METHODS OF SAMPLING AND TESTING
MT 422-12
METHOD OF TEST FOR SURFACE SMOOTHNESS AND PROFILE

1 Scope

1.1 This method covers the testing of a finished flexible pavement surface for smoothness and profile. The surface smoothness is expressed in International Roughness Index (IRI) in units of inches per mile. The surface profile is generated to locate variations in profile (e.g., bumps or dips). This method is not intended to be used with rigid pavement or gravel surfacing.

2 Reference Documents

Operator's Manual, Surface Systems & Instruments, LLC

Profiler Operations Manual (POM) for MDT Profilers (most recent version)

MDT QC/QA Plan (most recent version)

3 Terminology

3.1 *International Roughness Index (IRI)* – An index resulting from a mathematical simulation of vehicular response to the longitudinal profile of a pavement using a 'quarter-car' simulation model as described in NCHRP Report 228.

4 Apparatus

4.1 Class I laser road profiler as defined in ASTM E950. The road profiling system is mounted on a vehicle, usually a van or truck. It consists of the following components:

4.1.1 Vertical, non-contact, height measurement systems (i.e., laser) capable of measuring the height from the mounted sensor face to the surface of the pavement.

A linear distance measuring system (i.e., DMI) capable of measuring distance traveled.

4.1.3 An inertial referencing system (i.e., accelerometers) capable of measuring the movement of the vehicle as it traverses the pavement.

5 Software

5.1 The software must activate the testing using parameters (i.e., data collection initiation) that are stored by the control setup.

5.2 The software must receive, display, and store raw data received from the profiler.

5.3 The software must be capable of accumulating desired output and printing results.

6 Calibration

6.1 Perform a comprehensive calibration and sensor check at thirty (30) day intervals during construction season. Check the DMI and verify Laser each day before use.

6.2 Calibration is used to establish and adjust the operating characteristics of the SSI system. There are five (5) items that will either be calibrated or checked: laser height, distance measuring device, tire pressure, Accelerometer and Bounce Test.

6.3 Check tire pressure and inflate to manufacturer's recommended psi. Special care should be given to the tire on which the DMI device is mounted.

6.4 Laser Height Verification

6.4.1 The lasers have been calibrated at the factory. The lasers can only be verified.

6.4.2 A verification check of the laser will be performed each day before use.

6.4.3 A full verification check of the laser sensors must also be performed whenever problems are suspected, or when a sensor is repaired or replaced.

6.5 Facility for Laser Height Verification

6.5.1 Each MDT District should have a facility available (e.g.; enclosed garage at District).

6.5.2 Facility should have a level surface and be free of vibration.

6.6 Procedure for Laser Height Verification

6.6.1 Verify laser height in accordance with section 3.3 (pages 15-16) of the SSI Operations Manual.

6.7 Accelerometers

6.7.1 Accelerometers need an occasional static verification. Perform static verification (1) every 30 days during times when the system is used frequently, (2) after any prolonged period that the system has not been used, (3) when repairs are performed on the accelerometer(s) or associated system, or (4) any time the system is generating data that appears erroneous or suspect.

6.8 Facility for Accelerometer Verification

6.8.1 Each MDT District should have a facility available (e.g.; enclosed Garage at District).

6.8.2 Facility should have a level surface and be free of vibration.

6.9 Procedure for Accelerometer Verification

6.9.1 Perform the Accelerometer verification as per section 3.6 (page 21) of the SSI Operations Manual.

6.10 Bounce Test

6.10.1 The bounce test is a controlled-conditions procedure that uses the profiler's built-in simulation capabilities to test that the profiling system is operating properly. Perform the bounce test (1) every 30 days during times when the system is used frequently, (2) after any prolonged period that the system has not been used, (3) when repairs are performed on the associated system, or (4) any time the system is generating data that appears erroneous or suspect.

6.11 Facility for Bounce Test

6.11.1 Each MDT District should have a facility available (e.g.; enclosed garage at District).

6.11.2 Facility should have a level surface and be free of vibration.

6.12 Procedure for Bounce Test

6.12.1 Perform the Bounce Test as per sections 3.4 and 3.5 (page 17) of the SSI Operations Manual.

6.13 Distance Measuring Instrument (DMI)

6.13.1 Calibrate DMI whenever problems are suspected, the tires are replaced, suspension repairs are performed, wheels are rotated/ aligned, or repairs are performed on the DMI.

6.14 DMI Calibration Site

6.14.1 Each MDT District should have a calibration site established.

6.14.2 This site should be located on a straight portion of roadway that is reasonably level and has low traffic volume.

6.14.3 The site should be measured with a standard surveying tape or wheel (using standard surveying procedures), or laid out using an electronic distance measuring system.

6.15 Procedure for DMI Calibration

6.15.1 Calibrate the Distance Measuring Instrument (DMI) as per section 3.2 (pages 14-15) of the SSI Operations Manual.

6.16 Record Keeping

6.16.1 SSI software has a Calibration/Verification Report that Tracks DMI Calibration and Accelerometer Verification dates. That report may be printed from any Data Analysis files you may have. A simple record of all calibrations and verifications can be kept with the machine as per attached. (SEE “Calibration and Run Information” form)

7 Project Testing

7.1 Preparation of Surface

7.1.1 Test the roadway only when it is free of moisture and any deleterious material that will not provide accurate test results.

7.1.2 The Contractor is responsible for all work to prepare the roadway for testing, such as, but not limited to sweeping off of debris.

7.1.3 Do not conduct testing while it is raining or under other weather conditions determined inclement by the Engineering Project Manager (EPM).

7.2 Project Setup

7.2.1 Engineering Project Manager (EPM) or one of his/her representatives will meet with the Contractor and identify the Beginning-of-Project (BOP), the End-of-Project (EOP), and all excluded areas (e.g., bridges not paved, curves with short radii).

7.2.2 If possible, project should be marked for testing using reflective tape or reflective traffic cones. This is the preferred method. There are two other acceptable methods: back-up to start or manual.

7.2.3 If it is not feasible to use the photocell to initiate and stop data collection, data collection can be initiated and stopped manually. When manually initiating and stopping profile data collection, cones should be placed at the beginning and end of the project to be used as reference points by the operator.

7.3 Profiler Operations

7.3.1 Operation of profiler should be consistent with guidelines discussed in the latest version of the SSI Profiler Operations Manual. This includes but is not limited to the following:

- Run in English unit system.
- If possible, initiate data collection via reflective surface and photocell.
- Use approved file naming convention. (Contract#_Lane Direction_Lane_Run#) example 09610_NB_DR_Run1
- Document any issues that occurred during testing.
- Process data with software.
- Properly backup data.
- Provide report to EPM or one of his/her representatives.

7.3.2 MDT collects two comparable runs.

- Once the operator is confident that a minimum of two comparable runs have been obtained, the Quality Control Review and Bump Reports are used to evaluate their acceptability. Profiler runs should satisfy the following criteria:
- The average IRI values at each 1 mi (1.61 km) interval for each of the two runs are within ±5.7% of the mean IRI of both runs.
- If spikes (e.g., unusually high IRI) are present in the data, the operator should determine if spikes are pavement related or the result of equipment or operator error. The operator should examine the profile bump reports for discrepancies and features that cannot be explained by observed pavement features.
- Rerun the entire project if any one mile section does not match within the 5.7% tolerance established above (bullet #2) and compare that run to the previous runs.
- Use the results of the two runs that compare for project acceptance.
- If the third run does not compare to either of the first two runs, recheck all calibrations and then rerun the entire project and compare the results to the previous runs. Use the two runs that compare favorably.

7.4 Testing Results

7.4.1 Results shall be provided to EPM or one of his/her representatives and shall be processed into desired segments (e.g., 0.5 miles) as described in the contract Ride Specification.

7.4.2 A Roughness Report will be generated for the first profile run deemed to be within the comparison values for each lane profiled. This report will contain the IRI values for the left and right wheel paths. These IRI values will be applied to the most recent pay incentives/disincentives as described in Ride Specification.

7.4.3 A Bump Report will be generated for the first profile run deemed to be error free for each lane profiled. The Bump Report will indicate the locations of potential defects. These will be reviewed with the EPM. Location should be physically examined to determine if, at the EPM's discretion, the location should be considered a defect.