STATE EXAMPLES FOR THE APPLICATION OF PORTABLE TEMPORARY RUMBLE STRIPS (PTRS) IN WORK ZONES

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American Traffic Safety Services Association

Photo Source: Getty

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ATSSA

SAFER ROADS SAVE LIVES

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Background

Portable Temporary Rumble Strips (PTRS) are raised transverse rumble strips that consist of intermittent, narrow, transverse areas of rough-textured surfaces and extend across the travel lane to alert drivers of work zone conditions ahead. These devices are different from other transverse rumble strips in that they stay in place under their own weight, do not attach to the pavement with adhesives or fasteners, and can be quickly installed and removed. PTRS use audible and vibratory stimuli to increase driver awareness when approaching flaggers positioned at lane closures on two-lane highways within a temporary traffic control zone. PTRS are designed for short-term and intermediate-term stationary applications such as flagging operations, while agencies often refer to "transverse rumble strips" as those that are fixed to the pavement for long-term applications (such as those applied to lane closures, narrowed lanes, or lane shifts).

Some PTRS weigh approximately 100 to 120 pounds per strip. The devices include hinged sections of equal length – approximately one foot by 4 feet and ¾ of an inch to one inch in height. When connected, some units include three sections that cover the width of a typical lane. Under normal conditions, their life expectancy is three to five years, and some are designed for posted speed limits up to 80 miles per hour.

The Manual on Uniform Traffic Control Devices (MUTCD) also provides guidance on the use of rumble strips (section 6F.87). Specifically, the MUTCD states that transverse rumble strips should not be placed on sharp horizontal or vertical curves or through pedestrian crossing or on bicycle routes. It also states that they should only be placed in locations where a minimum clear bicycle path of four feet is provided at each edge of the roadway or on paved shoulders.

In 2013, the American Traffic Safety Services Association (ATSSA) developed *Guidance for the Use of Temporary Rumble Strips in Work Zones*.[1] This document was timely in outlining the application of this relatively new innovative device for enhancing work zone safety. Since that time, agencies have developed guidelines for application of PTRS. In some cases, agencies require internal maintenance forces and external contractors to use PTRS under the appropriate conditions.

The purpose of this document is to supplement the 2013 ATSSA Guideline on PTRS with a summary of noteworthy practices on the implementation and requirements of the PTRS developed since the original document was published. It is also designed to provide detailed examples that facilitate greater implementation and standards development by other interested practitioners and agencies.

Figure 1. Installation of PTRS on a Flagging Operation (Source: VDOT)

[1] The American Traffic Safety Services Association, *Guidance for the Use of Temporary Rumble Strips in Work Zones* (September 2013). https://www.workzonesafety.org/files/documents/training/fhwa_wz_grant/atssa_temporary_rumble_strips.pdf

This document outlines state agency requirements and guidance on when to use PTRS for work zone applications, especially flagging operations. While several states have documentation and guidance, along with several years of experience with use (Iowa, Texas, Kansas, Massachusetts, Pennsylvania, Illinois, Maryland, Michigan, and Ohio), this document outlines practices in Virginia, Missouri, and California due to their detailed requirements. This document also provides a requirements comparison across the three featured owner-agencies.

Virginia Department of Transportation Application of PTRS in Work Zones

The Virginia Department of Transportation (VDOT) requires the use of PTRS on flagging operations from three to 72 hours in duration. For projects with a duration that exceeds 72 hours, the DOT and its contractors use a long-term transverse rumble strip that attaches to the pavement. The center-to-center spacing of the PTRS is 10, 15, or 20 feet, depending on the posted speed limit.

VDOT established the following criteria[2] for projects where PTRS are required when the conditions are met concurrently:

- Flagging on two-lane roads during daylight hours.
- Speed limits from 35 to 55 miles per hour (some devices are tested for posted speed limits up to 80 miles per hour; however, the VDOT roadways covered by the PTRS specifications would not include the higher speed limit range).
- Not a low volume road (500 ADT or higher – typically indicated by a marked centerline).

Based on the VDOT standard, PTRS are:

- *Recommended* on unmarked two-lane roads over 18 feet wide
- *Optional:*
    - Where the speed limit is less than 35 miles per hour
    - When using an automated flagging assistance device (AFAD) on a one-lane, two-way closure
    - at night, or
    - on divided four-lane highways (non-limited access, and requires approval of resident engineer).
- *Not required* during emergency activities or during inclement weather conditions.
- Black or white in color, unless they match the color of the pavement.
- Centered at the 'Be Prepared To Stop' sign in the standard VDOT flagger layout.

VDOT began researching PTRS in 2011, and has been testing and deploying these devices since 2014.

[2] Virginia Department of Transportation, *Instructional and Informational Memorandum* (October 2018). https://www.virginiadot.org/business/resources/IIM/TE-386_USE_OF_PTRS.pdf

Figure 2 outlines VDOT's Typical Application for PTRS during flagging operations.[3]

VDOT also established project criteria where PTRS should not be used. These situations include surface conditions such as loose gravel, 'bleeding' asphalt, heavily rutted pavement, or unpaved surfaces, and through pedestrian crossings or bicycle lanes.

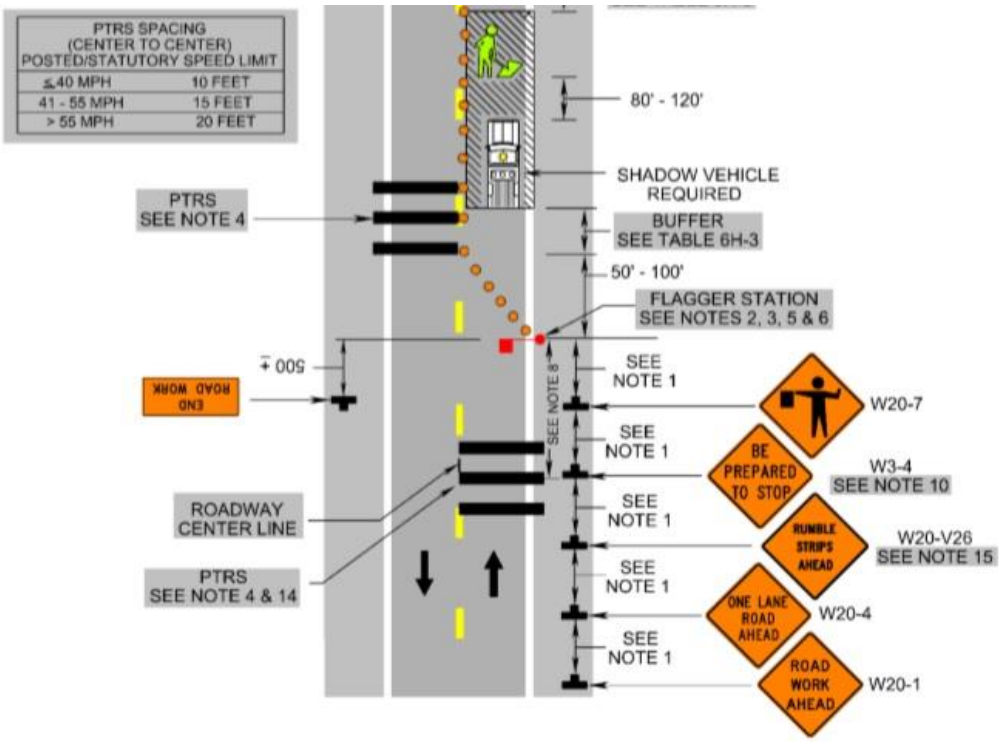


Figure 2. Excerpt from VDOT Typical Application for Flagging Operation Using PTRS (Source: Virginia WAPM)

VDOT's specification for PTRS states the device must be able to withstand crossing by up to an 80,000 pound truck, and not move more than 6 inches in an eight hour period. VDOT requires installation of the Rumble Strips Ahead (W20-V26) sign as part of the advance warning sign sequence.

VDOT began requiring PTRS in early 2019 to enhance work zone safety at one-lane, two-way taper approaches on two-lane roads. Other standard drawings from the VDOT Work Area Protection Manual, such as those for lane closures on multi-lane highways, also illustrate the application of PTRS in Virginia.

Utility companies and municipalities are not required to use PTRS in Virginia, though they may use them.

[3] Virginia Department of Transportation, *Work Area Protection Manual Revision 2 – TTC 23.2* (September 2019). https://www.virginiadot.org/business/resources/traffic_engineering/2011_WAPM_REV_2.pdf

Missouri Department of Transportation Application of PTRS in Work Zones

The Missouri Department of Transportation (MoDOT) guidelines describe PTRS as "short term rumble strips made to be portable and stable, without using adhesive or other anchoring."[4] The guidelines also describe the weight of the devices and recommend appropriate caution when handling short-term rumble strips by using proper lifting techniques. The policy requires that, when used in short-term operations, PTRS deployments include a set of three strips spaced at a minimum of 10 feet apart, center-to center. MoDOT also requires Special Provisions for long and short-term rumble strips when included in projects.

MoDOT outlines several work zone traffic control applications that are generally appropriate for consideration of PTRS, including: lane merge, lane shift, or reduced speed situations. The MoDOT Engineering Policy Guide (EPG) standards also indicate that the plans or drawings should provide the recommended distance ahead of the PTRS and the traffic feature in question. The location of the PTRS should be adjusted when needed to comply with the guidance or based on performance observations.

MoDOT guidance outlines that PTRS are used on roadways with a posted speed of 50 mph and above. They are optional for posted speed limits lower than 50 mph. MoDOT also suggests that PTRS not be placed on horizontal curves, and that care should be taken when placing the devices on vertical curves. Users should especially avoid placement at or beyond a steep crest. MoDOT policy also states they should not be used on heavily rutted roadways since the bottom surface of the PTRS would not be in complete contact with the roadway surface. MoDOT also recommends avoiding pedestrian crossings or bicycle routes, with guidelines for a clear path of four feet at each edge of the roadway or on each paved shoulder. This could include offsetting the PTRS from the center of the lane in order to provide a clear path.

MoDOT policy also states temporary rumble strips should not be placed where routine vehicle braking is expected on the rumble strips themselves. As noted, routine braking may cause displacement of the strips and require more effort than otherwise would be needed to keep them in place. In this case, relocating the rumble strips may be necessary if the displacement persists. MoDOT requires PTRS to be orange in color. Additional detail on MoDOT guidance is included in Figures 3 and 4.

[4] Missouri Department of Transportation, *Engineering Policy Guide – Section 616.6.87* (April 2020). https://epg.modot.org/index.php/616.6_Temporary_Traffic_Control_Zone_Devices_(MUTCD_6F)#616.6.87_Temporary_Rumble_Strips_.28MUTCD_6F.87.29

SPEED	SIGN SPACING (ft.)		TAPER LENGTH (ft.)		OPTIONAL	CHANNELIZER SPACING (ft.)	
Permanent Posted (mph)	Undivided (S)	Divided (S)	Shoulder (T1)	Lane (T2)	BUFFER LENGTH (ft.) (B)	Tapers	Buffer/ Work Areas
0-35	200	-	-	-	280	-	40
40-45	350	-	-	-	400	-	80
50-55	500	-	-	-	560	-	80
60-70	1000	-	-	-	840	-	120

NOTES:

See EPG 616.6.87 Temporary Rumble Strips for rumble strip guidance and locations.

Flagging operation can include human flaggers, automated flagger assistance devices, portable signal flagging devices and traffic control signals operations.

Review appropriate typical applications for signs, sign spacing, taper length, buffer length, channelizer spacing, TMAs, etc.

Temporary rumble strips shall be orange in color.

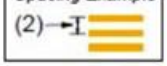
Long-term rumble strips shall consist of 5 strips separated at 10-12 ft. centers or manufacturer's recommendation.

Short-term rumble strips shall consist of 3 strips.

Two sets of rumble strips (3 & 4) may be used simultaneously or one set of rumble strips may be used. If one set of rumble strips are used, the preferred placement is at location (3)

Short-term Rumble Strips		
Speed (MPH)	Distance (ft.) (1)	Spacing (ft.) (2)
0 - 45 (Optional)	120	10
50 - 55	160	20
60 - 70	200	35

Spacing Example



Spacing (2) may need to be adjusted if temporary rumbles strips are sliding or moving.

Figure 3. MoDOT EPG Policy on Use of PTRS in Work Zones (Source: MoDOT Engineering Policy Guide)

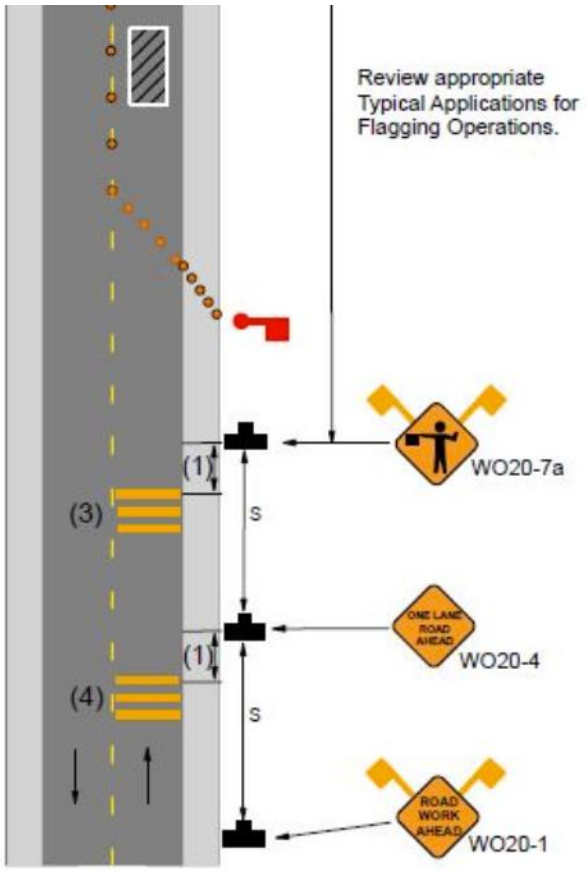


Figure 4. MoDOT Flagging Operation PTRS Guidelines (Source: MoDOT Engineering Policy Guide)

California Department of Transportation Application of PTRS in Work Zones

In 2014, the California Department of Transportation (Caltrans) published a memorandum on implementation of PTRS with supplemental special provision 12-3.19.[5] An evaluation of the effectiveness of PTRS led to the development of updated requirements for use in conjunction with flagging operations on two-lane highways. Caltrans also implemented Standard Plan Sheet T13 in 2010 to outline a typical application for flagging operations including: signing, flagger location, and channelizing device placement.[6] The standard detail includes PTRS located at the one-lane road ahead and flagger symbol advanced warning sign locations, along with guidance for six to 10 foot open spacing between strips.

When used, Caltrans requires that PTRS be used on straight sections of roadway, avoiding pedestrian crossings or bicycle lanes, and that they be readjusted when they shift or change alignment by more than six inches.

For two-lane flagging operations, PTRS are required for all construction, maintenance, and encroachment permit flagging operations on two-lane conventional highways. However, the devices are not required when one of the following conditions is met:

- The work duration is four hours or less.
- The posted speed limit is less than 45 miles per hour.
- Work is of an emergency response nature.
- The work zone is under snowy or icy weather conditions.

The four-hour work window was chosen as a balance between the enhancements to public and worker safety, along with the additional exposure experienced by workers installing the PTRS.

Summary

PTRS are a viable traffic control enhancement for multi-lane and two-lane highways. Some agencies are now requiring their use in an effort to improve flagger and worker safety at one-lane, two-way tapers. Agencies are also applying PTRS to lane closures on multi-lane highways. The primary focus is on reducing distracted driver incidents. An effectiveness study performed by Iowa State University showed that PTRS increased the overall percentage of drivers braking by a factor of three and reduced vehicle speeds by up to 5.5 miles per hour on the approaches.[7] All with minimal driver avoidance of the devices.

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[5] California Department of Transportation, *Memorandum on Implementation of Portable Transverse Rumble Strips* (September 2014). https://dot.ca.gov/-/media/dot-media/programs/traffic-operations/documents/memos-letters/f0018533-memo-portable-rumble-strips-9-18-14-a11y.pdf

[6] California Department of Transportation, *Flagging Instruction Handbook* (July 2020). https://dot.ca.gov/programs/construction/safety-traffic/flagging-handbook

[7] Roads and Bridges Magazine, *Report Indicates Temporary Portable Rumble Strips are Effective in Work Zones* (June 2017). https://www.roadsbridges.com/report-indicates-temporary-portable-rumble-strips-are-effective-work-zones

A common performance measure within agency specifications is that the PTRS be able to withstand an 80,000 pound vehicle without moving more than six inches in an eight hour period. Inspection and maintenance of the devices is an important consideration for implementation. In addition, consideration must be given to pedestrian and bicycle movements when determining appropriate use of PTRS in work zones.

The following table compares requirements and considerations across the three featured states for the application of PTRS in work zones.

Table 1. PTRS Specifications Summary by State (Source: VDOT, MoDOT, and Caltrans)

	Virginia DOT	Missouri DOT	Caltrans
Required?	Yes	No	Yes
Project Duration Requirements	Greater than 3 hours and less than 72 hours	Less than long term (72 hours)	Greater than 4 hours
Speed Limit	35 to 55 mph	50 mph and above	45 mph and above
Color	Black, white, or pavement color	Orange	Black or Orange
Exceptions	Emergency activity or inclement weather	Speeds less than 50 mph; heavily rutted pavements	Snow or ice conditions or emergency response activities
Spacing of PTRS units	10, 15, or 20 feet on centers depending on speed	10-12 feet on centers	6 to 10 feet of open space between edges