



MN Roads Low Volume Road Testing to Validate the Purdue TPTA Textures and Predicted Joint Effects

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MN Roads Low Volume Road Field Test Plan

Background

The IGGA and ACPA have been working with Purdue University to develop a diamond grinding texture with improved noise characteristics. The research began by attempting to optimize blade width and spacer configurations. Traditionally, this had been thought to control resulting noise characteristics. However, the Purdue work indicated that fin profile was the controlling variable and not the blade/spacer configuration.

Work then began to produce fin profiles that were essentially uniform on top. After experimentation, two different techniques appeared to work best. The use of three chopper blades utilized as spacers placed between two 0.125 inch conventional diamond grinding blades, and a “flush” grind with grooving. The flush grind was produced by using 0.090 inch width blades with 0.090 inch spacers to lightly grind the surface. The Purdue grinding head was then offset slightly to grind a second time to remove the fins. The flush ground texture was then grooved with 0.125 inch diamond grinding blades spaced on 0.50 inch centers. The grooves produced measured 0.012 inches deep. The chopper blade configuration used chopper blades that were dressed to 0.08 inches shorter in radius than the 0.125 inch blades.

The results of this testing are shown in Figure 1. Both the chopper blade and the flush grinding with grooving produced quieter surfaces than previously obtained. The red bars indicate the phase three testing where this was verified. The triple chopper and flush grind surfaces are indicated in the lower right hand corner of Figure 1.

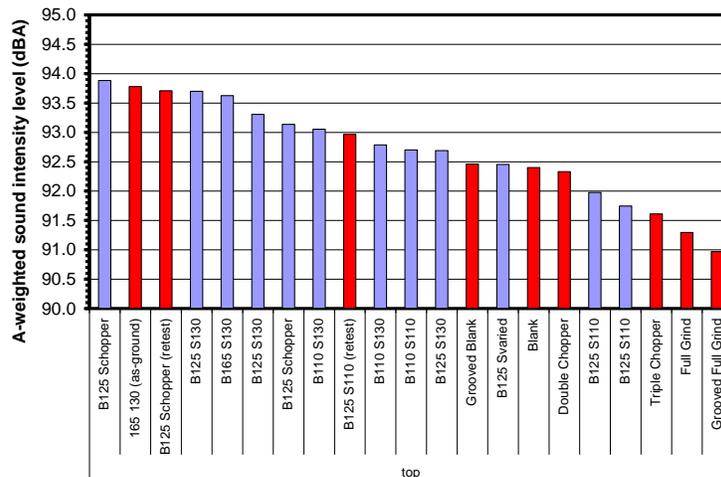


Figure 1 Results of Top Track Purdue Testing

The Purdue research uses the Purdue Tire Pavement Test Apparatus (TPTA) to evaluate the various textures. This laboratory based device, shown in Figure 2, consists of a twelve foot diameter drum upon which six cast segments are placed around the circumference as shown. The IGGA developed grinding head was used to grind the various textures and is shown in the right hand side of Figure 2.



Figure 2 Photos of Purdue TPTA Equipment

Purdue TPTA Issues

Noise testing, using Sound Intensity (SI) techniques can only be conducted to 30 mph. Field evaluations are typically conducted at 60 mph. The diamond ground surface, although resembling actual field grinding, has not been produced using actual diamond grinding equipment. The flush grind surface was produced on the TPTA by offsetting the head and making a second pass such that the fins were ground off. This approach cannot be exactly replicated in the field.

Therefore, field validation is expected to be a two-part process. First will be the “proof of concept” intended to prove or disprove that textures created and measured on the TPTA reflect diamond ground textures in the field. Once this is confirmed, a second round of field testing will be necessary using a standard size diamond grinding head to determine if these textures can be reproduced in a production based construction operation. It is anticipated that these textures would then be tested for noise as well as friction characteristics. The second, or production level testing, is not part of the current experiment.

Field Validation

To field validate the Purdue TPTA work, it is desirable to validate both the triple chopper configuration and the flush grind with grooves. To accomplish this, a plan to construct 18 inch wide wheelpaths at the MN Roads Low Volume Road Test Section has been developed. The layout of the MnROAD low volume road sections are indicated in Figure 3. Sections 37 and 39 have been selected as potential candidates with section 37 the current preferred option.

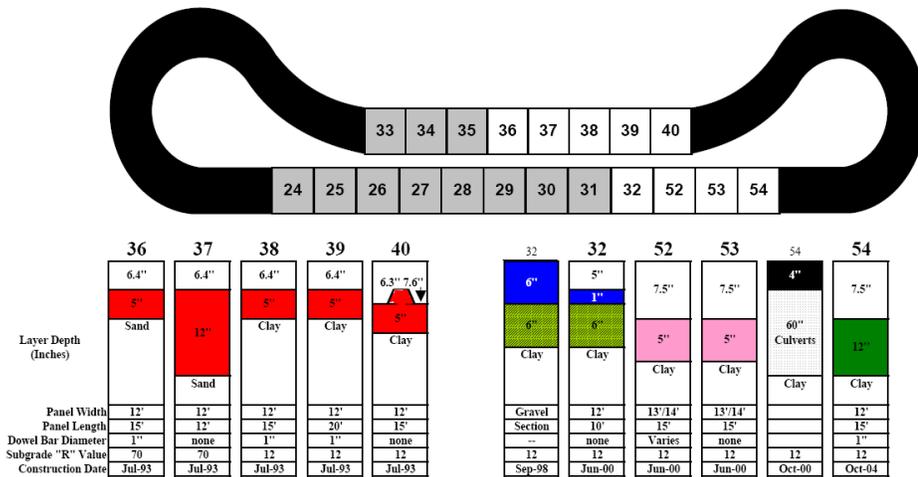


Figure 3 Mn ROADS Low Volume Road Concrete Test Sections

Field Review of Low Volume Road Sections

On May 24, 2007 sections 37, 38, and 39 of the Mn ROADS low volume concrete test sections were reviewed. It was noted that section 38 had significant cracking and distress. Section 37 and 39 both appeared useable but one large transverse crack existed in section 39. The field inspection consisted of observations from inside the vehicle as it was raining.

All the sections had surface textures in good condition with well sealed joints. The existing texture was a random transverse tine pattern installed at right angles to the roadway direction. The transverse joints were skewed. The joints appeared to be approximately 3/8 to 1/2 inch in width with an approximate 3/16 inch recess in the silicone sealant.

In the eastbound direction two inch cores had been retrieved across two joint locations. This requires that the WB directions be used for the testing to avoid these joints. The WB sections, however, included instrumentation access covers in the wheelpath locations. This will require offsetting the grinding wheelpaths.

Both section 37 and 39 have adequate run in length to attain test speed for conducting OBSI testing. At this time, section 37 appears to be the preferred option. However, final determination should be made just prior to testing.

**Field Validation Experiment
Diamond Grinding**

The proposed field validation experiment consists of grinding two wheeltracks, each 18 inches wide by 500 ft long, and one wheel track 24 inches wide by 500 ft long. One wheeltrack will be ground using 0.125 inch blades with 0.120 inch spacers. This wheeltrack will be considered the "control" and used as a benchmark to evaluate the other two tracks against. It will be ground 24 inches wide to eliminate the need to restack the equipment head as its current configuration is 24 inches wide.

A second track will use the triple chopper blades in combination with 0.125 inch conventional blades. A third track will use a technique to produce a flush grind condition similar to the Purdue work and then groove it with 0.125 blades spaced on 0.50 inch centers. The Purdue work used 0.090 inch blades and spacers to produce this texture and then offset and reground to remove the fins. An alternative technique will be required in the field to produce the flush grind condition.

Since the existing random transverse tined texture will have an impact on the On Board Sound Intensity (OBSI) levels, it will need to be ground through so that no transverse texture remains. This adds additional complication to the experiment.

The diamond grinding wheeltracks will have to be positioned as shown in Figure 4 to avoid the instrument boxes.

Joint Effect Testing

In addition to validating the diamond grinding, the joint effects prediction of the Purdue TPTA work will also be attempted. This effort will consist of OBSI noise testing prior to grinding, after grinding, and then removing the joint sealant to produce an unsealed condition and testing again for noise. The joint sealant only needs to be removed in the areas of the four wheeltracks (see Figure 5) with a device such as a joint plow.

Test Section Construction

Diamond Grinding Experiment

Test section construction will occur in the west bound direction of cell 37 as indicated in Figure 4. Three test sections, two 18 inches wide and one 24 inches wide will be constructed. TS 1&2 will be constructed near the center of the lane to avoid the instrument boxes. The conventional grind or “control” grind will be placed adjacent to the center line stripe.

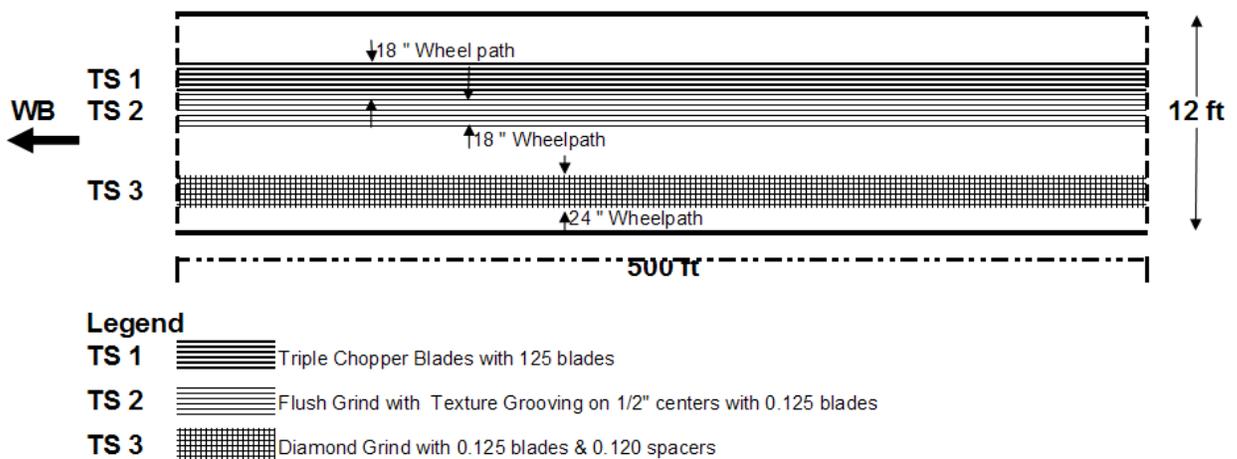


Figure 4 Diamond Grinding Test Section Layout

Joint Effect Experiment

Upon conclusion of construction and testing of the diamond grinding experiment, the joint sealant will be removed from the test areas so that additional OBSI testing can occur to evaluate the effect of joints. To conduct this testing, a fourth wheeltrack will also be tested as indicated in Figure 5. This wheel track represents a noisy texture condition. Two joint width and sealant recess depth measurements will be made near the center of each wheeltrack. The joint effect experiment will require joint sealant removal from within the four wheelpaths. However, there are no provisions within this project to re-install joint sealant. Therefore, upon completion of this experiment, the wheeltracks would no longer be sealed.

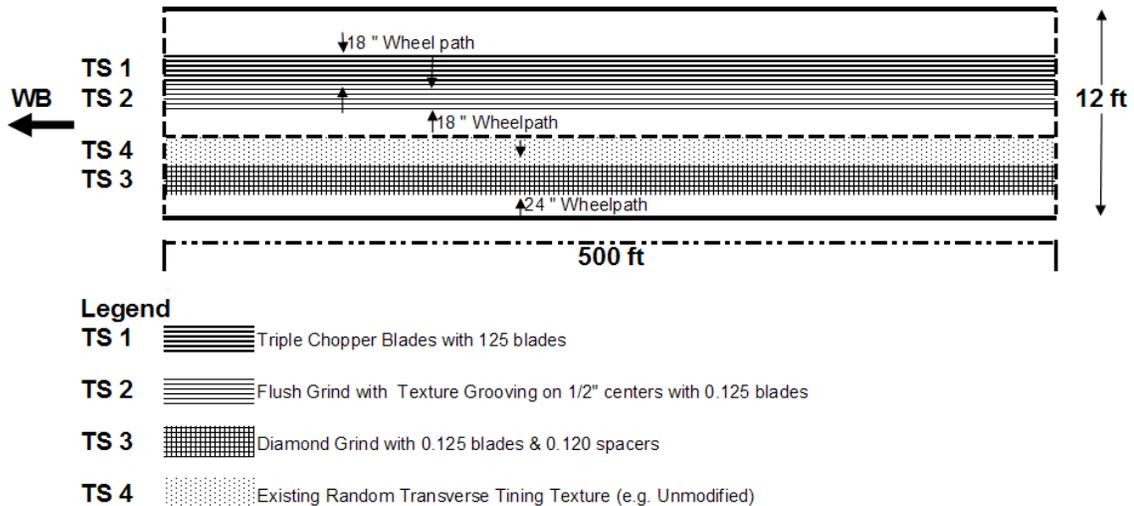


Figure 5 Joint Effects Test Section Layout

OBSI Noise Testing Sequence

OBSI testing will be conducted on the existing random transverse tining in each of the four wheelpaths prior to grinding. Upon completion of the diamond grinding, the surface of each of the three test grind wheeltracks will be tested again. Upon conclusion of this testing, the joint seal will be removed using a joint plow or other suitable device. Upon completion of sealant removal, the four wheeltracks will have OBSI testing conducted again. The intent is to provide validation of both the Purdue TPTA recommended surfaces and to validate the Purdue TPTA predicted joint effects for one joint width level.

For each of the four wheel track tests, four replicate runs will be conducted with the ACPA OBSI equipment. This results in 12 tests for each of wheeltracks 1-3 and 8 tests for wheeltrack 4 for a total of 44 OBSI tests.

Since the wheeltrack is only 18 inches wide, guidance of the test vehicle (e.g. Chevy Malibu) will be necessary during OBSI testing. This will be accomplished by painting dots on the PCCP surface to use for guidance. A separate set of dots will be needed for each wheeltrack. The markings will need to extend through the test areas and beyond to allow adequate alignment.

OBSI testing will be conducted by the ACPA using the dual probe configuration. Testing will be conducted at 60 mph with the 16 inch ASTM SRTT tire. ACPA will conduct the analysis of the diamond grinding performance while Purdue University will evaluate the joint effects.

Upon completion of the MN Roads testing, the ACPA OBSI test tire and wheel (e.g. ASTM SRTT tire mounted on Chevy Malibu Wheel) will be mounted on the Purdue TPTA and used to retest the original TPTA texture samples (e.g. triple chopper and flush grind). The recently calibrated ACPA Cal Tone will also be used to calibrate the Purdue equipment. This will remove as much tire bias and microphone calibration bias as possible between the field and laboratory comparisons.

Friction Testing

Mn DOT will conduct ASTM E-274 Locked-Wheel Skid testing with the ASTM smooth tire. Friction testing will be conducted two times during the experiment: (1) After completion of the initial (e.g. prior to grinding) OBSI testing on test sections TS1, TS2 and TS3; and a second time on these same sections after the joint seal has been removed and the final OBSI test measurements obtained. This sequencing will eliminate the possibility of contamination of the textures by the skid tester while still obtaining before and after measurements to evaluate frictional changes.

If the first round of friction testing cannot be accomplished in advance of the grinding operation, similar nearby textures will be tested to provide a baseline friction level for the original texture.

Test Schedule

Date	Activity	Organizations
June 17 & 18	<ul style="list-style-type: none"> • Layout Test Sections • Conduct OBSI Testing & Analysis • Conduct ASTM E-274 Friction Testing 	Mn DOT, ACPA, & Purdue
June 19-21	<ul style="list-style-type: none"> • Conduct Diamond Grinding 	Diamond Surface, Inc.
June 20-21	<ul style="list-style-type: none"> • Conduct Brooming • Conduct OBSI Testing & Analysis 	Mn DOT and ACPA
June 21-22	<ul style="list-style-type: none"> • Remove Joint Sealant 	PCI
June 22-23	<ul style="list-style-type: none"> • Conduct OBSI Testing 	ACPA & Purdue
June 22-25	<ul style="list-style-type: none"> • Conduct Friction Testing 	Mn DOT