

ROADSIDE

Edge Line Rumbles (1 of 2)

DESCRIPTION AND DEFINITION

Rumble Strips—Grooves cut into the paved shoulder outside the edge/fog line.



Rumble StripEs—Grooves cut into the outer edge of the traffic lane. The edge/fog line is placed on the grooves.

TYPICAL COSTS

Implementation Costs = \$3,000 per mile

SAFETY CHARACTERISTICS

The primary objective of edge line rumbles is to reduce the number of road departure crashes by enhancing drivers' ability to stay on the road. Over 700 miles of edge line rumbles have been installed in Minnesota, and over 200 are planned to be implemented in the year 2011.

Advantages

- Positive/tactile warning for drivers approaching the road edge
- Relative low cost compared to other safety strategies
- Rumble stripEs offer improved visibility during at night and in wet conditions
- Considered to be PROVEN effective at reducing road departure crashes

Disadvantages

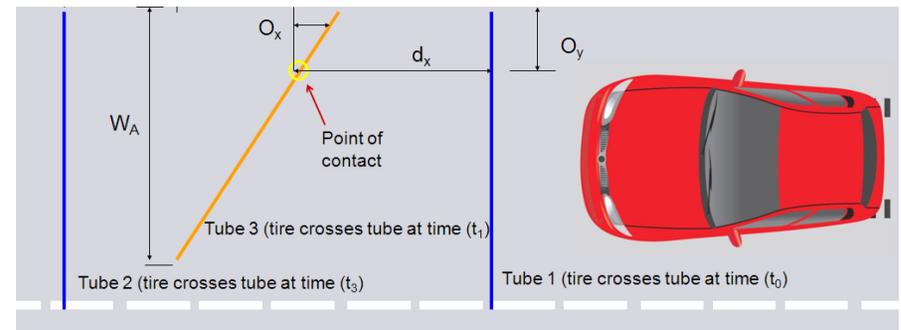
- Concern expressed by residents about noise
- Concern expressed by bicyclists about increased risk to riders
- Concern expressed by maintenance forces about road edge deterioration

PROVEN, TRIED, INEFFECTIVE, OR EXPERIMENTAL

- The edge line rumble strip is considered to be **PROVEN** effective at reducing road departure crashes. The Federal Highway Administrations Crash Modification Factors (CMF) Clearinghouse documents 12 studies with crash reduction ranging from 7 to 79 percent, with an average reduction in road departure crashes of 20 percent.
- One study in the CMF examines ways to reduce crashes on rural two-lane roadways in Minnesota. The documented crash reduction was 18 percent of severe road departure crashes.

ROADWAY OPERATIONS

A concern about the installation of edge line rumble strips is that they cause vehicles to move away from the edge of the road and may increase head-on collisions. Iowa State University recently completed an evaluation along two-lane roadways. The study found that there was a lateral displacement of approximately 7 inches. For vehicles between 6 and 8 feet wide on a 12-foot lane, a 7-inch displacement should not induce cross-centerline crashes.



Source: Evaluation of Rumble Stripes on Low-Volume Rural Roads in Iowa—Phase I, Iowa State University Institute for Transportation, Dr. Shauna Hallmark, July 2009.

DESIGN FEATURES

The following issues should be considered when implementing edge line rumble strips:

- **Noise**—A number of county engineers in Minnesota that have deployed edge line rumbles reported receiving several complaints about increased traffic noise levels



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associated with errant vehicles. A 2011 MnDOT study found that noise levels would likely increase by about 1 decibel—the equivalent of one heavy truck driving down the road. Observations in the Brainerd area found actual “hit rates” to be in the range of 0.5 to 1 percent of vehicles travelling along the roadway.

- **Bikes**—Bicycle advocates have expressed concerns that the installation of edge line rumble strips would be a hazard to bicyclists. The following bicycle-friendly patterns are recommended:
 - At locations with paved shoulder, move the rumble to the outside edge of the paved shoulder to provide space for the bicyclist to move between the roadway lane and shoulder without having to run over the rumbles.
 - At locations without a shoulder, consider bike-friendly designs (such as 48-foot grooves with a 12-foot skip) or adding narrow paved shoulder, moving the edge line to 11 feet, and adding the rumbles to the outside edge of the shoulder.

Additional design features to consider at these locations are:

- An 8-inch wide rumble should be used instead of the standard 16-inch
- Attempt to keep the depth of the rumble strips as close to $\frac{3}{8}$ -inch as possible
- For narrow 2-foot shoulders, keep the strip as close to the outside edge as possible without damaging the shoulder edge



Rumble strip layout for section without paved shoulders

TYPICAL CHARACTERISTICS OF CANDIDATE LOCATIONS

Typical candidate locations for rumble strips and stripEs are:

- Rural roadways
- Areas with low density of residential development (few noise sensitive receivers)
- Roadways with curvilinear alignment
- Specific horizontal curves
- Areas with few or no other noise sensitive receivers (lake cabins, golf courses, etc.)
- Roads with hazardous edges—no shoulder, lack of clear zones, etc.

AASHTO's *Roadside Design Guide* suggests a three-step prioritized approach to dealing with road departure crashes:

1. Improve road edges to keep drivers on the road
2. Improve clear zones
3. Improve highway hardware

Deployment of edge line rumbles strips is consistent with this prioritized approach, and is one of the least costly to implement.

BEST PRACTICE

Minnesota has adopted the intermittent pattern as its recommended approach to balancing the needs of addressing road departure crashes while still providing bicyclists with a reasonable opportunity to move between travel lanes and shoulders without having to cross the grooves of edge line rumble strips and stripEs.

SOURCES

- Evaluation of Rumble Strips on Low-Volume Rural Roads in Iowa – Phase I*, Institute for Transportation, Iowa State University, Hallmark, S. et. al., 2009.
- Guidance for the Design and Application of Shoulder & Centerline Rumble Strips*, NCHRP Report 641, 2009.
- Effects of Center-Line Rumble Strips on Non-Conventional Vehicles*, MnDOT Research Report 2008-07.
- Synthesis on the Effectiveness of Rumble Strips*, Minnesota Local Road Research Board, Report 200207, 2007.
- Identification of Causal Factors and Potential Countermeasures for Fatal Rural Crashes*, Minnesota Local Road Research Board, Report 200542, 2005.



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POLICY PURPOSE/INTRODUCTION

The purpose of this policy is to establish uniformity and consistency in the application, installation, and maintenance of roadway edge enhancements on <Insert Agency>'s roadway system.

In response to an overrepresentation of road departure crashes along the rural county highway system in Minnesota, <Insert Agency> identified a variety of potential mitigation strategies (as documented in the NCHRP 500 Series reports on implementation of AASHTO's *Strategic Highway Safety Plan* and in the Federal Highway Administration's Technical Memorandum on Consideration and Implementation of Proven Safety Countermeasures). Current safety-related guidance suggests that the first step in addressing road departure crashes involves considering the deployment of techniques and features along road edges that help keep vehicles on the road. The techniques include enhancing edge line pavement markings, enhancing delineation of highway curves, constructing wider or paved shoulders, providing a safety wedge as part of bituminous paving projects, and installing edge line rumble strips/stripEs.

Considering implementation costs and estimated effectiveness, the use of edge line rumble strips/stripEs has been selected as a targeted strategy for reducing the occurrence of road departure crashes along segments of rural county highways.

DEFINITIONS

Edge Line Rumble Strip—A 12- to 16-inch-wide grooved pattern, approximately ½ inch deep, constructed on the outside edge of the travelled lane or in the shoulder.

Edge Line Rumble StripE—An 8- to 12-inch-wide grooved pattern, approximately ½ inch deep, constructed on the outside edge of the travelled lane that contains the edge line pavement marking. Experience has demonstrated that installing the edge line pavement marking over the grooves of the rumble strip provides improved visibility of the marking at night and during wet conditions, as well as extends the life of the pavement marking material.

6-inch Wet Reflective Epoxy in Grooves—A 6-inch wet reflective epoxy marking within a groove. A contractor must cut a 20-millimeter groove in the edge of the pavement and then install a wet reflective marking within the groove. The wet reflective beads in the marking reflect light during wet conditions and better delineate road edges for driving in wet conditions. The groove protects the more expensive marking from damage by snowplows.

6-inch Latex Marking—A 6-inch road edge using latex paint.

Rural County Highways—Segments that are generally categorized as having a rural drainage system (ditches and culverts), a 55-mph speed limit, average daily traffic volumes under 3,500 vehicles per day, and low levels of development (farmsteads and low-density residential).

POLICY

It is <Insert Agency>'s long-term goal to reduce road departure crashes along all of the rural county and city highway system. Effective strategies to achieve this goal are the use of enhanced road edge treatments. Given that the rural system includes approximately ____ miles of <Insert Agency> highways, the total implementation costs could exceed millions of dollars. This level of funding will require using a phased approach to construct and install the edge line rumble strips/stripEs over several years, as funding permits.

<Insert Agency> will periodically evaluate the rural county highway system, based on traffic volumes, road departure crashes, and shoulder characteristics, and will establish a priority for implementation of edge line rumble strips/stripEs consistent with the following guidelines:

- Rumble strip—High-priority segments (more than 200 vehicles per day [vpd]) with existing shoulders
- Rumble stripE—High-priority segments (more than 200 vpd) with no paved shoulders and 12-foot lanes
- 6-inch wet reflective epoxy in grooves—High-priority segments (more than 200 vpd) with adjacent noise sensitive land uses
- 6-inch latex marking—High-priority segments with low volumes (less than 200 vpd)

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<Insert Agency>'s approach to implementing edge line rumble strips/stripEs will include two basic components:

1. Including safety strategies in traditional maintenance and regular construction projects.
2. Adding safety strategies by undertaking stand-alone projects that capitalize on securing state and federal highway safety improvement funds.

POLICY CRITERIA

Rumble strips in the travelled way have several potential pitfalls that should be considered carefully in any decision to implement them, including the following:

1. Noise that may disturb nearby residents
2. Potential loss-of-control problems for motorcyclists and bicyclists
3. Difficulties created for snowplow operations
4. Inappropriate driver responses, such as using the opposing travel lanes to drive around the rumble strips

Bicycle advocates have expressed concern on the use of edge line rumble strips/stripEs, citing a potential impact to their safety when bicycle tires cross over the grooves of the rumble strips/stripEs. A review of the highway traffic safety literature found several references to concerns about the interaction of bicyclists and edge line rumble strips/stripEs, but no documentation of any injuries or fatalities because of them.

However, in response to bicyclist's concerns, a number of states (including Alaska, Arizona, Colorado, Florida, Iowa, and Minnesota) developed and evaluated alternative rumble strip/stripE designs. The designs included a narrower

groove (between 4 and 12 inches instead of the typical 16 inches), a shallower profile (the lower end of MnDOT's specification range of 3/8 to 1/2 inch), and an intermittent pattern (48 feet with grooves followed by 12 feet without grooves). The literature goes on to indicate that most of the states that have implemented rumble strips/stripEs, including Minnesota, have dismissed the idea of using the narrower 4-inch grooves because there is not enough tactile sensation to adequately warn drivers.

Minnesota, as well as other states, has adopted the intermittent pattern as its recommended approach to balancing the need of addressing road departure crashes while still providing bicyclists a reasonable opportunity to move between travel lanes and shoulders without having to cross the grooves of the edge line rumble strip/stripE.

For locations designated as bike routes or routes with regular bike traffic, also consider:

- At locations with paved shoulder, moving the rumble to the outside edge of the paved shoulder to provide space for the bicyclist to move between the roadway lane and shoulder without having to run over the rumbles
- At locations without shoulders, consider bike-friendly designs (such as 48-foot grooves with a 12-foot skip) or adding a narrow paved shoulder, moving the edge line to 11 feet, and adding the rumbles to the outside edge of the shoulder.

FINANCIAL CONSIDERATIONS

Edge enhancements eligible for Highway Safety Improvement Program (HSIP) funding and state aid funds will require long-term maintenance.