
Standard Practice for

Assessment of Body Motion Cancellation in Transverse Pavement Profiling Systems

AASHTO Designation: PP 107-24¹

Technically Revised: 2024

Editorially Revised: 2024

Technical Subcommittee: 5a, Pavement Measurement



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1. SCOPE

- 1.1. This practice describes the procedure to assess the accuracy and precision of the transverse pavement profiler (TPP) when the system is excited at the primary ride and wheel hop excitation frequencies. The particular specification which will be assessed is vehicle body motion error.
- 1.2. The minimum requirements focus on the need for accurate and repeatable transverse measurements for network- and project-level data collection.
- 1.3. If any part of this practice is in conflict with referenced documents, such as ASTM standards, this practice takes precedence for its purposes.
- 1.4. This standard practice is intended to be conducted in conjunction with three other standard practices to fully assess and certify the TPP in typical operating conditions. For static assessment, see PP 106; for typical dynamic operation, see PP 109; and for assessment of drift mitigation, see PP 108.
- 1.5. *This practice does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this practice to establish appropriate safety and health practices and determine the applicability of regulatory limitations related to and prior to its use.*

2. REFERENCED STANDARDS

- 2.1. *AASHTO Standards:*
 - PP 106, Assessment of Static Performance in Transverse Pavement Profiling Systems
 - PP 108, Assessment of Navigation Drift Mitigation in Transverse Pavement Profiling Systems
 - PP 109, Assessment of Highway Performance of Transverse Pavement Profiling Systems
 - PP 111, Definition of Terms Related to Transverse Pavement Profiling Systems and Ground Reference Equipment
- 2.2. *ISO Standards:*
 - ISO 3650, Geometrical Product Specifications (GPS) – Length Standards – Gauge Blocks
 - ISO 12781, Geometrical Product Specifications – Flatness Standards

2.3. *Other Document:*

- Smith, H. Improving the Quality of Terrain Measurement. Masters Thesis. Virginia Polytechnic and State University, Blacksburg, VA, 2009. Available from <https://vtechworks.lib.vt.edu/handle/10919/5534>

3. TERMINOLOGY

- 3.1. See PP 111 for definition of terms used in this standard practice.
- 3.2. Table 1 provides the physical parameter definitions, symbols, and default values to be used when administering this standard.

Table 1—Physical Parameter Definitions and Default Values

Physical Parameter	Symbol	Default Value(s)
Minimum Transverse Width of Test Section	W_{TS}	4.25 m (14 ft)
Excitation Board Length	L_e	1.34 ± 0.05 m (4.4 ± 0.2 ft)
Excitation Board Width	L_b	0.61 ± 0.05 m (2.0 ± 0.2 ft)
Excitation Board Cleat Spacing	a	256.0 ± 6.0 mm (10.0 ± 0.25 in.)
Excitation Board Cleat Width	w	90.0 ± 6.0 mm (3.5 ± 0.25 in.)
Cleat Height and Base Board Height	h_e	9.0 ± 1.0 mm (0.375 ± 0.05 in.)
TPP Test Speed	v	10.0 ± 2.0 kph (6 ± 2 mph), 15.0 ± 2.0 kph (9 ± 2.0 mph), 19 ± 2.0 kph (12 ± 2 mph)
Minimum Flat Plate Length	l_p	1.2 m (4.0 ft)
Flat Plate Width	w_p	0.61 ± 0.05 m (24.0 ± 2.0 in.)
Flat Plate Thickness	t_p	19.0 ± 9.0 mm (0.475 ± 0.375 in.)
Flat Plate Offset from Front Center of Excitation Board	d_p	TPP dependent
TPP Track Width of the Nearest Wheelset	w_t	TPP dependent
Minimum Number of Passes through the Test Section at Each Speed	n_p	2
Minimum Number of Transverse Profiles Acquired for Each Speed	N_s	100
Number of Measurements to Randomly Select	N_r	50

4. SIGNIFICANCE AND USE

- 4.1. Measured transverse profiles of road surfaces are used to extract pavement deformation parameters such as rut depth, cross slope, and edge/curb drop-off. The accuracy of the estimated pavement deformation parameters depends on the collected data accurately representing the transverse section of the road surface.
- 4.2. Requirements on the cancellation of vehicle body motion ensure that the TPP is effectively cancelling out the motion of the vehicle body and the resulting collected data accurately represents the road surface.
- 4.3. This practice outlines standard procedures for assessing the expected operational accuracy and precision of transverse pavement profilers when driving over rough road surfaces. The standard prescribes a procedure to evaluate the ability of the system to accurately represent a planar surface through multiple transverse profile measurements (TPP data) captured while the vehicle is subject to primary ride and roll excitations at a set range of speeds. Because the data are used for subsequent calculations for rut depth, cross slope, and edge/curb drop-off, tables of the necessary

accuracy and precision for certification are provided in the form of confidence intervals for each use.

5. EQUIPMENT

5.1. The TPP must be able to collect transverse profiles at a minimum sampling rate of 100 complete transverse profile scans per second.

Note 1—To cancel the body motion (which is critical in obtaining accurate profiles), ride frequencies must be accounted for and a minimum sample rate of 100 samples/s must be used for all measurements. This minimum sampling rate is for all mapping and localization sensors with the exception of GPS or GNSS measurements.

5.2. Provide all collected transverse profiles of the test section in electronic text files following the format prescribed by Annex B.

6. DATA COLLECTION AND REPORTING

6.1. A test site that has ample space for a TPP to safely achieve the maximum test speed in the set of test speeds, v , and to safely slow down afterwards shall be selected.

6.2. Two reference lines (e.g., chalk lines) shall be marked on the road surface to ensure that the excitation boards and reference objects are aligned appropriately. The first reference line, a central primary reference line, shall be placed in the longitudinal direction of the test site. A secondary reference line shall be placed in the transverse direction as shown in Figure 1. The primary reference line is used to align the reference objects and excitation boards in the longitudinal direction and act as a datum for transverse alignment. The secondary reference line is used to indicate the “end” of the reference objects, shown as a transverse dashed line in Figure 1.

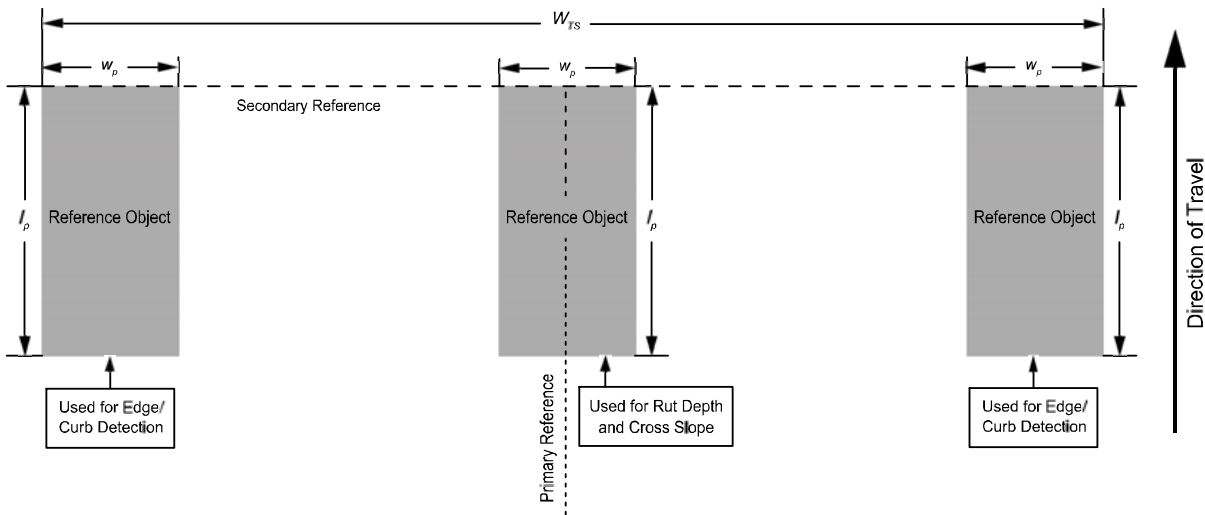


Figure 1—Reference Objects

6.3. Figure 1 provides a schematic of the test site and shows the orientation of all three reference objects with respect to the primary and secondary reference lines. For data reduction, the central reference object shall be used for rut depth and cross slope analysis, while the two transversely

offset reference objects shall be used for edge/curb detection analysis. To reduce reflectance issues, apply a dulling material appropriate for 3D scanners.

- 6.4. The central reference object of longitudinal length l_p , transverse width w_p , and vertical thickness t_p conforming to the specifications provided in Annex A shall be centered transversely along the primary reference line indicated by a longitudinal dashed line in Figure 1.
- 6.5. Two additional transversely offset reference objects of longitudinal length l_p , transverse width w_p , and vertical thickness t_p conforming to the specifications provided in Annex A shall be placed outside the excitation boards/wheel path of the TPP. Each reference object shall be placed on opposite sides of the test site and placed such that the furthest transverse edges are a distance $W_{TS}/2$ from the primary reference line, as shown in Figure 1.
- 6.6. The excitation boards shall be offset in the longitudinal direction by a distance d_p from the reference objects. The offset, d_p , in the longitudinal direction between the secondary reference line and the excitation reference line (both shown as dashed lines in Figures 3 and 4) shall be dependent on the nominal offset of the mapping sensors from the nearest TPP wheelset. Figure 5 provides a side view representation of the longitudinal offset of the mapping sensor that is following the nearest wheelset (rear-mounted mapping sensors). Figure 6 provides a side view representation of the longitudinal offset of the mapping sensor that precedes the nearest wheelset (front-mounted mapping sensors). The longitudinal offset, d_p , will vary between TPP systems.

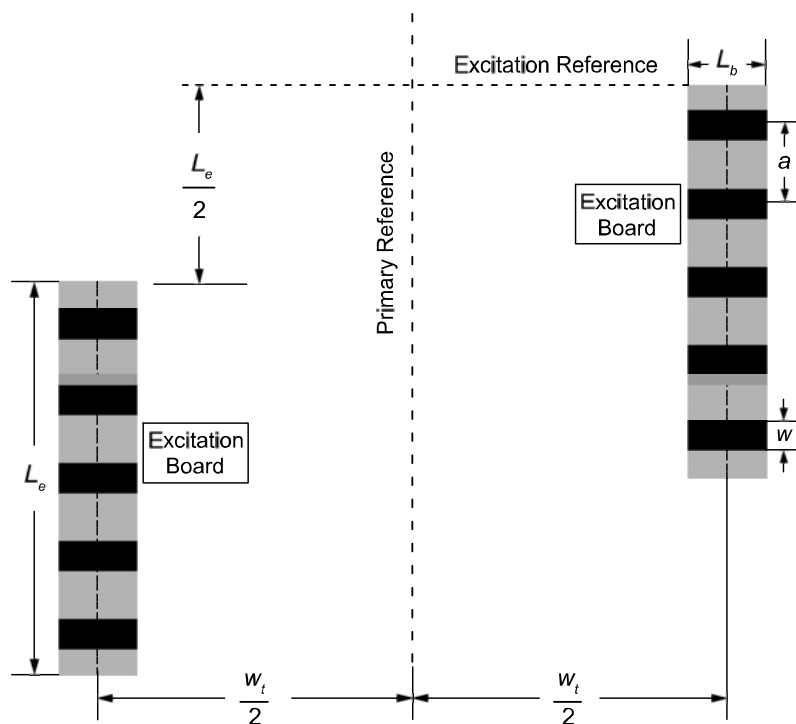


Figure 2—Excitation Boards