Audible & Vibratory Treatment: Arterials and Collectors

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Webinar Topics:

- Introduction
  - Standard Plans Process
  - Terminology
- Overview of results from Developmental Phase
- Roadway Design Bulletin 18-03
  - Standard Plans
  - FDOT Design Manual (FDM)
  - Basis of Estimates (Pay Items)
- Typical Scenario Renderings
- Project-Specific Examples
Audible & Vibratory Treatment: Arterials and Collectors

Standard Plans process and procedures are now clearly described in FDM 115:

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<thead>
<tr>
<th>FDOT Design Manual</th>
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<tr>
<td>To view the Implementation Bulletin for the 2018 FDM, please see <a href="#">RDB17-12</a></td>
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<tr>
<th>Development and Processes - Complete FDM Part 1 (<a href="#">Link</a>)</th>
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Audible & Vibratory Treatment: Arterials and Collectors

Terminology:

- **Rumble Striping**
  - Ground-in Rumble Strip is in-line with pavement marking

- **Rumble Strips**
  - Refers to the ground-in rumble strip only, regardless of location of pavement marking
  - With new policy, either condition could be specified

- **Profiled Thermoplastic**
  - Thermoplastic bumps are always in line with thermoplastic pavement marking

- **Audible and Vibratory Treatment (AVT)**
  - General term which refers to both Ground-in Rumble Strips and Profiled Thermoplastic
Steps taken since the initial release of Rumble Striping:

- Released Roadway Design Bulletin 16-07
  - Pulled the Design Standard back to a Developmental phase
  - Reduced the depth of the cylindrical patterns from ½” to 3/16”
  - Created new details to move rumble strips into shoulder where possible
  - Reviewed all projects in design and construction for context, made adjustments to reduce noise pollution based on context
- Performed noise testing on various patterns and depths
- Researched what other states are doing to reduce noise pollution
- Used experience gained in the noise testing and the review of all projects to draft the policy
- Worked closely with Districts to ensure policy met their needs
- Studied optional ground-in sinusoidal patterns to further reduce noise pollution

* Note: These requirements are applicable to flush-shoulder arterials and collectors with a posted speed of 50 MPH or greater; All rigid shoulder roadways will use Profiled Thermoplastic.
Audible & Vibratory Treatment: Arterials and Collectors

Depth of Cylindrical Rumble Strips for Arterials and Collectors:

- Depth has been reduced from 1/2” to 3/16”
- Approx. 6 decibels above typical road noise
  - Sinusoidal Rumble Strips: Approx. 4 decibels
  - Profiled Thermoplastic: Approx. 2 decibels
Audible & Vibratory Treatment: Arterials and Collectors

Changes to Location of Edge Line Rumble Strips for Arterials and Collectors:

OLD

NEW
Audible & Vibratory Treatment: Arterials and Collectors

Changes to Location Center Line Ground-in Rumble Strips for Arterials and Collectors:

OLD

NEW
Audible & Vibratory Treatment: Arterials and Collectors

Roadway Design Bulletin 18-03:
- Released 03/14/18
- Introduced new context-based policy for the use of Audible and Vibratory Treatments on arterials and collectors
- Publications affected
  - Standard Plans (Interim Revision)
  - FDM
    - PPM (may still be used on some Design-Build projects)
  - BOE (simplified pay item structure)
- Standard Plans, Index 546-010 (Previously Design Standards, Index 518)
  - No changes to shoulder rumble strips on Limited Access Facilities
  - Added sheets for Arterials and Collectors
  - New Standard Plans Instructions
  - New “Type” designations for Arterials and Collectors
Audible & Vibratory Treatment: Arterials and Collectors

SUBJECT: Audible and Vibratory Treatments (AVTs)

This bulletin implements a new policy for the use of audible and vibratory treatments on arterials and collectors. This new policy affects the Standard Plans, the Plans Preparation Manual (PPM) and the FDOT Design Manual (FDM).

REQUIREMENTS FOR STANDARD PLANS

1. Standard Plans, Index 546-010 and the associated instructions have been updated and are released as a Standard Plans Interim Revision to the FY 2018-19 Standard Plans.
## Standard Plans for Road Construction

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<thead>
<tr>
<th>Standard Plans Index</th>
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Audible & Vibratory Treatment: Arterials and Collectors

NOTES:

1. When friction course extends more than 8" beyond the edge of the traveled way, take off the extended friction course to the 8" line prior to rumble strip graving.

2. Use the continuous array on both inside and outside shoulders or in advance of bridge ends or back to the gore recovery area for median interchange bridges. Use the skip array for all other locations.

3. Include rumble strips at the following locations:
   - A. At median crossover openings, terminate rumble strips at the end of the median crossover section.
   - B. At AP Emissions Testing (APET) facilities, terminate rumble strips within 50 feet of the exterior line of the test area.
   - C. Do not include shoulders of mainline ramp terminals, terminate rumble strips at the point of the physical gore and resume at the end of the acceleration lane taper.
   - D. Do not include shoulders of exit ramp terminals, terminate rumble strips at the start of the deceleration lane taper and resume at the end of the physical gore.
   - E. On approaches to bridges, terminate rumble strips at the approach slab joint.
   - F. On either side of median crossover openings, terminate rumble strips within 400 feet.

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RUMBLE STRIP DEPTH TABLE

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<thead>
<tr>
<th>LOCATION</th>
<th>DEPTH FROM SURFACE (IN)</th>
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<td>B</td>
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RUMBLE STRIP ARRAY DETAILS

- SKIP ARRAY
  - Center to Center: 12" (303mm)
  - 7'-0" (2139mm) Spacing
  - 5'-0" (1525mm) Spacing

- CONTINUOUS ARRAY
  - Center to Center: 12" (303mm)
  - 12'-0" (3657mm) Spacing
  - 9'-0" (2743mm) Spacing

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LIMITED ACCESS ROADWAYS

Florida Department of Transportation

FY 2018-19
STANDARD PLANS
GROUND-IN RUMBLE STRIPS
INDEX 546-010 SHEET 1 of 3

REVISED 04/04/18
LAST REVISION 04/04/18
REVISED SHEET TO INCORPORATE ARTERIALS AND COLLECTORS.
Audible & Vibratory Treatment: Arterials and Collectors
Why is there no Type “A2”??
# Audible & Vibratory Treatment: Arterials and Collectors

**Office of Design**


**Standard Plans Interim Revisions - FY 2018-19**

<table>
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<tr>
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<th>Revised Sheets</th>
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<tr>
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<td></td>
<td>Ground-In Rumble Strips</td>
<td>SPI-546-010 N/A N/A N/A RDB18-03</td>
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</tbody>
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N/A = Not Applicable
N/C = No Change

*Site Updated: 3/16/18*
Audible & Vibratory Treatment: Arterials and Collectors

Standard Plans Instructions:
- Used by designers
- Determine limitations of use
- How to properly include it in the plans
- Includes some payment information

Index 546-010 Ground-In Rumble Strips

Design Criteria
FDOT Design Manual (FDM)

Usage Criteria
Limited Access – See FDM 211.4.4.
Arterials and Collectors – See FDM 210.4.6.

Plan Content Requirements
Arterials and Collectors – Identify and tabulate in the Signing and Pavement Marking plans. Include the “Type” (see Sheet 2-3 of Index 546-010 for information) in the pavement marking callout labels (e.g., 6” White with Ground-In Rumble Strips, Type B1). It is not necessary to call out the array for Arterials and Collectors.
See FDM 325 for plan content requirements.

Payment

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<th>Item Description</th>
<th>Unit Measure</th>
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<tbody>
<tr>
<td>546-72-A</td>
<td>Ground-In Rumble Strips</td>
<td>GM</td>
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</table>

See the BOE and Specifications 546 for additional information on payment, pay item use and compensation. In all cases, payment for ground-in rumble strips is separate from any accompanying permanent pavement markings.
<table>
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</table>

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(Site Updated: 3/16/18)
REQUIREMENTS FOR FDM

1. Replace **FDM 210.4.6** with the following:

**210.4.6 Audible and Vibratory Treatment**

Provide audible and vibratory treatment (AVT) on **flush-shoulder roadways with a posted speed of 50 mph or greater.** Do not exclude sections of the project where advisory speeds are used due to restricted horizontal or vertical geometry. **Do not place AVTs within the limits of crosswalks.**
Consider potential noise impacts to residents and businesses adjacent to the roadway when selecting an appropriate AVT. A higher probability of strikes should be expected on the inside radius of horizontal curves. The expected increase in noise levels over typical road noise is as follows:

- Approximately 6 decibels for cylindrical ground-in rumble strips.
- Approximately 4 decibels for sinusoidal ground-in rumble strips.
- Approximately 2 decibels for profiled thermoplastic.

AVT type selected for each edge line or centerline should be consistent throughout the project length; however, there may be a clear change in condition for which a change in AVT type is appropriate. Use the same type of treatment for centerlines as is used for edge lines on undivided roadways.

Determine the appropriate AVT in accordance with FDM 210.4.6.1 and FDM 210.4.6.2.
210.4.6.1  Ground-in Rumble Strips

Standard Plans, Index 546-010 provides three configurations (Types A, B, and C) for ground-in rumble strips along edge lines. The selection of Type A, B, or C is as follows:

- Use Type A on outside paved shoulder when width is between 1 and 5 feet. Do not use this type for sinusoidal ground-in rumble strips, or when there are residences within a minimum of 650 feet of the proposed edge line.

- Use Type B on outside paved shoulder when width is $\geq$ 5 feet, and on inside paved shoulder when width is $\geq$ 1 foot.

- Use Type C on flush shoulder roadways with buffered striping.

Sinusoidal ground-in rumble strips produce less noise, and are an alternative to the cylindrical ground-in rumble strips. They may be used for Types B and C in noise-sensitive locations.

Ground-in rumble strips are to be detailed (i.e., limits, Type A, B, or C) and quantified in the Signing and Marking Plans component set. Include “1” for cylindrical ground-in rumble strips or “2” for sinusoidal ground-in rumble strips; e.g., A1, B1, B2, C1, C2.

See Exhibit 210-7 for common placement of AVTs.
210.4.6.2 Profiled Thermoplastic

Use profiled thermoplastic when any of the following conditions exist:

- Rigid pavement
- The requirements for installing ground-in rumble strips cannot be met
- Paved shoulder width prevents the construction phasing required for installation of ground-in rumble strips
- Restriping projects where the District Maintenance Engineer has determined ground-in rumble strips are not cost effective based on the remaining service life of the pavement
- Edge lines for bridges with narrow shoulders as a countermeasure for barrier impacts
### Audible & Vibratory Treatment: Arterials and Collectors

**Basis of Estimates:**
- Simplified pay item structure for projects let July 2018 or later

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<td>546-72-AB,-A</td>
<td>Rumble Strips</td>
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**Notes**
- See the Standard Plans and Standard Plans Instructions.

**Plan Summary Box**
- Limited Access Facilities: Show in the roadway plans. The pay item should be loaded in the Roadway Category.
- Arterials and Collectors: Show in the Signing and Pavement Marking plans. The pay items should be loaded in the Signing and Pavement Marking Category.

**Struct.**
- 546-72- A Ground-In Rumble Strips, GM Effective 1-1-2018
- **A= Description**
  - 1 (16") for limited access roadways, used on shoulders; Load in Roadway category
  - 2 (8" Cylindrical) for arterials and collectors, used on shoulders or centerline; Load in Signing and Pavement Marking
  - 3 (8" Sinusoidal) for arterials and collectors, used on shoulders or centerline; Load in Signing and Pavement Marking
Audible & Vibratory Treatment: Arterials and Collectors

- For paved shoulders greater than or equal to 5’, use ground-in rumble strips located in the shoulder.
• For buffered bike lanes, use ground-in rumble strips between the longitudinal buffer lines.
Audible & Vibratory Treatment: Arterials and Collectors

- Regardless of context, use Profiled Thermoplastic for paved shoulders 1’ or less. This is for durability of pavement and constructability. May be used with ground-in rumble strips on outside shoulder.
Audible & Vibratory Treatment: Arterials and Collectors

• With residences nearby and for paved shoulders greater than 1’ and less than 5’, use Profiled Thermoplastic. Residences are considered nearby when located within a minimum of a 650 ft radius. (650 ft radius is guidance only; the District may choose to increase this distance)
Audible & Vibratory Treatment: Arterials and Collectors

- With no residences nearby and for paved shoulders greater than 1’ and less than 5’, use ground-in rumble strips on the edge line. Residences are considered nearby when located within a minimum of a 650 ft radius. (650 ft radius is guidance only; the District may choose to increase this distance)
Audible & Vibratory Treatment: Arterials and Collectors

• Sinusoidal ground-in rumble strips show promising results with initial noise testing and will be used as an optional treatment to the 3/16” Cylindrical pattern.
Audible & Vibratory Treatment: Arterials and Collectors

• 3/16” Cylindrical Edgeline Pattern
Audible & Vibratory Treatment: Arterials and Collectors

• Sinusoidal Edgeline Pattern
Audible & Vibratory Treatment: Example #1

- **Existing Conditions:**
  - Two-way, two-lane roadway
  - 4’ Paved Shoulders
  - No residences adjacent to the roadway

- **Recommended Audible & Vibratory Treatment:**
  - Cylindrical ground-in rumble strips for the entirety of the project
Audible & Vibratory Treatment: Example #2

• Existing Conditions:
  - Divided, multilane roadway
  - 4’ outside paved shoulders
  - Industrial land north of the bridge (3.5 miles); residential land south of the bridge (1.4 miles)

• Recommended Audible & Vibratory Treatment:
  - Cylindrical ground-in rumble strips north of the bridge
  - Profiled thermoplastic markings south of the bridge
Audible & Vibratory Treatment: Example #3

- **Existing Conditions:**
  - Divided, multilane roadway
  - 5’ outside paved shoulders
  - Sporadic subdivisions along the length of the project with a significant risk for noise complaints

- **Recommended Audible & Vibratory Treatment:**
  - Sinusoidal ground-in rumble strips for the entirety of the project
Audible & Vibratory Treatment: Example #4

• Existing Conditions:
  - Divided, multilane roadway
  - 5’ outside paved shoulders
  - Residences adjacent to the roadway

• Recommended Audible & Vibratory Treatment
  - Cylindrical ground-in rumble strips for the entirety of the project.
Audible & Vibratory Treatment: Example #5

• Existing Conditions:
  - Divided, multilane roadway
  - 4’ - 5’ outside paved shoulders
  - Residences adjacent to the roadway

• Recommended Audible & Vibratory Treatment
  - Profiled thermoplastic for the entirety of the project
Questions

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