
Standard Practice for

Measuring Pavement Profile Using a Dipstick®



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1. SCOPE

- 1.1. This practice is used to manually collect precision profile data utilizing the Face Technologies Dipstick®. The dipstick measures profiles (relative elevation differences) at a rate and accuracy greater than traditional rod and level surveys. Procedures for measuring both longitudinal and transverse profiles are described.
- 1.2. Experienced operators have been able to obtain 500 readings per hour using this procedure.
- 1.3. *This standard may involve hazardous materials, operations, and equipment. It does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of this standard to consult and establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. REFERENCED DOCUMENTS

- *Dipstick Manual*. Face Technologies, Norfolk, Virginia.

3. DEFINITIONS

- 3.1. *dipstick*—the dipstick is a manually operated device that houses an inclinometer and measures relative elevation differences from one foot to the other. The dipstick measurements can either be recorded manually or stored in a hand-held computer using either a trigger or an automatic storage method.

4. SUMMARY OF PRACTICE

- 4.1. For longitudinal profile measurements, the wheelpaths are first located, then cleared of any excess debris. Chalk lines are established to ensure the same path is surveyed in both directions. The dipstick is then moved along the chalk line and measurements are recorded at 0.3-m (1-ft) intervals. The dipstick is “walked” up and back along the same line thereby allowing a closure error to be calculated. If the closure error exceeds a given amount, the recorded measurements are questionable and the survey may need to be repeated. Collected information can then be used to calculate various roughness indices such as the international roughness index.
- 4.2. Transverse dipstick measurements are conducted in a fashion similar to the longitudinal. That is, the location for the transverse measurement is established, a chalk line is snapped perpendicular to the travel lane, the dipstick is walked over and back across the lane, and the closure error is calculated. Measurements are recorded at 0.3-m (1-ft) intervals and can be used to calculate rutting using various computational methods.

5. SIGNIFICANCE AND USE

- 5.1. Longitudinal profile measurements are used during construction to assess the pavement smoothness and are often used to determine contractor pay factors. Elevation profiles, when converted to roughness measurements, are also gathered for estimating the performance of in-service pavements, which can then be utilized in a pavement management system. Increasingly, dipstick measurements are being utilized to calibrate other high-speed profiling devices.
- 5.2. Transverse dipstick measurements are used to develop a cross profile of the roadway. Cross profiles are then used to calculate rut depths along a given roadway. This method of rut depth determination can be more accurate than using a straightedge and allows for rut depths to be calculated based on differing standards such as a 12-ft wire line, 6-ft straightedge or 4-ft straightedge.

6. EQUIPMENT

- 6.1. *Face Technologies Dipstick®*—A manually operated device for the collection of precision profile measurements at a rate and accuracy greater than traditional rod and level survey procedures for individual readings.
- 6.1.1. The body of the dipstick houses an inclinometer (pendulum), LCD panels, and batteries for power supply. The sensor of the dipstick is mounted in such a manner that its axis and the line passing through the contact points of the footpads are coplanar. The sensor becomes unbalanced as the dipstick is pivoted from one foot to the other as it is moved down the pavement, causing the display to become blank. After the sensor achieves equilibrium, the difference in elevation between the two points is displayed.
- 6.1.2. The dipstick is equipped with a choice of hardened steel spike feet or ball-and-swivel footpads. The swivel pads shall be used on textured pavements.
- 6.1.3. Multiple readings may contain systematic cumulative errors, which may cause a shift of the true profile.

7. DIPSTICK MAINTENANCE

- 7.1. *Maintenance*—Specific, detailed maintenance procedures are contained in the manuals provided with each individual piece of equipment, and the operator shall become intimately familiar with the maintenance recommendations contained in all equipment manuals.
- 7.1.1. It is not the intention of this practice to supersede manufacturers' minimum services and service intervals, but to provide supplementary service requirements. Where there is a conflict between this guide and the manufacturers' instructions, the more stringent requirements shall be followed.
- 7.1.2. *Routine Maintenance*—Routine maintenance includes those functions that can be easily performed by the operator with minimal disassembly of a particular device. Routine maintenance for the dipstick includes the cleaning and lubrication of the ball and socket joints on the footpads, replacement of the batteries and cleaning of the battery contacts. These items are basic and easily performed preventive measures and shall always be completed prior to operation of the equipment.

- 7.1.3. *Major Maintenance*—Major preventive services shall include much more than the routine checks and will require some disassembly of the equipment by personnel with technical capabilities beyond the skill of the operators, such as the manufacturer. Items such as battery connector replacement would fall into the major maintenance category. The appropriate service intervals are outlined in the equipment manufacturer's manual.

8. DIPSTICK PREOPERATIONAL CHECKS

- 8.1. Check the condition of footpads and replace if necessary. Clean and lubricate the ball and socket joints on the footpads to insure smooth pivoting of the instrument. When the joint is dirty, pivoting becomes difficult and slippage of the footpad can occur. A cleaning agent such as WD-40 and a light oil for lubrication will work for the ball and socket joint.
- 8.2. Install a fresh set of batteries in the instrument and securely close the battery compartment. Batteries shall be changed after 4 hours of usage to insure continuity of measurements.
- 8.3. Check and, if necessary, retighten the handle on the instrument.
- 8.4. *Zero Check*—Perform the zero check prior to and after any dipstick measurements. This test shall be performed on a smooth clean location where the instrument can be properly positioned (the carrying case for the dipstick, or a flat board will suffice). After positioning the dipstick draw two circles around the two footpads and note the reading on the display (reading = R1). The instrument shall then be rotated 180 degrees and the two footpads placed on the two circles that were drawn earlier. Note the reading obtained (reading = R2). If the readings from the two placements (R1 and R2) add up to within ± 0.001 , the dipstick has passed the zero check. If the addition of two readings do not fall within these limits, zero adjustment is necessary. The zero adjustment shall be performed using the following procedure.
- 8.4.1. Obtain the average of the two dipstick readings in Equation 1:
$$e = 0.5 (R1 + R2) \quad (1)$$

Then subtract this value from reading R2 to obtain R2o in Equation 2:
$$R2o = R2 - e \quad (2)$$
- 8.4.2. With the dipstick still in the R2 reading position, loosen the setscrew. Adjust the start end, moving the pin up or down so that the display reads R2o. Thereafter, tighten the setscrew and rotate the dipstick back to the R1 reading position and read the display (reading = R1o). Now the addition of R1o and R2o should be within tolerance. If this sum is not within tolerance, repeat the adjustment procedure until the two readings are within tolerance.
- 8.4.3. This zero adjustment is the only adjustment the operator is allowed to make on the dipstick.
- 8.5. *Calibration Check*—Check the calibration of the device before and after any dipstick measurements, after the zero check and zero adjustments are performed. To check the calibration, place the 3.175-mm (0.125-in.) calibration block under one of the dipstick footpads. The reading displayed, minus 0.125, should equal the previous reading ± 0.003 . If the answer is not within this tolerance, Face Technologies shall be contacted to repair the dipstick.
- 8.5.1. Both the zero check and calibration check shall be performed at the beginning and end of data collection.