1. Introduction

Inertial Profilers (IP) shall be certified, as required by the contract, before evaluating final mainline smoothness on MnDOT bituminous or concrete paving projects.

The International Roughness Index (IRI) is used for smoothness measurement of pavement surfaces. The segment Mean Roughness Index (MRI)—an average of left and right wheel path IRI values—is used to determine pavement smoothness pay adjustments. IRI shall be calculated according to ASTM E 1926-98 (Reapproved 2003) Standard Practice for Computing International Roughness Index of Roads from Longitudinal Profile Measurements.

Certification does not eliminate the need for daily calibration of the IP on the project.

For purposes of this certification, an IP is defined as a device that uses accelerometers, height sensors, and a distance measuring instrument to measure pavement smoothness. All IP must be equipped with a minimum of two height sensors and be capable of simultaneously collecting profile data in both the left and right wheel paths. Non-inertial smoothness measuring devices, such as the California type 25-foot profilograph, do not fulfill these criteria, and therefore are not eligible for certification testing.

For purposes of this certification, the calculation of IRI and distance measurement for both the concrete and bituminous sections shall constitute one test. Any IP that requires a retest shall repeat the entire certification procedure.

Companies may have up to three IP tested for certification without a charge. Additional IP testing beyond three per company shall be charged $1,000.00 per initial certification test. Checks shall be made payable to: Commissioner of Transportation. Checks shall be due prior to having a fourth device tested.

The preferred method of check delivery is to submit payment to the MnDOT representative conducting the certification at the test site. An alternate method of check delivery is to mail payment to:

Glenn Engstrom
Director
Minnesota Department of Transportation
Office of Materials and Road Research
1400 Gervais Avenue
Maplewood, MN 55109
2. Associated Documents and Requirements

- Minnesota Standard Specifications for Construction
- Specification – 2399 Pavement Surface Smoothness
- Special Provision – 2302 Concrete Pavement Rehabilitation
- Special Provision – 2302 Concrete Grinding
- Special Provision – 2302 Concrete Grinding with No Incentives
- Class I requirements of ASTM E950

3. General Information/Expectations

The Inertial Profiler Certification Program is not a training program. **It is expected that all participating operators be well-versed in the operation of the IP.** MnDOT staff will serve as technical experts and may provide guidance during the certification process, but will not be responsible or accountable for the training of IP operators.

MnDOT staff will not make any corrections or modifications to devices. It is not the role of MnDOT to repair, maintain, or calibrate IP. If repairs or modifications are necessary, the owner/operator of the device must contact the manufacturer. MnDOT will not initiate contact with any manufacturer on behalf of an IP owner/operator.

The owner/operator of the IP will be responsible for transporting the device to the certification site and assuring the device is in proper working condition. The owner/operator of the IP is responsible for having the machine in proper working order at the test site.

The owner/operator of the IP shall make all repairs and adjustments as needed before taking measurements at the test site. The owner/operator of the IP shall have all tools and components necessary to adjust and operate the IP according to the manufacturer's instructions and recommendations. All equipment manufacturer specifications and manuals must accompany the IP to be certified.

4. Scheduling

MnDOT will designate two weeks, in the spring of each year, to conduct the Inertial Profiler Certification Program. MnDOT will attempt to provide all contractors with an IP the dates of certification testing. However, it is the responsibility of the owner/operator of the IP to contact MnDOT for scheduling.

5. Site Location

Certification testing will take place at the MnROAD research facility near Albertville, Minnesota. When arriving for a scheduled certification appointment, please report to the main building. A MnDOT employee must be present as an escort at all times that a visitor is at the MnDOT facility.
6. Test Sections

Two test sections (one concrete and one bituminous) will be established, designated, and maintained by MnDOT for the purpose of certifying IP.

MnDOT will determine daily IRI values for the test sections. The results of MnDOT’s International Cybernetics SurPRO Profiler will serve as the baseline for the test sections’ IRI values.

All IP will be required to follow the designated path through each test section. IP will be tested on both concrete and bituminous surfaces.

Cones and/or other appropriate material will be used to define the start and end locations of the test sections.

MnDOT will assure that the intended test path is clear of loose material and foreign objects.

7. Software Settings

The operator of the IP shall set the high- and low-pass filters to zero. Additional settings should be set according to equipment manufacturer specifications. Once an IP is certified, its settings will be recorded and posted to MnDOT’s Smoothness Program webpage: www.dot.state.mn.us/materials/smoothness.html. The operator of a certified IP must use the same software settings on MnDOT projects that were used during the Inertial Profiler Certification Program.

8. Height Sensor Identification

Each of the IP’s height sensors must possess a unique identification number that is prominently displayed on the box in which the sensor is housed.

9. Data Collection

IP operators are required to perform all necessary start-up procedures as specified by the manufacturer.

All IP must be equipped with an auto-start, auto-stop feature. Any hardware needed to activate/deactivate the IP’s auto-start, auto-stop mechanism (such as cones and/or reflective tape) shall be supplied by the IP operator.

Five pavement profiles (passes) must be collected on each test section. For each required pass, the operator of the IP shall perform the following:

- Position the IP at a point from which testing speed can be reached before testing is to begin.
- Check that all software and hardware are ready to collect data.
• Activate the IP far enough in advance of the beginning of the test section to ensure proper
collection of the required data.
• Collect data throughout the test section, maintaining a uniform speed.
• Deactivate the IP far enough beyond the end of the test section to ensure proper data
collection.

10. Acceptance Criteria

All test results shall be reported in English units (inches/mile).

Test values shall be reported to one digit right of the decimal in accordance with conventional
rounding procedures.

Provide a summary printout of IRI values for all passes throughout the test sections. IRI shall be
calculated using a quarter-car simulation as outlined in NCHRP Report 228.

Provide a USB flash drive with unfiltered longitudinal profiles in ERD format for the ten
certification passes. Each of the passes shall be clearly labeled so that MnDOT personnel can
easily analyze the file data. For each test section, each of the five longitudinal profiles will be
compared against the reference profile to verify validity.

The average IRI value of the five runs on each test section must be within 5% (five percent) of
the reference IRI value. In addition, when individually compared against the reference profile,
all five profiles must correlate at a level of 85% (eighty-five percent) or higher. The average of
the five correlations must be at least 90% (ninety percent).

The standard deviation of the five IRI values shall be no larger than 3% (three percent) of the
average IRI of the five passes.

All statistical comparisons will be performed by MnDOT using the FHWA’s Profile Viewing
and Analysis (ProVAL) software, with a 250-mm filter applied.

The IP must be equipped with a distance measuring instrument capable of measuring the length
of each section within 0.2% (zero point two percent) of the actual length of each section (e.g.,
within one foot on a 500-foot test section, within two feet on a 1,000-foot test section, etc.). In
order for the IP to be certified, all five passes on each test section must be within 0.2% (zero
point two percent) of the actual length. The actual length of the test sections will be determined
using a steel tape and verified with MnDOT’s SurPRO reference profiler.

11. Required Minimum Test Data Reporting

At a minimum, the following information must be printed in either the header or footer of each
run’s summary printout.

1) Date and time
2) Operator identification
3) Vehicle identification
4) Height sensor identification: a unique number for each sensor
5) Surface description: type of pavement
6) Unique run number
7) Software name and version
8) Profiler settings: high- and low-pass filters, accelerometer constants, etc.
9) IRI and MRI values

All required data must be submitted to a MnDOT representative at MnROAD before exiting the facility.

12. Results from MnDOT

MnDOT will provide the operator of the IP with results on the day of the certification test. For passing devices, an official certification letter will be mailed out to the owner/operator of the IP at a later date.

13. Decals

IP with acceptable test results will be furnished a 2017 Inertial Profiler Certification decal for each of its passing height sensors. The date of acceptance, sensor identification number, vehicle identification number, device manufacturer, operational system software version, and signature of a MnDOT representative will be denoted on the decal. The decal shall by affixed to the corresponding height sensor box by a MnDOT representative. Removal of the decal by the IP operator/owner will result in decertification of the device.

If, for any reason, the IP is recertified during the same year, updated decals will be issued. If, for any reason, an IP certification is revoked, the decals shall be removed by MnDOT.

14. Software Changes

The owner/operator of a certified IP must report any software changes within seven days of the change to Tom Nordstrom, Pavement Management Analyst (651-366-5537).

If a change in software affects raw data collection, the IP will be decertified.

If a change in software affects IRI computation, but not raw data collection, new IRI values shall be computed with the new version of the software. If the recomputed IRI values satisfy the aforementioned Acceptance Criteria, the certified IP will remain certified, but be issued new decals that contain the updated software version. If the recomputed IRI values do not satisfy the aforementioned Acceptance Criteria, the certified IP will be decertified.

Before use on a MnDOT project, all decertified IP must be recertified at MnROAD.
15. Major Component Failure

The major components of an IP include, but are not limited to, the accelerometer and its associated hardware, the height sensor and its associated hardware, and any printed circuit board necessary for the collection of raw sensor data or the processing of profiles.

If a major component of an IP fails, repairs/replacements must be completed before any further profiling is allowed.

If a major component is repaired/replaced during a MnDOT project, the Project Engineer will decide if a formal MnROAD recertification is required or if it is acceptable to temporarily allow the IP to continue on the project.

Recognizing that there may not be adequate time to schedule a formal MnROAD recertification in the event of a major component repair/replacement, it is recommended that a 528-foot test strip with no traffic be set up at the onset of all projects. It is recommended that the test strip be located adjacent to the project; however, if this is not possible, another location that is acceptable to the Project Engineer can be designated.

The same IP that is planned for use on the project shall collect profile data on the test strip. Prior to any profiling on the project, the Project Engineer shall be given a summary printout containing a composite MRI value for the test strip.

In the event that a major component of an IP is repaired/replaced during the project, the test strip shall be rerun by the same IP. In order to continue using the IP on the project, the rerun composite MRI value must be within 5% (five percent) of the initial recorded value.

Before use on any subsequent MnDOT projects, all IP that experience a major component failure or undergo major component repairs/replacements must be recertified at MnROAD.

16. Certification Follow-Up

Each certified IP shall undergo a mid-season, side-by-side comparison with a MnDOT high speed IP. Whenever possible, this comparison shall be conducted on a current MnDOT construction project on which the contractor IP will collect profile data. A portion of the project, between 500 and 1,000 feet in length, shall be designated by MnDOT as the test section. In order to pass the side-by-side comparison, the contractor IP’s left wheel path and right wheel path IRI values must be within 10% (ten percent) of those of the MnDOT high speed. Any IP that fails to meet this criterion, will be decertified by MnDOT and required to pass a certification retest at MnROAD.

17. Length of Certification

Regardless of when an IP is certified, the certification will be valid only for the remainder of the same calendar year.
18. Records

MnDOT will maintain records of the results of the certification program. The owner, unique identification number, make of device, software version, and the date of acceptance or failure will be included in these records.

19. Department Contacts

The Inertial Profiler Certification Program is directed and administered by the Minnesota Department of Transportation, Office of Materials, Maplewood, Minnesota.

To request additional information on this program or to schedule an IP certification testing date, contact Greg Schneider, Assistant Bituminous Engineer (651-366-5403), or Rob Golish, Assistant Concrete Engineer (651-366-5576).