Traffic Engineering & Highway Safety Bulletin

Military Surface Deployment and Distribution Command Transportation Engineering Agency

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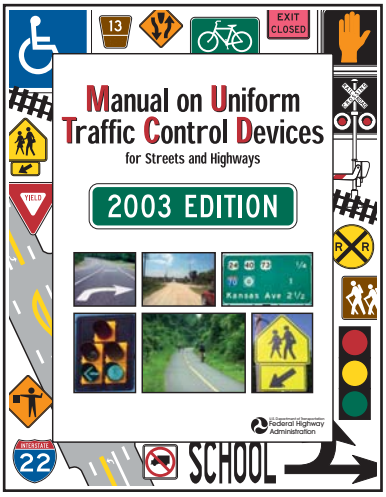
Speed Limits

Except for the stop sign, the speed limit sign is the most common type of traffic sign, but research shows that speed limits have little effect on the actual speed that motorists drive their vehicles. Moreover, the presence of an inappropriate speed limit increases the probability of crashes.

Speed Limit Basics

Most motorists select a speed that will allow them to arrive at their destination in the shortest time possible but without endangering themselves and others. As drivers, we select our speed by considering the roadway width and alignment, presence of intersections and driveways, roadside conditions, parked vehicles, pedestrian traffic, mix and density of vehicular traffic, weather, and other conditions. However, drivers pay almost no attention to *posted speed limits*, and studies have repeatedly proven that raising or lowering the speed limit has little effect on most drivers. All states have a law that requires a driver to operate his or her vehicle at a speed that is reasonable and prudent for existing conditions, regardless of the presence of a posted speed limit.

Speed differences between vehicles increase crash potential, and the greater the speed differences, the greater the damage when vehicles collide with one another. In a perfect world, everybody would drive at exactly the same speed at any given location.



Research shows that the safest speed limit approximates the *85th-percentile speed*, which is the speed that 85 percent of the free-flowing vehicles are traveling at or below. In reality, it is necessary to round the speed limit to the nearest 5-mph multiple at or below the 85th-percentile speed.

IN THIS ISSUE:

Did You Know?

- Most people will drive at a safe speed, even without a posted speed limit.
- An unrealistically low speed limit creates safety and enforcement problems.
- Most people will only obey an unusually low speed limit if they perceive a viable reason – either a safety issue or an above-average enforcement effort.
- The ideal speed limit is typically higher than the average speed of all vehicles.

Studies repeatedly show that establishing the speed limit below the 85th-percentile speed increases the number of crashes. The cause of this increase in crashes may be the direct result of a few drivers who actually attempt to obey the speed limit, which in turn frustrates other drivers and causes traffic queues and congestion, and the temptation to tailgate and pass slower vehicles.

Basing the speed limit on the 85th-percentile speed implies that 85 percent of the drivers travel at reasonable speeds. It also implies that we use a democratic process to establish speed limits where motorists vote for the speed limit with their right foot.

Although not as common as the 85th-percentile speed, another good indicator of an appropriate speed limit is the upper limit of the *pace*, which is defined as the 10-mph range of observed speeds with the largest percentage of free-flowing vehicles.

The basic reason to have a posted speed limit is to encourage speed uniformity and to provide a means to prosecute the few drivers that travel at excessive speeds and jeopardize the safety of others.

What is Wrong with This Sign?

Answer on Page 7

What is Speed Zoning?

Speed zoning is the process used to determine the proper speed limit. Every state uses the 85th-percentile speed as a major factor in selecting the appropriate speed limit; however, other factors such as roadside conditions, accident experience, and design speed are often considered.

All states have at least one *statutory speed limit* that may or may not require speed limit signs to make them enforceable. For example, a state may have statutory speed limits such as:

- 25 mph in urban business districts.
- 35 mph in residential districts.
- 70 mph on rural freeways.
- 55 mph on all other roadways.

However, agencies generally may revise these speed limits if they perform traffic-engineering studies that document that the speed limit should be higher or lower than the statutory provisions. Therefore, it is essential that installations know the specifics for their state to ensure that all posted speed limits are enforceable under your state's vehicle code. For example, you should know:

- Statutory speed limits.
- Required engineering and traffic studies.
- Maximum spacing intervals for speed limit signs.

Information regarding speed laws for your state is available via Massachusetts Institute of Technology at http://www.mit.edu/~jfc/laws.html. Generally, most states require engineering and traffic studies to determine the following:

- Prevailing vehicle speeds.
- Physical features of the roadway.
- Crash locations and crash rates.
- Any special safety concerns that may not be readily apparent to drivers; for example, limited sight distance.

Spot Speed Studies

Spot speed studies determine the speed distribution of vehicular traffic at a specific location. The most common method to determine vehicle speeds is with a radar speed gun.

To establish a regulatory speed limit, perform the spot speed studies on straight sections of roadway, away from intersections where congestion may slow traffic. Design the study to avoid influencing the speeds; for example, technicians with radar guns should not be visible to passing motorists, if possible.

Perform speed studies under ideal weather, road and traffic conditions, and without the presence of police vehicles or any restriction that could influence speeds.

As a rule-of-thumb, spot speed studies should include a minimum of 100 free-flowing vehicles, but if traffic volumes are very light you may reduce the sample to about 50 vehicles or a 2-hour sample. If there are traffic queues, record only the speed of the first vehicle in the queue since other vehicles are not free-flowing vehicles.

Use a data sheet, as shown in **Table 1**, to annotate the spot speed information. One advantage of recording the speeds of exactly 100 vehicles is the simplicity of determining the 85th-percentile speed. By examination, the 85th-percentile speed in **Table 1** is between 35 and 36 mph because 19 vehicles exceeded 35 mph and 12 vehicles exceeded 36 mph.

The Federal Highway Administration's *Manual on Uniform Traffic Control Devices* (*MUTCD*) indicates that the speed limit should be within 5 mph of the 85th-percentile speed. However, some states make provisions for reductions below the 85th-percentile speed if crash rates are abnormally high or if special safety concerns exist that may not be readily apparent to drivers. For example, drivers may be unaware of limited stopping sight distance or restricted sight distance from a side road.

Table 1. Radar Spot Speed Data

Speed (mph)	Record	No.	Cumulative Total
20			
21			
22			
23			
24			
25	//	2	2
26			
27	//	2	4
28	////	4	8
29	//	2	10
30	~~///~~ ~~///~~ //	12	22
31	~~///~~	5	27
32	~~///~~ ~~///~~	10	37
33	~~///~~ ~~///~~ ~~///~~ ////	19	56
34	~~///~~ ~~///~~ ~~///~~	15	71
35	~~///~~ ~~///~~ //	12	83
36	~~///~~ //	7	90
37	~~///~~	5	95
38	///	3	98
39			
40	//	2	100
41			
42			
43			
44			
45			
TOTALS		100	

Note: This column indicates that the 85th-percentile speed is between 35 and 36 mph.

Although installation personnel can collect spot speed data, only a qualified traffic engineer can actually set speed limits based on analyses of the data and through personal observations. If there are no extenuating circumstances, establish the speed limit to the nearest 5-mph increment at or below the 85th-percentile speed. For our example in **Table 1**, establish the speed limit at 35 mph.

By examination, the pace is the range of 28 to 37 mph. The upper limit (i.e., 37 mph) is also similar to the 85th-percentile speed, which also supports establishing a 35-mph speed limit.

Speed limits should generally apply to all vehicles, but under unusual situations, it is possible to establish a separate speed limit for trucks or large vehicles. However, as noted, the perfect scenario is to have all vehicles travel at the same speed.

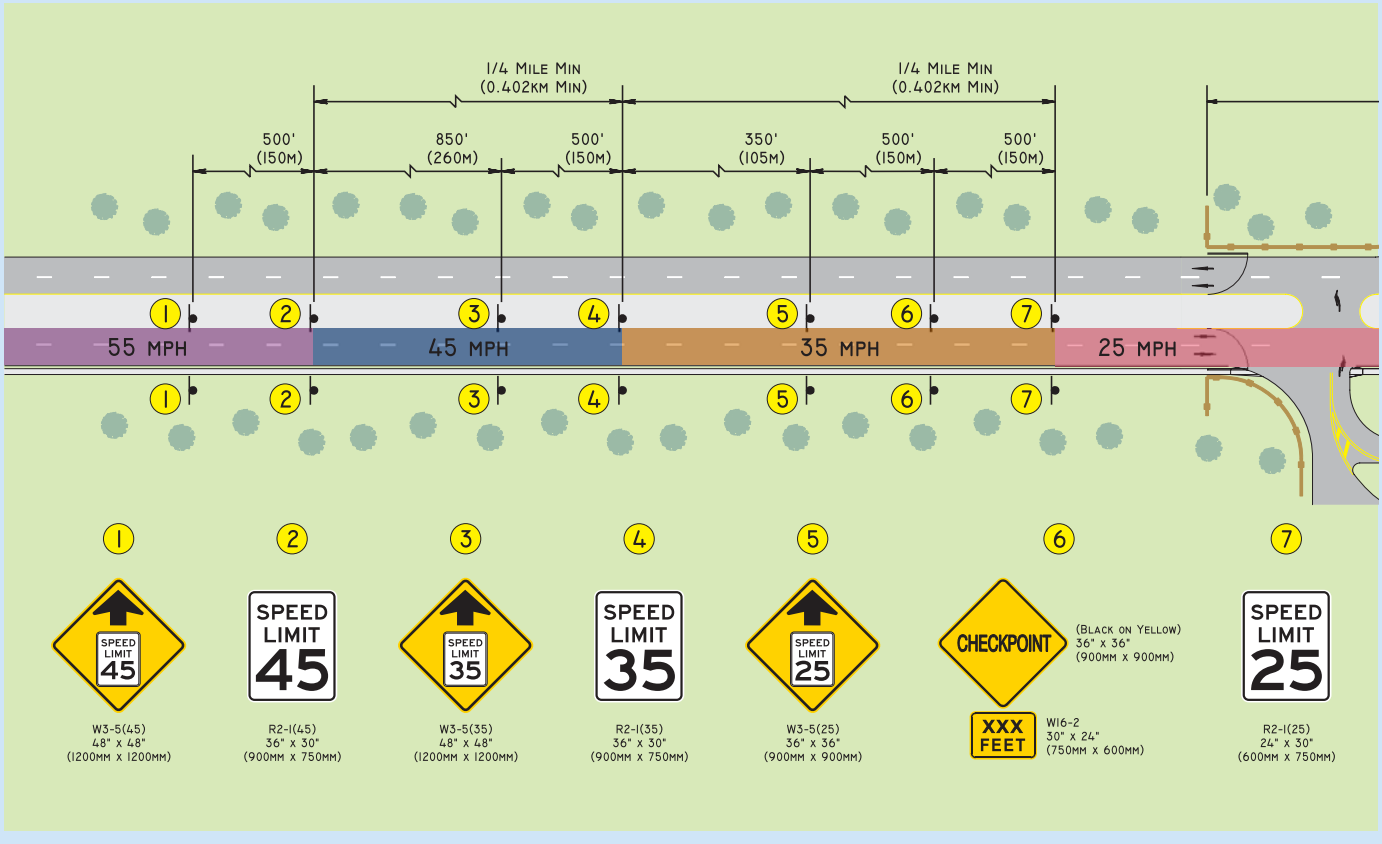
Some locations such as entry control facilities (ECFs) do not lend themselves to spot speed studies. However, based on an engineering and traffic study at many installations, it was determined that a 25-mph speed limit is appropriate in both directions within an ECF.

Although many installations desire to post speed limits at speeds less than 25 mph due to safety and security concerns, the consensus of traffic engineers is that lower speed limits do not improve safety. In addition, many state vehicle codes do not permit these limits, thus making such speed limits unenforceable. Therefore, a 25-mph speed limit is the lowest speed limit that you should use.

Transitional Speed Limit Reductions

When the reduction in the posted speed limits is greater than 15 mph, installations should use transitional signing to reduce the speed limit in steps

Figure 1. Transitional Speed Limit Reductions



to allow motorists to reduce their speed without having to apply their brakes. For example, if the speed limit is reduced from 55 mph to 25 mph, use the transitional signing as illustrated in **Figure 1**.

As illustrated, the recommended speed reduction would occur in three zones (55-45; 45-35; and 35-25), and each intermediate speed zone should be approximately one-quarter mile in length.

Speed Limit Signs

The standard Speed Limit (R2-1) sign is 24 by 30 inches. On roads with more than one travel lane in the same direction, it is a good idea to use a larger size such as 30 by 36 inches. You may also use larger sizes for additional emphasis at other locations.

Locate a speed limit sign at every location where the speed limit changes, and at intermediate locations as necessary to comply with any state requirements. Additional signs must be installed beyond major intersections and at other locations where it is necessary to remind the road users of the applicable speed limit. However, try to avoid placing a sign immediately in advance of a curve or turn, especially since warning signs may be present with a conflicting *advisory speed*; for example, an advisory speed on an Advisory Speed (W13-1) plaque.

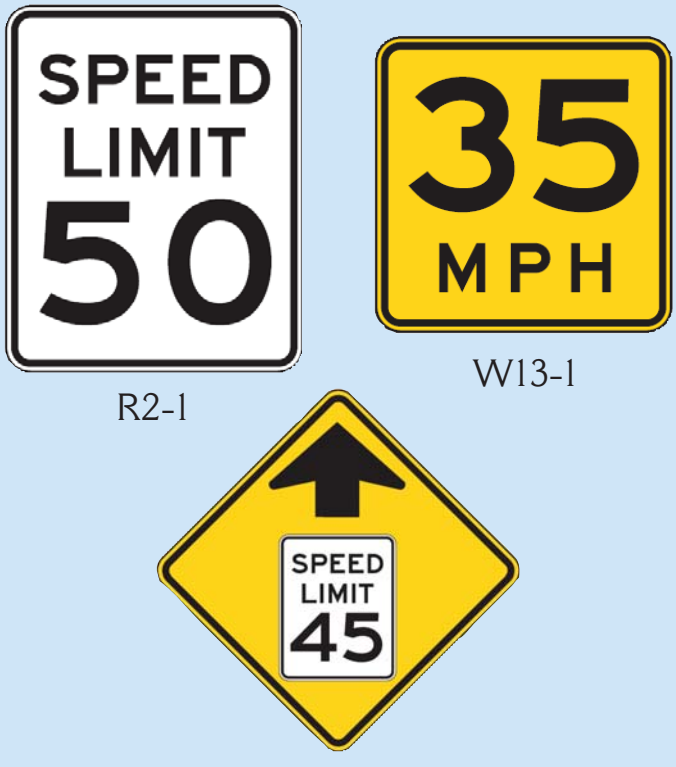
The *MUTCD* does not contain any maximum spacing requirements for Speed Limit signs, but many states have unique requirements that must be followed in order to enforce speed limits. In the absence of any specific state spacing requirements, installations are encouraged to use maximum 1-mile spacing for speed limits of 35 mph or lower, and maximum 3-mile spacing for higher speed limits.

Most states require advance signs to inform drivers of speed reductions, especially if the reduction is over 10 mph. Some states require unique regulatory signs in advance of speed reductions, but the trend is to use the new Speed Reduction (W3-5) sign as shown in **Figure 2**. Therefore, it is important to know the specific requirements for your state.

Engineering Expertise

The Surface Deployment and Distribution Command Transportation Engineering Agency (SDDCTEA) is available to help establish speed limits and to perform other engineering and traffic studies. Please feel free to contact our office for assistance.

Figure 2. Common Speed-Related Signs



Advisory Speeds

An advisory speed is a recommended safe speed. However, this speed is relative, since a speed that is safe or comfortable for a driver of a car may not be safe or comfortable for a truck driver; and the safe or comfortable speed for a driver of sports car may not be safe or comfortable for the driver of a family sedan. Therefore, an advisory speed is only a recommendation.

The most common application of an advisory speed is with the Advisory Speed (W13-1) plaque (see **Figure 2**) installed below the Turn (W1-1) sign or Curve (W1-2) sign (see **Figure 3**), but you may install a W13-1 plaque below any warning sign.

If a regulatory speed limit, as displayed by black-and-white signs, is not appropriate at a turn or curve, the appropriate advisory speed may either be determined by making several test drives around the turn or curve using a ball bank indicator (see **Figure 4**), or from the 85th-percentile speed on the curve. If using the ball bank indicator, find the maximum 5-mph speed increment that produces a reading that is equal to or less than 16 degrees.

If using the 85th-percentile speed on the turn or curve, the advisory speed should be the nearest multiple of 5 mph that is at or below the 85th-

Figure 3. Curve Sign with an Advisory Speed Limit Sign

W1-2 & W13-1

Figure 4. Ball Bank Indicator

Model 1023W1 Ball Bank Indicator, Courtesy of Rieker, Inc., ©2002-2006 Rieker® All Rights Reserved.

Definitions

Advisory speed. A recommended safe speed at a given location such as a curve, where the speed is shown on a warning sign.

85th-percentile speed. The numerical speed at which 85 percent of the sampling of free-flowing vehicles are traveling at or below. This speed should be determined by conducting a spot speed study during ideal conditions; i.e., daylight, dry roads, straight sections, and so on.

Pace. The 10-mph range of observed speeds with the largest percentage of free-flowing vehicles.

Posted speed limit. The numerical speed limit noted on regulatory signs placed along the roadway to which it applies.

Speed zoning. A structured process used to determine the proper speed limit, usually based on an engineering and traffic study.

Statutory speed limit. A speed limit established by law that applies to a specific class or category of road; such as, rural freeway, residential streets, business district, and so on, and in some cases does not even require speed limit signs to make it legally enforceable. Statutory speed limits are specific to each state.

percentile speed.

On the recommendation of a qualified traffic engineer, advisory speed plaques may be used at other locations such as below intersection signs like the Cross Road (W2-1) sign or the Side Road (W2-2) sign, or whenever the engineer determines that there may be a limited sight distance problem.

Regardless of the application or methodology, do not use an advisory speed unless it is at least 5 mph less than the posted speed limit or the statutory speed limit.

Other Speed Management Techniques

As noted in Section 10 of the *Traffic and Safety Engineering for Better Entry Control Facilities (SDDCTEA Pamphlet 55-15)*, the following applications will typically reduce speeds:

- Rumble strips.
- Speed humps and raised crosswalks.
- Textured crosswalks.
- Electronic speed warning signs; i.e., "YOUR SPEED IS 43 MPH."
- Flashing warning devices on warning signs.

However, the best approach is to design roads for the intended speed limit. For example, if there will be a lot of pedestrian activity, design the road for a 25-mph speed limit rather than a 55-mph speed limit. Narrow roads and roads with curves tend to reduce speeds.

SDDCTEA Can Help!

SDDCTEA highway engineers stand ready to help installations with their traffic engineering concerns—especially those involving high crash locations or access control. We perform many types of studies with an emphasis on low-cost improvements that are immediate or short-term and yield high benefits to their implementation costs. Generally, the studies conducted include the following:

- Access control
- Access roads
- Fatal crash analysis
- Force protection
- High crash locations
- Safety audits
- Signal operations
- Traffic calming evaluations
- Traffic engineering
- Traffic impact (such as BRAC)

Answer from Page 2

The speed limit sign is not legible during the day or night. The *MUTCD* states that traffic control devices need to meet the following five basic requirements:

(A) Fulfill a need.

(B) Command attention.

(C) Convey a clear, simple meaning.

(D) Command respect from road users.

(E) Give adequate time for proper response.

The sign illustrated on Page 2 does not fulfill requirements (B) and (D); therefore, the sign should be replaced.

REFERENCE LIST

- U.S. Department of Transportation, Federal Highway Administration. *Manual on Uniform Traffic Control Devices*. Washington, D.C. 2003 Edition (www.mutcd.fhwa.dot.gov).
- www.fhwa.dot.gov
- www.tea.army.mil
- www.ite.org
- Massachusetts Institute of Technology, "State Traffic and Speed Laws" (http://www.mit.edu/~jfc/laws.html).

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