



Traffic Engineering & Highway Safety Bulletin



December 2007
Military Surface Deployment and Distribution Command Transportation Engineering Agency
Bldg. 661 Sheppard Place, Ft. Eustis, VA 23604

Traffic Signs

Did You Know?

A common problem on military installations is too many regulatory and warning signs. There is a misconception that extra signs “can’t do any harm.” In reality, extra signs create unnecessary clutter and detract from necessary traffic signs.

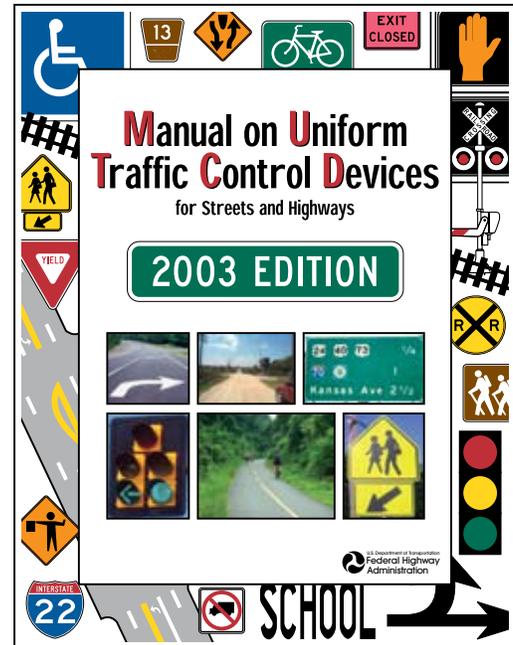
Other common problems include:

- ✓ Using non-standard, homemade-type signs, frequently with substandard size legends and without retroreflective sheeting material.
- ✓ Installing signs at a substandard height.
- ✓ Installing signs too close to other signs, or too close to a curve, turn, or intersection.
- ✓ Installing totem pole or ladder-type signs.
- ✓ Using improper colors, (e.g., brown-and-white signs).
- ✓ Allowing obsolete (non-retroreflective or non-legible) signs to remain in place.

The “how-to” book for traffic signs is Part 2 of the *Manual on Uniform Traffic Control Devices (MUTCD)*, as published by the Federal Highway Administration (FHWA). The primary purpose of the *MUTCD* is to improve safety and reduce driver frustration by promoting uniformity in the design and application of traffic control devices.

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FHWA also sponsors research to improve the quality and recognition of signs, and works internationally to share ideas with and borrow ideas from other countries to promote uniformity on a global basis. This sharing of research on sign shapes, colors, symbols, and design details is very important when considering the number of international visitors.

Traffic signs, like other types of traffic control devices, should meet the following five basic requirements:

1. Fulfill a need;
2. Command attention;
3. Convey a clear, simple meaning;
4. Command respect from road users; and
5. Allow adequate time for proper response.

What is Wrong with This Picture?



Answer on Page 10

Fulfill a Need

To determine if a sign will fulfill a need, a traffic engineering study must be conducted to collect and analyze data such as traffic volume, pedestrian volume, speed, and crash data; measure geometric features; and observe noteworthy vehicle behavior. This information is then compared to the warrants for the specific sign to determine whether the sign is appropriate.

Always base the decision to use a particular traffic sign on an engineering study or the application of engineering judgment. For this reason, a qualified engineer should make the decision whether or not to use a specific sign.

There are only three general classifications of signs, which serve the following functions:

1. **Regulatory** – gives notice of traffic laws or restrictions.
2. **Warning** – gives notice of a situation that might not be readily apparent.
3. **Guide** – shows route designations, street names, destinations, directions, distances, services, points of interest, and other geographical, recreational, or cultural information.

As illustrated in Exhibit 1, the general shape and the basic color of signs should be consistent with the type of sign.

Exhibit 1: Sign Type Basics

Type Sign	General Shape	Basic Color	Common Exceptions
Regulatory 	Rectangular	Black legend on a white background	<ul style="list-style-type: none"> ✓ STOP (R1-1), YIELD (R1-2), and Railroad Crossbuck (R15-1) signs have a unique shape. ✓ STOP (R1-1), YIELD (R1-2), DO NOT ENTER (R5-1), and WRONG WAY (R5-1a) signs are red-and-white in color. ✓ A red circle and slash indicate prohibitions.
Warning 	Diamond	Black symbols or legend on a yellow background	<ul style="list-style-type: none"> ✓ School (S1-1) and Advance Railroad Crossing (W10-1) signs, and the NO PASSING ZONE (W14-3) pennant, have a unique shape. ✓ Pedestrian, bicycle, and school series signs <u>may</u> have a fluorescent yellow-green background. ✓ Signs in construction areas have an orange background.
Guide 	Rectangular	White legend on a green background	<ul style="list-style-type: none"> ✓ Route (M-series) markers generally have a unique color and shape. ✓ Motorist service signs (e.g., gas, food, lodging, attractions, etc.) have a blue background. ✓ Recreational signs may have a brown background.

Command Attention

When developing a signing plan, it is important to use only signs that motorists understand. Therefore, use signs of the types included in the *MUTCD*. Although the *MUTCD* details the general use of traffic signs, the actual design details for the sign faces and the legend are in FHWA's *Standard Highway Signs* book.

Homemade-type signs are not only unenforceable, but they are illegal. Therefore, when there is a need for a sign not in the *MUTCD* or the state's list of approved signs, consult SDDCTEA for design assistance.

Exhibit 2 shows typical sizes of some common signs. Larger sizes may be warranted on roads with a speed limit greater than 45 mph, or when greater legibility or emphasis is needed. A qualified engineer should make this determination.

Almost without exception, guide signs on military installations should have white legend on a green background. These signs generally direct drivers to the installation and to specific buildings or areas within the installation.

To further assist visitors, it is desirable to distribute easy-to-read maps at the entry control facility (ECF) to show common visitor destinations.

The *MUTCD* assigns a unique nomenclature to all common types of traffic signs. All states use the nomenclature in the *MUTCD*, but each state also has some additional traffic signs that they have approved for unique applications, and for which they have assigned their own nomenclature. The first letter in sign nomenclature conforms to the following:

- ✓ Regulatory signs – R.
- ✓ Warning signs – W, except school signs start with the letter S.
- ✓ Guide signs – a variety of letters, but most commonly D, G, I, or M.

Sign names used in this bulletin may look awkward because some are in all capital letters while others are in title case. This mix of styles is common because the *MUTCD* and most other sign manuals generally use the following practice:

- ✓ All uppercase legends (capitals) for sign names when the sign name and the sign legend message are the same (e.g., STOP, YIELD, and DO NOT ENTER signs).
- ✓ Title case for symbol signs and when the sign name and sign message are not the same (e.g., Speed Limit, Turn, and Intersection signs).

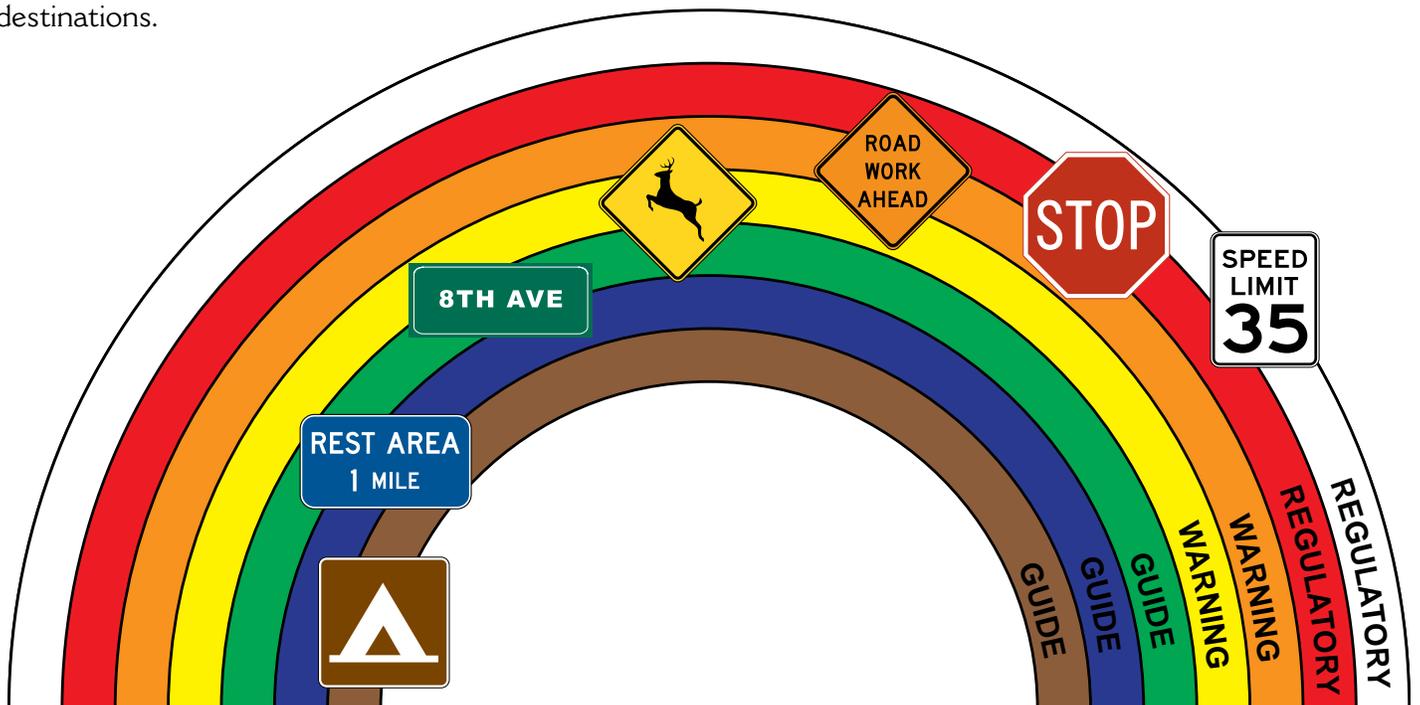


Exhibit 2: Sizes of Common Signs

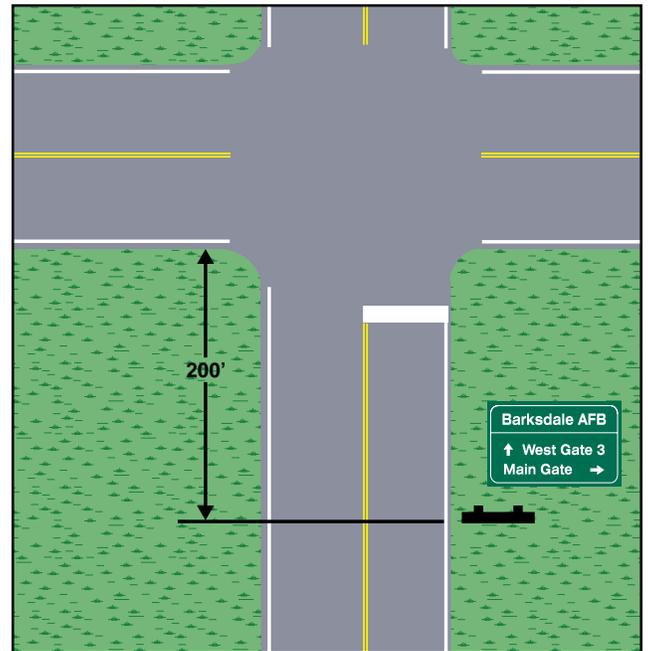
Sign Name and Nomenclature		Typical Size, Width x Height (inches)
STOP (R1-1)		30x30
YIELD (R1-2)		36x36x36*
Speed Limit (R2-1)		24x30
Turn Prohibition (R3-series)		24x24
DO NOT PASS (R4-1)		24x30
DO NOT ENTER (R5-1)		30x30
WRONG WAY (R5-1a)		36x24
ONE WAY (R6-1)		36x12
No Parking (R7-series)		12x18
NO TURN ON RED (R10-11, R10-11a)		24x30
Turn (W1-1)/Curve (W1-2)		30x30
Chevron (W1-8)		18x24
Intersection (W2-series)		30x30
Stop/Yield/Signal Ahead (W3-series)		36x36
Railroad Advance Warning (W10-1)		36
Advisory Speed (W13-1)		18x18
NO PASSING ZONE (W14-3 pennant)		48x48x36*
Destination (D1-, D2-series)		6-inch legend

*Length of each side

Guide signs that are outside of the installation are generally a cooperative effort with the state or local government entity that owns the road. For installations with two or more ECFs, it is desirable to develop a comprehensive guide sign plan to direct traffic to the appropriate ECF. Signs approaching the installation can inform drivers of the various ECF locations. Where appropriate, signs should detail:

- ✓ Location
- ✓ Gate name
- ✓ Usage type (visitors, decal POVs, trucks)
- ✓ Any limited hours of operation

Signs on public highways approaching the installation should generally use a minimum 8-inch white legend on a green background. To improve legibility, use title case (i.e., uppercase and lowercase) legends for all destinations.



In addition to having the proper sign face (e.g., layout, legend, dimensions, color, etc.), signs need to be retroreflective so that the sign is visible at night under headlamp illumination. To accomplish this, sign shops apply a “retroreflective sheeting material” over the entire sign. In addition, any white legend (i.e., letters, numerals, arrows, symbols, and borders) also need to be retroreflective.

Currently, there are eight types of retroreflective sheeting material available for permanent-type traffic signs. However, the two least expensive types of retroreflective sheeting (i.e., Type I and Type II) frequently do not meet some of the minimum retroreflectivity values suggested by recent research.

In addition to better visibility and legibility, signs made from Type III or higher types of retroreflective sheeting material have a longer service life and a lower annual cost than signs made from Type I or Type II materials.

For more information on retroreflectivity, see the Sign Retroreflectivity safety bulletin at [http://www.tea.army.mil/pubs/nr/dod/bulletins/Retroreflective\(Apr06\).pdf](http://www.tea.army.mil/pubs/nr/dod/bulletins/Retroreflective(Apr06).pdf).

When ordering signs:

- ✓ Only order from a reputable sign shop – if in doubt, discuss with the appropriate state Department of Transportation.
- ✓ Specify aluminum sign blanks since they are more durable than most other sign blank materials.
- ✓ Specify Type III or higher type retroreflective sheeting material.

In order to command attention, it is also important to place signs where other signs, parked cars, buildings, or vegetation will not obscure them. Signs should be placed on the right side of the road unless the *MUTCD* defines a different location. For example, No Left Turn, DO NOT ENTER, NO PASSING ZONE, Keep Right, and Chevron signs frequently installed at other locations.

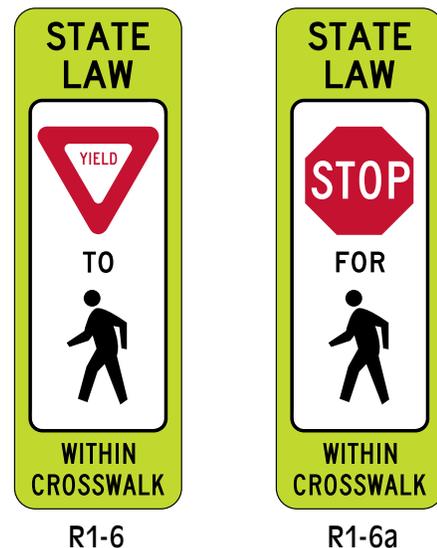
Each sign should be individually mounted unless one sign supplements another (e.g., an ALL WAY plaque and a STOP sign), or unless guide signs must be grouped. The *MUTCD* also encourages some back-to-back installations, (e.g., DO NOT ENTER sign on the back of a STOP or YIELD sign).

Typical heights and lateral locations of signs are illustrated in Exhibit 3. Use a minimum 7-foot mounting height if curb and gutter exists, parking is allowed, or pedestrians walk near the signs.

However, there is an exception to the normal height requirement – the In-Street Pedestrian Crossing (R1-6 and R1-6a) signs rest directly on the roadway. These “in-street” signs generally reduce speeds because they narrow the travel lane.

These signs create an extra object that can be hit, potentially inflicting injury to pedestrians and damage to vehicles. Therefore:

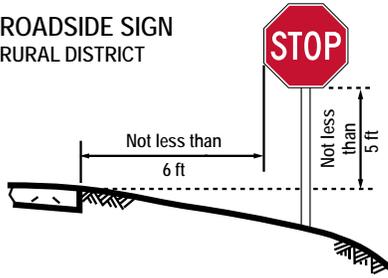
- ✓ Use these signs only on roadways with a speed limit of 35 mph or less, and with lanes that are at least 10 feet wide.
- ✓ Use only at marked mid-block crosswalks or marked crosswalks at non-signalized intersections.
- ✓ Use the appropriate sign (R1-6 or R1-6a) to correspond to the requirements of the applicable state vehicle code.
- ✓ Place the sign near the crosswalk, either on the centerline or a lane line pavement marking.



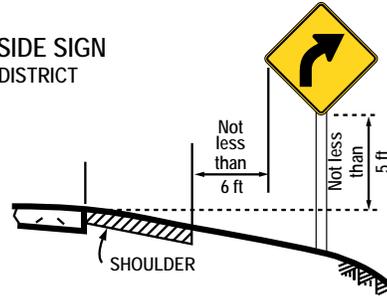
Sometimes it is desirable to install signs above the roadway. For example, overhead lane-use signs should be used when there are three or more lanes in one direction, or when a single lane can serve multiple movements. When used, overhead signs should be a minimum of 17 feet above the roadway surface.

Exhibit 3: Heights and Lateral Locations of Signs

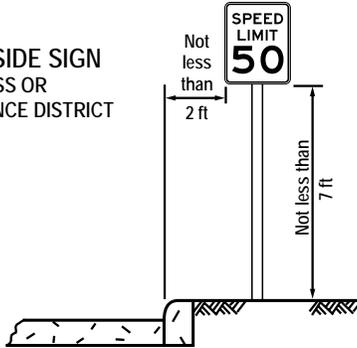
ROADSIDE SIGN
RURAL DISTRICT



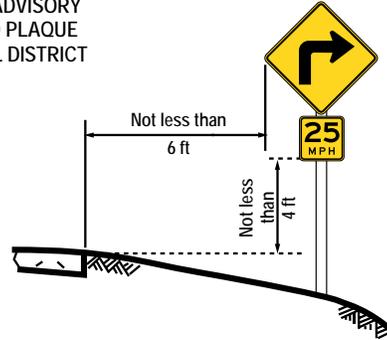
ROADSIDE SIGN
RURAL DISTRICT



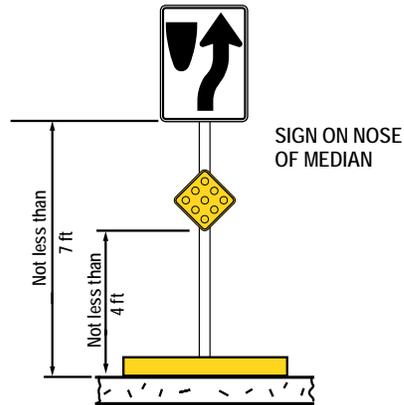
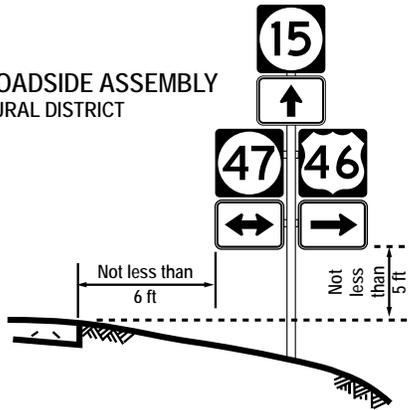
ROADSIDE SIGN
BUSINESS OR
RESIDENCE DISTRICT



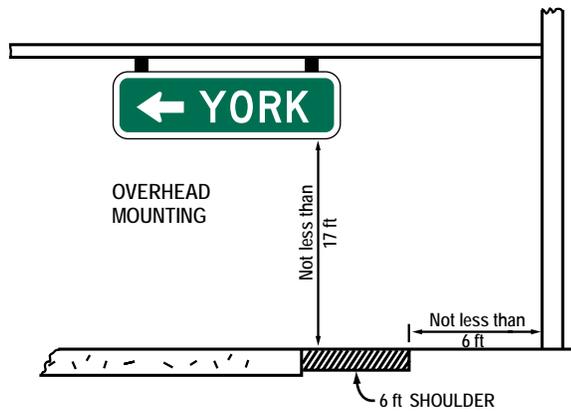
WARNING SIGN
WITH ADVISORY
SPEED PLAQUE
RURAL DISTRICT



ROADSIDE ASSEMBLY
RURAL DISTRICT



Note:
See MUTCD Section 2A.19 for reduced lateral offset distances that may be used in areas where lateral offsets are limited, and in urban areas where sidewalk width is limited or where existing poles are close to the curb.



Convey a Clear, Simple Meaning

Many military installations still use ladder-type signs for guide signing. These sign assemblies typically contain more information than can be processed by passing motorists. Therefore, it is important to limit the number of destinations at any location to a maximum of three, and to install a second sign assembly at a separate location if there are more than three destinations.

Exhibit 4 provides some examples of good and bad signs.

The current “rule-of-thumb” is that signs are legible from a distance of 40 feet for every one inch in the legend height. This means that a sign with 6-inch legend should be legible from a distance of about 240 feet.

The legibility of symbol signs depends on the size and detail of the symbol. Fortunately, most symbol signs use bold symbols (e.g., Stop Ahead, Intersection, Curve, Turn, Pedestrian, etc.) and are legible from distances greater than 240 feet.

Whenever possible, use symbol signs instead of legend messages because they are legible from greater distances, and because they help non-English-speaking people understand the message.

The *MUTCD* allows the use of title case (i.e., uppercase/lowercase) legends for all destinations and street names. Since drivers can read title case legends at a greater distance than legends using all capitals, new signs should use title case legends whenever permitted.

Command Respect

To command respect, sign messages must be realistic. For example, excessively low speed limits, unnecessary STOP signs, an overabundance of signs, and lack of maintenance, cause drivers to lose respect for all signs.

Signs require regular maintenance such as tightening fasteners, realigning posts, cleaning sign faces, and removing vegetation around the post and in front of the sign. In addition, damaged signs and sign posts should be immediately repaired and, if necessary, replaced.

Signs also deteriorate over time; therefore, replace all signs every 10 to 12 years (if existing signs have Type I or Type II retroreflective sheeting, replace after 7 years). An effective sign inventory system can help to maintain a complete and accurate accounting of the locations, types, and conditions of installed traffic signs as discussed in the Sign Retroreflectivity safety bulletin.

Exhibit 5 shows additional requirements of signs to command proper respect.

Exhibit 4: The Good and the Bad

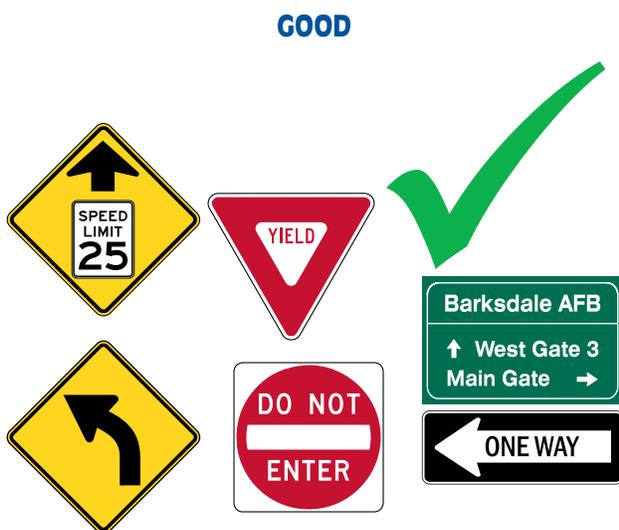


Exhibit 5: Sign Requirements

Requirements	Examples
Be Legible	<ul style="list-style-type: none"> ✓ Use symbol messages when available ✓ Use minimum 6-inch high lettering (except for signs like No Parking signs) ✓ Use the proper type legend from FHWA's <i>Standard Highway Signs</i> book
Be Visible	<ul style="list-style-type: none"> ✓ Space signs at intervals of at least 150 feet from other signs ✓ Orient signs to face approaching traffic ✓ Clear obstructions and roadside features such as vegetation and utility poles ✓ Require Type III retroreflective sheeting on new signs ✓ Replace or repair damaged or misaligned signs ✓ Replace signs at least every 10 or 12 years
Be Correctly Placed	<ul style="list-style-type: none"> ✓ Use proper lateral offset distance from the edge of the road ✓ Install signs at the proper height above the roadway surface ✓ Use an approved breakaway or yielding signpost and install in accordance with the manufacturer's recommendations ✓ Use overhead lane use signs for three or more lanes in one direction, or when a single lane can serve multiple movements

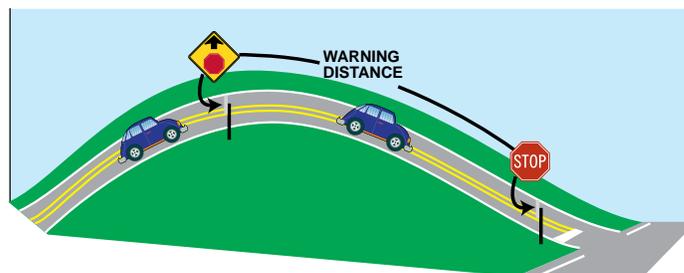
Allow Adequate Time for Proper Response

Signs should usually be spaced a minimum of 150 or 200 feet from other signs so that drivers have adequate time to read a sign before being confronted with another sign. This concept of trying not to overload the driver with too much information is sometimes referred to as “sign spreading.”

When installing a regulatory sign, such as a Speed Limit (R2-1) or Weight Limit (R12-1) sign, military installations should install a sign at the location where the restriction physically begins. In addition, military installations may need to install a warning sign in advance of the regulatory sign to allow drivers ample time to make necessary adjustments.

The placement of warning signs must allow these drivers sufficient time to see the sign, understand the intent, identify the potential hazard, decide what action must be taken, and then perform any necessary maneuver. Exhibit 6 (Table 2C-4 of the *MUTCD*) provides minimum recommended sign placement distances for warning signs.

When using Exhibit 6, note that Condition A is only for those situations where motorists may have to change lanes in heavy traffic.



Applicable signs using Condition A include:

- ✓ Merge (W4-1).
- ✓ Lane Reduction Transition (W4-2L, W4-2R).
- ✓ Entering Roadway Merge (W4-5).
- ✓ RIGHT LANE ENDS (W9-1).

The advance placement distances for Condition B are typically much smaller than the historical values used by traffic engineers. However, remember that these are minimum advance distances.

For Stop Ahead, Yield Ahead, Signal Ahead and Intersection Warning signs, use the advance distance for the “0 mph” advisory speed because some drivers may wish to turn at the intersection or may need to stop due to other stopped or turning traffic. For example, the minimum advance distance for a warning sign for a potential stop condition is 175 feet on a 45-mph roadway.

Exhibit 6: Minimum Advance Placement Distances for Warning Signs (MUTCD Table 2C-4)

Posted or 85th-Percentile Speed	Advance Placement Distance ¹								
	Condition A: Speed reduction and lane changing in heavy traffic ²	Condition B: Deceleration to the listed advisory speed (mph) for the condition ⁴							
		0 ³	10	20	30	40	50	60	70
20 mph	225 ft	N/A ⁵	N/A ⁵						
25 mph	325 ft	N/A ⁵	N/A ⁵	N/A ⁵					
30 mph	450 ft	N/A ⁵	N/A ⁵	N/A ⁵					
35 mph	550 ft	N/A ⁵	N/A ⁵	N/A ⁵	N/A ⁵				
40 mph	650 ft	125 ft	N/A ⁵	N/A ⁵	N/A ⁵				
45 mph	750 ft	175 ft	125 ft	N/A ⁵	N/A ⁵	N/A ⁵			
50 mph	850 ft	250 ft	200 ft	150 ft	100 ft	N/A ⁵			
55 mph	950 ft	325 ft	275 ft	225 ft	175 ft	100 ft	N/A ⁵		
60 mph	1100 ft	400 ft	350 ft	300 ft	250 ft	175 ft	N/A ⁵		
65 mph	1200 ft	475 ft	425 ft	400 ft	350 ft	275 ft	175 ft	N/A ⁵	
70 mph	1250 ft	550 ft	525 ft	500 ft	425 ft	350 ft	250 ft	150 ft	
75 mph	1350 ft	650 ft	625 ft	600 ft	525 ft	450 ft	350 ft	250 ft	100 ft

Notes:

1. The distances are adjusted for a sign legibility distance of 175 ft for Condition A. The distances for Condition B have been adjusted for a sign legibility distance of 250 ft, which is appropriate for an alignment warning symbol sign.
2. Typical conditions are locations where the road user must use extra time to adjust speed and change lanes in heavy traffic because of a complex driving situation. Typical signs are Merge and Right Lane Ends. The distances are determined by providing the driver a PIEV time of 14.0 to 14.5 seconds for vehicle maneuvers (2001 AASHTO Policy, Exhibit 3-3, Decision Sight Distance, Avoidance Maneuver E) minus the legibility distance of 175 ft for the appropriate sign.
3. Typical condition is the warning of a potential stop situation. Typical signs are Stop Ahead, Yield Ahead, Signal Ahead, and Intersection Warning signs. The distances are based on the 2001 AASHTO Policy, Stopping Sight Distance, Exhibit 3-1, providing a PIEV time of 2.5 seconds, a deceleration rate of 11.2 ft/second², minus the sign legibility distance of 175 ft.
4. Typical conditions are locations where the road user must decrease speed to maneuver through the warned condition. Typical signs are Turn, Curve, Reverse Turn, or Reverse Curve. The distance is determined by providing a 2.5 second PIEV time, a vehicle deceleration rate of 10 ft/second², minus the sign legibility distance of 250 ft.
5. No suggested distances are provided for these speeds, as the placement location is dependent on site conditions and other signing to provide an adequate advance warning for the driver.

Answer from Page 2

Multiple signs should not be installed on the same post unless they supplement one another, (e.g., it is acceptable to install a 3-WAY (R1-3) or ALL WAY (R1-4) plaque below a STOP sign, or an Advisory Speed (W13-1) plaque below a Curve sign). However, the signs in the photo do not supplement the STOP sign, and should not be used.

Although this type of sign installation is inappropriate, it would be much worse if similar signs were installed at a high-speed location instead of at a stop condition. Drivers would have absolutely no opportunity to read and comprehend the sign message while performing their normal driving tasks.

- ✓ Steel channel bar posts with a bolted connection at ground level.
- ✓ Wood posts, typically with two drilled holes to create a “shear plane” for the post to break if impacted by a vehicle.

Generally, a maximum of two of these posts can be used, and signs with areas greater than about 20 square feet generally require larger, more sophisticated sign support systems. Before ordering steel sign posts, require the manufacturer or distributor to provide the following:

- ✓ Certification that the sign post is approved by FHWA, including the maximum number of sign posts that may be within a 7-foot width.
- ✓ Documentation showing the maximum sign area that the sign post will support in your locale (the design wind speeds and soil conditions vary).
- ✓ Proper installation instructions.

Wood posts should be pressure-treated Yellow Pine or Douglas Fir lumber. Except for the 4"x4" size, wood posts require two holes drilled through the posts on the vertical center line of the post.

Other Considerations

Sign Posts

To reduce potential injuries and vehicle damage, all sign posts must be of an approved breakaway or yielding design as approved by the FHWA. The most common types of approved sign posts are:

- ✓ Steel square posts where the upper part nests inside a slightly larger anchor post.

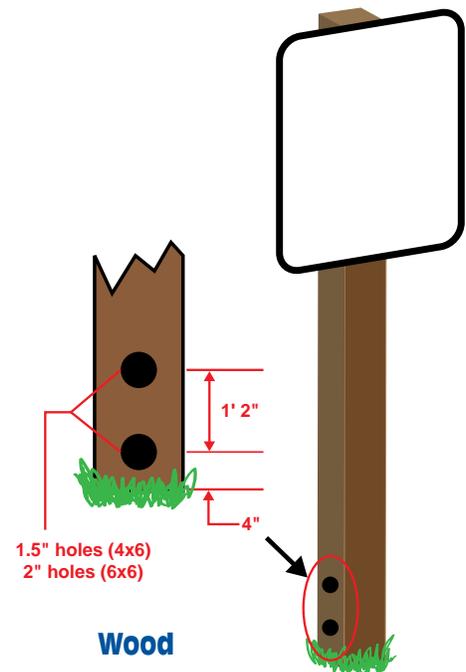
Breakaway Sign Posts



Steel Square



Steel Channel Bar



Wood

Attention-Getting Devices

When engineering judgment indicates that there is a need to draw additional attention to a regulatory or warning sign, there are several methods to accomplish this. First, it is permissible to attach a single flashing light to the top of the sign. However, the cost of running commercial power to a sign or replacing batteries is significant.

Section 2A.08 of the *MUTCD* allows the use of small light emitting diodes (LEDs) along the sign border or to supplement a symbol or word message of a regulatory, warning, or guide sign. To date, the effectiveness of these lights has not been studied and the relatively high cost per installation indicates that it may be beneficial to consider other measures.



Image provided courtesy of Traffic And Parking Control Co., Inc. TAPCO (www.tapconet.com)

For regulatory and warning signs, Section 2A.21 of the *MUTCD* allows strips of retroreflective sheeting material on the front side of sign posts to draw attention to signs. When used, the strips are a minimum of 2 inches wide, and applied from the bottom of the sign to within 2 feet of the bottom of the post. The color of a retroreflective strip must match the background color of the sign.

Plastic retroreflective sleeves are commercially available from several sources, and sign crews can generally use self-tapping screws to attach them to the posts. Depending on the type of sign post, a similar effect can be obtained by applying a strip of pressure-sensitive retroreflective sheeting directly to the posts.

These retroreflective strips are very effective at night, perhaps because they help define the physical location of the sign instead of allowing the sign to just float in the air. During daylight hours, the colored strips are also somewhat effective as an attention-getting device. Since these strips are relatively inexpensive and require no batteries or electricity, they currently are the recommended attention-getting device.



Contact Us

Phone:	DSN: 826-7418 ◆ Richard Quesenberry, P.E., PTOE Telephone: (757) 878-8654 E-mail: Richard.Quesenberry@sddc.army.mil
Fax:	Commercial: (757) 878-7885
E-mail:	Traffic@sddc.army.mil
Mailing Address:	SDDCTEA Attn: SDTE-SA Bldg. 661 Sheppard Place Fort Eustis, VA 23604

REFERENCE LIST

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- ❖ Surface Deployment and Distribution Command Transportation Engineering Agency, SDDCTEA. "Speed Limits" safety bulletin. Newport News, VA October 2006 ([http://www.tea.army.mil/pubs/nr/dod/bulletins/SpeedLimits\(Oct06\).pdf](http://www.tea.army.mil/pubs/nr/dod/bulletins/SpeedLimits(Oct06).pdf)).
- ❖ Surface Deployment and Distribution Command Transportation Engineering Agency, SDDCTEA. "Intersection Control" safety bulletin. Newport News, VA July 2007 ([http://www.tea.army.mil/pubs/nr/dod/bulletins/IntersectionControl\(Jul07\).pdf](http://www.tea.army.mil/pubs/nr/dod/bulletins/IntersectionControl(Jul07).pdf)).
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- ❖ www.fhwa.dot.gov
- ❖ www.tea.army.mil
- ❖ www.ite.org



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Georgia Institute of Technology	(404) 385-3501	www.gatech.edu
Northwestern University Center for Public Safety	(800) 323-4011	www.northwestern.edu/nucps/index.htm
Texas A&M University	(979) 845-3211	www.tamu.edu
University of Washington; College of Engineering	(206) 543-2100	www.engr.washington.edu/epp

Prepared with the assistance of  **Gannett Fleming**

Michael K. Williams
Director, SDDCTEA

DEPARTMENT OF THE ARMY

Military Surface Deployment and
Distribution Command Transportation
Engineering Agency
Bldg. 661 Sheppard Place
Ft. Eustis, VA 23604

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