</tr>
</tbody>
</table>

** Type A - Passenger cars govern design.  
Type B - Single unit trucks govern design.  
Type C - Semitrailer vehicles (WB-50) govern design. Larger units may need to be rerouted if their required width cannot be accommodated.

Note: Widths shown in excess of 10 feet are based on the width of wheel track plus a 1.5 foot allowance for maneuverability. Minimum barrier offset in addition to the widths shown is 1.5 foot. Values marked by an asterisk (*) are those situations where minimum barrier clearance cannot be waived.
### Table 697-5. Sample Phasing Chart for Actuated Signal Control

<table>
<thead>
<tr>
<th>Phase*</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial</td>
<td>7+/−</td>
<td>10</td>
<td>8</td>
<td>10+/−</td>
</tr>
<tr>
<td>Vehicle</td>
<td>4</td>
<td>3</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>Maximum</td>
<td>11</td>
<td>30</td>
<td>12</td>
<td>30</td>
</tr>
<tr>
<td>Yellow</td>
<td>3</td>
<td>3.5</td>
<td>3</td>
<td>3.5</td>
</tr>
<tr>
<td>All Red</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Recall</td>
<td>ON+/−</td>
<td>OFF</td>
<td>ON</td>
<td>OFF+/−</td>
</tr>
</tbody>
</table>

* Phases as shown on SCD MT-96.20 for Actuated Control.
+/- Provide timing for the signal location under consideration.
The table “Selection of Crash Cushions and Barriers - TRACC and Triton” has been deleted, but the number/space has been reserved for future information.
Table 697-7. Reserved for Future Information

The table “Selection of Crash Cushions - QuadGuard” has been deleted, but the number/space has been reserved for future information.
Table 697-8. Maximum Closure Lengths

<table>
<thead>
<tr>
<th>MAXIMUM ADT</th>
<th>MAXIMUM CLOSURE LENGTH Feet</th>
</tr>
</thead>
<tbody>
<tr>
<td>10,000</td>
<td>200</td>
</tr>
<tr>
<td>9,000</td>
<td>400</td>
</tr>
<tr>
<td>8,000</td>
<td>600</td>
</tr>
<tr>
<td>7,000</td>
<td>800</td>
</tr>
<tr>
<td>5,000</td>
<td>1200</td>
</tr>
<tr>
<td>4,000</td>
<td>1600</td>
</tr>
<tr>
<td>3,000</td>
<td>2000</td>
</tr>
</tbody>
</table>
Table 697-9. Barrier Offset on Curved Roadways

<table>
<thead>
<tr>
<th>Degree of Curvature (Radius)</th>
<th>Required Offset From Edge of Pavement Feet</th>
<th>Minimum Width of Median Required Feet</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.5 to 3.5</td>
<td>36</td>
<td>66</td>
</tr>
<tr>
<td>3.6 to 4.5</td>
<td>42</td>
<td>72</td>
</tr>
<tr>
<td>4.6 to 5.5</td>
<td>48</td>
<td>78</td>
</tr>
</tbody>
</table>
Table 697-10. Decision Sight Distance for Entrance Ramp Applications
(see Sections 607-13 and 607-15)

<table>
<thead>
<tr>
<th>Posted Mainline Speed (mph)</th>
<th>Rural</th>
<th>Urban</th>
</tr>
</thead>
<tbody>
<tr>
<td>45</td>
<td>675 feet</td>
<td>930 feet</td>
</tr>
<tr>
<td>55</td>
<td>865 feet</td>
<td>1135 feet</td>
</tr>
<tr>
<td>65</td>
<td>Diamond ramp = 1050 feet Loop Ramp = 1200 feet</td>
<td>1365 feet</td>
</tr>
</tbody>
</table>
698 FIGURES INDEX

698-1 Component Parts of a Traffic Control Zone

As noted in Sections 602-4.1, 602-4.4.4 and 605-5.1, Figure 698-1 illustrates the components of a traffic control zone.

698-2 Reserved for Future Information

Figure deleted but the space has been saved for now.

698-3a&b Temporary Traffic Control Signs

As noted in Section 605-2.1, Figures 698-3a and 698-3b illustrate Regulatory, Warning and Guide Signs discussed in this Manual that are not shown in the O MUTCD.

698-4 Median Crossover for Entrance Ramp

Figure 698-4 illustrates a typical application involving a median crossover for an entrance ramp. Section 607-13 provides additional information directly related to this application. Section 606-17 also provides additional information about work near interchanges.

698-5 Work in Vicinity of Entrance Ramp

Figure 698-5 illustrates a typical application involving work in the vicinity of an entrance ramp. Section 607-15 provide additional information directly related to this application. Section 606-17 also provides additional information about work near interchanges.

698-6 Two-Lane Crossover Design (Existing 4-Lane Facility)

Figure 698-6 illustrates a two-lane crossover design for an existing four-lane facility. Sections 606-16, 607-12 and 640-12 address crossovers.

698-7 Example of Typical Sections (Existing 4-Lane Facility)

Figure 698-7 illustrates typical sections for a median crossover on an existing four-lane facility. Sections 606-16, 607-12 and 640-12 address crossovers.

698-8 Two-Lane Crossover Design (Existing 6-Lane Facility)

Figure 698-8 illustrates a two-lane crossover design for an existing six-lane facility. Sections 606-16, 607-12 and 640-12 address crossovers.

698-9 Example Typical Sections (Existing 6-Lane Facility)

Figure 698-9 illustrates typical sections involving a median crossover for an existing six-lane facility. Sections 606-16, 607-12 and 640-12 address crossovers.

698-10 Sample Lane Configuration Diagrams and Cross Sections

Figure 698-10 provides a couple of samples of Lane Configuration Diagrams and Cross Sections described in Section 630-5 as part of an MOTAA.

698-11 Pothole Patching on Multi-Lane Facilities That Will Violate the PLCS

Figure 698-11 is an example of TTC guidelines established in Section 660-4.3 for pothole patching on ODOT-maintained multi-lane facilities that will violate the PLCS.

Revised July 20, 2012 October 23, 2002 6-227
698-12 Pothole Patching on Multi-Lane Facilities That Will Not Violate the PLCS

*Figure 698-12* is an example of TTC guidelines established in *Section 660-4.4* for pothole patching on ODOT-maintained multi-lane facilities that will not violate the PLCS.
Figure 698-1. Component Parts of a Traffic Control Zone

- Legend
  - Direction of travel
  - Channelizing device
  - Work space
  - Sign

- Traffic Space allows traffic to pass through the activity area
- Buffer Space (lateral) provides protection for traffic and workers
- Buffer Space (longitudinal) provides protection for traffic and workers
- Work Space is set aside for workers, equipment, and material storage
- Termination Area lets traffic resume normal operations
- Activity Area is where work takes place
- Transition Area moves traffic out of its normal path
- Shoulder Taper
- Advance Warning Area tells traffic what to expect ahead
Figure 698-2.

Figure has been deleted; however, for now the space has been saved for a future revision.
Figure 698-3a. Temporary Traffic Control Signs

- M2-H3
  - 605-7.3
- M4-H9bR
  - 605-7.2
- R11-H5a
  - 605-4.3
- W3-H7
  - 642-33
- W8-H12
  - 605-5.15
- W8-H12a
  - 605-5.15
- W8-H16
  - 605-17
- W9-H4R
  - 641-17
- W9-H5
  - 641-17
- W9-H6
  - 641-17
- W20-7
  - 605-5.7
Figure 698-3b. Temporary Traffic Control Signs

- **W20-H13**
  - 605-6.2

- **W20-H14**
  - 605-6.2

- **W21-H5**
  - 606-6

- **W21-H6**
  - 605-5.9

- **W21-H8**
  - 606-6

- **W23-H2**
  - 607-15

- **Road Will Be Closed Monday for 27 Days**
  - Info: 555-555-1212
  - OHIO DEPT OF TRANSPORTATION
Figure 698-4. Median Crossover for Entrance Ramp
(See Section 607-13 for related details.)
Figure 698-5. Work in Vicinity of Entrance Ramp
(See Section 607-15 for related details.)
Figure 698-6. Two-Lane Crossover Design
(Existing 4-Lane Facility)
Figure 698-7. Example of Typical Sections
(Existing 4-Lane Facility)
Figure 698-8. Two-Lane Crossover Design (Existing 6-Lane Facility)
Figure 698-9. Example Typical Sections
(Existing 6-Lane Facility)
Figure 698-10. Sample Lane Configuration Diagrams and Cross Sections
Notes:
1.) All vehicles shall be equipped with high-intensity rotating, flashing oscillating or strobe lights.
2.) Preferred location of work vehicle and the first shadow vehicle is in the lane adjacent to the shoulder when the shadow vehicle has a TMA.
3.) Both shadow vehicles shall be equipped with arrow boards.
4.) The second shadow vehicle may be replaced by a law enforcement officer (LEO).
Figure 698-12. Pothole Patching on Multi-Lane Facilities That Will Not Violate the PLCS (Sheet 1 of 2)

Detail A

Notes:
1. The shadow vehicle shall be equipped with an arrow board.
2. The preferred location of the work vehicle is in the lane adjacent to the shoulder.
3. If a TMA is not available, the work vehicle and shadow vehicle should be located on the shoulder.
4. All vehicles shall be equipped with high-intensity rotating, flashing, oscillating or strobe lights.
Notes:
1. This drawing is only intended to be used for low-volume multi-lane highways where roadway geometry and terrain do not necessitate the use of a shadow vehicle, TMA, LEO, etc.
2. The work vehicle shall be equipped with a truck-mounted arrow board and high-intensity rotating, flashing, oscillating or strobe lights.
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### Table 797-1. School Zone Number Assignments
700 GENERAL

OMUTCD Part 7 addresses traffic controls for school areas. Part 7 of the Traffic Engineering Manual (TEM) provides additional guidance for use of traffic control devices for school areas.

701 SCHOOL ROUTES AND ESTABLISHED SCHOOL CROSSINGS

As noted in OMUTCD Section 7A.01, it is important to have a uniform approach to school area traffic controls. A School Route Plan Map developed through the combined efforts of school officials, law enforcement and local traffic officials can be useful in identifying recommended walking routes to school. Such a map can aid in an orderly review of school area traffic control devices, and coordination of education and engineering activities. OMUTCD Section 7A.02 and Figure 7A-1 also address school route plans.

In 1978, ODOT published an Implementation Guide to Recommended Walking Route to School Program to help encourage and support these efforts. This publication was discontinued in June 1991, and the information was incorporated into an updated Pedestrian Safety Curriculum Guide published by the Ohio Department of Education (ODE). Part V of this Guide included a sample map and letter that teachers could use when discussing a Recommended Walking Route to School Program with students. The Guide is no longer published by ODE; however, copies of the Part V material are available upon request from the Office of Traffic Engineering (OTE).
Intentionally blank.
702 SCHOOL SIGNS

702-1 General

School-related signing is generally addressed in OMUTCD Chapter 7B. Additional information about school-related signing is provided herein.

702-2 Use of Fluorescent Yellow-Green Retroreflective Sheeting

Standard school area signs shall use fluorescent yellow-green sheeting. Section 220-7 describes the process ODOT has established to transition to fluorescent yellow-green sheeting.

702-3 School Speed Limit Signs

A School Speed Limit sign is a regulatory traffic control device in accordance with OMUTCD Section 7B.10. It may be a passive device (sign only) or an active one (sign with Speed Limit Sign Beacons). However, when used in conjunction with an active SCHOOL ENTRANCE sign assembly, an active School Speed Limit Sign with Beacons (see Section 702-4) should be used to help clarify when the 20 mile per hour requirement is in effect.

702-4 School Speed Limit Sign with Beacons

702-4.1 General

A School Speed Limit Sign with Beacons is an active device which consists of a School Speed Limit sign with a pair of alternately flashing yellow beacons, and may have an illuminated "20." Further details about the beacons are addressed in OMUTCD Sections 7B.10, and 4L.04.

Section 702-6 addresses the division of responsibilities and duties related to installation, operation and maintenance of these devices.

Also, Section 742-2 provides Plan Note 742-2 for use with solar-powered School Speed Limit Sign assemblies.

702-4.2 School Speed Limit Sign with Rear-Facing Beacon

A rear-facing beacon is a single flashing amber beacon that is installed on the back of a School Speed Limit sign equipped with forward-facing beacons. The rear-facing beacon is intended to reinforce the location of the end of the school zone or to notify road users that the forward-facing beacons are operating. The rear-facing beacon is an optional treatment that may be considered in school zones where motorist compliance with the School Speed Limit through the end of the zone is low.

Rear-facing beacons should be considered upon receipt of a written communication from a school official requesting their installation. Any one of the following conditions (not shown in priority order) may be considered to determine if rear-facing beacons would be beneficial:

1. Excessively long school zone.
2. STOP sign or traffic signal controlled intersection within the school zone.
3. High-volume access point (i.e., driveway) within the school zone.

If used, the rear-facing beacon shall conform to OMUTCD Section 4L.04. An END SCHOOL
SPEED LIMIT (S5-3) sign (OMUTCD Section 7B.10) shall be mounted with the rear-facing beacon, to supplement the right-hand mounted END SCHOOL SPEED LIMIT sign.

Rear-facing beacons may be used selectively in a particular school zone. The installation of a rear-facing beacon at one end of a school zone does not necessitate the installation of rear-facing beacons at other locations within that same school zone.

The rear-facing beacon shall only operate when the forward-facing beacons are operating.

702-5 SCHOOL ENTRANCE Sign (S3-H3)

A SCHOOL ENTRANCE sign (S3-H3) may be used to help identify a school entrance and/or driveway where there is poor sight distance or a fairly large volume of traffic entering or exiting the driveway. It may be a passive device (sign only) or an active device (sign with flashing yellow warning beacon(s)). When the traffic is seasonal, the sign should be removed, folded or covered during the period the entrance is not in common use.

When supplemented with one or two flashing yellow warning beacons (see OMUTCD Section 4L.03), this sign can be used to provide advance warning of the location and the related traffic at times when the School Zone speed limit is not in effect.

SCHOOL ENTRANCE signs may be either ground or overhead mounted. When supplemented with beacons, the sign is operated either manually, or by a timer, usually programmable, which is typically located in a cabinet on the highway right-of-way, or alternatively off the highway right-of-way in the school building.

Although this sign is not shown in the OMUTCD, it can be found in the Sign Designs and Markings Manual.

Section 702-6 addresses the division of responsibilities and duties related to installation, operation and maintenance of these devices.

702-6 Responsibilities for School Signs with Beacons

This section defines the responsibilities and division of duties of those concerned with the installation, operation and maintenance of school signs with beacons on ODOT-maintained highways. The provisions herein also apply to rural state highway extensions within the municipal corporation limits of Villages which have requested assistance from ODOT in accordance with ORC Section 5521.01, and have an executed Form MR 689 on file with ODOT. (Form MR 689 is available on the ODOT Maintenance Administration’s website from their “M & R Forms” page.)

For purposes of this discussion a “school sign with beacons” refers to a School Speed Limit Sign with Beacons (see Section 702-4) or a SCHOOL ENTRANCE sign with beacons (see Section 702-5).

The following responsibilities and division of duties shall apply:

1. The District will bear the cost and:
   a. determine where school signs with beacons are justified,
   b. develop the plans for the installation of school signs with beacons,
   c. furnish, install, maintain and repair all school signs with beacons and other related appurtenances located within the highway right-of-way (this does not apply to the emergency maintenance of school signs with beacons located in Villages, which are the responsibility of the Village in accordance with the provisions of the Form MR 689).
d.  program and operate timers located within the highway right-of-way, in accordance with ORC Section 4511.21 and the OMUTCD, and in accordance with the times of operation determined by the school with the concurrence of the District (Form 796-2 depicts a sample letter that may be used to have the schools annually provide school schedule and timings for the new school year), and

e.  remove school signs with beacons and other related appurtenances located within the highway right-of-way whenever it is determined by the District that their installation is no longer justified.

2.  The School will bear the cost and:

   a.  furnish, install, maintain and repair all appurtenances located on the school’s property,

   b.  furnish the electric energy required for the operation of the school signs with beacons and other appurtenances,

   c.  determine appropriate times of operation of the school signs with beacons in accordance with the ORC Section 4511.21,

   d.  obtain concurrence from the District regarding the times of operation, and

   e.  manually operate the school signs with beacons, or program and operate timers located on the School’s property, in accordance with the ORC and OMUTCD.

Arrangements other than those described herein are permissible provided they are agreed upon and are acceptable to all involved parties, do not conflict with the ORC or OMUTCD, and the District’s responsibilities do not exceed those described above.

It is recommended that a written agreement be executed between the District and the School (and the Village if appropriate) describing the provisions described herein. Form 796-1 is a sample agreement that can be used. The Director’s name should be signed by the District Deputy Director. A copy of the agreement should be kept at the District and the School (and the Village if appropriate). The agreement should be retained as long as the school signs with beacons are in place.

702-7  School Bus Stop Ahead Sign (S3-1); SCHOOL BUS TURN AHEAD Sign (S3-2)

As noted in OMUTCD Sections 7B.14 and 15, these signs should be used in advance of locations where a school bus, when turning or stopped to pick up or discharge passengers, is not visible for an adequate distance in advance. Ohio Administrative Code Section 3301-83-13 B(4) states, “School bus stops shall be located at a distance from the crest of a hill or curve to allow motorists traveling at the posted speed to stop within the sight distance. If the line of sight is less than five hundred feet in either direction, an approved “School Bus Stop Ahead” sign shall be installed at least five hundred feet in advance of the school bus stop.”

To avoid unnecessarily perpetuating these signs, a procedure should be established in each District whereby a record is kept when these signs are erected, documenting the location and date of the installation. This record should be checked regularly to assure that there is still a need for the sign. Form 796-3 depicts a sample letter used to have the schools annually reaffirm the need for these signs and/or to request signs for a new location.
Intentionally blank.
704 SCHOOL AREA MARKINGS

School area pavement markings are described in OMUTCD Sections 3B.20 and 7C.03, and additional details are noted in SCD TC-71.10.

As noted in Note 1 of SCD TC-71.10:

The SCHOOL marking shall be installed on paved approaches in advance of all School Zones.

It should be placed at least 100 feet in advance of the School Zone. The preferred placement of the SCHOOL marking is adjacent to the School Zone Advance sign.

On two-way, two-lane highways:

- When the approach lane to the School Zone is 11 feet or more in width, the SCHOOL word marking and transverse lines shall be contained in, and centered in, the lane, and the character height shall be 6 feet for urban areas and 8 feet for rural areas; and
- When the approach lane to the School Zone is less than 11 feet in width, the SCHOOL word marking and transverse lines shall extend across both lanes of traffic and the characters should be 10 feet or more in height.

On two-way, multilane highways:

- When the approach lanes to the School Zone are 11 feet or more in width, the SCHOOL word marking and transverse lines shall be contained in, and centered in, each lane, and the character height shall be 6 feet for urban areas and 8 feet for rural areas; and
- When the approach lanes to the School Zone are less than 11 feet in width, the SCHOOL word marking shall extend to the width of two approach lanes and transverse lines shall extend across all approach lanes of traffic and the characters should be 10 feet or more in height.

Center or lane lines shall not pass through the SCHOOL word marking.
Intentionally blank.
705 SCHOOL ZONES

705-1 General

**ORC Section 4511.21(B)(1)(c)** defines the term “school zone.” Except as noted in **ORC Section 4511.21(H)**, there are no exceptions to the existence of a School Zone. **ODOT** does not have discretion (e.g., based on the lack of pedestrians, the presence of fencing, etc.) to not install School Speed Limit signs for School Zones established per **Section 4511.21** (see **OMUTCD Section 7B.09**).

Whenever, the **Director** determines on the basis of a geometric and traffic characteristic study that the school speed limit is less than reasonable or safe under the conditions found, the 20 mile per hour School Zone may be excepted, with School Zone signing not installed. The provisions of **ORC Section 4511.21(H)** (the speed zoning process) do apply to School Zones. Locations where the implementation of a 20 mile per hour School Zone might cause serious safety problems in the traffic stream, with little or no benefit to students attending the adjacent school, should be the only basis for retaining the existing speed limit. Locations where the 20 mile per hour provision is just an inconvenience to road users, or those locations where the school officials prefer something other than the 20 mile per hour School Zone, do not fit into this category.

Since the law requires 20 miles per hour at all School Zones, it is very important that any studies conducted be thoroughly documented and retained in the **District’s** files. Although the Speed Warrant sheet will probably not be applicable in these situations, approval of these studies should follow the normal Speed Zone study approval process. Should any future litigation be filed against **ODOT** due to any incidents that might occur at one of these locations, the documentation will be very critical in defending the **District’s** actions in not installing the 20 mile per hour School Zone signing.

705-2 Requesting a School Zone Extension

Although the traditional School Zone boundaries are defined by projecting the school property lines, **ORC 4511.21(B)(1)(c)** also allows that, upon request, the **Director** may extend the traditional School Zone boundaries.

Requests for School Zone Extensions are submitted to the **District** using the School Zone Extension Request Form (**Form 796-4**).

If the request involves an **ODOT**-maintained highways, the **District** shall document the background for the extension request; prepare a description of the School Zone Extension for the **Director’s** approval using the School Zone Extension Request Form (**Form 796-4**); and following approval, the **District** shall erect or relocate the appropriate School Zone signs and notify the school, the **Ohio State Highway Patrol (OSHP)** and other law enforcement agencies as appropriate.

School Zone Extension requests involving local roads, shall be submitted to the **District** using the School Zone Extension Request Form (**Form 796-4**), and all appropriate documentation shall be included. The **District** shall determine reasonable and safe School Zone limits based on the documentation provided with the request and a field study (to document and confirm the physical features). If this determination is substantially different from that which was requested, the local authorities may be asked to further substantiate their original request and a new determination may be made. The **District** shall notify the school, local authorities, and OSHP and other law enforcement agencies, as appropriate, of **ODOT’s** final action on the proposed School Zone Extension.

For purposes of requesting School Zone Extensions, rural state highway extensions within the municipal corporation limits of **Villages** are considered “local roads,” even if the **Village** has requested assistance from **ODOT** in accordance with **ORC Section 5521.01**, and has an executed **MR 689** form on file with **ODOT**. (**Form MR 689** is available on the **ODOT Maintenance Administration’s** website from their “M & R Forms” page.)
705-3 Withdrawing a School Zone Extension

The withdrawal of a School Zone Extension is accomplished in generally the same manner as establishment of the extension (Section 705-2). The School Zone Extension Withdrawal Form (Form 796-5) is used to document the withdrawal.

705-4 Documentation

Table 797-1 establishes the School Zone Number Assignments to be used by Districts for School Zone Extensions. This number shall be used on Forms 796-4 and 796-5.

The District shall retain the reports used in establishing the School Zone Extensions in their permanent files. Originals of the official document authorizing the regulation, as well as any originals of local requests or resolutions, shall also be retained permanently in District files.

A copy of the signed authorizations shall be forwarded to the Office of Traffic Engineering (OTE). For purposes of maintaining a statewide inventory and historical record, OTE shall maintain an inventory of School Zone Extensions. This inventory is available on the OTE website (see Misc. Applications, Documents, Projects and Programs/Regulations). The electronic files are updated, depending on current workload, as revisions are received.
742 PLAN NOTES

742-1 General

Typical Plan Notes have been consolidated here for convenience in preparing plans. The number used for the Plan Note will be the same as the Section number. When a Plan Note revises the material or contractor requirements from that which is specified in the CMS, both the note and the bid items 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. Each note is accompanied by a “Designer Note” in an attempt to give some guidance as to when the note should be used.

In keeping with the 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.

742-2 631 School Speed Limit Sign Assembly, Solar-Powered, As Per Plan

This specification applies to school sign flashers powered by batteries and recharged by solar panels.

The entire school zone flasher and sign assembly shall meet the requirements set forth in the OMUTCD. The sign size shall be _____” x _______” and sign code ____________.

The flasher control and battery will be housed in one or more stainless steel or aluminum enclosures with a NEMA rating of at least 3R. Enclosure exterior surfaces shall be bare or powder coat aluminum or stainless steel. The enclosure interior surfaces shall be the same as the exterior.

If contained in a single enclosure, the control electronics and battery shall be separated in a manner to prevent damage to the control electronics if the battery envelope is compromised.

Only sealed gel-cell lead acid or AGM (Absorbed Glass Mat) batteries will be used for power.

The battery compartment must be capable of accommodating at least one 105 amp-hour battery.

LED signal beacons meeting the current ITE Vehicle Traffic Control Signal Heads (VTCSH) standard will be used unless otherwise specified. The manufacturer of the signal beacon shall be listed on the Department's Qualified Products List for LED vehicular signal heads.

The Solar Panel and/or Controller manufacturer will provide signed copies of calculations used to size the solar panel and batteries. Included in these calculations will be the insolation value used and its source, the solar panel efficiency, charger/controller efficiency, inverter efficiency, proposed LED lamp load, and a figure representing anticipated miscellaneous losses.

Solar panel manufacturer must test panel according to IEC61215 or equivalent approved standard. Solar panel mounting must be rated for 90mph design wind.

Run requirements are 4 hours per day for two weeks under continuous worst-case (minimum) insolation figures (usually December) for the proposed geographic location, using a panel elevation angle appropriate to the site latitude, at a sustained temperature of 25 degrees Fahrenheit (-4 degrees Celsius).

If voltages over 50V AC or DC are present, grounding and bonding requirements specified in the ODOT CMS will be followed.

Any timer included in the assembly must satisfy the requirements of 731.10 and be listed on the ODOT Qualified Products List.
Payment for 631 School Speed Limit Sign Assembly, Solar Powered, As Per Plan, shall be made at the contract unit price bid per each. Payment shall be full compensation for all labor, materials, tools, equipment, testing, certifications and other incidentals necessary to furnish the solar powered school zone flasher complete in place, including all connections made, wiring complete, tested and accepted.

**Designer Note:** This note should be included when the maintaining agency requests a Solar Powered School Speed Limit Sign Assembly.

### 795 REFERENCE RESOURCES

Various reference resources that may be useful have been noted in *Sections 193 and 194.*
796  FORMS INDEX

796-1  Agreement for School Signs with Beacons

As noted in Section 702-6, Form 796-1 is a sample that can be used in establishing an agreement for the maintenance of school signs with beacons.

796-2  Letter Confirming Operation of School Signs with Beacons

As noted in Section 702-6, Form 796-2 is a sample letter that can be used to have a school confirm annually the school schedule and timings for operation of school signs with beacons.

796-3  Letter Confirming School Bus Stop Ahead / SCHOOL BUS TURN AHEAD Signs

As noted in Section 702-7, Form 796-3 is a sample letter that can be used to have a school annually confirm the need for School Bus Stop Ahead / SCHOOL BUS TURN AHEAD signs.

796-4  School Zone Extension Request Form

As noted in Section 705-2, Form 796-4 is used when submitting a request to extend the boundaries of a School Zone beyond the traditional boundary limits.

796-5  School Zone Extension Withdrawal Form

As noted in Section 705-3, Form 796-5 is used for withdrawal of an established School Zone Extension.
Intentionally blank.
Form 796-1. Agreement for School Signs with Beacons

Agreement for School Signs with Beacons

THIS AGREEMENT is made and entered into by and between the STATE OF OHIO, DEPARTMENT OF TRANSPORTATION (hereinafter called "THE STATE"), the ___________ School District (hereinafter called "THE SCHOOL") and the Village of ___________ (hereinafter called "THE VILLAGE").

WITNESSETH THAT:

FOR AND IN CONSIDERATION of mutual covenants hereinafter contained and for the purposes of regulating traffic on ____________ for the ___________ School District in ___________ County, the parties hereby covenant and agree to the following:

1. THE STATE shall bear the cost and develop the plans for the installation of school signs with beacons, and furnish, install, maintain and repair all school signs with beacons and appurtenances located within the highway right-of-way.

2. THE SCHOOL shall bear the cost and furnish, install, maintain and repair all appurtenances located on THE SCHOOL's property. [Note: Eliminate this item for installations located entirely within the highway right-of-way.]

3. THE SCHOOL shall furnish the electric energy required for the operation of the school signs with beacons and appurtenances.

4. THE SCHOOL shall determine appropriate times of operation of the school signs with beacons in accordance with the Ohio Revised Code, and obtain concurrence from THE STATE.

5. THE SCHOOL shall manually operate the school sign with beacons in accordance with the times of operation determined by THE SCHOOL and agreed upon by THE STATE, and in accordance with the Ohio Revised Code and the Ohio Manual of Uniform Traffic Control Devices. [Note: For use with manually operated signs.]

   or

   THE SCHOOL shall program and operate the timer in accordance with the times of operation determined by THE SCHOOL and agreed upon by THE STATE, and in accordance with the Ohio Revised Code and the Ohio Manual of Uniform Traffic Control Devices. [Note: For use with timers located in the school building.]

   or

   THE STATE shall program and operate the timer in accordance with the times of operation determined by THE SCHOOL and agreed upon by THE STATE, and in accordance with the Ohio Revised Code and the Ohio Manual of Uniform Traffic Control Devices. [Note: For use with timers located on the highway right-of-way.]

6. THE STATE will remove school signs with beacons and appurtenances located within the highway right-of-way whenever it is determined by THE STATE that their installation is no longer justified, and this agreement shall thereupon terminate.

7. THIS AGREEMENT shall be binding upon and inure to the benefit of the parties hereto, their respective successors and/or assigns.

IN WITNESS WHEREOF, the parties hereto have caused this agreement to be executed by their duly authorized officers or agents.

(April 18, 2008)  October 23, 2002
Notes:

1. For installations located outside of Village corporation limits, eliminate references to THE VILLAGE.

2. The form should be modified as necessary. Three wording options are provided for item #5 to address different types of installations.
Form 796-2. Letter Confirming Operation of School Signs with Beacons

(DATE)

(ADDRESS)

RE: (2012-2013) School Clock Schedule

Dear Superintendent,

Would you please send us a copy of your (2012-2013) school year calendar for the school signs with beacons that ODOT signal electricians maintain on U.S. or State Routes in your school district. Please complete and return the enclosed Daily School Clock Schedule Form by (date), indicating when you wish to have the school flashers operate, including recess times.

We will input this information into the programmable time clocks that control the school flashers at each of the school locations. Your cooperation in this matter will allow us to have each location programmed and ready when school begins next fall. Please forward the information to me at the above address.

If you should have any questions concerning this request, please contact me at the above listed telephone number, (extension).

Respectfully,

Enclosure

c: file
Form 796-3. Letter Confirming School Bus Stop Ahead / SCHOOL BUS TURN AHEAD Signs

(DATE)

(ADDRESS)

Dear (Superintendent or Transportation Coordinator),

Each year the Ohio Department of Transportation receives numerous requests from school personnel and parents requesting SCHOOL BUS STOP AHEAD and SCHOOL BUS TURN AHEAD Warning Signs.

If you have locations on rural state highways where your bus drivers have indicated, or in the future indicate the need for such signs, we will be happy to investigate the location. These signs are intended for use in areas where sight distance is limited to less than 500 feet. A copy of the portion of the Ohio Manual of Uniform Traffic Control Devices relating to these signs is enclosed for your information.

Many times it is much safer for the bus driver to stop at a location not directly in front of a residential driveway, or to turn around at a location not quite convenient, i.e., on top of the hill or around the curve. Where this is possible, we request that this be done rather than having a sign erected, which the road user may not notice.

Since this will also involve the parents, any requests received by this office from parents for these signs will be referred to your office for initial review and approval.

We also ask your assistance in updating the existing signs on the rural state highway system within your school district. We request a review of your existing signs with your bus drivers to determine signs that are no longer needed due to student graduation or a family moving to a new residence. By eliminating unneeded signs drivers will gain respect for the signs that have already been erected. Please provide a listing of the SCHOOL BUS STOP AHEAD and SCHOOL BUS TURN AHEAD Warning Signs needed in your school district, noting any new requests. Also, please provide a list of any existing signs that can be removed.

We share your concern about pupil transportation safety and wish to thank you in advance for your cooperation in this matter. If you have any questions, please contact this office,

Respectfully,

Enclosure

cc: file
SCHOOL ZONE EXTENSION FORM

In accordance with the provisions of Section 4511.21, Ohio Revised Code, it is hereby requested that the Director of Transportation approve the appropriate distance for the school zone for the:

MUNICIPALITY: ____________________  SCHOOL NAME: ____________________
COUNTY: ____________________  ADDRESS: ____________________
TOWNSHIP: ____________________  ____________________
BY: NAME ____________________  TITLE ____________________

(Elected Official)

* "X-out School" or "A" or "B" as necessary.
** "Established School Crossing" where children are directed to cross the street or roadway on their way to and from school, selected on the basis of a School Route Plan Map developed by local school and safety authorities. (Attach a copy of the map.)
Note: Additional data may be required.

(For Department use only)

APPROVED SCHOOL ZONE DISTANCES

Under authority of Section 4511.21(B)(1)(c) and (d), these distances have been approved for the ____________________ School, Zone No. _____________, ____________________ County,
ODOT District ______, Jurisdiction ____________________

<table>
<thead>
<tr>
<th>Street Name</th>
<th>School Zone Distances</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<td></td>
<td></td>
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</table>

Date: ____________________  Director of Transportation

(April 18, 2008)  October 23, 2002
Form 796-5. School Zone Extension Withdrawal Form

STATE OF OHIO
DEPARTMENT OF TRANSPORTATION

WITHDRAWAL OF APPROVED SCHOOL ZONE EXTENSIONS

District: _____ School Zone No.: ________ Name of Street: _________________________________

Municipality: __________________________ County: ________________________________

State Route No.: ________________ Name of School: _______________________________

Under Authority of Section 4511.21(B)(1)(c) and (d) of the Ohio Revised Code, the following described School Zone Extension(s) approved by the Director of Transportation on ______________________, has been determined, on the basis of a traffic and engineering investigation, to be unreasonable and approval of the same is hereby withdrawn.

LOCATION OF SCHOOL ZONE DISTANCES

<table>
<thead>
<tr>
<th>From</th>
<th>To</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</tbody>
</table>

Signs relating to the School Zone Extension shall be immediately removed.

Date: ____________________________ Director of Transportation

Immediately after removal or relocation of School Zone signs, return the attached copy of this School Zone Extension Withdrawal form to the ODOT District Deputy Director or his designee, with the following certification properly executed.

I hereby certify that appropriate signs, giving notice of the above School Zone Extension were removed on ______________________ Signed ________________________________

Title ________________________________
As noted in Section 705-4, Table 797-1 assigns numbers to be used by Districts when submitting/reviewing School Zone Extension requests.

### Table 797-1. School Zone Number Assignments

<table>
<thead>
<tr>
<th>District</th>
<th>School Zones</th>
</tr>
</thead>
<tbody>
<tr>
<td>District 1</td>
<td>10000 - 14999</td>
</tr>
<tr>
<td>District 2</td>
<td>15000 - 19999</td>
</tr>
<tr>
<td>District 3</td>
<td>20000 - 24999</td>
</tr>
<tr>
<td>District 4</td>
<td>25000 - 29999</td>
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<tr>
<td>District 5</td>
<td>30000 - 34999</td>
</tr>
<tr>
<td>District 6</td>
<td>35000 - 39999</td>
</tr>
<tr>
<td>District 7</td>
<td>40000 - 44999</td>
</tr>
<tr>
<td>District 8</td>
<td>45000 - 49999</td>
</tr>
<tr>
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<td>50000 - 54999</td>
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<tr>
<td>District 10</td>
<td>55000 - 59999</td>
</tr>
<tr>
<td>District 11</td>
<td>60000 - 64999</td>
</tr>
<tr>
<td>District 12</td>
<td>65000 - 69999</td>
</tr>
</tbody>
</table>
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