Signs & Markings Technician II

Advancing the Future of Public Safety

 Revision Date: May 16, 2023

Study Guide

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Signs & Markings II

Introduction

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Introduction to Signs and Markings 2

Welcome to the next step in the certification process. You have passed Signs and Markings level 1 and now ready for the next step. In this level we will go into some more details of a few processes like:

- Sign Fabrication
- Sign Installation
- Pavement markings
- Speed Enforcement Radar Signs
- Changeable Message signs
- Inspection of projects
- Traffic Counts and Left Turn Movements

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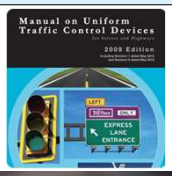
Manual of Uniform Traffic Control Devices - MUTCD

The MUTCD stands for the Manual on Uniform Traffic Control Devices. It is a document published by the Federal Highway Administration (FHWA) in the United States that provides national standards and guidelines for the design, placement, and maintenance of traffic control devices.

The primary purpose of the MUTCD is to promote uniformity and consistency in traffic control devices across the country. These devices include signs, signals, pavement markings, and other elements used to regulate, warn, and guide road users.

Sign sizes are well documented within the MUTCD. They are determined primarily on the speed of the roadway.

This Manual ensures uniformity across the United States and Canada (MUTCDC).



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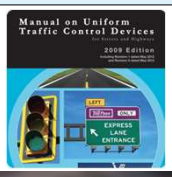

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Sign Sizes based on Roadway Type

Table 2B-1. Regulatory Sign and Plaque Sizes (Sheet 1 of 4)

Sign or Plaque	Sign Designation	Section	Conventional Road		Expressway	Freeway	Minimum	Oversized
			Single Lane	Multi-Lane				
Stop	R1-1	2B.05	30 x 30"	36 x 36	36 x 36	—	30 x 30"	48 x 48
Yield	R1-2	2B.08	36 x 36 x 36"	48 x 48 x 48	48 x 48 x 48	60 x 60 x 60	30 x 30 x 30"	—
To Oncoming Traffic (plaque)	R1-2aP	2B.10	24 x 18	24 x 18	36 x 30	48 x 36	24 x 18	—
All Way (plaque)	R1-3P	2B.05	18 x 6	18 x 6	—	—	—	30 x 12
Yield Here to Peds	R1-5	2B.11	—	36 x 36	—	—	—	36 x 36
Yield Here to Pedestrians	R1-5a	2B.11	—	36 x 48	—	—	—	36 x 48
Stop Here for Peds	R1-5b	2B.11	—	36 x 36	—	—	—	36 x 36
Stop Here for Pedestrians	R1-5c	2B.11	—	36 x 48	—	—	—	36 x 48
In-Street Ped Crossing	R1-6,6a	2B.12	12 x 36	12 x 36	—	—	—	—
Overhead Ped Crossing	R1-9,9a	2B.12	90 x 24	90 x 24	—	—	—	—
Except Right Turn (plaque)	R1-10P	2B.05	24 x 18	24 x 18	—	—	—	—
Speed Limit	R2-1	2B.13	24 x 30"	30 x 36	36 x 48	48 x 60	18 x 24"	30 x 36
Truck Speed Limit (plaque)	R2-2P	2B.14	24 x 24	24 x 24	36 x 36	48 x 48	—	36 x 36
Night Speed Limit (plaque)	R2-3P	2B.15	24 x 24	24 x 24	36 x 36	48 x 48	—	36 x 36
Minimum Speed Limit (plaque)	R2-4P	2B.16	24 x 30	24 x 30	36 x 48	48 x 60	—	36 x 48
Combined Speed Limit	R2-4a	2B.16	24 x 48	24 x 48	36 x 72	48 x 96	—	36 x 72
Unless Otherwise Posted (plaque)	R2-5P	2B.13	24 x 18	24 x 18	—	—	—	—
Citywide (plaque)	R2-5aP	2B.13	24 x 6	24 x 6	—	—	—	—
Neighborhood (plaque)	R2-5bP	2B.13	24 x 6	24 x 6	—	—	—	—

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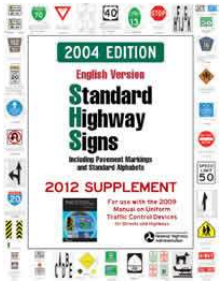
Standard Highway Signs

The "Standard Highway Signs and Markings" book, commonly referred to as the SHS, is a publication that provides standardized designs and specifications for traffic signs and pavement markings used on public roadways in the United States. It is published by the Federal Highway Administration (FHWA) and serves as a companion to the Manual on Uniform Traffic Control Devices (MUTCD).

Standard Highway Signs—PDF and EPS files for New and Revised Signs - FHWA MUTCD (dot.gov)



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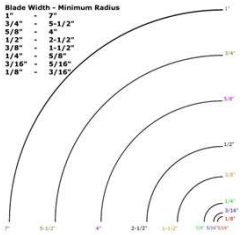
Standard Highway Signs – sign details and radius



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Standard Highway Signs – sign details and radius

Sign Spacing:

Sign Letter spacing is determined by the Standard Highway Signs and Markings book. It will have every known sign available to get the proper measurements of sign blank, radius, letter spacing, and letter height.

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Signs & Markings II

Useful Definitions

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Definitions

Average Annual Daily Traffic (AADT)—the total volume of traffic passing a point or segment of a highway facility in both directions for one year divided by the number of days in the year. Normally, periodic daily traffic volumes are adjusted for hours of the day counted, days of the week, and seasons of the year to arrive at average annual daily traffic.

Average Daily Traffic (ADT)—the average 24 hour volume, being the total volume during a stated period divided by the number of days in that period. Normally, this would be periodic daily traffic volumes over several days, not adjusted for days of the week or seasons of the year.

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Signs & Markings II

Interchanges

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Interchanges

Interchange Classification

Support: For signing purposes, interchanges are classified as major, intermediate, and minor. Descriptions of these classifications are as follows:

A. **Major interchanges** are subdivided into two categories: (a) interchanges with other expressways or freeways, or (b) interchanges with high-volume multi-lane highways, principal urban arterials, or major rural routes where the volume of interchanging traffic is heavy or includes many road users unfamiliar with the area.

B. **Intermediate interchanges** are those with urban and rural routes not in the category of major or minor interchanges.

C. **Minor interchanges** include those where traffic is local and very light, such as interchanges with land service access roads. Where the sum of exit volumes is estimated to be lower than 100 vehicles per day in the design year, the interchange is classified as minor.

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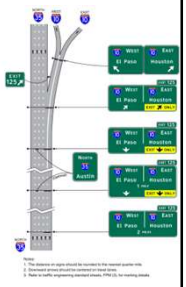
Interchanges

Freeway-to-Freeway Interchange

Support: Freeway-to-freeway interchanges are major decision points where the effect of taking a wrong ramp cannot be easily corrected. Reversing direction on the connecting freeway or reentering to continue on the intended course is usually not possible. Figure 2E-34 shows examples of guide signs at a freeway-to-freeway interchange.

Guidance: The sign messages should contain only the route shield, cardinal direction, and the name of the next control city on the route. Arrows should point as indicated in Section 2D.08, except where Overhead Down Arrow, Overhead Arrow-per-Lane or Diagrammatic signs are used in accordance with the provisions of Sections 2E.20 through 2E.22.



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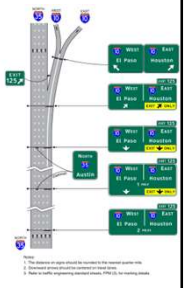
Interchanges

Freeway-to-Freeway Interchange

Overhead signs shall be used at a distance of 1 mile and at the theoretical gore of each connecting ramp. When Overhead Down Arrow, Overhead Arrow-per-Lane or Diagrammatic guide signs are used, they shall comply with the provisions of Sections 2E.20A, 2E.21 and 2E.22.

Option: Overhead signs may also be used at the 1/2-mile and 2-mile locations.

The arrow and/or the name of the control city may be omitted on signs that indicate the straight-ahead continuation of a route on a Pull-Through sign (see Section 2E.12).



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Interchanges

Freeway-to-Freeway Interchange

An Advisory Exit Speed sign may be used where an engineering study shows that it is necessary to display a speed reduction message for ramp signing (see Section 2C.14).

Where extra emphasis of an especially low advisory ramp speed is needed, an EXIT XX MPH (E13-2) sign panel (see Figure 2E-27) may be placed at the bottom of the Exit Direction sign to supplement, but not to replace, the exit or ramp advisory speed warning signs.

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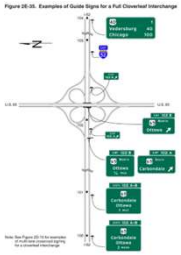
Interchanges

Cloverleaf Interchange

Support: A cloverleaf interchange has two exits for each direction of travel. The exits are closely spaced and have common Advance Guide signs. Examples of guide signs for cloverleaf interchanges are shown in Figure 2E-35.

Guidance: The Advance Guide signs should include two place names, one corresponding to each exit ramp, with the name of the place served by the first exit on the upper line.



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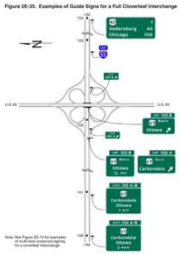
Interchanges

Cloverleaf Interchange

Standard: An overhead guide sign shall be placed at the theoretical gore of the first exit ramp, with a diagonally upward-pointing directional arrow on the Exit Direction sign for that exit and the message XX MILES, or EXIT XX MILES if interchange numbering is not used, on the Advance Guide sign for the second exit, as shown in Figure 2E-35. The second exit shall be indicated by an overhead Exit Direction sign over the auxiliary lane. An Exit Gore sign shall also be used at each gore.



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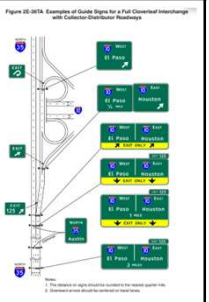
Interchanges

Cloverleaf Interchange with Collector-Distributor Roadways

Support: Examples of guide signs for full cloverleaf interchanges with collector-distributor roadways are shown in Figure 2E-36TA.

Guidance: Signing on the collector-distributor roadways should be the same as the signing on the mainline of a cloverleaf interchange.



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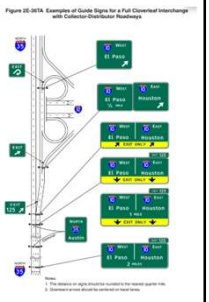
Interchanges

Cloverleaf Interchange with Collector-Distributor Roadways

Standard: Guide signs at exits from the collector-distributor roadways shall be overhead and located at the theoretical gore of the collector-distributor roadway and the exit ramp.

Option: Exits from the collector-distributor roadways may be numbered with an appropriate suffix. If the exits from a collector-distributor roadway are numbered with suffixes, the Advance Guide signs on the mainline may include two place names and their corresponding exit numbers with the plural EXITS. If only the exit from the mainline is numbered or if interchange numbering is not used, the Advance Guide signs on the mainline may use the singular EXIT



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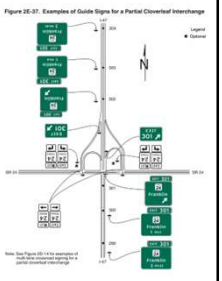
Interchanges

Partial Cloverleaf Interchange

Support: Examples of guide signs for partial cloverleaf interchanges are shown in Figure 2E-37.

Guidance: Where the mainline passes under the crossroad and the exit roadway is located beyond the overcrossing structure, the overhead Exit Direction sign should be placed either on the overcrossing structure (see Figure 2E-37) or on a separate structure located immediately in front of the overcrossing structure.

Standard: A post-mounted Exit Gore sign shall also be installed in the ramp gore. Support: 04 Partial cloverleaf interchanges with successive exit ramps from the same direction of travel are signed the same as cloverleaf interchanges for that direction of travel (see Section 2E.45).



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Interchanges

Diamond Interchange

Support: Examples of guide signs for diamond interchanges are shown in Figure 2E-38.

Standard: For numbered exits, the singular message EXIT shall be used on the Exit Number plaques (see Section 2E.31) with the Advance Guide and Exit Direction signs. For non-numbered exits, the singular message EXIT shall be used as part of the distance message on the Advance Guide signs.

Support: The typical diamond interchange ramp departs from the mainline roadway such that a speed reduction generally is not necessary in order for a driver to negotiate an exit maneuver from the mainline onto the ramp roadway.

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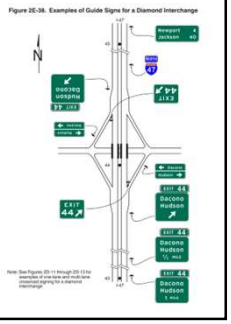
Interchanges

Diamond Interchange

Guidance: When a speed reduction is not necessary, an exit speed sign should not be used.

Option: An Advisory Exit Speed sign may be used where an engineering study shows that it is necessary to display a speed reduction message for ramp signing (see Section 2C.14).
Guidance: The Advisory Exit Speed sign should be located along the deceleration lane or along the ramp such that it is visible to the driver far enough in advance to allow the driver to decelerate before reaching the curve associated with the exiting maneuver.



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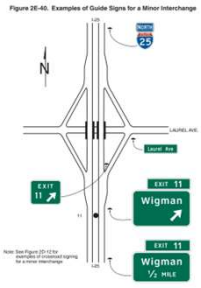
Interchanges

Minor Interchange.

At minor interchanges, only one Advance Guide sign should be used. It should be located 1/2 to 1 mile from the exit gore.

If the sign is located less than 1/2 mile from the exit, the distance displayed should be to the nearest 1/4 mile. Fractions of a mile, rather than decimals, should be displayed in all cases.



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Interchanges

Diamond Interchange

Option: A Stop Ahead or Signal Ahead warning sign may be placed, where engineering judgment indicates a need, along the ramp in advance of the cross street, to give notice to the driver (see Section 2C.36).

Guidance: When used on two-lane ramps, Stop Ahead or Signal Ahead signs should be used in pairs with one sign on each side of the ramp.

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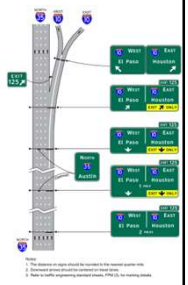
Interchanges

For major and intermediate interchanges (see Section 2E.32), Advance Guide signs should be placed at 1/2 mile and at 1 mile in advance of the exit with a third Advance Guide sign placed at 2 miles in advance of the exit if spacing permits.



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Interchanges

Minor Interchange

Option: Less signing may be used for minor interchanges because such interchanges customarily serve low volumes of local traffic.

Support: Examples of guide signs for minor interchanges are shown in Figure 2E-40.

Standard: At least one Advance Guide sign and an Exit Gore sign shall be used at a minor interchange.

Guidance: An Exit Direction sign should also be used.

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Signs & Markings II

PREFERENTIAL AND MANAGED LANE SIGNS

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Scope

Scope
Support:
01 Preferential lanes are lanes designated for special traffic uses such as high-occupancy vehicles (HOVs), light rail, buses, taxis, or bicycles. Preferential lane treatments might be as simple as restricting a turning lane to a certain class of vehicles during peak periods, or as sophisticated as providing a separate roadway system within a highway corridor for certain vehicles.

02 Preferential lanes might be barrier-separated (on a separate alignment or physically separated from the other travel lanes by a barrier or median), buffer-separated (separated from the adjacent general-purpose lanes only by a narrow buffer area created with longitudinal pavement markings), or contiguous (separated from the adjacent general-purpose lanes only by a lane line). Preferential lanes might allow continuous access with the adjacent general-purpose lanes or restrict access only to designated locations. Preferential lanes might be operated in a constant direction or operated as reversible lanes. Some reversible preferential lanes on a divided highway might be operated counter-flow to the direction of traffic on the immediately adjacent general-purpose lanes.

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Scope

03 Preferential lanes might be operated on a 24-hour basis, for extended periods of the day, during peak travel periods only, during special events, or during other activities.

04 Open-road tolling lanes and toll plaza lanes that segregate traffic based on payment method are not considered preferential lanes. Chapter 2F contains information regarding signing of open-road tolling lanes and toll plaza lanes.

05 Managed lanes typically restrict access with the adjacent general-purpose lanes to designated locations only.

06 Under certain operational strategies, such as the occupancy requirement of an HOV lane changing in response to actual congestion levels, a managed lane is a special type of preferential lane (see Sections 2G.03 through 2G.07).

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Scope

07 A managed lane operated on a real-time basis in response to changing conditions might be operated as an HOV lane for a period of time as needed to manage congestion levels.

08 Sections 2G.16 through 2G.18 contain additional information regarding signs for managed lanes that use tolling or pricing as a management strategy.

09 Section 9B.04 contains information regarding Preferential Lane signs for bike lanes.

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Scope

Regulatory Signs for Preferential Lanes – General

Standard:

01 When a preferential lane is established, the Preferential Lane regulatory signs (see Figure 2G-1) and pavement markings (see Chapter 3D) for these lanes shall be used to advise road users.

Support:

02 Preferential Lane (R3-10 series through R3-15 series) regulatory signs consist of several different general types of regulatory signs as follows (see Figure 2G-1):

A. Vehicle Occupancy Definition signs define the vehicle occupancy requirements applicable to an HOV lane (such as "2 OR MORE PERSONS PER VEHICLE") or types of vehicles not meeting the minimum occupancy requirement (such as motorcycles or ILEVs) that are allowed to use an HOV lane (see Section 2G.04).

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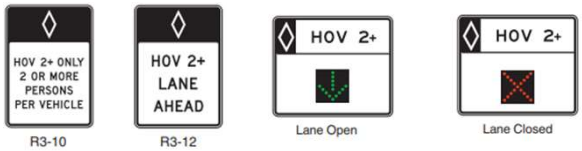
Scope

B. Periods of Operation signs notify road users of the days and hours during which the preferential restrictions are in effect (see Section 2G.05).

C. Preferential Lane Advance signs notify road users that a preferential lane restriction begins ahead (see Section 2G.06).

D. Preferential Lane Ends sigs notify users of the termination point of the preferential lane restrictions



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Preferential Lane Word and Symbol Markings

Preferential Lane Word and Symbol Markings

Support:
01 Preferential lanes are established for one or more of a wide variety of special uses, including, but not limited to, high-occupancy vehicle (HOV) lanes, ETC lanes, high-occupancy toll (HOT) lanes, bicycle lanes, bus only lanes, taxi only lanes, and light rail transit only lanes.

Standard:
02 When a lane is assigned full or part time to a particular class or classes of vehicles, the preferential lane word and symbol markings described in this Section and the preferential lane longitudinal markings described in Section 3D.02 shall be used.

03 All longitudinal pavement markings, as well as word and symbol pavement markings, associated with a preferential lane shall end where the Preferential Lane Ends (R3-12a or R3-12c) sign (see Section 2G.07) designating the downstream end of the preferential only lane restriction is installed.

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Preferential Lane Word and Symbol Markings

04 Static or changeable message regulatory signs (see Sections 2G.03 to 2G.07) shall be used with preferential lane word or symbol markings.

05 All preferential lane word and symbol markings shall be white and shall be positioned laterally in the center of the preferential lane.

06 Where a preferential lane use exists contiguous to a general-purpose lane or is separated from a general-purpose lane by a flush buffered space that can be traversed by motor vehicles, the preferential lane shall be marked with one or more of the following symbol or word markings for the preferential lane use specified:

A. HOV lane—the preferential lane-use marking for high-occupancy vehicle lanes shall consist of white lines formed in a diamond shape symbol or the word message HOV. The diamond shall be at least 2.5 feet wide and 12 feet in length. The lines shall be at least 6 inches in width.

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Preferential Lane Word and Symbol Markings

B. HOT lane or ETC Account-Only lane—except as provided in Paragraph 8, the preferential lane-use marking for a HOT lane or an ETC Account-Only lane shall consist of a word marking using the name of the ETC payment system required for use of the lane, such as E-Z PASS ONLY.

C. Bicycle lane—the preferential lane-use marking for a bicycle lane shall consist of a bicycle symbol or the word marking BIKE LANE (see Chapter 9C and Figures 9C-1 and 9C-3 through 9C-6).

D. Bus only lane—the preferential lane-use marking for a bus only lane shall consist of the word marking BUS ONLY.

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Preferential Lane Word and Symbol Markings

E. Taxi only lane—the preferential lane-use marking for a taxi only lane shall consist of the word marking TAXI ONLY.

F. Light rail transit lane—the preferential lane-use marking for a light rail transit lane shall consist of the word marking LRT ONLY.

G. Other type of preferential lane—the preferential lane-use markings shall consist of a word marking appropriate to the restriction.

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Preferential Lane Word and Symbol Markings

07. If two or more preferential lane uses are permitted in a single lane, the symbol or word marking for each preferential lane use shall be installed.

Option:

08. Preferential lane-use symbol or word markings may be omitted at toll plazas where physical conditions preclude the use of the markings (see Section 3E.01).

Guidance:

09. The spacing of the markings should be based on engineering judgment that considers the prevailing speed, block lengths, distance from intersections, and other factors that affect clear communication to the road user.

Support:

10. Markings spaced as close as 80 feet apart might be appropriate on city streets, while markings spaced as far as 1,000 feet apart might be appropriate for freeways.

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Signs & Markings II

Reversible Lane Control Signs

Advancing the Future of Public Safety

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Reversible Lane Control Signs

Reversible Lane Control Signs (R3-9e through R3-9i)

Option:

01 A reversible lane may be used for through traffic (with left turns either permitted or prohibited) in alternating directions during different periods of the day, and the lane may be used for exclusive left turns in one or both directions during other periods of the day as well. Reversible Lane Control (R3-9e through R3-9i) signs (see Figure 2B-6) may be either static type or changeable message type. These signs may be either post-mounted or overhead.

Standard:

02 Post-mounted Reversible Lane Control signs shall be used only as a supplement to overhead signs or signals. post-mounted signs shall be identical in design to the overhead signs and an additional legend such as CENTER LANE shall be added to the sign (R3-9f) to indicate which lane is controlled. For both word messages and symbols, this legend shall be at the top of the sign.

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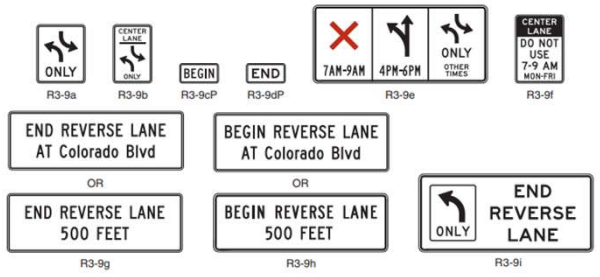
Reversible Lane Control Signs

Figure 2B-6. Center and Reversible Lane Control Signs and Plaques



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Reversible Lane Control Signs

03 Where it is determined by an engineering study that lane-use control signals or physical barriers are not necessary, the lane shall be controlled by overhead Reversible Lane Control signs (see Figure 2B-7).

Option:

04 Reversing traffic flow may be controlled with pavement markings and Reversible Lane Control signs (without the use of lane control signals), when all of the following conditions are met:

A. Only one lane is being reversed,
B. An engineering study indicates that the use of Reversible Lane Control signs alone would result in an acceptable level of safety and efficiency, and
C. There are no unusual or complex operations in the reversible lane pattern.

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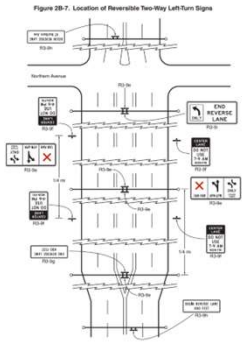

Figure 2B-7. Location of Reversible Two-Way Left-Turn Signs

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Reversible Lane Control Signs

Standard:

05 Reversible Lane Control signs shall contain the legend or symbols designating the allowable uses of the lane and the time periods such uses are allowed. Where symbols and legends are used, their meanings shall be as shown in Table 2B-2.

Table 2B-2. Meanings of Symbols and Legends on Reversible Lane Control Signs

Symbol / Word Message	Meaning
Red X on white background	Lane closed
Upward pointing black arrow on white background (if left turns are permitted, the arrow shall be modified to show left / through arrow)	Lane open for through travel and any turns not otherwise prohibited
Black two-way left-turn arrows on white background and legend ONLY	Lane may be used only for left turns in either direction (i.e., as a two-way left-turn lane)
Black single left-turn arrow on white background and legend ONLY	Lane may be used only for left turns in one direction (without opposing left turns in the same lane)

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Reversible Lane Control Signs

06 Reversible Lane Control signs shall consist of a white background with a black legend and border, except for the R3-9e sign, where the color red is used.

07 Symbol signs, such as the R3-9e sign, shall consist of the appropriate symbol in the upper portion of the sign with the appropriate times of the day and days of the week below it. All times of the day and days of the week shall be accounted for on the sign to eliminate confusion to the road user

08 In situations where more than one message is conveyed to the road user, such as on the R3-9e sign, the far right for symbol signs.

Option:

09 The symbol signs may also include a downward pointing arrow with the legend THIS LANE. The term OTHER TIMES may be used for either the symbol or word message sign.

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Signs & Markings II

Jughandles

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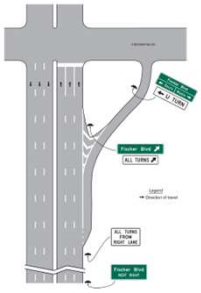
Jughandle Intersection

A jughandle intersection is a type of road junction or intersection design commonly used in transportation engineering to improve traffic flow and safety at intersections. It is characterized by a curved or U-shaped ramp that allows vehicles from one direction to make a right turn or a U-turn onto a cross street without directly crossing the opposing lanes of traffic. This design helps reduce the need for left turns at the main intersection, which can lead to congestion, delays, and potential safety hazards.

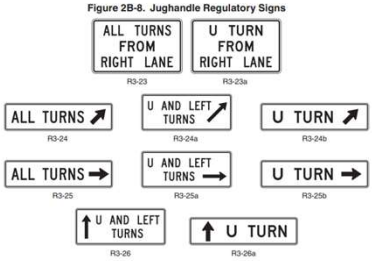
Jughandle intersections are often used in areas where there is a need to manage high traffic volumes, reduce congestion, and enhance safety by minimizing left-turning conflicts. They are particularly common in regions with heavy traffic and limited space, such as urban areas and major highways.



47

Jughandle Signs

Figure 2B-8. Jughandle Regulatory Signs



48

Jughandle Intersection

On multi-lane roadways, since road users generally anticipate that they need to be in the left-hand lane when approaching a location where they desire to turn left or make a U-turn, an ALL TURNS FROM RIGHT LANE (R3-23) or a U TURN FROM RIGHT LANE (R3-23a) sign (see Figure 2B-9) shall be installed in advance of the location to inform drivers that left turns and/or U-turns will be made from the right-hand lane.

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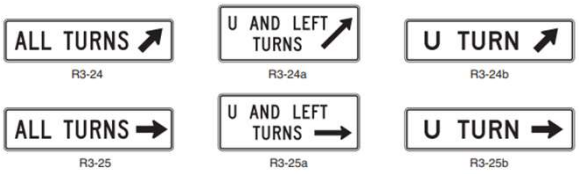
Jughandle Intersection



An R3-24 series sign with an upward diagonal arrow pointing to the right if the jughandle entrance is designed as an exit ramp (see Drawings A and B of Figure 2B-9) or an R3-25 series sign with a horizontal arrow pointing to the right if the jughandle entrance is designed as an intersection shall be installed on the right-hand side of the roadway at the entrance to the jughandle. The legend on the sign shall be ALL TURNS, U TURN, or U AND LEFT TURNS, as appropriate.

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Jughandle Intersection

If the jughandle is designed such that the jughandle entrance is downstream of the location where the turn would normally have been made (see Drawing C of Figure 2B-9), an R3-26 series sign with an arrow pointing straight upward shall be installed on the right-hand side of the roadway at the intersection to inform road users that they need to proceed straight through the intersection in order to make a left turn or U-turn. The legend on the sign shall be U TURN or U AND LEFT TURNS, as appropriate.

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Signs & Markings II

Roundabouts

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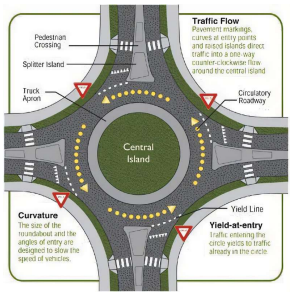
Roundabout Intersection

A roundabout intersection is a type of road junction or intersection design that uses a circular traffic island to facilitate the movement of vehicles in a controlled and efficient manner. Unlike traditional intersections with traffic signals or stop signs, a roundabout relies on the principles of yield and continuous flow to manage traffic.



53

Roundabout Intersection

Roundabouts offer several benefits, including:

Improved Traffic Flow: Roundabouts typically have higher capacity than traditional intersections, as they allow for continuous movement of vehicles. This can lead to reduced delays and congestion.

Reduced Conflicts: Roundabouts eliminate many of the conflict points that occur at traditional intersections, such as left-turning vehicles crossing paths with oncoming traffic.

Enhanced Safety: Roundabouts often result in fewer severe collisions compared to traditional intersections, as the lower speeds and reduced conflict points decrease the likelihood of high-impact crashes.

Lower Fuel Consumption and Emissions: The reduced need for full stops and the smoother traffic flow in roundabouts can lead to lower fuel consumption and emissions.

Aesthetic and Landscaping Opportunities: Roundabouts can be aesthetically pleasing and offer opportunities for landscaping and public art, enhancing the visual appeal of the surrounding area.

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Roundabout Intersection

Roundabout Directional Arrow Signs (R6-4, R6-4a, and R6-4b)

Guidance:

01 Where the central island of a roundabout allows for the installation of signs, Roundabout Directional Arrow (R6-4 series) signs (see Figure 2B-20) should be used in the central island to direct traffic counter-clockwise around the central island, except as provided in Paragraph 11 in Section 2B.40.

Standard:

02 The R6-4 sign shall be a horizontal rectangle with two black chevron symbols pointing to the right on a white background. The R6-4a sign shall be a horizontal rectangle with three black chevron symbols pointing to the right on a white background. The R6-4b sign shall be a horizontal rectangle with four black chevron symbols pointing to the right on a white background. No border shall be used on the Roundabout Directional Arrow signs.

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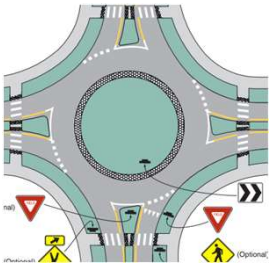
Roundabout Intersection

When used on the central island of a roundabout, the mounting height of a Roundabout Directional Arrow sign should be at least 4 feet, measured vertically from the bottom of the sign to the elevation of the near edge of the traveled way.

Option:

More than one Roundabout Directional Arrow sign and/or R6-4a or R6-4b signs may be used facing high-speed approaches, facing approaches with limited visibility, or in other circumstances as determined by engineering judgment where increased sign visibility would be appropriate.



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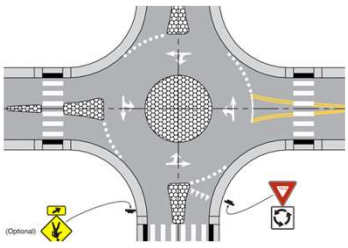
Roundabout Intersection

Roundabout Circulation Plaque (R6-5P)

Guidance:

01 Where the central island of a roundabout does not provide a reasonable place to install a sign, Roundabout Circulation (R6-5P) plaques (see Figure 2B-20) should be placed below the YIELD signs on each approach.



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Signs & Markings II

Sign Fabrication

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Application Table

A squeeze rolling table, also known as an application table, is a specialized piece of equipment used in traffic sign fabrication for the application of vinyl films onto sign substrates. It is designed to ensure efficient and accurate placement of the vinyl film, creating a smooth and bubble-free surface. The table typically consists of a flat surface with a roller mechanism and may include additional features for improved functionality.

1. Here are some key aspects and benefits of using a squeeze rolling table or application table in traffic sign fabrication:
2. Flat and Stable Surface
3. Roller Mechanism
4. Uniform Pressure Distribution
5. Time and Labor Efficiency
6. Bubble-Free Results
7. Versatility
8. Consistency and Accuracy
9. Ergonomic Design

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3 Primary Types of sign sheeting

Engineer Grade Sheeting (Type I):

- Reflectivity: Engineer grade sheeting provides moderate reflectivity.
- Standards: In the United States, engineer grade sheeting is classified under ASTM D4956 Type I. Its minimum retroreflectivity values are outlined in the Manual on Uniform Traffic Control Devices (MUTCD) published by the FHWA.

High-Intensity Prismatic Sheeting (Type III):

- Reflectivity: High-intensity prismatic sheeting offers increased reflectivity compared to engineer grade sheeting.
- Standards: In the United States, high-intensity prismatic sheeting is classified under ASTM D4956 Type III. Its minimum retroreflectivity values are outlined in the MUTCD.

Diamond Grade Sheeting (Type XI):

- Reflectivity: Diamond grade sheeting provides the highest level of reflectivity among the three types.
- Standards: In the United States, diamond grade sheeting is classified under ASTM D4956 Type XI. Its minimum retroreflectivity values are outlined in the MUTCD.

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Engineer Grade Sheeting (Type I)

- **Type 1 traffic sign sheeting refers to a specific classification of retroreflective sheeting used for traffic signs. It is often referred to as Engineer Grade Sheeting. Here are some key characteristics and features of Type 1 traffic sign sheeting:**
- **Reflectivity**: Type 1 sheeting offers moderate reflectivity, providing a basic level of visibility for traffic signs. It reflects light back to the source, enhancing sign visibility during nighttime or low-light conditions.
- **Construction**: Type 1 sheeting is typically composed of a monolayer of acrylic or other polymers with embedded glass beads or microprisms. These reflective elements help to redirect light back to its source, improving sign visibility.
- **Durability**: While Type 1 sheeting offers basic reflectivity, it is generally considered to have a lower durability compared to higher-grade sheeting types. It may be less resistant to fading, cracking, and damage from environmental factors such as UV radiation and weather conditions.
- **Application**: Type 1 sheeting is commonly used for non-critical signs, such as parking lot signs, signs on private property, or in areas with low traffic volume and slower speeds. It may also be suitable for temporary signs or short-term applications.
- **Standards**: In the United States, Type 1 sheeting meets the reflectivity standards outlined in ASTM D4956 Type I and the requirements specified by the Manual on Uniform Traffic Control Devices (MUTCD). The MUTCD provides guidelines for the design and placement of traffic signs to ensure uniformity and consistency across roadways.

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High-Intensity Prismatic Sheeting (Type III)

HIP sheeting is constructed using multiple layers of prismatic lenses that enhance the reflection of light. These lenses are designed to reflect light back to its source, making the sign more visible to drivers, particularly during low-light conditions or at night.

Some key features and characteristics of High-Intensity Prismatic (HIP) Sheeting include:

1. **Increased Reflectivity**: HIP sheeting provides a higher level of reflectivity compared to Engineer Grade Sheeting. This increased reflectivity helps improve sign visibility, especially from longer distances.
2. **Durability**: HIP sheeting is designed to withstand the outdoor elements and has excellent resistance to fading, cracking, and weathering. It is often made with durable materials such as acrylic or polycarbonate to ensure long-term performance.
3. **Color Options**: High-Intensity Prismatic sheeting is available in a variety of colors, including white, yellow, red, green, and blue. This allows for the creation of signs with different colors and designs to convey specific messages and comply with traffic regulations.
4. **Compliance Standards**: High-Intensity Prismatic (HIP) Sheeting meets the reflectivity standards specified by transportation authorities and organizations. In the United States, these standards are outlined in the Manual on Uniform Traffic Control Devices (MUTCD) published by the Federal Highway Administration (FHWA).

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Diamond Grade Sheeting (Type XI)

Diamond grade sheeting is a type of reflective material commonly used in traffic signs, road markings, and other applications that require high visibility, particularly during nighttime and low-light conditions. It is named for its diamond-shaped microprismatic optical elements that enhance reflectivity. Here are the key aspects of diamond grade sheeting:

1. **Reflectivity**: Diamond grade sheeting offers excellent reflectivity due to its microprismatic design. It reflects light back to the source, enhancing visibility and improving safety on the road.
2. **Visibility and Conspicuity**: The reflective properties of diamond grade sheeting make signs and markings highly visible, even in adverse weather conditions such as rain, fog, or darkness. This helps drivers quickly identify signs and navigate roads more safely.
3. **Performance Grades**: Diamond grade sheeting is available in different performance grades, such as DG3 (highest performance) and DG2. These grades indicate the level of reflectivity and durability. DG3 sheeting provides the highest level of performance and is typically used for critical signs like stop signs and warning signs.
4. **Durability**: Diamond grade sheeting is designed to be durable and resistant to environmental factors, such as UV radiation, humidity, and temperature fluctuations. It has a longer lifespan compared to lower-grade reflective materials.
5. **Compliance with Standards**: Diamond grade sheeting typically meets or exceeds various national and international standards, such as the ASTM D4956 Type XI specification in the United States and the EN 12899-1 standard in Europe. Compliance with these standards ensures consistent performance and quality.
6. **Application Versatility**: Diamond grade sheeting is suitable for a wide range of applications, including traffic signs, pavement markings, vehicle markings, barricades, and work zone signage. It can be used on various substrates, such as metal, plastic, and concrete.

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Sign Fabrication Methods

Silk screening
- High volume of the same type of sign
- Needs a dedicated area & chemicals
- Needs time to dry

Cut and plot
- Medium to low qualities
- Flexible on design
- Relatively inexpensive

Digital printing
- Medium/high quantities
- Flexible on design
- More expensive than cut & plot
- Most efficient

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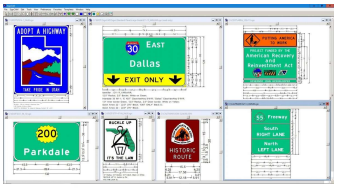
Silk Screening

- **Steps To Silk Screening**
  - Design / obtain design of sign
  - Prepare the screen
  - Apply Emulsion
  - Create a film Positive
  - Prepare the exposure setup
  - Wash out the design
  - Dry the screen
  - Setup print station
  - Apply ink
  - Print the sign
  - Cure the Ink
  - Inspect and finish

65

Cut and Plot



- **Steps To Cut and Plot**
  - Design / obtain design of sign
  - Load the proper Material in your plotter.
  - Send the file from the computer program (SignCAD, TrafficCAD, COCUT, Flexi, ETC) to the plotter and let it cut the proper lines.
  - Remove material from plotter and transfer to a flat surface
  - Weed out the material that is not needed.
  - Use Transfer Tape to hold the little pieces in place
  - Line up the face of the sign on the substrate making sure it was centered.
  - Apply with Rolling apparatus
  - Use **utility knife** to trim off the excess around the edge of the substrate.

66

Cut and Plot

One key to successfully plotting a sign is to be sure you have a sharp cutting edge.

- Dull Edge – may drag the material and not cut the rest completely which will leave unfinished cuts.
- If you are having issues removing the material from the backing you should try to lower the pressure a bit.
- If you are plotting a sign with a lot of tiny components you would want to turn down the speed of the cut. This will allow it to cut more accurately.

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Cut and Plot

Removing a sign from the plotter:
To ensure the sign remains intact there is a few options to consider.

- **Cutting Settings**: Before cutting the sign on the plotter, make sure to adjust the cutting settings appropriately. If the cutting pressure is too high, it may cut too deeply into the vinyl and increase the risk of tearing or damaging the sign. Similarly, if the cutting speed is too fast, it might cause the vinyl to lift or stretch, leading to potential issues during removal. Adjusting these settings based on the type and thickness of the vinyl material can help ensure a cleaner cut and easier removal process.
- **Test Cuts**: It's always a good idea to perform test cuts on a small portion of the vinyl material before cutting the entire sign. This allows you to check if the cutting settings are appropriate and make any necessary adjustments before committing to the full sign. By doing test cuts, you can identify any potential issues or errors early on and avoid damaging the entire sign.
- **Slow and Controlled Removal**: When removing the sign from the plotter, do it slowly and with care. Gently lift one corner or edge of the sign and slowly peel it away from the vinyl backing. By taking your time and being cautious during the removal process, you can minimize the risk of tearing or leaving behind any unwanted portions.

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Cut and Plot

Another issue you may come across is material running on the plotter.

- If your material begins to run, which means moving to the side off the rollers which could jam the plotter or have a deformed sign. This is usually because the material becomes loose on the roll. Cut off the wasted material and remove the roll from the machine. Which both hands, tighten the roll up and load it back on the machine making sure that the rollers are on the material and locked in position.

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Cut and Plot

Maintaining the Plotter and Tools

- Be sure to keep the pinch rollers clean and free of debris to ensure proper tracking. Pinch rollers are important for feeding the material through the plotter.
- A plotter is not a difficult machine to maintain. It is always best to keep some spare blades on hand if you need to replace a dull blade. Wiping it down regularly will keep the machine free of dust and debris and be sure to clean out your material catching system.
- The tools used generally being a Utility Knife, Exacto Knife, Tweezers, and squeegees. It is best to keep extra blades on hand to replace dull Knife blades.
- Proper maintenance will allow Increased quality production.

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Weeding / reverse Weeding

Reverse Weeding

- Reverse weeding, on the other hand, is a variation of the traditional weeding process. It is used when working with certain types of vinyl or designs where the smaller or more intricate pieces are easier to handle and weed if the process is reversed.
- In reverse weeding, instead of removing the excess vinyl material, the desired design elements are weeded and kept intact, while the surrounding or background vinyl is removed. This technique is often used for intricate designs or when dealing with designs that have a lot of small details or lettering.
- Reverse weeding can be particularly useful when working with vinyl that has a strong adhesive or when the design requires delicate handling to avoid damaging the smaller elements. It allows for greater control and ease during the weeding process, ensuring that the desired design remains intact.

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Weeding / reverse Weeding

Weeding

- refers to the process of removing excess vinyl material from a cut or printed design, leaving behind only the desired graphic or lettering. It is an essential step in sign-making, particularly when working with adhesive vinyl or heat transfer vinyl.
- This is done by following the lines of the design and removing the negative space or areas that are not part of the intended graphic or text.
- Weeding allows for the creation of clean and precise designs, where the vinyl graphics or text stand out against the background or substrate.

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Tools of the Trade

Here are some essential tools for weeding out traffic signs:

1. **Weeding Tool**: A weeding tool, also known as a weeder or a weeding hook, is a small handheld tool with a sharp point or hook-like tip. It is used to carefully lift and remove the excess vinyl material from the sign. The tool should have a comfortable grip and a precise tip to navigate around fine details.
2. **Tweezers**: Tweezers can be handy for picking up and removing small vinyl pieces or debris left behind after weeding. They provide more control when handling delicate or intricate parts of the sign.
3. **Magnifying Glass**: For intricate designs or small text, a magnifying glass or a magnifying lamp can be helpful. It allows for better visibility and precision during the weeding process.
4. **Cutting Mat**: A self-healing cutting mat is commonly used as a protective surface while weeding out the sign. It helps prevent damage to the work area and ensures clean cuts without leaving behind unwanted marks.
5. **Transfer Tape**: Masking tape is used to secure the sign design to the cutting mat, making it easier to work with and preventing any movement or misalignment during the weeding process.
6. **Vinyl Release Agen**t: In some cases, especially when working with adhesive vinyl that is difficult to weed, a vinyl release agent can be used. This agent is applied to the vinyl before weeding, making it easier to separate the excess material from the design.

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Digital Printing

Steps For Digital Printing

- Design / obtain design of sign
- Load the proper Material in your Printer
- Send the file from computer using Flexi or other application
- While it is printing you can cut your laminate to fit the sign.
- Remove from Printer and lay on flat surface.
- Use a rolling Apparatus to apply the laminate to the printed sign.
- Lay the material onto a substrate like a metal blank and use the roller to apply.
- Use **Utility Knife** to trim off the excess material from around the substrate.

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Digital Printing

Benefits of Digital Printing

- Less material waste
- Less need for transfer tape
- The ability to print multiple colors on a single sign.
- Saves money over time compared to other fabrication processes.

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Squeegee Roller applicator

Squeegee roller applicator issues
Always be sure to center your blank and material under the center of the roller. Doing this will reduce the likeliness of the material running or wrinkling when you apply it to the blank. This is caused by uneven pressure applied to the substrate.

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Laminate application types

Typically there are three ways laminate can be applied.

- **Vacuum Press**

- **Machine roller**

- **Manual roller**

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Digital Printing

Common Issues in Digital Printing for Traffic Signs and Solutions:

1. **Color inconsistencies**: Ensure that the color profile and settings on the printer match the design file. Regularly calibrate the printer to maintain color accuracy.
2. **Banding or streaking**: Clean the printheads Daily and ensure they are properly aligned. If the issue persists, consider replacing or servicing the printheads.
3. **Print quality issues**: Check the print heads, ink levels, and media settings. Perform test prints and adjust print settings as needed. If necessary, replace or repair faulty components.
4. **Adhesion problems**: Ensure the sign substrate is clean and properly prepared before printing. Consider using adhesion promoters or specialized inks for better ink adhesion to the substrate.
5. **Media jams or misfeeds**: Regularly clean the media feed rollers and ensure they are in good condition. Adjust the media settings and avoid overloading the printer with heavy or stiff materials.

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Squeegee Roller applicator

Squeegee roller applicator
A squeegee roller applicator is a tool used for applying pressure and smoothing surfaces, particularly in the context of vinyl application, such as sign making or vehicle wraps. It typically consists of a handle and a roller mechanism.

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Signs & Markings II

Line Locates

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Line Locates - Call 811 - Know what's below. Call before you dig.

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Before any Installation – Line Locates

Underground utilities should be located before installing signs or conducting any excavation work to prevent accidental damage to the utilities. The primary reasons for locating underground utilities are:

- **Safety**: Hitting underground utilities can lead to severe accidents, injuries, or even fatalities. Locating them beforehand ensures the safety of workers and the public.
- **Cost and Time Efficiency**: Damaging underground utilities can result in costly repairs, project delays, and disruptions to essential services. Locating utilities in advance helps avoid these issues and ensures efficient project execution.

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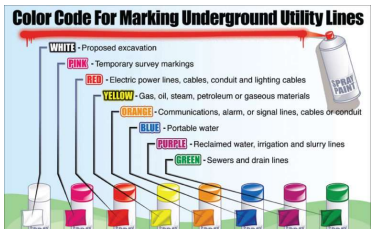
Before any Installation – Line Locates

It generally takes 48 – 72 hours for the utility marking company to respond and Typically, line locates are valid for a certain period, usually ranging from a few weeks to a couple of months. It is essential to check with the local utility providers or the responsible authorities to determine the exact validity period in your area.

If utilities have been marked but for some circumstance the work is unable to be completed before the markings expire, just renew the ticket with the locators and give them the same 48 – 72 hour period.

When utility lines are located, they are marked with specific colors to indicate the type of utility. While color codes may vary slightly between regions, the general color codes for utility markings are:



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Before any Installation – Line Locate Contact Info

For line locates in the states of Texas, Oklahoma, Arkansas, and Louisiana, you would typically contact the appropriate regional or state-level agency responsible for utility locating. Here are the relevant agencies for each state:

- **Texas**: In Texas, you would contact the Texas811 service. It is a one-call notification center that helps coordinate utility line locates across the state. You can reach them by dialing 811 or visiting their website at https://www.texas811.org/.
- **Oklahoma**: In Oklahoma, you would contact the Oklahoma One-Call System. They are responsible for coordinating utility line locates in the state. You can reach them by dialing 811 or visiting their website at https://www.okie811.org/.
- **Arkansas**: In Arkansas, you would contact the Arkansas One Call. They provide a central point of contact for utility line locates in the state. You can reach them by dialing 811 or visiting their website at https://www.arkonecall.com/.
- **Louisiana**: In Louisiana, you would contact the Louisiana One Call System. They are responsible for coordinating utility line locates in the state. You can reach them by dialing 811 or visiting their website at https://www.laonecall.com/.

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Signs & Markings II

Sign Installation – Placement considerations

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Considerations to sign installation placement

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Determining placement of signs - Topography

Topography plays a crucial role in sign installation for several reasons.

Visibility and Line of Sight:

Topography can affect the visibility of traffic signs. Hills, slopes, or curves in the terrain may obstruct the line of sight for drivers, making it challenging for them to see and read signs. In such cases, it becomes crucial to position signs at locations where they are visible to approaching motorists, taking into account sight distance requirements and potential visual obstructions caused by the topography.

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Visibility and Readability

When installing traffic signs near hills and curves, there are specific rules and guidelines to ensure road safety and provide appropriate warnings to drivers. The rules may vary depending on local regulations and engineering standards, but here are some general considerations:

1. **Regulatory Signs:** Regulatory signs, such as speed limit signs, stop signs, or no passing signs should be placed before the curve or hill, providing drivers with sufficient notice and time to adjust their speed or take necessary actions. The distance between regulatory signs and the hazard should be determined based on engineering judgment, considering factors like the speed of traffic and visibility.

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Visibility and Readability

When installing traffic signs near hills and curves, there are specific rules and guidelines to ensure road safety and provide appropriate warnings to drivers. The rules may vary depending on local regulations and engineering standards, but here are some general considerations:

1. **Warning Signs**: Warning signs are crucial in alerting drivers to the presence of a hill or curve ahead. These signs typically have a yellow background with black symbols or text. Consider the following guidelines when installing warning signs:

   - Hill Warning Signs: Install "Hill" warning signs in advance of an uphill section to alert drivers of the upcoming change in road grade. The signs may include additional information, such as the grade percentage or distance of the hill.

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Structural Considerations

1. **Curve Warning Signs**:

   Install "Curve" warning signs before a curved section to alert drivers of the upcoming change in direction. The signs may indicate the recommended speed for navigating the curve or display an arrow indicating the direction of the curve.

2. **Chevron Signs**:

   Chevron signs are often used in combination with warning signs to provide additional emphasis for curves. These signs consist of a series of yellow, diagonal arrows pointing in the direction of the curve. They help visually guide drivers through the curve and enhance awareness of the upcoming road alignment change.

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Signs & Markings II

Traffic Counts and Traffic Warrants

Advancing the Future of Public Safety

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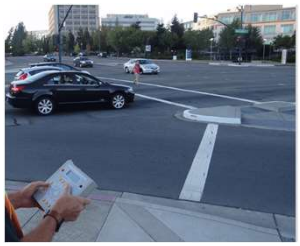
Traffic Counts and Warrants



What are Warrants for Traffic Control Devices?

A warrant is basically a criteria used by several road departments to find out whether a traffic control device is needed at an intersection or on the street, highway or road. The criteria for a warrant for signs are:

- A sign or signal that needs to attract the attention, such as a 'Signs of One Way'
- Signs that lay down the law such as 'Fines Double in Construction Zones'
- Fulfillment of something considered necessary, such as accident reduction
- Gives a driver a clear direction as to where they need to go, such as a directional sign
- Signs that let you know something is about to change, such as 'Road Closed in 1 Mile'

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Traffic Counts

Traffic counts, or traffic surveys, are conducted at various times and intervals depending on the specific objectives and requirements of the study. Here are some common scenarios and reasons when traffic counts are typically performed:

- Transportation Planning
- New Development Impact Assessment
- Intersection Analysis and Design
- Roadway Capacity Analysis
- Safety Studies
- Traffic Impact Studies
- Special Events

The timing and duration of traffic counts depend on the specific objectives and context of the study. Counts can be conducted for short durations, such as a few hours or days, to capture peak traffic periods or for longer periods to assess daily or seasonal variations. Typically, A total of eight hours of turning movement is generally mandated for this type of assessment.

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Traffic Counts

EXAMPLES OF TRAFFIC VOLUME COUNT STUDIES

Intersection counts are used for timing traffic signals, designing channelization, planning turn prohibitions, computing capacity, analyzing high crash intersections, and evaluating congestion (Homburger et al. 1996). The manual count method is usually used to conduct an intersection count. A single observer can complete an intersection count only in very light traffic conditions.

The intersection count classification scheme must be understood by all observers before the count can begin. Each intersection has 12 possible movements (see Figure 3.6). The intersection movements are through, left turn, and right turn. The observer records the intersection movement for each vehicle that enters the intersection.

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Traffic Counts

Pedestrian Counts

Pedestrian count data are used frequently in planning applications. Pedestrian counts are used to evaluate sidewalk and crosswalk needs, to justify pedestrian signals, and to time traffic signals. Pedestrian counts may be taken at intersection crosswalks, midblock crossings, or along sidewalks.

Vehicle Classification Counts

Vehicle classification counts are used in establishing structural and geometric design criteria, computing expected highway user revenue, and computing capacity. If a high percentage of heavy trucks exists or if the vehicle mix at the crash site is suspected as contributing to the crash problem, then classification counts should be conducted.

Typically cars, station wagons, pickup and panel trucks, and motorcycles are classified as passenger cars. Other trucks and buses are classified as trucks. School buses and farm equipment may be recorded separately. The observer records the classification of the vehicles and the vehicles' direction of travel at the intersection.

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Traffic Counts

Average Daily Traffic and Annual Average Daily Traffic Counts

Average daily traffic (ADT) counts represent a 24-hour count at any specified location. These counts are obtained by placing an automatic counter at the analysis location for a 24-hour period. Accuracy of the ADT data depends on the count being performed during typical roadway, weather, and traffic demand conditions. Local levels of government will typically conduct this type of count.

Annual average daily traffic (AADT) counts represent the average 24-hour traffic volume at a given location averaged over a full 365-day year. AADT volume counts have the following uses:

- measuring or evaluating the present demand for service by the roadway or facility
- developing the major or arterial roadway system
- locating areas where new facilities or improvements to existing facilities are needed
- programming capital improvements

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Traffic Counts

Traffic count studies can range in duration based on various factors including the purpose of the study, the type of road, and the specific traffic characteristics that are being investigated. However, for general purposes, a typical traffic count is conducted over a 24-hour period. This gives a complete picture of traffic flow for an average day, including peak and off-peak hours.

For more detailed studies or where the data is being used to inform substantial infrastructure investments, counts may be carried out over a longer period such as a week, a month, or even a year to understand seasonal variations, impact of holidays, and other long-term trends.

However, the duration of the study should be sufficient to provide representative data that isn't overly influenced by temporary conditions or unusual circumstances. For example, conducting a traffic count on a holiday or during a major event that disrupts normal traffic patterns could provide misleading data if used as an indication of typical conditions.

So, while the minimum duration might technically be less than 24 hours for specific studies, most professionals would recommend at least a 24-hour count for a broad understanding of traffic patterns. Always consult with local authorities or traffic engineering professionals for standards and practices in your specific location.

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Turn Movement Counts

Turning Movement Count (TMC) is a key part of transportation engineering studies. It is a detailed count of vehicles, pedestrians, or cyclists as they move through an intersection, documenting the number and direction of these movements. It is used to understand how traffic operates at specific intersections and aids in decision-making for traffic signal timings, road layout, and safety improvements.

Typically, TMC records the following turning movements at intersections:

- Left turn
- Right turn
- Straight-through

This data can be recorded manually by individuals or through automated methods like cameras or sensors. TMC is vital for evaluating the effectiveness of traffic control measures, determining the need for modifications to the existing infrastructure, planning for future development, and conducting accident analyses.

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Traffic Warrants

Traffic warrants refer to a set of established criteria or guidelines used by transportation professionals, traffic engineers, and local authorities to determine if specific traffic control measures or infrastructure improvements are necessary at a particular location. These warrants help ensure that the implementation of traffic control devices, such as traffic signals, stop signs, or other traffic control measures, is justified based on specific traffic and safety conditions.

Different types of traffic control devices, such as traffic signals, stop signs, yield signs, or pedestrian crossings, may have their own set of warrants. The specific warrants can vary depending on local regulations, engineering practices, and the context of the location being evaluated. However, some common factors considered in traffic warrants include:

- Traffic Volume
- Intersection or Roadway Configuration
- Crash History and Safety
- Pedestrian and Bicycle Activity
- Delay and Level of Service
- Special Conditions

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Traffic Warrants – Trafic Volume

Table 4C-1. Warrant 1, Eight-Hour Vehicular Volume

Condition A—Minimum Vehicular Volume

Number of lanes for moving traffic on each approach		Vehicles per hour on major street (total of both approaches)				Vehicles per hour on higher-volume minor-street approach (one direction only)			
Major Street	Minor Street	100%[A]	80%[A]	70%[A]	56%[A]	100%[A]	80%[A]	70%[A]	56%[A]
1	1	500	400	350	280	150	120	105	84
2 or more	1	600	480	420	336	150	120	105	84
2 or more	2 or more	600	480	420	336	200	160	140	112
1	2 or more	500	400	350	280	200	160	140	112

Condition B—Interruption of Continuous Traffic

Number of lanes for moving traffic on each approach		Vehicles per hour on major street (total of both approaches)				Vehicles per hour on higher-volume minor-street approach (one direction only)			
Major Street	Minor Street	100%[A]	80%[A]	70%[A]	56%[A]	100%[A]	80%[A]	70%[A]	56%[A]
1	1	750	600	525	420	75	60	53	42
2 or more	1	900	720	630	504	75	60	53	42
2 or more	2 or more	900	720	630	504	100	80	70	56
1	2 or more	750	600	525	420	100	80	70	56

[A] Basic minimum hourly volume

[B] Used for combination of Conditions A and B after adequate trial of other remedial measures

[C] May be used when the major-street speed exceeds 40 mph or in an isolated community with a population of less than 10,000

[D] May be used for combination of Conditions A and B after adequate trial of other remedial measures when the major-street speed exceeds 40 mph or in an isolated community with a population of less than 10,000

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Signs & Markings II

Speed Display Board / Trailer

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Speed Display Board / Trailer

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Speed Display Board / Trailer

A speed display board, also known as a speed sign or radar speed sign, is an electronic device used to display the speed of vehicles to drivers on the road. It is designed to provide real-time feedback to motorists about their current speed, promoting awareness and encouraging them to adhere to speed limits. The primary purpose of a speed display board is to enhance road safety by reducing speeding and promoting responsible driving behavior.

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Speed Display Board / Trailer

The key features and components of a typical speed display board include:

- **Display Panel**: The display panel is the main component of the speed display board. It consists of a digital or LED display that shows the speed of approaching vehicles. The display is usually large and easily visible from a distance, ensuring that drivers can quickly and clearly read their speed.
- **Radar or Sensor**: Speed display boards utilize radar technology or other sensors to detect the speed of oncoming vehicles. The radar or sensor is integrated into the device and measures the speed of passing vehicles accurately.
- **Speed Thresholds**: Speed display boards can be programmed with different speed thresholds or limits. When a vehicle exceeds the predetermined threshold, the display panel is activated, and the driver's speed is shown. The threshold can be set to correspond to the posted speed limit or customized based on specific road conditions or requirements.
- **Power Supply**: Speed display boards require a power source to operate. They are typically powered by electricity through a connection to the local power grid or by using solar panels for more remote or environmentally friendly installations.
- **Mounting and Housing**: Speed display boards are mounted on poles or other structures at the side of the road. They are designed to be durable, weather-resistant, and able to withstand various environmental conditions. The housing provides protection for the electronic components, ensuring the device's longevity and functionality.
- **Data Collection and Connectivity (optional)**: Some speed display boards may include additional features such as data collection capabilities and connectivity. These boards can collect data on vehicle speeds, traffic patterns, or other relevant information. They may be equipped with wireless or network connectivity for remote monitoring and analysis.

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Speed Display Board / Trailer

Placing the trailer:

Speed display boards / trailers can be mounted below a speed limit sign or if it is a trailer can be placed on the right shoulder of the road. When determining the placement of a speed display board, several factors should be considered to maximize its effectiveness in promoting safe driving behavior. Here are some key considerations for placing a speed display board:

- High-Traffic Areas
- Proximity to Speed Limit Changes
- Visibility and Line of Sight
- Adequate Warning Distance
- Strategic Placement within Communities
- Speeding Hotspots and Problem Areas
- Temporary Construction Zones
- Data Collection and Analysis
- Local Regulations and Guidelines
- Flexibility and Mobility

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Speed Display Board / Trailer

programming the trailer:

Programming a speed display board involves configuring its settings, thresholds, and behavior to ensure accurate speed measurement and appropriate display functionality. It is based off the actual speed of the road and given a threshold of around 5 to 10 mph before flashing a warning to the driver. While specific programming methods may vary depending on the manufacturer and model of the speed display board, here is a general overview of the programming process:

- Accessing the Programming Interface
- Setting Speed Thresholds
- Configuring Display Behavior
- Adjusting Display Duration
- Customizing Messages (Optional)
- Time and Date Configuration
- Additional Configuration (Optional)
- Saving and Applying Settings

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Tuning A Radar Trailer

Radar speed trailers, sometimes referred to as "speed display boards," use radar technology to measure the speed of passing vehicles and display the speed on an LED sign. This is usually for the purpose of traffic calming, reminding drivers of the speed limit to encourage safer driving habits.

The tuning process involves setting up the radar system correctly and checking its accuracy. While the exact procedure may vary based on the specific model of radar speed trailer, a typical procedure might involve the following steps:

- Set up the radar speed trailer in a safe and appropriate location, taking care to ensure it is well stabilized and correctly angled towards the road. The angle is usually straight to the oncoming traffic.
- Use the radar speed trailer's user interface (which could be a physical interface on the device or a software interface on a computer or other device) to adjust the radar settings, including the minimum and maximum speed display.

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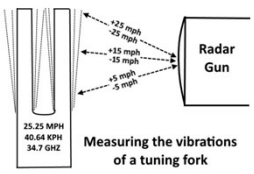
Tuning A Radar Trailer

Validate the radar speed trailer's accuracy. This is often done using a tuning fork.

A tuning fork is a tool that, when struck, vibrates at a specific frequency. For radar guns used by law enforcement (and similar radar systems), a tuning fork can be used to check the accuracy of the radar. The radar measures the Doppler shift of the return signal to determine speed, and a tuning fork's vibration frequency can simulate a particular speed.

In the context of a radar speed trailer, you would use a tuning fork that simulates a known speed, and you'd expect the radar speed trailer to display that speed when the vibrating tuning fork is placed in front of the radar.



Measuring the vibrations of a tuning fork

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Tuning A Radar Trailer

Here's a basic procedure for how this could work:

1. Strike the tuning fork against a soft surface to make it vibrate. It should be noted that the tuning fork should not be struck hard enough to damage it, but just enough to create the vibration.
2. Hold the vibrating tuning fork in front of the radar antenna. The radar should read the speed that corresponds to the tuning fork's frequency.
3. Compare the radar speed reading with the expected speed of the tuning fork. If there's a discrepancy, you might need to adjust the radar's calibration.
4. Repeat the process until the radar speed trailer is providing accurate readings.

The actual process for adjusting the radar's calibration will depend on the specific make and model of the radar speed trailer. It might involve adjusting settings on the radar unit itself, using a separate calibration tool, or using software provided by the manufacturer. Always refer to the manufacturer's instructions or consult with a qualified technician if you're unsure about any part of the process

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Signs & Markings II

Changeable Message Signs

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Changeable Message Signs

A changeable message sign (CMS) is a traffic control device that is capable of displaying one or more **alternative** messages. Some changeable message signs have a blank mode when no message is displayed, while others display multiple messages with only one of the messages displayed at a time (such as OPEN/CLOSED signs at weigh stations).

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Before Deployment Battery Inspection

Since the battery status checking method could vary based on the specific model of the CMS, it's important to consult the user manual provided by the manufacturer. However, here's a general guide to get you started:

- **Physical Inspection**: If it's a solar-powered sign with a backup battery, you might start by checking to see if the solar panel is clean and unobstructed. Then, inspect the battery to see if there are any signs of damage or corrosion.
- **On-Screen Display or Indicator Lights**: Some models might have a display screen or indicator lights that show the battery status. This could be something simple like a set of LEDs that light up to indicate the current battery level.
- **CMS Control Interface**: If the CMS has a control panel or a software interface, there might be a battery status indicator there. You might need to navigate through the menus or settings to find it.
- **Testing the Battery**: Some models might have a battery testing function. This could be a button that you press to test the battery, or it could be a function that you need to activate through the control panel or software interface.
- **Using a Multimeter**: If the battery is accessible and you have the necessary equipment, you could use a multimeter to test the battery. However, you should only do this if you're comfortable working with electronics and you're sure it won't void the warranty or cause other issues.

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Changeable Message Signs

Changeable message signs have a large number of applications including, but not limited to, the following:

- Incident management and route diversion
- Warning of adverse weather conditions
- Special event applications associated with traffic control or conditions
- Control at crossing situations
- Lane, ramp, and roadway control
- Priced or other types of managed lanes
- Travel times
- Warning situations
- Traffic regulations
- Speed control
- Destination guidance

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Changeable Message Signs - MUTCD

Message Standard:
Portable changeable message signs shall comply with the applicable design and application principles established in Chapter 2A. Portable changeable message signs shall display only traffic operational, regulatory, warning, and guidance information, and shall NOT be used for advertising messages.

1. Support:
   Section 6F.61 contains information regarding the use of arrow boards that use flashing or sequential displays for lane closures.

Guidance:

1. *Except in the case of a limited-legend CMS (such as a blank-out or electronic-display changeable message regulatory sign) that is used in place of a static regulatory sign or an activated blank-out warning sign that supplements a static warning sign at a separate location, changeable message signs should be used as a supplement to and not as a substitute for conventional signs and markings.*
2. *CMS should be limited to no more than three lines, with no more than 20 characters per line.*
3. *The spacing between characters in a word should be between 25 to 40 percent of the letter height. The spacing between words in a message should be between 75 and 100 percent of the letter height. Spacing between the message lines should be between 50 and 75 percent of the letter height.*
4. *Except as provided in Paragraph 18, word messages on changeable message signs should be composed of all upper-case letters. The minimum letter height should be 18 inches for changeable message signs on roadways with speed limits of 45 mph or higher. The minimum letter height should be 12 inches for changeable message signs on roadways with speed limits of less than 45 mph.*

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Changeable Message Signs - MUTCD

Message Standard:
The colors used for legends on portable changeable message signs shall comply with those shown in Table 2A-5.
Support:
Section 2L.04 contains information regarding the luminance, luminance contrast, and contrast orientation that is also applicable to portable changeable message signs. A changeable Message Sign like any other Traffic sign should command Attention and Respect.

Section 2L.03 Legibility and Visibility of Changeable Message Signs

Changeable message signs used on roadways with speed limits of 55 mph or higher should be visible from 1/2 mile under both day and night conditions. The message should be designed to be legible from a minimum distance of 600 feet for nighttime conditions and 800 feet for normal daylight conditions. When environmental conditions that reduce visibility and legibility are present, or when the legibility distances stated in the previous sentences in this paragraph cannot be practically achieved, messages composed of fewer units of information should be used and consideration should be given to limiting the message to a single phase (see Section 2L.05 for information regarding the lengths of messages displayed on changeable message signs).

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Changeable Message Signs – Acceptable Abbreviations

Table 1A-1. Acceptable Abbreviations

Word Message	Standard Abbreviation
Afternoon / Evening	PM
Alternate	ALT
AM Radio	AM
Avenue	AVE, AV
Bicycle	BIKE
Boulevard	BLVD*
Bridge	(See Table 1A-2)
CB Radio	CB
Center (as part of a place name)	CTR
Circle	CIR
Civil Defense	CD
Compressed Natural Gas	CNG
Court	CT*
Crossing (other than railroad rail)	X-ING
Drive	DR*
East	E
Electric Vehicle	EV
Expressway	EXPWY*
Feet	FT
FM Radio	FM
Freeway	FRWY, FWY*
Friday	FRI
Hazardous Material	HAZMAT
High Occupancy Vehicle	HOV

Word Message	Standard Abbreviation
Highway	HWY*
Hospital	HOSP
Hour(s)	HR, HRS
Information	INFO
Inherently Low Emission Vehicle	ILEV
International	INTL
Interstate	(See Table 1A-2)
Junction / Intersection	JCT
Lane	(See Table 1A-3)
Liquid Propane Gas	LP-GAS
Maximum	MAX
Mile(s)	MI
Miles Per Hour	MPH
Minimum	MIN
Minute(s)	MIN
Monday	MON
Morning / Late Night	AM
Mount	MT
Mountain	MTN
National	NATL
North	N
Parkway	PKWY*
Pedestrian	PED
Place	PL*

Word Message	Standard Abbreviation
Pounds	LBS
Road	RD*
Saint	ST
Saturday	SAT
South	S
State, county, or other (not an Interstate numbered route)	(See Table 1A-2)
Street	ST*
Sunday	SUN
Telephone	PHONE
Temporary	TEMP
Terrace	TER*
Thursday	THURS
Thruway	THWY*
Tons of Weight	T
Trail	TR*
Tuesday	TUES
Turnpike	TPK*
Two-Way Intersection	2-WAY
US Numbered Route	US
Wednesday	WED
West	W

*This abbreviation shall not be used for any application other than the name of a roadway.

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Variable Message Signs - VMS

A Variable Message Sign (VMS), also known as a Dynamic Message Sign (DMS), or Changeable Message Sign (CMS), is an electronic traffic sign often used on roadways to provide travelers with real-time information about specific events. The information displayed on the VMS can be changed as required, hence the name.
VMS are generally used for:

1.Traffic management and control: They provide real-time traffic information to motorists, such as delays, accidents, road works, detours, or lane closures, to manage traffic flow more effectively and reduce congestion.
2.Emergency alerts: In cases of emergencies such as natural disasters, VMS can provide crucial, timely information to guide the public and direct traffic flow accordingly.
3.Public transportation status updates: VMS can be used to display times of next buses or trains in public transportation systems, helping passengers plan their journey better.
4.Speed limit enforcement: These signs can also display variable speed limits, adapting to current traffic or weather conditions, to enhance road safety.
5.Advertising: Some VMS are also used for promotional or advertising purposes, especially in commercial or event areas.
In addition to road networks, VMS are also used in car parks, airports, railway stations, and various other environments where providing dynamic information can aid in managing and directing movement of people or vehicles. These signs can be controlled remotely and display messages in text or graphic format.

The intent of using a VMS is to inform drivers and other road users about unexpected changes, incidents, or conditions on the road ahead in time for them to make informed decisions. This can help to improve traffic flow, reduce incidents, and increase overall road safety

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Variable Message Signs - VMS

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Signs & Markings II

Changeable Message Sign - Review

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Signs & Markings II

Markings / Markings Standards

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Markings Standards

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Markings Standards

Section 3A.02 Standardization of Application

Standard:

- Each standard marking shall be used only to convey the meaning prescribed for that marking in this Manual. When used for applications not described in this Manual, markings shall conform in all respects to the principles and standards set forth in this Manual.

Guidance:

- Before any new highway, private road open to public travel (see definition in Section 1A.13), paved detour, or temporary route is opened to public travel, all necessary markings should be in place.

Standard:

- Markings that must be visible at night shall be retroreflective unless ambient illumination assures that the markings are adequately visible. **All markings on Interstate highways shall be retroreflective**.
- Markings that are **no longer applicable or Viable** for roadway conditions or restrictions and that might cause confusion for the road user shall be removed or obliterated to be unidentifiable as a marking as soon as practical.

Option:

- Until they can be removed or obliterated, markings may be temporarily masked with tape that is approximately the same color as the pavement.

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Markings Standards - Colors

Standard:

- Markings shall be yellow, white, red, blue, or purple. The colors for markings shall conform to the standard highway colors. Black in conjunction with one of the colors mentioned in the first sentence of this paragraph shall be a usable color.

1. When used, white markings for longitudinal lines shall delineate:

- A. The separation of traffic flows in the same direction
- B. The right-hand edge of the roadway

2. When used, yellow markings for longitudinal lines shall delineate:

- A. The separation of traffic traveling in opposite directions
- B. The left-hand edge of the roadways of divided highways and one-way streets or ramps
- C. The separation of two-way left-turn lanes and reversible lanes from other lanes.

3. When used, red raised pavement markers or delineators shall delineate:

- A. Truck escape ramps
- B. One-way roadways, ramps, or travel lanes that shall not be entered or used in the direction from which the markers are visible.

4. When used, blue markings shall supplement white markings for parking spaces for persons with disabilities.
5. When used, purple markings shall supplement lane line or edge line markings for toll plaza approach lanes that are restricted to use only by vehicles with registered electronic toll collection accounts

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Markings Standards - Stop Lines

stop lines shall consist of solid white lines extending across approach lanes to indicate the point at which the stop is intended or required to be made.

yield lines (see Figure 3B-16) shall consist of a row of solid white isosceles triangles pointing toward approaching vehicles extending across approach lanes to indicate the point at which the yield is intended or required to be made.

Guidance:

- **Stop lines should be 12 to 24 inches wide.**
- The individual triangles comprising the yield line should have a base of 12 to 24 inches wide and a height equal to 1.5 times the base. The space between the triangles should be 3 to 12 inches.
- **If used, stop and yield lines should be placed a minimum of 4 feet in advance of the nearest crosswalk line at controlled intersections**, except for yield lines at roundabouts as provided for in Section 3C.04 and at midblock crosswalks. In the absence of a marked crosswalk, the stop line or yield line should be placed at the desired stopping or yielding point, but should not be placed more than 30 feet or less than 4 feet from the nearest edge of the intersecting traveled way. Stop lines at **midblock signalized Locations would be placed at least 40 feet in advance of the nearest signal.**

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Signs & Markings II

Working With Contractors

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Working with Contractors

Working with traffic sign and markings contractors involves collaboration and coordination to ensure the effective installation, maintenance, and management of traffic signs and pavement markings. Here are some key considerations when working with such contractors:

- **Project Planning and Specifications**: Clearly define the project requirements and specifications for traffic signs and markings. Provide detailed plans, drawings, or documentation specifying the types of signs and markings needed, their locations, dimensions, colors, and any applicable standards or regulations. Ensure that the contractors have a clear understanding of the project scope.
- **Contractor Selection**: Select reputable contractors with experience and expertise in traffic sign and marking installations. Consider their track record, qualifications, certifications, and their ability to meet project deadlines. Obtain references and evaluate past projects to ensure the contractors have a history of delivering quality work.

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Working with Contractors

- **Pre-Construction Meetings**: Conduct pre-construction meetings with the contractors to discuss project details, clarify expectations, and address any questions or concerns. Review the project plans, specifications, and scheduling requirements. Establish clear lines of communication and define roles and responsibilities for both parties.
- **Coordination and Communication**: Maintain open lines of communication with the contractors throughout the project. Regularly communicate project updates, changes, or any issues that may arise. Ensure that any modifications or variations from the original plans are properly documented and approved to avoid misunderstandings.

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Working with Contractors

- **Quality Assurance and Inspection**: Establish a process for quality assurance and inspection of the work performed by the contractors. Conduct regular inspections to verify that the installed signs and markings meet the specified requirements and comply with applicable standards. Document any deficiencies and work with the contractors to rectify them promptly.
- **Compliance with Regulations and Standards**: Ensure that the contractors are familiar with and adhere to all relevant regulations, guidelines, and standards pertaining to traffic signs and markings. This includes compliance with local, state, or national transportation regulations, as well as standards such as the Manual on Uniform Traffic Control Devices (MUTCD).
- **Safety Considerations**: Emphasize the importance of safety during all aspects of the project. Ensure that the contractors follow proper safety protocols, use appropriate personal protective equipment (PPE), and adhere to traffic control measures to protect workers and road users during installation or maintenance activities.

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Working with Contractors

- **Contract Management**: Maintain clear and well-defined contracts or agreements with the contractors. Clearly outline project deliverables, timelines, payment terms, and any other relevant contractual terms. Monitor progress and ensure that the contractors fulfill their obligations according to the agreed-upon terms.
- **Ongoing Maintenance and Management**: Establish a plan for ongoing maintenance and management of traffic signs and markings after installation. Discuss with the contractors the expected lifespan of the signs and markings and establish a maintenance schedule to ensure their visibility, legibility, and overall effectiveness over time.
- **Performance Evaluation**: Evaluate the performance of the contractors upon completion of the project. Assess their adherence to project requirements, quality of work, responsiveness, and ability to meet project objectives. Provide constructive feedback and share recommendations for improvement.

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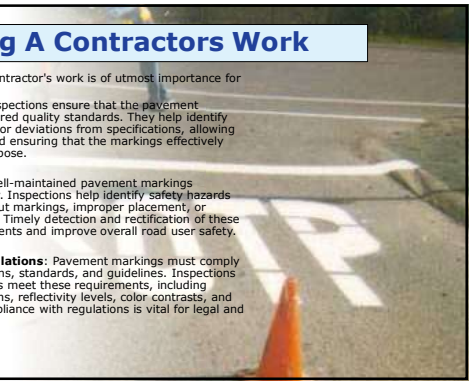
Inspecting A Contractors Work



Inspecting a markings contractor's work is of utmost importance for several reasons:

- **Quality Assurance**: Inspections ensure that the pavement markings meet the required quality standards. They help identify any deficiencies, errors, or deviations from specifications, allowing for timely corrections and ensuring that the markings effectively serve their intended purpose.
- **Safety**: Accurate and well-maintained pavement markings contribute to road safety. Inspections help identify safety hazards such as faded or worn-out markings, improper placement, or inconsistent dimensions. Timely detection and rectification of these issues can prevent accidents and improve overall road user safety.
- **Compliance with Regulations**: Pavement markings must comply with applicable regulations, standards, and guidelines. Inspections ensure that the markings meet these requirements, including factors such as line widths, reflectivity levels, color contrasts, and placement criteria. Compliance with regulations is vital for legal and liability reasons.

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Signs & Markings II

Sign Inspections

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How weather affects signs

Traffic signs are subject to various environmental conditions, including weather, which can affect their effectiveness and longevity. The effects of weather on traffic signs can include:

1. **Fading**: Extended exposure to the sun's UV rays can cause the colors on traffic signs to fade. Fading reduces the sign's visibility and its effectiveness. Signs with bright colors, like stop signs (red) or warning signs (yellow), tend to be more affected as any fading can decrease their ability to grab attention.
2. **Wind Damage**: Strong winds, hurricanes, or tornadoes can cause physical damage to traffic signs. This could lead to the sign becoming dislodged from its post, bent, or even broken. Larger signs or those with a broad surface area can be more affected as they present more resistance to wind.
3. **Snow and Ice**: In colder climates, snow and ice can cover signs, making them unreadable. The weight of accumulated ice or snow could potentially cause a sign to bend or fall.
4. **Corrosion**: In coastal areas or regions with heavy snowfall (where de-icing salts are often used on roads), the metal components of traffic signs can corrode over time. Corrosion can weaken the sign post and fasteners, leading to potential failure.
5. **Temperature Effects**: Extreme temperatures, both hot and cold, can affect the materials of traffic signs. In hot weather, signs can warp or buckle, while in cold temperatures, they may become brittle and more prone to cracking or breaking.

These are just a few reasons why a Sign Inspection Plan is important

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Sign Inspections

Traffic sign inspections are a crucial part of maintaining a safe and efficient transportation system. They help ensure that all signs are in good condition, clearly visible, and providing accurate information. Inspections typically focus on several key aspects:

1. **Visibility**: Signs should be easily visible to drivers. This includes both daytime and nighttime visibility. For instance, inspectors may use a retroreflectometer, a device that measures the level of retroreflectivity (how much light the sign reflects back to its source), to ensure that the sign still meets the required standards for nighttime visibility.
2. **Physical Condition**: This includes checking for any physical damage to the sign, such as bends, dents, or cracks, as well as any damage to the post or mounting. Any graffiti or stickers that could obscure the sign's message would also be noted.
3. **Position and Height**: The sign's height and position should be checked to ensure it's mounted at the correct height and angle, facing the oncoming traffic for maximum visibility.

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Sign Inspections

4. **Corrosion**: In coastal areas or regions with heavy snowfall (where de-icing salts are often used on roads), the metal components of traffic signs can corrode over time. Corrosion can weaken the sign post and fasteners, leading to potential failure.
5. **Legibility**: Over time, a sign's message can fade or become obscured due to weather, UV radiation, or other factors. The sign's legibility should be checked to ensure drivers can easily read and understand the sign's message.
6. **Compliance with Standards**: The sign should be checked for compliance with local and national standards regarding size, color, design, and reflectivity.
7. **Surrounding Environment**: The surrounding environment should also be inspected to ensure that the sign is not obscured by things like overgrown vegetation, dirt, or other structures.

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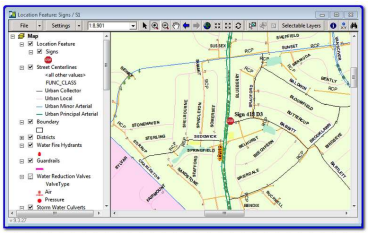
Sign Inspections - GPS



- Many departments have now started to use sign management systems to help manage this process. These systems use GPS and database technology to create a record of every sign, its installation date, condition, and date of last inspection. It helps automate the process and ensures that no sign is overlooked.

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Sign Inspections

Inspections for traffic signs are crucial for maintaining roadway safety and ensuring signs meet local and national standards. Here are some common types of inspections:

1. **Nighttime Inspections**: These inspections are conducted at night to evaluate the retroreflectivity of the sign, which is the ability of the sign to reflect light back to the source, making it visible in the dark. For this, a vehicle with headlights on is driven on the road to check if the signs are clearly visible and legible.
2. **Daytime Inspections**: During the day, signs are inspected for general visibility, legibility, correct positioning, physical condition (checking for damage, rust, or wear), and if they are obscured by overgrown vegetation or other obstructions.
3. **Scheduled Inspections**: Regularly scheduled inspections are conducted at predetermined intervals, which could be annually, biannually, or based on some other timeline. These inspections might include both daytime and nighttime checks.
4. **In-Depth Inspections**: These could involve a detailed evaluation of each sign to assess its condition, including factors like sign sheeting (the material the sign face is made of), post integrity, and hardware (bolts, brackets, etc.). These are generally more time-consuming and might be conducted on a rotating schedule, with different sections of the roadway being inspected each time.

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Nighttime Inspection

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Daytime Inspections

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Scheduled Inspections

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Scheduled Inspections

Traffic sign retroreflectivity refers to the ability of a sign's surface to reflect light back to its source, such as a vehicle's headlights. It plays a crucial role in maintaining visibility and legibility of signs, especially during nighttime and low-light conditions. Table 2A-3 from the MUTCD is the Minimum Maintained Retroreflectivity levels. Retroreflectivity is one of the primary aspects of signs that determine if they require replacement.

Table 2A-3. Minimum Maintained Retroreflectivity Levels[1]

Sign Color	Sheeting Type (ASTM D4956-04)				Additional Criteria
	Beaded Sheeting			Prismatic Sheeting	
	I	II	III	III, IV, VI, VII, VIII, IX, X	
White on Green	W': $Q \geq 7$	W': $Q \geq 15$	W': $Q \geq 25$	$W \geq 250$; $Q \geq 25$	Overhead
	W': $Q \geq 7$			$W \geq 120$; $Q \geq 15$	Post-mounted
Black on Yellow or Black on Orange	Y': Q'	$Y \geq 50$; $Q \geq 50$			*
	Y': Q'	$Y \geq 75$; $Q \geq 75$			*
White on Red	$W \geq 35$; $R \geq 7$				*
Black on White	$W \geq 50$				--

[1] The minimum maintained retroreflectivity levels shown in this table are in units of cd/lx/m² measured at an observation angle of 0.2° and an entrance angle of -4.0°.
[2] For text and line symbol signs measuring less than 48 inches and for all sizes of bold symbol signs
[3] For text and line symbol signs measuring less than 48 inches
[4] Minimum sign contrast ratio ≥ 3:1 (white retroreflectivity ÷ red retroreflectivity)
[5] This sheeting type shall not be used for this color for this application.

Bold Symbol Signs

- W1-1,2 – Turn and Curve
- W1-3,4 – Reverse Turn and Curve
- W1-5 – Winding Road
- W1-6 – Large Arrow
- W1-8 – Chevron
- W1-10 – Intersection in Curve
- W1-11 – Hairpin Loop
- W1-15 – 270 Degree Loop
- W2-1 – Cross Road
- W2-2 – Side Road
- W2-4,5 – T and Y Intersection
- W2-6 – Circular Intersection
- W2-7,8 – Double Side Roads
- W3-1 – Stop Ahead
- W3-2 – Yield Ahead
- W3-3 – Signal Ahead
- W4-1 – Merge
- W4-2 – Lane Ends
- W4-3 – Added Lane
- W4-5 – Entering Roadway Merge
- W4-6 – Exiting Roadway Added Lane
- W6-1,2 – Divided Highway Begins or Ends
- W6-3 – Two-Way Traffic
- W10-1,2,3,4,11,12 – Grade Crossing Advance Warning
- W11-2 – Pedestrian Crossing
- W11-3,4,16-22 – Large Animals
- W11-5 – Farm Equipment
- W11-6 – Snowmobile Crossing
- W11-7 – Equestrian Crossing
- W11-8 – Fire Station
- W11-10 – Truck Crossing
- W11-15 – Advisory Speed
- W16-9P/9P/7P – Pointing Arrow Plaques
- W20-7 – Flagger
- W21-1 – Worker

Fine Symbol Signs (symbol signs not listed as bold symbol signs)

Special Cases

- W3-1 – Stop Ahead: Red retroreflectivity ≥ 7
- W3-2 – Yield Ahead: Red retroreflectivity ≥ 7; White retroreflectivity ≥ 35
- W3-3 – Signal Ahead: Red retroreflectivity ≥ 7; White retroreflectivity ≥ 7
- W3-5 – Speed Reduction: White retroreflectivity ≥ 50
- For non-diamond shaped signs, such as W14-2 (No Passing Zone), W4-4P (Cross Traffic Does Not Stop), or W13-1P,2,3,5,7 (Speed Advisory Plaques), use the largest sign dimension to determine the proper minimum retroreflectivity level.

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Common Tools for Sign Inspections

- **Retroreflectometer**: This device measures the retroreflective properties of the sign. It's used to ensure that the sign meets the minimum retroreflectivity levels set by standards like the Manual on Uniform Traffic Control Devices (MUTCD) in the United States.

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Reasons for Inspection

A sign inspection program is crucial for a few key reasons:

- **Safety**: Traffic signs play a vital role in road safety, providing necessary information and guidance to drers and pedestrians. Faded, damaged, or obscured signs can lead to confusion or misinterpretation, potentially causing accidents. When a tech is sent out to observe a line of sight of a sign, they should be ready to remove the obstruction like the image shown.
- **Legal Compliance**: Regular inspections ensure that all signs are in compliance with local and national regulations, which may change over time.
- **Maintenance and Budget Planning**: Regular inspections allow for identification of signs that need maintenance or replacement, helping to budget and plan for these expenses effectively.

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Reasons for Inspection

- **Aesthetics and Community Image**: Well-maintained signs contribute to a positive community image and show attention to public safety.

As for the frequency of inspections, it can depend on a number of factors including local regulations, the type of sign, the environment, and the amount of wear and tear they typically experience. However, the Manual on Uniform Traffic Control Devices (MUTCD) suggests an inspection at least once a year for regulatory and warning signs, and once every two years for guide signs.

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Signs & Markings II

Asset Management / Inventory

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Asset Management

Asset management plays a crucial role in the effective management and maintenance of traffic signs. Here are some key reasons why asset management is important in this context:

- **Inventory Management**: Asset management helps in maintaining an accurate inventory of traffic signs. It includes recording details such as the type, location, condition, and age of each sign. This information is vital for planning maintenance, replacement, and upgrades.
- **Maintenance Planning**: By monitoring the condition of traffic signs and their components, asset management allows transportation agencies to schedule regular maintenance activities effectively. It ensures that signs are kept in proper working order, legible, and visible to road users.
- **Cost Efficiency**: Effective asset management minimizes unnecessary costs associated with traffic sign maintenance. It enables agencies to prioritize repairs and replacements based on the signs' condition, ensuring that resources are allocated efficiently.

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Asset Management

- **Compliance and Safety**: Traffic signs are essential for conveying information, regulating traffic, and ensuring road user safety. Asset management ensures that signs meet regulatory requirements, are visible, and provide accurate information to drivers. Regular inspections and maintenance help identify signs that may be damaged, faded, or obscured, thereby mitigating potential safety risks.
- **Planning and Decision Making**: Accurate data collected through asset management allows transportation agencies to make informed decisions regarding sign placement, upgrades, and replacements. This data can be used to identify areas with inadequate signage, areas prone to vandalism or theft, or signs that require specific attention due to changing traffic conditions.
- **Performance Monitoring**: Asset management provides a framework for monitoring the performance and effectiveness of traffic signs. It enables agencies to track key performance indicators, such as sign lifespan, maintenance costs, compliance rates, and response times for repairs. This information assists in evaluating the overall efficiency of sign management practices and identifying areas for improvement.

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Sign Management Software

- Some jurisdictions use sign management software systems, which help in tracking the condition, maintenance, and replacement of signs. These systems can schedule inspections, store photos and conditions of the signs, and help in planning budgets for sign replacement or repair.

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Signs & Markings II

Asset Management / Inventory Review

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