PennDOT LTAP
technical
INFORMATION
SHEET #169
WINTER/2015

HORIZONTAL CURVE SAFETY:
Placement of Warning Signs

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Warning signs are intended to alert road users of changing conditions ahead. Just as important as the selection of the sign itself is the proper installation of a warning sign to ensure its effectiveness. All traffic signs should follow the guidelines for mounting height, lateral offset, and orientation outlined in the Manual on Uniform Traffic Control Devices (MUTCD) Chapter 2 and PennDOT Publication 111.

WARNING SIGNS AND OBJECT MARKERS
2009 MUTCD,
Chapter 2C

Placement of Advanced Horizontal Alignment (Curve) Warning Signs

Proper placement of a warning sign is necessary to allow for a driver's perception-response time. This refers to the distance traveled during the time required for a driver to identify a sign and react to its message. For horizontal alignment warning signs, this distance is determined by using Table 2C-4 in the MUTCD *(shown below)*.

The required distance from the curve is determined by noting the posted or 85th percentile speed on the left-hand column and the deceleration to the listed advisory speed for the condition (Condition B along the top of the table). The deceleration speed is the difference between the posted speed limit (or 85th percentile speed) and the advisory speed for the curve.

For example, if a road has a posted speed limit of 45 mph and a curve has an advisory speed of 25 mph, the deceleration to the listed advisory speed would be 20 mph. This value, along with the posted speed limit, determines an advance placement distance in this example of 100 feet. The advance placement distance is the distance before the beginning of the curve at which the sign should be placed. If the distance is "N/A" on the chart, the warning sign may be placed anywhere from the point of curvature up to 100 feet in advance of the curve and at least 100 feet from any other signs.

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							
		0[3]	10[4]	20[4]	30[4]	40[4]	50[4]	60[4]	70[4]
20 mph	225 ft	100 ft[6]	N/A[5]	—	—	—	—	—	—
25 mph	325 ft	100 ft[6]	N/A[5]	N/A[5]	—	—	—	—	—
30 mph	460 ft	100 ft[6]	N/A[5]	N/A[5]	—	—	—	—	—
35 mph	565 ft	100 ft[6]	N/A[5]	N/A[5]	N/A[5]	—	—	—	—
40 mph	670 ft	125 ft	100 ft[6]	100 ft[6]	N/A[5]	—	—	—	—
45 mph	775 ft	175 ft	125 ft	100 ft[6]	100 ft[6]	N/A[5]	—	—	—
50 mph	885 ft	250 ft	200 ft	175 ft	125 ft	100 ft[6]	—	—	—
55 mph	990 ft	325 ft	275 ft	225 ft	200 ft	125 ft	N/A[5]	—	—
60 mph	1,100 ft	400 ft	350 ft	325 ft	275 ft	200 ft	100 ft[6]	—	—
65 mph	1,200 ft	475 ft	450 ft	400 ft	350 ft	275 ft	200 ft	100 ft[6]	—
70 mph	1,250 ft	550 ft	525 ft	500 ft	450 ft	375 ft	275 ft	150 ft	—
75 mph	1,350 ft	650 ft	625 ft	600 ft	550 ft	475 ft	375 ft	250 ft	100 ft[6]

These distances take into consideration that the sign is visible to oncoming drivers for 250 feet. If the visibility of the warning sign is obstructed, the obstruction should be removed if possible, or the sign should be positioned so that it is visible. These values are also minimum values. If an obstruction, such as a utility pole, driveway, or other object, prevents the placement of the sign at the required distance, then the sign should be moved farther away from the curve, not closer. There is no maximum distance a warning sign may be installed in advance of a condition; however, engineering judgment should be used to ensure the sign is close enough to the curve so that a driver will not forget the message.

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Chevrons and Large Arrows

Depending on the severity of the curve, other warning signs may be warranted, and in some cases required, in addition to advanced horizontal alignment warning signs. Chevrons and large arrow signs are the most common additional warning signs. In addition to the standard sign guidelines in the MUTCD, PennDOT Publication 46, "Traffic Engineering Manual," Section 2.5, outlines the proper placement criteria of chevrons and large arrow signs.

Unlike advanced horizontal alignment warning signs, chevrons and large arrow signs are placed along the outside of the curve, not on tangent sections. It is important to orient the signs at 90-degree angles to approaching vehicles, not necessarily to the roadway at the location of the sign. Chevrons may be placed back-to-back on the same mounting hardware, but it is important to ensure both signs are oriented properly to approaching traffic. Mount the signs on separate posts if necessary.

The number and spacing of chevron signs is dependent on the degree of curvature. PennDOT Publication 46, Exhibit 2-8, *(see box at top right)* should be used to determine the spacing of chevrons along a curve, keeping in mind that two signs should be visible to drivers at all times. This may require additional signs or the removal of obstructions. The spacing can be based on any one of the three methods listed in Exhibit 2-8. If proper spacing cannot be achieved due to an obstruction (i.e., driveway, culvert, etc.), use engineering judgment to adjust the placement while still obtaining a good delineation of the curve.

Large arrows may be installed alone or as a replacement to one chevron sign. Large arrow signs should be considered for use on short, sharp turns. In accordance with PennDOT Publication 46, curves and turns up to about 350 feet in length can be satisfactorily signed with one W1-6 arrow sign in each direction. If they are used, they should be placed on the outside of the curve in line with approaching traffic.

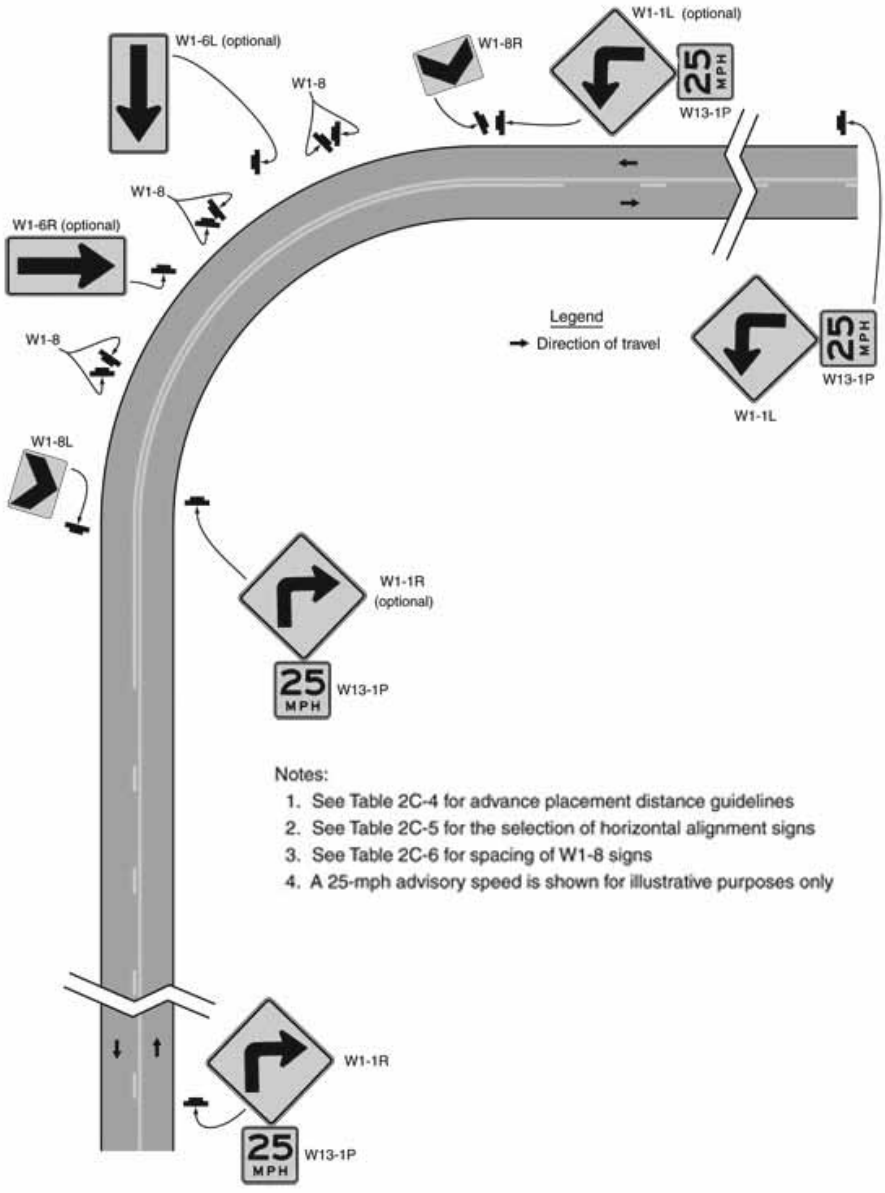
Figure 2C-2 from the MUTCD illustrates the placement of a number of horizontal alignment warning signs.

Exhibit 2-8 Suggested Spacing for W1-8 Signs

Method 1	Method 2	Method 3	Chevron Spacing (feet)
Curve Radius (feet)	Degree-of-Curve*	Curve Advisory Speed (mph)*	
< 200	> 28.6	≤ 15	40
200 - 400	14.3 -28.6	20 - 30	80
401 - 700	8.2 – 14.2	35 - 45	120
701 – 1250	4.6 – 8.1	50 - 60	160
> 1250	< 4.6	> 60	200

* "Degree-of-Curve" (D) is the measurement, in degrees, of the change in alignment over a 100-foot section of roadway. The degree-of-curve can be calculated by the formula D=5729.6/radius.

Figure 2C-2. Example of Warning Signs for a Turn



If you have any questions, you can call LTAP at 1-800-FOR-LTAP for assistance.