
Standard Practice for Assessment of Static Performance in Transverse Pavement Profiling Systems

AASHTO Designation: PP 106-24¹

Technically Revised: 2024

Technical Subcommittee: 5a, Pavement Measurement



**American Association of State Highway and Transportation Officials
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Standard Specification for

Assessment of Static Performance in
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1. SCOPE
- 1.1.

This practice describes the procedure to assess the specifications, accuracy, and precision of the sensor system used on transverse pavement profilers (TPP) in static mode. The particular specifications which will be assessed are transverse spacing, transverse width, vertical spacing, straightness error, vertical measurement error, and transverse measurement error.
- 1.2.

The minimum requirements stipulated herein are intended to 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 ground reference and transverse width assessment, see PP 109; for body motion assessment, see PP 107; 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:

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PP 107, Assessment of Body Motion Cancellation in Transverse Pavement Profiling Systems

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PP 108, Assessment of Navigation Drift Mitigation in Transverse Pavement Profiling Systems

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PP 109, Assessment of Highway Performance in Transverse Pavement Profiling Systems

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PP 111, Definition of Terms Related to Transverse Pavement Profiling Systems and Ground Reference Equipment

3. TERMINOLOGY
- 3.1.

See PP 111 for definitions 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 Length of the Straightedge	L_s	4.0 m (13 ft)
Minimum Width of the Straightedge	W_s	25 mm (1 in.)
Transverse Location of Straightedge Supports from the Edge of a 4.0-m (13-ft) Straightedge	S_s	890 ± 130 mm (35 ± 5 in.)
Vertical Height of the Gauge Blocks	h_{g1}	25 ± 1 mm (1 ± 0.05 in.), 50 ± 1 mm (2 ± 0.05 in.), 75 ± 2 mm (3 ± 0.1 in.)
	h_{g2}	6 ± 1 mm (0.25 ± 0.05 in.), 12 ± 1 mm (0.5 ± 0.05 in.), 25 ± 1 mm (0.1 ± 0.05 in.)
Minimum Transverse Width of the Gauge Blocks	w_g	19 mm (0.75 in.)
Transverse Distance from the Base of the Gauge Blocks to Edge of Straightedge	d_s	100 mm (4 in.)
Number of Transverse Profiles to be Collected per Straightedge Location	n_p	10
Distance that the TPP Shall Be Raised in Addition to the Vertical Distance from the Road Surface to the Top of the Straightedge	d_v	$0 + 25$ mm ($0 + 1$ in.)
Desired Transverse Locations of Gauge Blocks from the Transverse Centerline	d_t	1.9 ± 0.05 m (6.1 ± 0.2 ft)

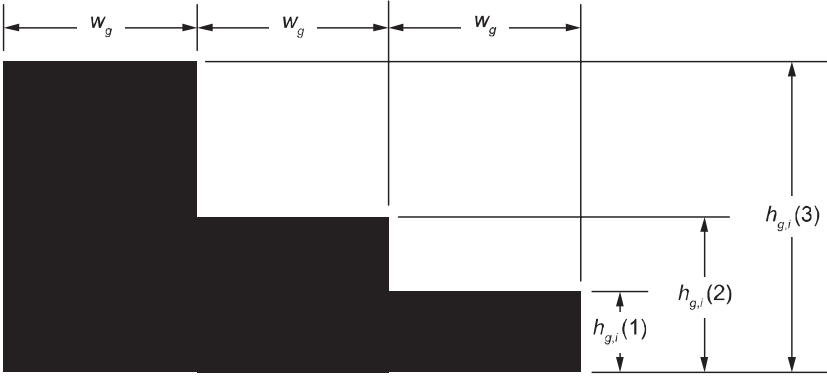


Figure 1—Default General Stair-Stepped Gauge Block Dimensions

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 measured transverse profile accurately representing a transverse section of the road surface.
- 4.2. Requirements on the specifications of mapping sensors ensure that the measured profile accurately represents the road surface. In addition, it is essential that the TPP sensors be able to accurately and precisely measure the height and transverse location of the road surface points.
- 4.3. This practice outlines standard procedures for assessing the operational accuracy and precision of transverse pavement profilers related to static measurement components. This standard prescribes procedures to evaluate transverse spacing between measurements, total width of measurements, vertical spacing of the measurements, straightness of the transverse measurements, and vertical and transverse measurement accuracy and precision. 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 are provided in the form of confidence intervals for each use.

5. EQUIPMENT

- 5.1. Capable of triggering mapping sensors when in a static mode.
- 5.2. Provide all collected transverse profiles of the test section in electronic text files following the format prescribed by Annex B1.

6. DATA COLLECTION AND REPORTING

- 6.1. Per mapping sensor, a certified straightedge of length L_{fs} and width W_{fs} shall be placed on a road surface directly in the field of view (FOV) of the mapping sensor and leveled to within 0.05 percent (0.029 degree = 103 seconds) using any desired method. The straightedge shall be oriented such that the complete FOV lies on the top surface of the straightedge. Figure 2 provides examples of orientation of the straightedge with respect to the mapping sensor FOV for four example mapping sensor setups.

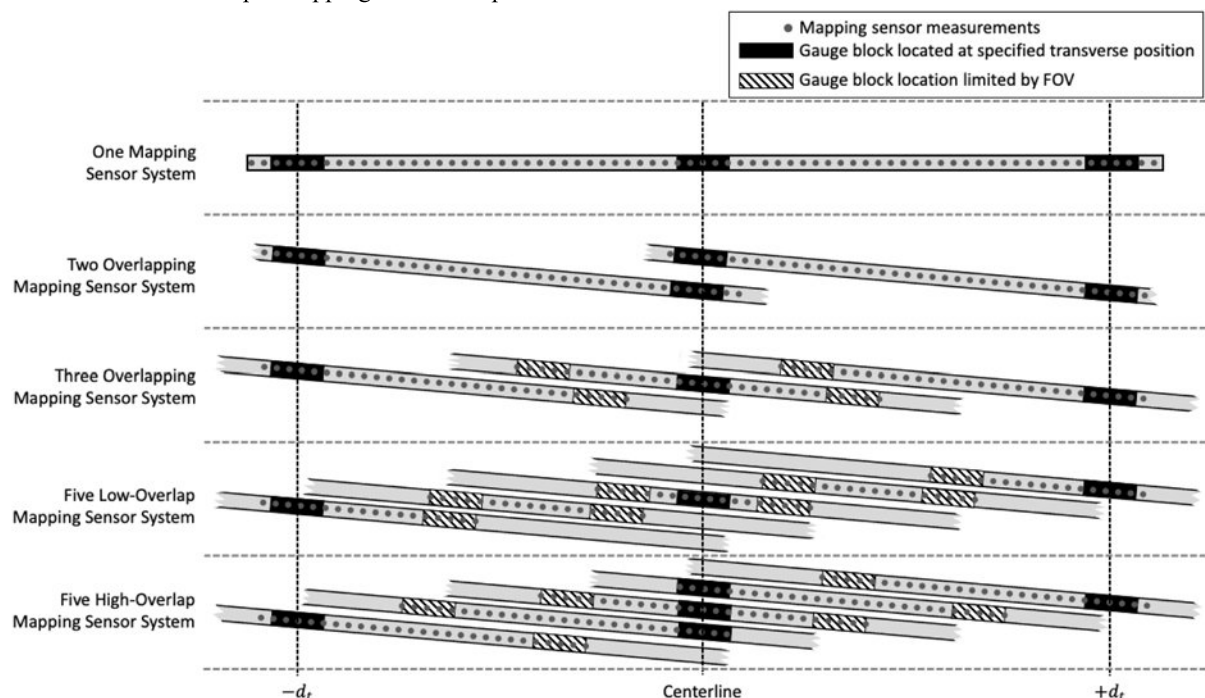


Figure 2—Alignment of the Straightedge with the Mapping Sensor Measurement Path

- 6.1.1. The data collection process must be repeated for each mapping sensor. If multiple mapping sensors are oriented such that the FOVs lie in a single plane, then the data collection for those sensors can be performed simultaneously by orienting the straightedge such that the complete field of view for all mapping sensors of interest lie on the top surface of the straightedge.
- 6.2. When conducting the static assessments, the TPP shall be raised an amount equal to the vertical distance from the road surface to the top of the straightedge plus the distance d_v . The intent is to locate the top of the straightedge at, or slightly below, the typical location of the road surface with respect to the TPP when in a typical operating condition. Any method of raising the TPP above the road surface or lowering the straightedge below the road surface can be used to achieve this relative positioning. Independent of the method used to achieve the distance d_v , the general orientation of the TPP shall not be affected (i.e., if the TPP is raised above the road surface the

front and rear of the TPP must be raised equally). See Figure 3 for a side-view schematic of the straightedge placement with respect to the reference plane.

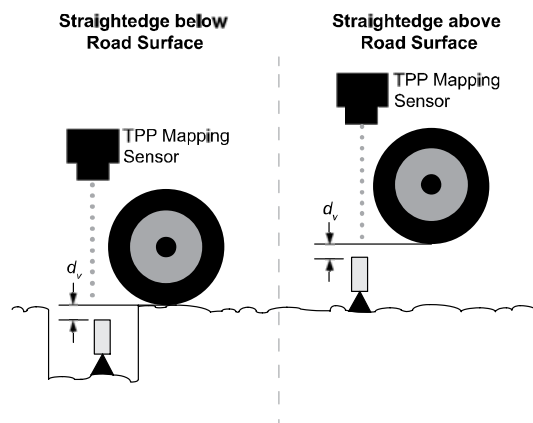


Figure 3—Elevation of the TPP, or Depression of the Straightedge, to Ensure Proper Vertical Positioning of the Mapping Sensor to the Top of the Straightedge

- 6.3. At least n_p scans shall be taken, per mapping sensor, of the straightedge with no gauge blocks on the surface. These collected profiles shall be used to analyze the respective mapping sensor's transverse spacing, transverse width, vertical spacing, and straightness error.
- 6.4. When a mapping sensor FOV spans three specified transverse locations: transverse centerline of the lane, positive d_l from the centerline of the lane, and negative d_l from the centerline of the lane, then the certification agency shall place gauge blocks at these three specified transverse locations as described in the subsequent paragraph. Figure 2 provides a top view of five example arrangements of mapping sensor spans (shown as dots) and corresponding placement of gauge blocks (shown as rectangles). A mapping sensor field of view spanning the three specified transverse locations is shown as the topmost example shown in Figure 2. However, if a mapping sensor FOV does not span all three specified transverse locations, gauge blocks shall be placed at specified transverse locations within the mapping sensor FOV (shown as black rectangles in Figure 2), and wherever the boundary of the span is not coincident with specified transverse locations (shown as a hatched rectangle in Figure 2). The placement of the gauge blocks shall be noted on the certification report. Figure 4 provides a side-view showing the gauge blocks placed on the straightedge.

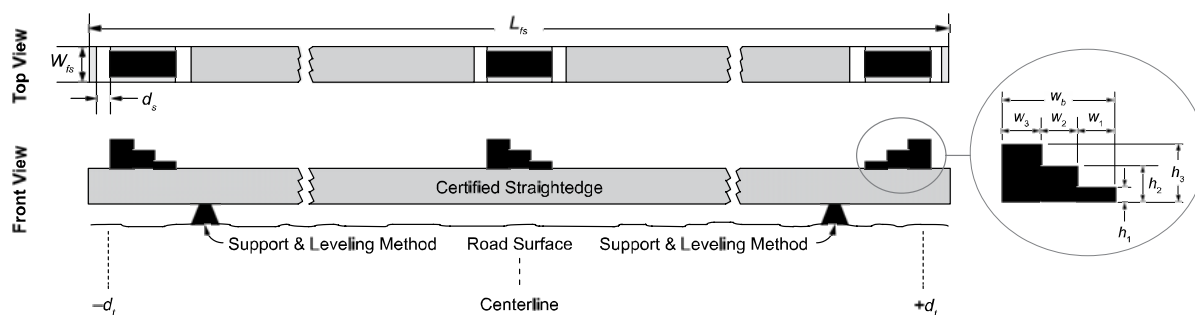


Figure 4—Layout of the Stair-Stepped Gauge Blocks at the Center, Left, and Right Side of the Straightedge

- 6.5. When placing the gauge blocks on the straightedge, the stair-stepped features shall be oriented to allow for the best collection of data and minimize the potential of missing data. Thus, the steps of the gauge blocks are oriented in line with the mapping sensor measurement window and the smallest stepped surface is the closest certified surface to the mapping sensor. Figure 5 provides a simple illustration of orientation of the stair-stepped gauge block depending on the location of the mapping sensor with respect to the gauge block.

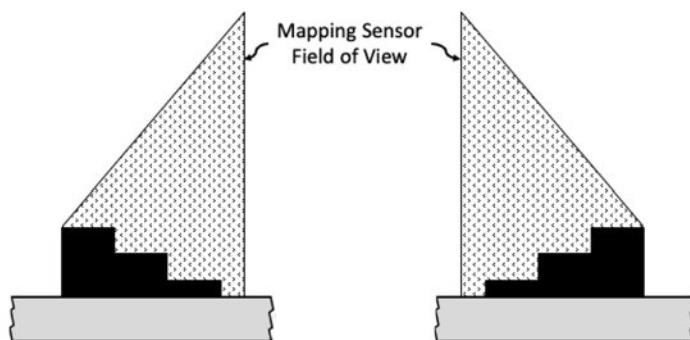


Figure 5—Orientation of a Stair-Stepped Gauge Block to Best Align with the Field of View (FOV) of the Mapping Sensor

- 6.6. The TPP operator shall acquire at least n_p transverse profiles of the stair-stepped gauge block in each transverse location.
- 6.7. To limit the amount of vertical distance between consecutive steps, two sets of stair-stepped gauge blocks shall be used having heights h_{g1} and h_{g2} .
- 6.8. The scans with the gauge blocks will be used to analyze the vertical measurement error and horizontal measurement error of the respective mapping sensor.
- 6.9. Details regarding the dimensioning, tolerances, surface finish, and material properties of the straightedge and gauge blocks are given in Annex A, Sections A1 and A2.
- 6.10. The mapping sensor data shall include: (a) n_p scans of the straightedge without gauge blocks for each scanning sensor, (b) i_p scans of the straightedge with gauge blocks for each scanning sensor, and (c) a composite file of all scans taken of the straightedge without the gauge blocks that has been merged from those files. All mapping sensor data shall be reported in the local sensor coordinate system in a transverse profile as explained in Annex B1.

7. DATA REDUCTION

- 7.1. *Parsing Measurement Data:*
- 7.1.1. Per system scan, all measurements that lie on the top surface of the straightedge shall be defined as the set S_{SE} . This set can have gaps in the transverse direction where gauge blocks are located. Table 2 defines the terms for parsing measurement.