

Guidelines for Application of Rumble Strips and Rumble Stripes



I. INTRODUCTION

A. PURPOSE

The intent of these guidelines is to establish SHA's policy on the proper use and application of longitudinal rumble strips (shoulder and centerline), transverse rumble strips, and rumble stripes on Maryland's highway system. These guidelines replace previous directives and guidelines regarding rumble strips and rumble stripes, such as MSHA's Draft *Directive and Guidance on the Use of Longitudinal Rumble Strips* (date Revised May 14, 2002), and *Use of Temporary Transverse Rumble Strips in Work Zones* (SHAs Work Zone Safety Toolbox), and consolidates them with new information into a single document.

All future revisions to this document that may impact bicyclists shall require the notification to both the SHA Bicycle and Pedestrian Coordinator within the Office of Planning and Preliminary Engineering and the MDOT Director of Bicycle and Pedestrian Access within the Office of Planning and Capital Programming to gain their input on proposed changes.

B. TARGET USERS

State Highway Administration (SHA) staff/engineers, consultants, and local government agencies.

II. DEFINITIONS

Rumble Strips: Rumble strips are raised or grooved patterns on the roadway or shoulder that provide audible and vibratory warnings to drivers that their vehicles are leaving the driving lane or are approaching an unusual or unexpected traffic or road condition.

Shoulder Rumble Strips: Shoulder rumble strips are rumble strips that are placed on or adjacent to the shoulder to alert drivers that they are leaving the roadway.

Centerline Rumble Strips: Centerline rumble strips are rumble strips that are placed along the centerline of an undivided highway with pavement markings applied over top of the rumble strips to warn drivers that they are crossing the centerline.

Transverse Rumble Strips: Transverse rumble strips are rumble strips that extend across the travel lane to alert drivers to unusual traffic conditions.

Applied Rumble Strips: Applied rumble strips are rumble strips that are created by placing pavement marking tape or other product on the roadway surface.

Milled or Ground Rumble Strips: Milled or ground rumble strips are rumble strips that are created by milling or grinding depressions into the pavement.

Rumble Stripes: Rumble stripes are rumble strips created by placing edgeline pavement markings over top of rumble strips.

III. POTENTIAL APPLICATIONS

This document provides guidance on where and how to install rumble strips and rumble stripes. Except in unusual circumstances as determined by engineering judgment, these devices should be installed in accordance with this guidance. In addition to the guidelines described herein, implementation of rumble strips should conform to the applicable guidelines in the 2011 MdMUTCD section 6F.87. Typical 670.05 lists details on the minimum shoulder width criteria required for installation. If the shoulder width is deficient (deficient shoulder width is defined as shoulders where the lateral distance from the outside edge of the rumble strip to the outside edge of the shoulder is less than 4 feet or to the face of traffic barrier is less than 5 feet) to install shoulder rumble strips then consider installing rumble stripes.

A. SHOULDER RUMBLE STRIPS

Shoulder rumble strips may be used along roadways with shoulders to warn motorists that they are leaving the travel lanes. See attached flow chart of recommended procedure for determining installation of shoulder rumble strips/stripes as guidance.

1. Interstates, Expressways & Beltways

Shoulder rumble strips should be installed along the inside and/or outside shoulders of Interstates, Expressways or Beltways, with the following exceptions:

- An interstate, expressway or beltway having a posted speed limit of less than 40 mph
- An interstate, expressway or beltway where an engineering study finds that the installation of shoulder rumble strips is not feasible (e.g., because of shoulder width or condition), the potential safety benefits of rumble strips likely cannot be realized, or that other considerations, such as the use of the shoulder by bicyclists, outweigh the potential safety benefits of rumble strips.
- The shoulder is designated for use by buses or for other motor vehicle travel.
- As otherwise precluded in these guidelines.

2. Other Highways

Shoulder rumble strips should be installed along the inside and/or outside of other divided highways, and along the outside shoulder of undivided highways where the posted speed limit is 40 mph or greater, except as otherwise precluded in these guidelines. Unless an extraordinary circumstance exists, shoulder rumble strips should not be installed along highways where the posted speed limit is less than 40 mph.

3. Roadways Where Bicycles are Permitted

Along expressways where bicycles are expressly permitted to travel and along other highways where shoulder rumble strips are desirable, the accommodation of bicyclists must be considered. While rumble strips/stripes provide a safe, inexpensive, and efficient way to reduce run-off the road crashes for motorists, if used indiscriminately and/or improperly they can pose an impediment to safe bicycle travel. Along highways where bicycles are allowed to travel, care must be exercised in selecting rumble strips/stripes design and placement so as not to create obstacles and/or risks to cyclists. This should include considering the use of narrower and/or shallow strips/stripes, as shown in Shoulder Rumble Strip and Rumble Stripe Details (Detail Sheet 670.05).

The following apply to these highways:

Shoulder Widths

- Where the paved outside shoulder is five feet or greater in width, rumble strips are to be installed in accordance with the typicals shown in Section IV.A. of this document.
- Where the outside shoulder is less than five feet in width:
 - A determination shall be made regarding the actual need for rumble strips or stripes through the specific section based on collision history, horizontal and vertical alignment, etc.
 - If it is determined that rumble strips or stripes are desirable, rumble strips shall be used whenever possible to retain as much shoulder width as possible.
 - If, due to motorized traffic conditions, the use of rumble strips is the only treatment that will be effective, the Lead Project Manager shall make a formal Design Waiver request to use them, as described in the *Policy and Design Waiver Process for Bicycle*

Accommodations along State Highways, to the Director of the Office of Highway Development.

- Roadway corridors with segments that have deficient shoulder widths should not preclude the use of shoulder rumble strips for the entire corridor. Deficient shoulders are defined as shoulders where the lateral distance from the outside edge of the rumble strip to the outside edge of the shoulder is less than 4 feet or to the face of traffic barrier is less than 5 feet. In these segments rumble strips should not be installed for the length that the deficient shoulder exists. In determining the minimum clear width, consideration should be given to decreasing the width of the rumble strips and/or placing them closer to the roadway edge, and the use of rumble strips.
- Shoulder widths should be based on actual field measurements and not on reliance of widths shown on plans, as-builts, or inventories.

Gaps

- Gaps for bicyclists are not to be provided along highways where the posted speed limit is 55 mph or greater, except at intersections and/or at other locations as noted in this guideline.
- Although safety is maximized by continuous rumble strips, for highways where the posted speed limit is less than 55 mph, gaps for bicyclists shall be installed.
- Gaps, except at approaches to intersections, should be installed with a 60-foot pattern (12-foot gap following a 48-foot length of rumble strips). This pattern can be adjusted to accommodate specific milling equipment or for other sound reasons; however, the gap should not be less than 8 feet nor greater than 12 feet and gaps should not be spaced less than 36 feet or more than 60 feet apart.
- Gaps shall be provided on all roadways with rumble strips at all intersections (i.e. 3-legged, 4-legged, etc.) regardless of posted speed.
 - For lower speed roadways (less than or equal to 40 mph) gaps shall start 25 feet in advance of the point of curvature of intersections or at the beginning of the taper for the left/right-turn lane(s), and stop 25 feet beyond the intersection.
 - For higher speed roadways (greater than 40 mph) gaps shall start 50 feet in advance of the point of curvature of intersections or at the beginning of the taper for the left/right-turn lane(s), and stop 50 feet beyond the intersection.
 - Providing gaps at all intersections allows bicyclists to make turns onto side streets from mainline roadways with rumble strips with no gaps (due to their posted speed).
 - In addition, providing gaps at all intersections allows bicyclists from side streets to enter mainline roadways with rumble strips with no gaps (due to their posted speed).
 - All gap spacing shall conform to the requirements below.

Additional Guidance and Consideration

- If any given roadway has open section on one side of the roadway and closed section on other side, the open section side of the roadway should be considered for shoulder rumble strip installation. Based on engineering judgment, closed section or curbed side of the roadway may be considered for shoulder rumble strip/stripe installation as well.
- Noise from rumble strip hits should be considered when determining whether to install rumble strips or rumble stripes near residential areas or other sensitive receptors. This should be a secondary consideration to safety.
- Rumble strips or rumble stripes should not be installed where the surface condition is inadequate for their installation or, except for unusual circumstances, where resurfacing or other work that would substantially decrease the effectiveness of the strips is anticipated within the next two years. The Assistant District Engineers for Maintenance, Traffic and

Construction shall evaluate roadway pavement condition when planning and programming projects for rumble strip application.

- Consideration should be given to selecting the shallower depth rumble strips from the range provided in Shoulder Rumble Strip and Rumble Stripe Details (Detail Sheet 670.05). The shallower depth rumble strips provide benefits to bicyclists while still maintaining the audible and vibratory warning to motorists.
- Rumble stripes may be installed in lieu of shoulder rumble strips with the concurrence of the District Engineer. See Section III.E. for further discussion of Rumble Stripes.
- More experienced bicyclists have expressed desire to ride between the edgeline and the rumble strip to avoid debris that commonly collects along the shoulders to the right of the rumble strip. Keeping the shoulders reasonably free from debris through periodic brooming and by the prompt removal of disabled vehicles (within the limits of Maryland law) will encourage bicyclists to ride to the right of the rumble strip.

B. CENTERLINE RUMBLE STRIPS

Centerline rumble strips should be installed along an undivided highway with a 40 mph or greater posted speed limit and 10 foot or greater lane widths in a generally rural area unless, based on engineering judgment, it has been determined that their installation would not improve safety. See attached flow chart of recommended procedure for installation of centerline rumble strips as guidance.

Centerline rumble strips should NOT be installed:

- In the area of intersections with public roads. Centerline rumble strips should be stopped 25 to 50 feet (25 feet for lower speed roadways and up to 50 feet for higher speed roadways) in advance of the point of curvature of intersections or at the beginning of the taper for the left-turn lane.
- In areas with a high density of access points or in areas with short distances between access points.

Additional Guidance and Consideration

- Centerline rumble strips may be installed in passing zones; however, the noise impacts to residential areas nearby should be considered.
- Consideration must be given to bicycle travel and the potential impact of reducing the clear lane width where bicycles ride in the roadway.

C. Transverse rumble strips

Transverse rumble strips may be used to attract the driver's attention to unexpected conditions or to bring the driver's attention to other warning devices. Transverse rumble strips may be considered for the following conditions:

1. Approaches to Intersections (Signalized, Stop Controlled, Roundabouts)

Transverse rumble strips should be considered on the approaches to intersections where there is a demonstrated safety problem (e.g. high crash rate), adequate trial of other warning devices has failed to reduce the crash frequency, and any of the following conditions exist:

- Inadequate stopping sight distance or signal/sign visibility.
- Intersection is at an unexpected location.
- Intersection is located on a roadway on which motorists have not been required to stop for a long period of time or distance.

2. Approaches to Horizontal Curves

Transverse rumble strips should be considered on the approaches to horizontal curves where there is a demonstrated safety problem (e.g. high crash rate), adequate trial of other warning devices has failed to reduce the crash frequency, and any of the following conditions exist:

- A significant speed reduction from the posted speed limit is required to safely traverse the curve.
- Curve is located at an unexpected location.

3. Approaches to Reduced Speed Zones

Transverse rumble strips should be considered on the approaches to reduced speed zones where an engineering study finds that excessive speeding is a problem in a reduced speed zone and adequate trial of other regulatory devices has failed to reduce the occurrence of speeding. Factors that may indicate a need include:

- Posted speed reduction of 20 mph or greater.
- Entrance to a town, business district, or location where significant pedestrian activity is anticipated.
- The character of the roadway changes, such as at the end of a freeway.

4. Approaches to Toll Plazas

Transverse rumble strips should be considered on the approaches to Toll Plazas where motorists are required to stop or slow to pay a toll.

5. Approaches to Work Zones

Transverse rumble strips may be used in work zones in advance of detours, flaggers, lane splits, crossovers, lane transitions, exit only lanes, lane closures, temporary traffic signals, and locations with major reductions in speed limits. Transverse rumble strips are not generally used for short-term maintenance related construction. When installed on a temporary basis, rumble strips should be sufficiently durable to cover the period of need. When temporary rumble strips are no longer needed, they should be removed from the pavement and the pavement should be cleaned and restored to normal conditions.

Additional Guidance and Consideration

- Other less invasive measures should be tried before transverse rumble strips are recommended.
- Transverse rumble strips should not be placed on roadways where bicycles are permitted unless a minimum clear path of 4 feet is provided at each edge of the roadway or each paved shoulder as described in AASHTO's *Guide to the Development of Bicycle Facilities*.
- Transverse rumble strips may be supplemented with additional pavement marking warning messages such as "STOP AHEAD" or "SIGNAL AHEAD" where the purpose of the rumble strips may not be clear.
- The use of transverse rumble strips near residential areas or other sensitive noise receptors should be carefully evaluated.
- Transverse rumble strips should not be placed on sharp horizontal or vertical curves.
- The use of transverse rumble strips in shoulders to deter motorists from traveling in the shoulder for long distances where there is specific justification for their installation requires the written concurrence of the Director, Office of Traffic and Safety and the Director, Office of Maintenance. Transverse rumble strips should not be installed in shoulders where bicycle activity is anticipated.

D. RUMBLE STRIPS BETWEEN LANES

With specific justification and the concurrence of the Director, Office of Traffic and Safety and the Director, Office of Maintenance, rumble strips may be installed between adjacent lanes moving in the same direction at the following locations:

- Where there is a need to further discourage prohibited lane changing.
- Between the through lanes and collector/distributor lanes where there is no physical barrier.

E. RUMBLE STRIPES

For any roadway with a 40 mph or greater posted speed limit and 11 foot or greater lane widths, rumble stripes may be installed where due to the lack of shoulders or adequate shoulder width, shoulder rumble strip installation is not feasible. See attached flow chart of recommended procedure for determining installation of shoulder rumble strips/stripes as guidance. At the discretion of the District Engineer, rumble stripes may be installed in lieu of shoulder rumble strips on any roadway, regardless of the presence of adequate shoulders.

Along roadways where bicycles are expressly permitted to travel and along other highways where shoulder rumble stripes are installed, the accommodation of bicyclists must be considered. The conditions set forth in Section III.A.3. regarding gaps and additional considerations shall apply.

IV. DESIGN GUIDELINES

The following guidelines apply to the design and installation of all rumble strips and rumble stripes:

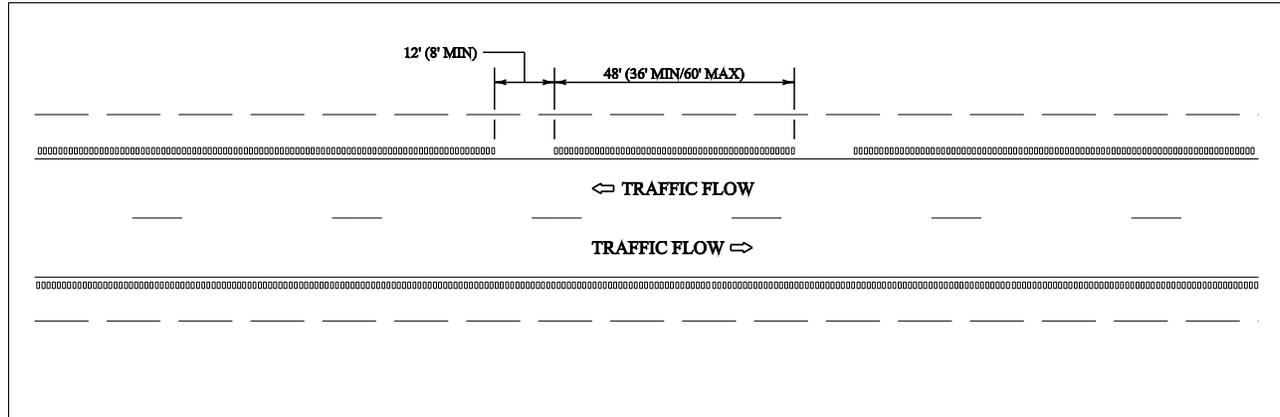
- Milled or ground rumble strips and rumble stripes are not to be installed on Portland Cement Concrete bridge decks or on Portland Cement Concrete bridge approach slabs.
- Milled or ground rumble strips and rumble stripes can be used on new or existing pavement. To retrofit rumble strips and rumble stripes on existing pavement, the pavement should be in sufficiently good condition to effectively accept the milling process without raveling or deteriorating. Otherwise the pavement should be upgraded prior to milling any desired rumble strips and rumble stripes. The Assistant District Engineers for Maintenance, Traffic and Construction shall evaluate roadway pavement condition when planning and programming projects for rumble strip and rumble stripe application.
- To the extent practicable, rumble strips and rumble stripes should avoid in-surface vehicle detectors and their leads, other highway wiring, raised pavement markers (RPMs), other traffic control devices, and other highway appurtenances.

A. SHOULDER RUMBLE STRIPS

Shoulder rumble strips are to be milled or ground into the pavement surface. With the concurrence of the Director, Office of Traffic and Safety and the Director, Office of Maintenance, applied shoulder rumble strips may be used on an experimental basis.

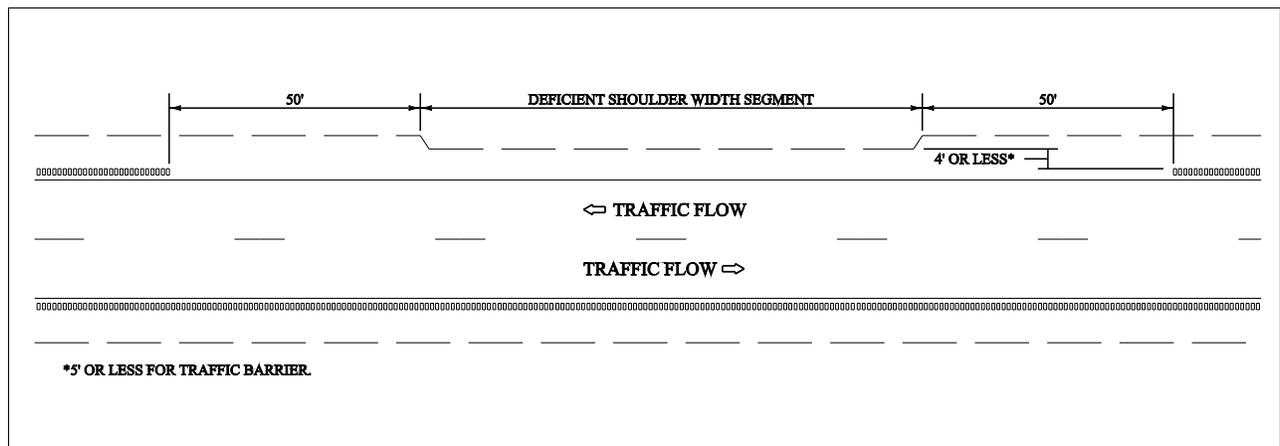
Where it is determined that gaps in shoulder rumble strips are required to accommodate bicycles (see Section III.3.), gap spacing should be installed as shown in Figure 1. Gaps in rumble stripes should be considered where appropriate or necessary to accommodate bicycles (i.e. areas with shoulders less than 4' in width being used by bicyclists), gap spacing should be installed as shown in Figure 1.

Figure 1 – Gap Spacing for Shoulder Rumble Strips and Rumble Strips to Accommodate Bicyclists



In roadway segments with deficient shoulder widths (defined as shoulders where the lateral distance from the outside edge of the rumble strip to the outside edge of the shoulder is less than 4 feet or to the face of traffic barrier is less than 5 feet) rumble strips should not be installed for the length that the deficient shoulder exists as shown in Figure 2.

Figure 2 – Shoulder Rumble Strips In Areas with Deficient Shoulder Widths



B. CENTERLINE RUMBLE STRIPS

Centerline rumble strips are to be milled or ground into the pavement surface with pavement marking material applied over top. With the concurrence of the Director, Office of Traffic and Safety and the Director, Office of Maintenance, applied centerline rumble strips may be used on an experimental basis.

Installation of centerline rumble strips should be coordinated with permanent pavement marking and RPM placement. Permanent pavement markings and RPMs should be installed after installation of the rumble strips is complete. Liquid applied pavement marking materials such as, thermoplastic or paint shall be used for centerline markings in conjunction with centerline rumble strips.

Centerline rumble strips should be spaced along the centerline of a roadway as shown in Centerline Rumble Strip Details and Typical Layout (Detail Sheet 670.06). Installation of raised pavement markers (RPMs) with centerline rumble strips is optional, as shown in Centerline Rumble Strip Details and Typical Layout (Detail Sheet 670.06).

Centerline rumble strips should be stopped 25 to 50 feet in advance of the point of curvature of intersections or at the beginning of the taper for the left-turn lane (25 feet for roadways with posted speed limits less than or equal to 45 MPH, and up to 50 feet for roadways with posted speed limits greater than 45 MPH).

C. TRANSVERSE RUMBLE STRIPS

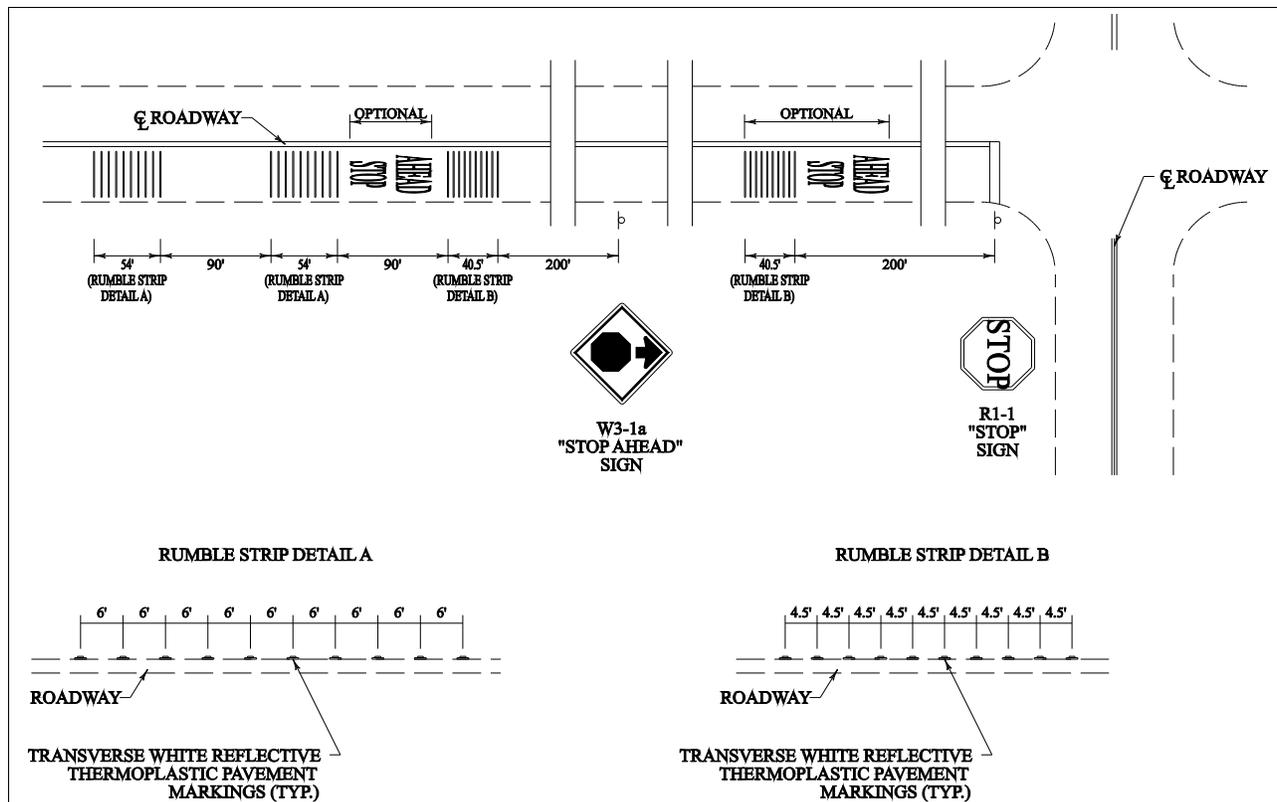
Transverse rumble strips are to be applied to the pavement surface with pavement marking material. Milled or ground transverse rumble strips may be used with the concurrence of the Director, Office of Traffic and Safety and the Director, Office of Maintenance. The guidelines described herein are applicable to applied transverse rumble strips.

Applied transverse rumble strips are created by placing two pieces of preformed pavement marking material on top of each other to obtain the desired thickness. Options include:

- Placing a 10” pavement marking strip on the pavement and then a 5” pavement marking strip on top of the 10” pavement marking strip.
- Placing two 5” pavement marking strips on the pavement applied on top of each other (more aggressive application).

Figure 3 shows an example of the recommended placement of applied transverse rumble strips on the approach to a "Stop Ahead" sign. The "STOP AHEAD" pavement markings and the two sets of rumble strips located after the "Stop Ahead" sign are optional. This same application could be used prior to other warning signs including "Signal Ahead", "Yield Ahead", "Roundabout Ahead", "Reduced Speed Ahead", and other traffic control devices.

Figure 3 – Transverse Rumble Strip Placement



D. RUMBLE STRIPS BETWEEN LANES

The specific design (width, spacing, lateral placement, etc.) of rumble strips to be installed between lanes should be selected based on the identified problems and specific traffic, roadway, and area conditions; and approved by the Director, Office of Traffic and Safety.

E. RUMBLE STRIPES

Rumble stripes are to be milled or ground into the pavement surface with pavement marking material applied over top.

Installation of rumble stripes should be coordinated with permanent pavement marking and RPM placement. Permanent pavement markings and RPMs shall be installed after installation of the rumble strips is complete. Typically thermoplastic or paint materials shall be used for rumble stripe markings. Preformed tape materials shall not be used for rumble stripe application.

Rumble stripes should be stopped 25 to 50 feet in advance of the point of curvature of intersections or at the beginning of the taper for the left-turn lane (25 feet for roadways with posted speed limits less than or equal to 45 MPH, and up to 50 feet for roadways with posted speed limits greater than 45 MPH).

One of the key considerations for the installation of rumble stripes is maintaining a minimum effective lane width. Effective lane width is defined as the clear distance between a pavement marking or centerline rumble strip on the left side of the travel lane and the rumble strip associated with the rumble stripe on the right side of the travel lane. The minimum effective lane width that should be maintained is 9' - 4". This is calculated assuming a minimum travel lane width (measured from the roadway centerline to the pavement joint/edge) of 11' and subtracting 8" for half the width of centerline rumble strips, 6" for the minimum offset for rumble strips from the pavement joint/edge, and 6" for the rumble strip/stripe width.

Another consideration for the installation of rumble stripes is maintaining the existing shoulder width for bicycle use, regardless of whether the width meets 48" minimum required by current standards. The intent is not to remove the current usable bicycle area in order to install rumble stripes. For roadways with no shoulders consideration should be given to bicycle accommodations with rumble stripes. See Section III.A.3. for further guidance.

F. DETAILS

Shoulder rumble strips, centerline rumble strips, transverse rumble strips, rumble strips between lanes, and rumble stripes are to be installed in accordance with the following details. These details, in some cases modify existing standard details. See the chart below for more information.

<i>Current Std. No.</i>	<i>New Detail No.</i>	<i>New Detail Title</i>	<i>Remarks</i>
670.00	670.00	LOCATION OF SHOULDER RUMBLE STRIPS	Revisions to current standard
670.01	n/a	n/a	<i>Standard to be deleted</i>
670.02	670.01	LOCATION OF SHOULDER RUMBLE STRIPS AT CRITICAL LOCATIONS	Revisions to current standard
n/a	670.02	OUTSIDE SHOULDER RUMBLE STRIP DETAILS TYPICAL LAYOUT	New detail
n/a	670.03	INSIDE SHOULDER RUMBLE STRIP DETAILS TYPICAL LAYOUT	New detail
n/a	670.04	RUMBLE STRIPE DETAILS TYPICAL LAYOUT	New detail
n/a	670.05	SHOULDER RUMBLE STRIP AND RUMBLE STRIPE DETAILS	New detail
n/a	670.06	CENTERLINE RUMBLE STRIP DETAILS AND TYPICAL LAYOUT	New detail

G. EXCLUSION FACTORS

The Districts may choose to exclude some segments of roadway based on the engineering judgment even though they qualify for Rumble Strips/Stripes installation based on guidance described in earlier sections of this document. However, the exclusions will have to be justified using the following exclusion factors for both centerline and edgeline rumble strips:

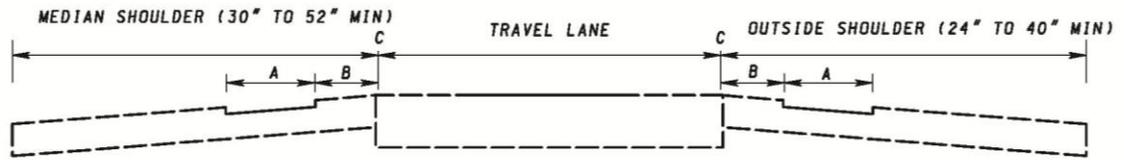
1. Centerline Rumble Strips

- Housing Density
- Reduced Speed Ahead Zone
- Sporting Event Location

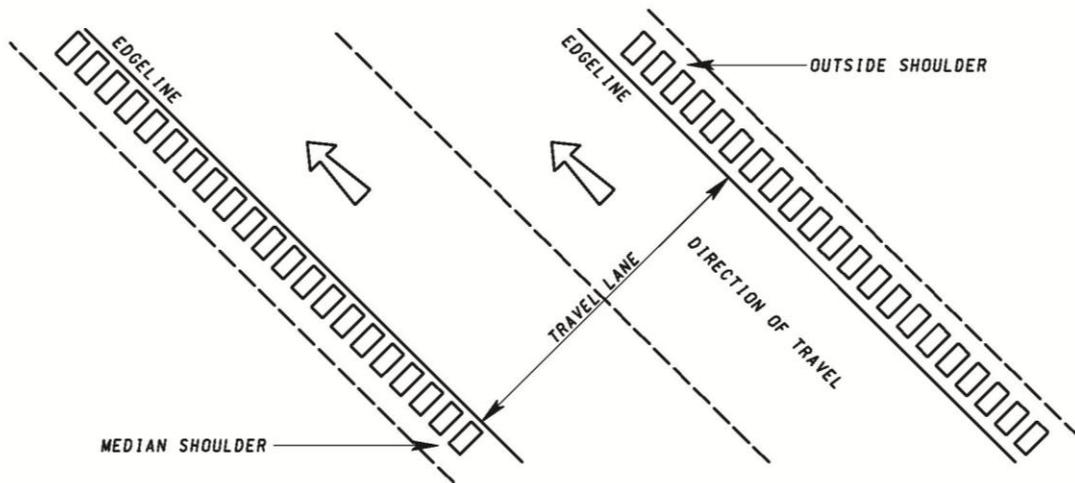
2. Shoulder Rumble Strips

- Poor Shoulder Condition
- Housing Density
- Reduced Speed Ahead Zone
- Sporting Event Location
- Shoulder Width Not Compatible With Bicycles

Disclaimer: The above factors are based on a D-6 pilot effort and there is potential to add more factors based on input from other Districts during Spring/Summer 2012.



- A. SEE DETAILS FOR SHOULDER RUMBLE STRIP DETAILS
- B. 6" - 12"
- C. EDGELINE

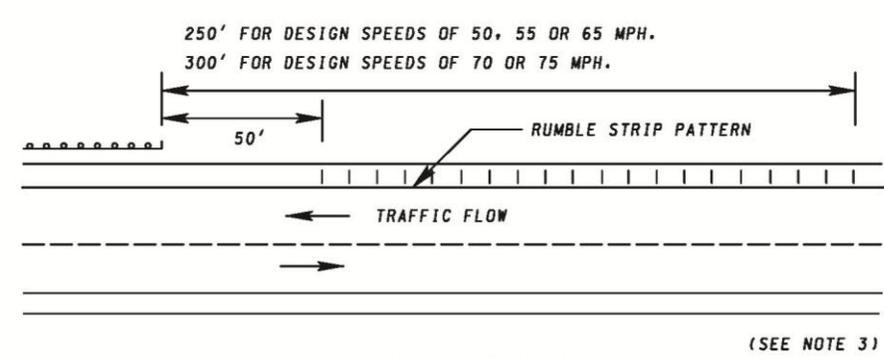
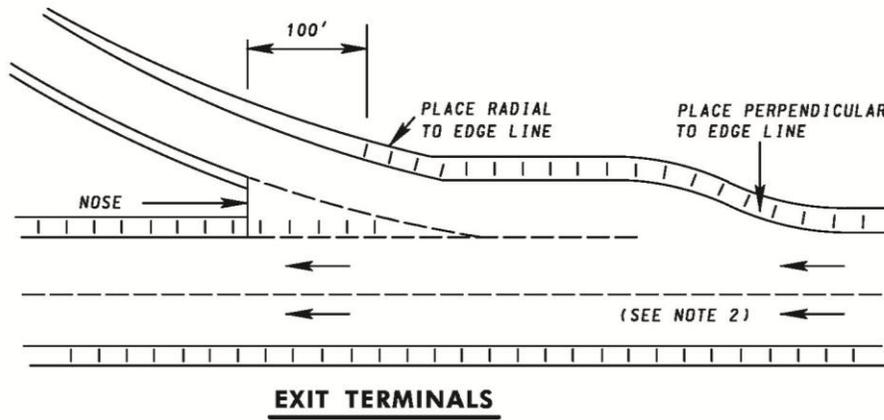
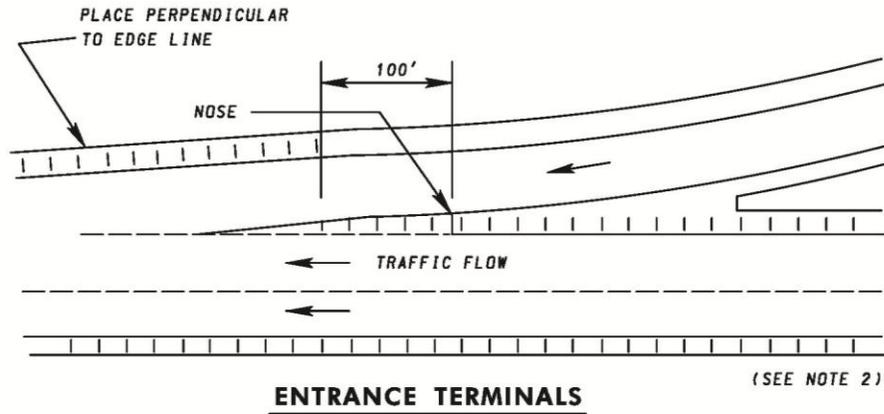


PLAN VIEW - EXPRESSWAYS

NOTES

1. THE RUMBLE STRIPS ARE FOR USE ON NEW OR EXISTING ASPHALT OR CONCRETE SHOULDERS. THE PATTERN IS DESIGNED SO THAT IT CAN BE MILLED OR GROUND INTO THE SHOULDER. SEE SPECIFICATIONS.
2. THE LEADING EDGE OF A RUMBLE STRIP SHOULD NOT BE CLOSER THAN 6" TO ANY JOINT, TRANSVERSE OR LONGITUDINAL, IN CONCRETE SHOULDERS.

		Maryland Department of Transportation STATE HIGHWAY ADMINISTRATION	
		LOCATION OF SHOULDER RUMBLE STRIPS	
		DETAIL SHEET	670.00



NOTES

1. SEE DETAILS FOR RUMBLE STRIP DETAILS.
2. AT ENTRANCE AND EXIT TERMINALS, THE OUTSIDE SHOULDER PATTERN SHOULD BE EXTENDED TOWARD THE RAMP JUNCTURE AS FAR AS POSSIBLE, AND THEN SHIFTED OVER TO THE OUTSIDE SHOULDER OF THE TERMINAL AREA. THE "NOSE" OF AN ENTRANCE OR EXIT TERMINAL IS A LOGICAL REFERENCE POINT. ON EITHER TERMINAL EXTEND THE PATTERN 100' INTO THE TERMINAL AREA AND THEN TRANSFER TO THE OUTSIDE SHOULDER.
3. RUMBLE STRIPS, WHEN USED IN ADVANCE OF CRITICAL LOCATIONS, SUCH AS APPROACHES TO NARROW BRIDGES, IN GORE AREAS, AND AHEAD OF TRAFFIC BARRIER END TREATMENTS, SHOULD BE PLACED AS SHOWN.

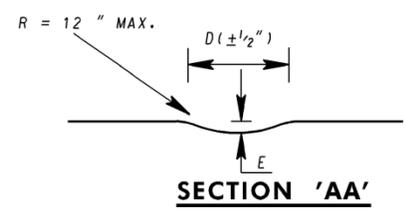
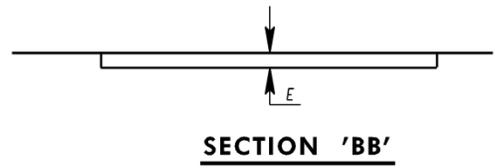
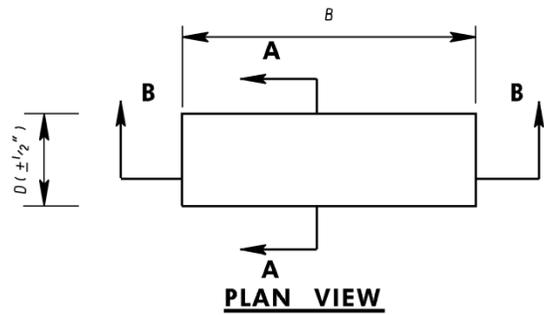
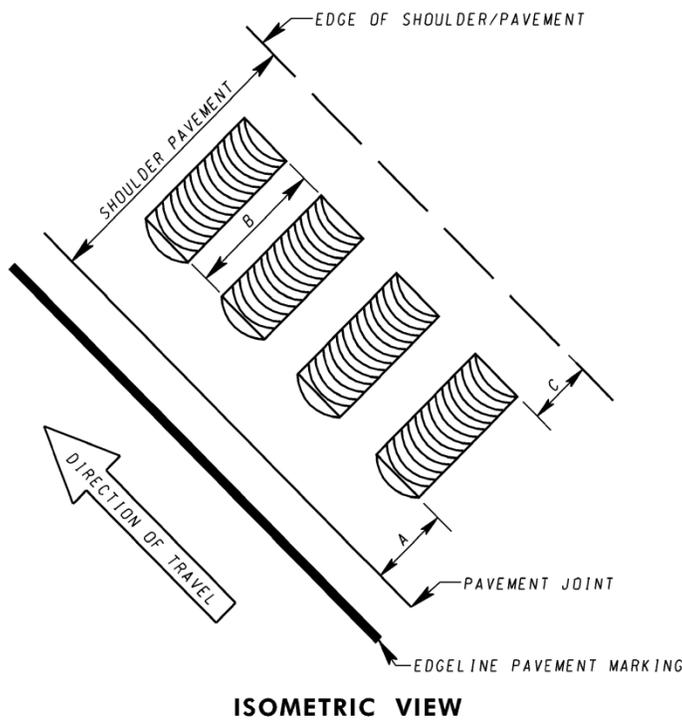


**Maryland Department of Transportation
STATE HIGHWAY ADMINISTRATION**

**LOCATION OF SHOULDER
RUMBLE STRIPS AT
CRITICAL LOCATIONS**

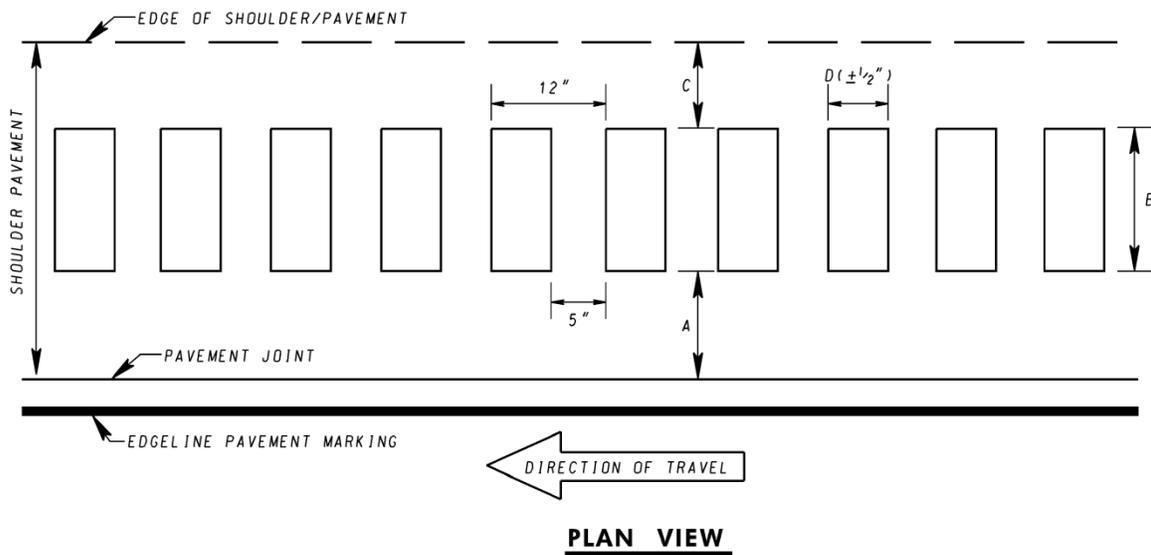
DETAIL SHEET

670.01



NOTE

SEE SHOULDER RUMBLE STRIP AND RUMBLE STRIPE DETAILS FOR MORE INFORMATION



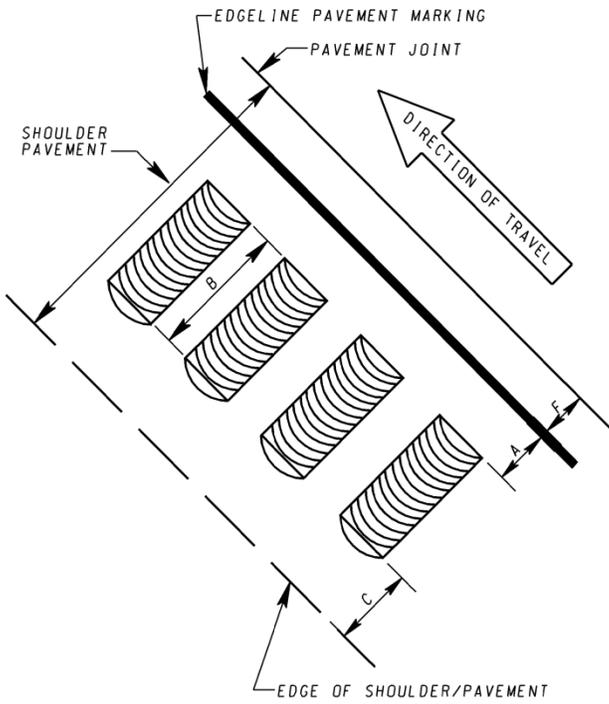
**Maryland Department of Transportation
STATE HIGHWAY ADMINISTRATION**

**OUTSIDE
SHOULDER RUMBLE STRIP DETAILS
TYPICAL LAYOUT**

DETAIL SHEET

670.02

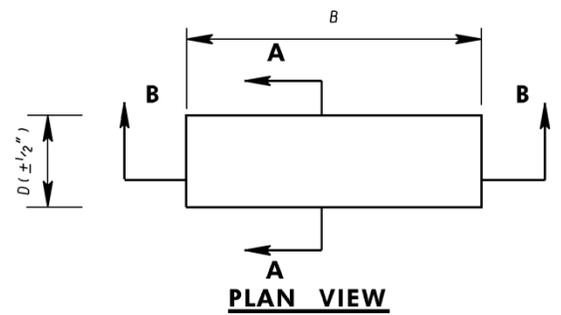




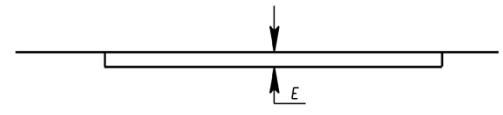
ISOMETRIC VIEW

NOTE

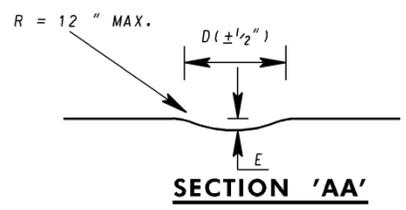
SEE SHOULDER RUMBLE STRIP AND RUMBLE STRIPE DETAILS FOR MORE INFORMATION



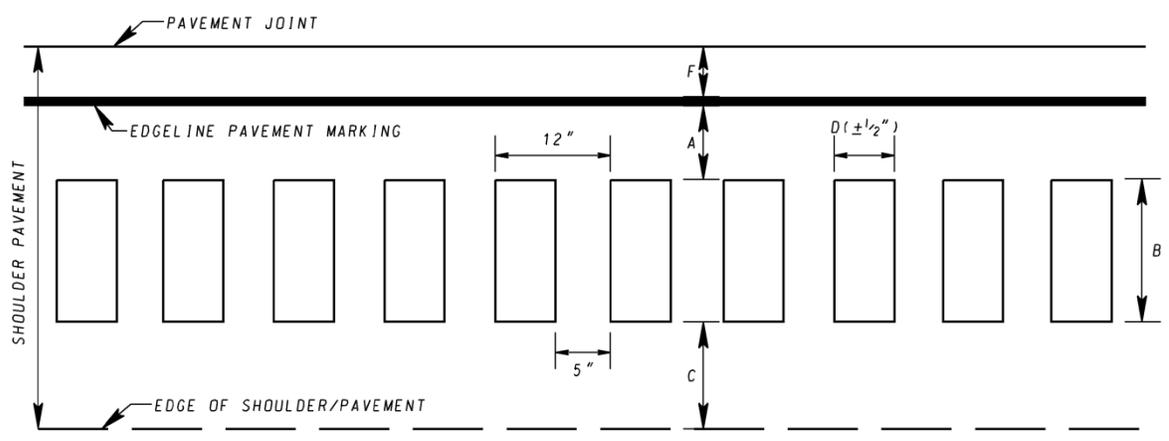
A PLAN VIEW



SECTION 'BB'



SECTION 'AA'



PLAN VIEW

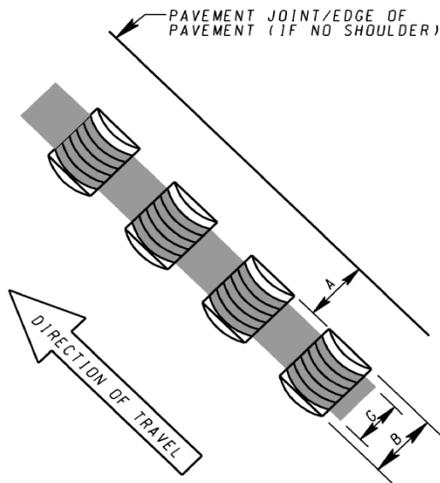
**Maryland Department of Transportation
STATE HIGHWAY ADMINISTRATION**

**INSIDE
SHOULDER RUMBLE STRIP DETAILS
TYPICAL LAYOUT**

DETAIL SHEET

670.03

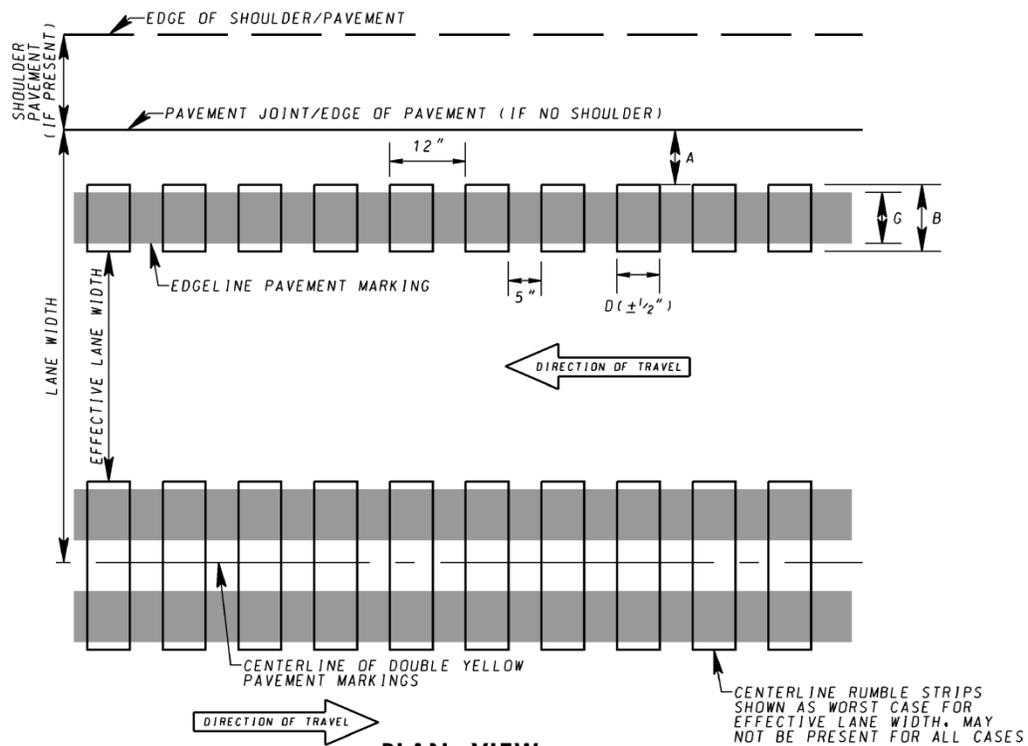




NOTES

1. SEE OUTSIDE/INSIDE SHOULDER RUMBLE STRIP DETAILS TYPICAL LAYOUT FOR RUMBLE STRIP DEPTH AND SECTION DETAILS.
2. EFFECTIVE LANE WIDTH IS MEASURED AS CLEAR DISTANCE BETWEEN OUTSIDE RUMBLE STRIP (TRAFFIC SIDE EDGE) AND INSIDE PAVEMENT MARKING (TRAFFIC SIDE EDGE) OR RUMBLE STRIP (TRAFFIC SIDE EDGE).
3. G = PAVEMENT MARKING WIDTH (TYPICALLY 5" OR 10"). RUMBLE STRIP WIDTH (B) VARIES ACCORDINGLY (6" FOR 5" MARKINGS, 12" FOR 10" MARKINGS). SEE SHOULDER RUMBLE STRIP AND RUMBLE STRIPE DETAILS FOR MORE INFORMATION.
4. SEE SHOULDER RUMBLE STRIP AND RUMBLE STRIPE DETAILS FOR MORE INFORMATION

ISOMETRIC VIEW



PLAN VIEW

**Maryland Department of Transportation
STATE HIGHWAY ADMINISTRATION**

**RUMBLE STRIPE DETAILS
TYPICAL LAYOUT**

DETAIL SHEET

670.04



OUTSIDE SHOULDER RUMBLE STRIP APPLICATION

ROADWAY TYPE * (SEE NOTES BELOW)	OFFSET FROM PAVEMENT JOINT TO RUMBLE STRIP	RUMBLE STRIP WIDTH	OFFSET FROM RUMBLE STRIP TO EDGE OF SHOULDER/PAVEMENT	RUMBLE STRIP LENGTH	RUMBLE STRIP DEPTH	MINIMUM SHOULDER PAVEMENT WIDTH
	A	B	C	D	E	
INTERSTATES OR EXPRESSWAYS * (POSTED SPEED GREATER THAN OR EQUAL TO 40 MPH)	6" MIN. 12" MAX.	12" MIN. 16" STD.	6" TO 12" MIN.	7"	1/2" MIN. 5/8" MAX.	VARIES 24" TO 40"
ALL OTHER HIGHWAYS * (POSTED SPEED EQUAL TO OR GREATER THAN 40 MPH AND LESS THAN OR EQUAL TO 55 MPH)	6" MIN. 12" MAX.	6" MIN. 12" STD.	48" MIN. REQUIRED	5" MIN. 7" STD.	3/8" MIN. FOR 5" LENGTH 1/2" MIN. - 5/8" MAX. FOR 7" LENGTH	VARIES 60" TO 72"

INSIDE SHOULDER RUMBLE STRIP APPLICATION

ROADWAY TYPE * (SEE NOTES BELOW)	OFFSET FROM PAVEMENT MARKING TO RUMBLE STRIP	RUMBLE STRIP WIDTH	OFFSET FROM RUMBLE STRIP TO EDGE OF SHOULDER/PAVEMENT	RUMBLE STRIP LENGTH	RUMBLE STRIP DEPTH	OFFSET FROM PAVEMENT JOINT TO PAVEMENT MARKING	MINIMUM SHOULDER PAVEMENT WIDTH
	A	B	C	D	E	F	
INTERSTATES OR EXPRESSWAYS * (POSTED SPEED GREATER THAN OR EQUAL TO 40 MPH)	6" MIN. 12" MAX.	12" MIN. 16" STD.	6" TO 12" MIN.	7"	1/2" MIN. 5/8" MAX.	1" MIN. 2" STD.	VARIES 30" TO 52"
ALL OTHER HIGHWAYS * (POSTED SPEED EQUAL TO OR GREATER THAN 40 MPH AND LESS THAN OR EQUAL TO 55 MPH)	6" MIN. 12" MAX.	6" MIN. 12" STD.	6" TO 12" MIN.	5" MIN. 7" STD.	3/8" MIN. FOR 5" LENGTH 1/2" MIN. - 5/8" MAX. FOR 7" LENGTH	1" MIN. 2" STD.	VARIES 24" TO 48"

RUMBLE STRIPE APPLICATION

ROADWAY TYPE * (SEE NOTES BELOW)	OFFSET FROM PAVEMENT JOINT TO RUMBLE STRIP	RUMBLE STRIP WIDTH	RUMBLE STRIP LENGTH	RUMBLE STRIP DEPTH	EFFECTIVE LANE WIDTH
	A	B	D	E	
INTERSTATES OR EXPRESSWAYS * (POSTED SPEED GREATER THAN OR EQUAL TO 40 MPH)	6" STD.	6" FOR 5" MARKINGS 12" FOR 10" MARKINGS	7"	1/2" MIN. 5/8" MAX.	9'-4" MIN. REQUIRED
ALL OTHER HIGHWAYS * (POSTED SPEED EQUAL TO OR GREATER THAN 40 MPH AND LESS THAN OR EQUAL TO 55 MPH)	6" STD.	6" FOR 5" MARKINGS 12" FOR 10" MARKINGS	5" MIN. 7" STD.	3/8" MIN. FOR 5" LENGTH 1/2" MIN. - 5/8" MAX. FOR 7" LENGTH	9'-4" MIN. REQUIRED

NOTES

1. BICYCLES ARE ASSUMED TO BE PROHIBITED FROM ALL INTERSTATES AND EXPRESSWAYS AS PER MD VEHICLE LAW.
2. IF BICYCLES ARE PERMITTED ON SEGMENTS OF INTERSTATES AND EXPRESSWAYS, REGARDLESS OF POSTED SPEED, RUMBLE STRIPS SHALL BE INSTALLED AS PER THE 'ALL OTHER HIGHWAYS' REQUIREMENTS.

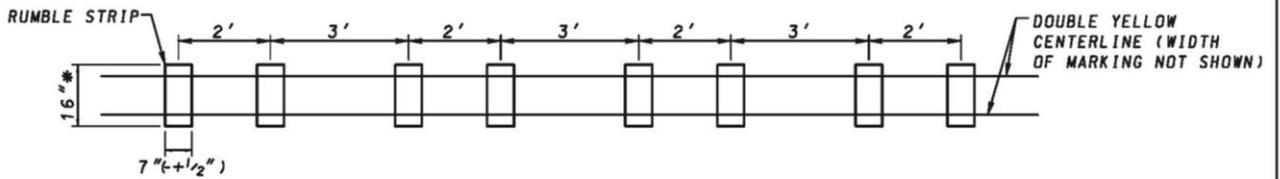
Maryland Department of Transportation STATE HIGHWAY ADMINISTRATION

SHOULDER RUMBLE STRIP AND RUMBLE STRIPE DETAILS

DETAIL SHEET

670.05

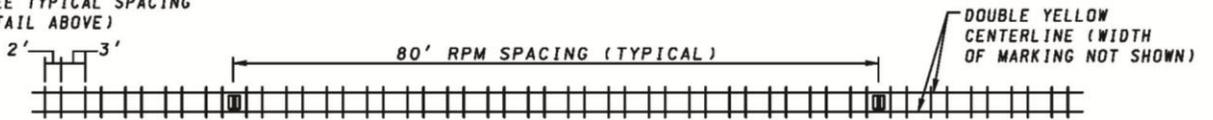




* - RUMBLE STRIP WIDTH MAY BE REDUCED TO 12" FOR ROADWAYS THAT HAVE ADJACENT TRAVEL LANES THAT ARE LESS THAN 12' IN WIDTH TO PROVIDE MORE EFFECTIVE LANE WIDTH

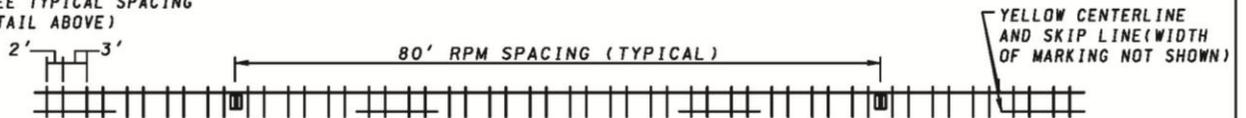
**TYPICAL SPACING DETAIL
(PLAN VIEW)**

RUMBLE STRIP LENGTH NOT SHOWN FOR CLARITY (SEE TYPICAL SPACING DETAIL ABOVE)



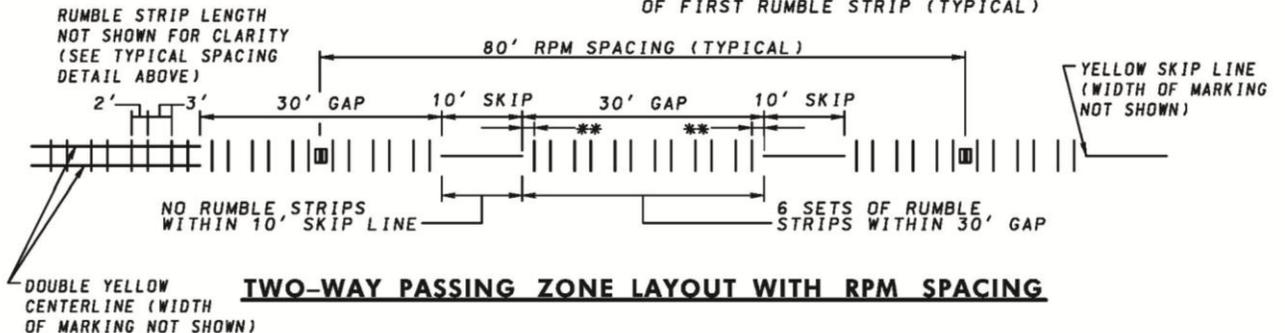
NON-PASSING LAYOUT WITH RPM SPACING

RUMBLE STRIP LENGTH NOT SHOWN FOR CLARITY (SEE TYPICAL SPACING DETAIL ABOVE)



SINGLE DIRECTION PASSING ZONE LAYOUT WITH RPM SPACING

** - 18" FROM EDGE OF SKIP TO CENTERLINE OF FIRST RUMBLE STRIP (TYPICAL)



TWO-WAY PASSING ZONE LAYOUT WITH RPM SPACING

**Maryland Department of Transportation
STATE HIGHWAY ADMINISTRATION**

**CENTERLINE RUMBLE STRIP DETAILS
AND TYPICAL LAYOUT**

DETAIL SHEET

670.06



SPECIAL PROVISIONS APPENDIX

- For Shoulder Rumble Strips – refer to Section 610 in Maryland State Highway Administration's Standard Specifications for Construction and Materials.
- For Centerline, Between Lane, and Edgeline Rumble Strips and Rumble Stripes – a copy of the latest Special Provision is provided for reference purposes only. Refer to the latest Special Provision from Maryland State Highway Administration's Office of Highway Development.
- For Transverse Rumble Strips – a copy of the latest Special Provision is provided for reference purposes only. Refer to the latest Special Provision from Maryland State Highway Administration's Office of Highway Development.

**CATEGORY 500
PAVING****CENTERLINE, BETWEEN LANE, AND EDGELINE
RUMBLE STRIPS AND RUMBLE STRIPES**

DESCRIPTION. Mill or grind rumble strips into existing hot mix asphalt or portland cement concrete roadways on the centerline strip, the between lanes, or at the edgeline at the specified locations. Rumble strips designated as Rumble Stripes will have pavement marking applied over the rumble strip

MATERIALS. Not Applicable.

CONSTRUCTION. Install rumble strips as specified or as directed.

Mill or grind centerline, between lane and edge line rumble strips into hot mix asphalt at a minimum rate of 4000 strips per hour, and into portland cement concrete at a minimum rate of 1000 strips per hour.

Rumble Stripes will have the pavement marking applied after the rumble strips are milled.

Equipment. Provide rotary type cutting heads with a maximum outside diameter of 24 in. and a length of 16 in. The cutting heads shall have the cutting tips arranged in a pattern providing a relatively smooth cut, approximately 1/16 in. between peaks and valleys. Provide cutting heads mounted on their own suspension, independent of the power unit, to allow the tool to self-align with the slope of the roadway and any irregularities in the roadway surface.

Provide cutting tools equipped with guides that provide consistent alignment of each cut in relation to the roadway, and provide uniformity throughout the project. The Engineer will randomly check the pattern edge alignment.

Control Strip. Mill or grind a minimum 100 ft control strip to demonstrate that the speed of operation, dimensions, and texture are acceptable.

Clean up. Clean pavement by sweeping or vacuuming the work area before the roadway is reopened to traffic. Remove all waste material resulting from the operation from the site, and disposed of it in an approved manner. Do not sweep the material to the side of the road.

MEASUREMENT AND PAYMENT. Centerline, Between Lane and Edgeline Rumble Strips in hot mix asphalt or portland cement concrete will be measured and paid for a the Contract unit price per linear foot as measured along the centerline where the rumble strips are actually placed. Payment will be full compensation for milling or grinding of rumble strips, cleaning and disposal of waste material, control strip installation, and for all material, labor, equipment, tools, and incidentals necessary to complete the work.

Pavement Marking Material for Rumble Stripes will be paid for as specified in the pavement marking item.

**CATEGORY 500
PAVING**

TRANSVERSE RUMBLE STRIPS

DESCRIPTION. Furnish and install heat applied preformed thermoplastic pavement marking lines to various surfaces to create transverse rumble strips as specified or as directed.

MATERIALS. Preformed Thermoplastic is a durable pavement marking material. Select all Preformed Thermoplastic Pavement Marking material shall be selected from the Qualified Products List.

Heat Applied Permanent Preformed Thermoplastic Pavement Marking Material	951.06
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CONSTRUCTION. Refer to Section 556.

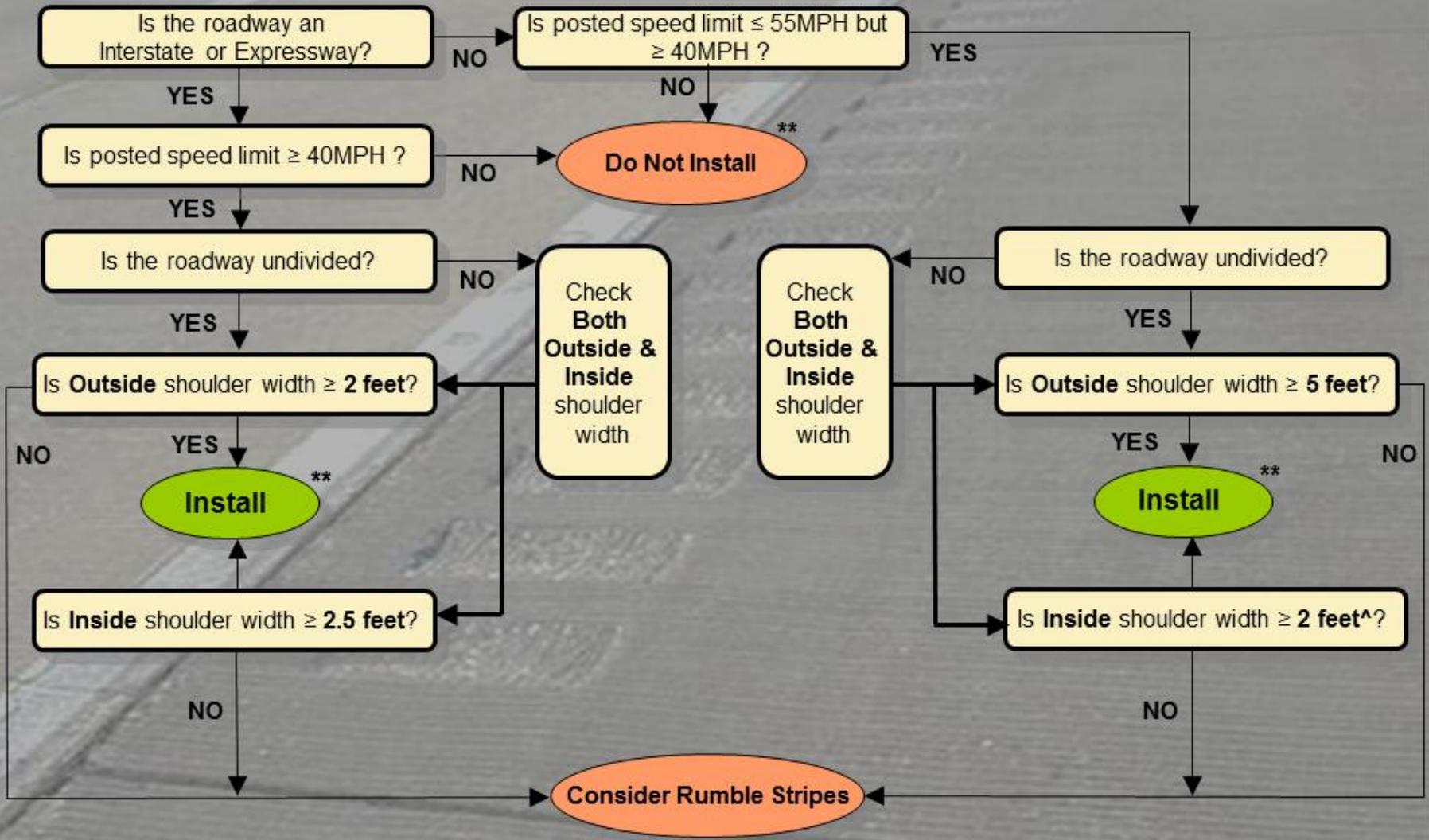
Cleaning Pavement Surfaces. Refer to 549.03.02.

Form Transverse Rumble Strips by placing two pieces or more of pavement marking material on top of each other to obtain the desired thickness as specified or as directed.

MEASUREMENT AND PAYMENT. Transverse Rumble Strips will be measured and paid for the actual length installed multiplied by the number of layers required to form each rumble strip within a set of rumble strips. Payment will be full compensation for all pavement preparation, color and width specified, markings, testing, and for all material, labor, equipment, tools, and incidentals necessary to complete the work.

Recommended Procedure for Determining Installation of Shoulder Rumble Strips/Rumble Stripes

Location: _____ Direction: _____
 Date: _____



****Use Engineering Judgment; ^Check for Bicycle Compatibility**

Recommended Procedure for Determining Installation of Centerline Rumble Strips

Location:

Direction:

Date:



** Use Engineering Judgment