
Standard Practice for Measuring Pavement Profile Using a Rod and Level

AASHTO Designation: R 40-10 (2022)^{1,2}

Technically Revised: 2010

Reviewed but Not Updated: 2022

Technical Subcommittee: 5a, Pavement Measurement



**American Association of State Highway and Transportation Officials
555 12th Street NW, Suite 1000
Washington, DC 20004**

Measuring Pavement Profile Using a Rod and Level

AASHTO Designation: R 40-10 (2022)^{1,2}



Technically Revised: 2010

Reviewed but Not Updated: 2022

Technical Subcommittee: 5a, Pavement Measurement

1. SCOPE

- 1.1. The rod and level can be used to accurately measure the profile of a pavement. The profile data can be used to evaluate the roughness of the pavement by computing a roughness index such as the International Roughness Index (IRI) or to evaluate effects such as frost heave or swelling of soils. In computing roughness indices, only the relative elevations and not the absolute elevations are needed. The guidelines in this standard practice can be applied to conventional survey equipment such as an optical level and graduated staff, which require the readings to be manually recorded, as well as automated equipment that is capable of automatically storing the measured data.
- 1.2. *This standard practice may involve hazardous materials, operations, and equipment. It does not purport to address all of the safety concerns associated with its use. It is the responsibility of the user of this standard practice to consult and establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. REFERENCED DOCUMENT

- 2.1. *ASTM Standard:*
- [E1364](#), Standard Test Method for Measuring Road Roughness by Static Level Method

3. SUMMARY OF METHOD

- 3.1. To measure the pavement profile using the rod and level, two persons are generally needed. One person is needed to hold the rod (rod person) and another to operate the level and take readings (instrument operator). If the level is not capable of automatically recording the readings, an additional person (record keeper) to record the readings will make the process quicker. An experienced crew of three would require fewer than 10 s to obtain one reading. This involves the positioning of the rod by the rod person, reading the level by the instrument operator, and recording the measurements by the record keeper.
- 3.2. Relative elevations are measured along the roadway at prescribed intervals. A rod is set on the roadway, and the rod reading is recorded.
- 3.3. Rod readings are then converted to either a true elevation or a reference elevation from which profile statistics are then computed.

4. SIGNIFICANCE AND USE

- 4.1. Longitudinal profile measurements are used during construction to assess the smoothness of new pavement. Elevation profiles, when converted to roughness measurements, are also gathered for estimating the performance of in-service pavements, and can then be utilized in a pavement management system.

5. APPARATUS

- 5.1. The rod and level used in routine surveying and road construction generally will not have the resolution needed for pavement profile measurements. For pavement profile measurements, precision leveling instruments are required. The instrument used for profile measurement shall satisfy the resolution criteria noted in [ASTM E1364](#), Table 1.
- 5.2. The rod used shall be equipped with a bubble level so that it can be held vertical accurately. A suitable base shall be selected for the rod in order to reduce the sensitivity to small variations in rod placement. For smooth-textured pavements, any type of base is suitable. For textured surfaces, a circular pad with a diameter of at least 2.0 cm (0.8 in.) is recommended. As only relative elevations are required for computing roughness indices, no correction is required for attaching a pad to the bottom of the rod.
- Note 1**—It is recommended that an invar rod be used to minimize the effects of temperature changes. This is particularly important for Class 1 surveys on smooth roads, for which the resolution requirements given in [ASTM E1364](#), Table 1 are more stringent.

6. EQUIPMENT MAINTENANCE, ADJUSTMENT, AND VERIFICATION

- 6.1. *Maintenance*—Use shockproof packaging when transporting the instrument. Clean the instrument after completing a profile measurement. Before cleaning the lenses, blow the dust off the lenses. Clean the lenses using a soft cloth. Do not touch the lenses with the fingers. If the instrument becomes wet in the field, dry it completely before packing. Inspect the tripod regularly to ensure that the connections are not loose.
- 6.2. *Adjustment*—The user manual for the level shall be consulted on how to perform adjustments of the instrument. Different makes and models of levels will require different adjustments to be performed. The following are some common adjustments that are required in levels in order to obtain accurate measurements. The user manual for the level shall be consulted to determine whether the following adjustments are needed for the level being used and, if so, how to perform the specific adjustment.
- 6.2.1. *Make Axis of Level Bubble Perpendicular to Vertical Axis*—After setting up the level, center the bubble. Move the telescope 180 degrees about the vertical axis. If the bubble moves, the instrument needs adjustment.
- 6.2.2. *Adjust Horizontal Crosshairs*—This adjustment will ensure that the horizontal crosshairs are truly horizontal when the instrument is leveled.
- 6.2.3. *Adjust Line of Sight*—This adjustment will make the axis of sight perpendicular to the vertical axis and parallel to the axis of the level. The method of adjustment for this error is commonly referred to as the two-peg method.
- 6.3. *Verification*—Verify the accuracy of the markings on the rod using a standardized tape.