

Colorado Procedure 78-21

Standard Practice for

Certification of Inertial Profilers and Operators

1. SCOPE

- 1.1 This test method describes the procedures for certifying high-speed profilers for use on CDOT projects.

2. REFERENCED DOCUMENTS

- 2.1 International Cybernetics Corp. SurPRO 3500 User's Manual.
- 2.2 *AASHTO Standards:*
 - M 328-10 Standard Equipment Specification for Inertial Profiler

3. EQUIPMENT

- 3.1 International Cybernetics Corporation's (ICC) SurPRO 3500.
- 3.2 Inertial Profiler
 - 3.2.1 The Inertial Profiler shall meet the specifications of AASHTO M 328 except that profilers used to measure the smoothness on concrete pavement shall use approved line lasers with at least a 3 in. wide footprint. Line lasers shall be aligned transversely to the pavement. Inertial profilers may be Light Weight Profilers (LWP) or High-Speed Profilers (HSP).
 - 3.2.2 The HSP or LWP shall use the following operation parameters:
 - 3.2.2.1 Shall have two height sensors spaced at 70 ± 1 inch. Profilers with 1 laser may be used for Process Control testing only.
 - 3.2.2.2 The sample interval at which relative profile elevations are reported shall be less than or equal to one inch.
 - 3.2.2.3 The algorithm for filtering the profile data shall use a cutoff wavelength of 300 ft.
 - 3.2.2.4 The profiler shall be capable of automated triggering using reflective tape affixed to the pavement or traffic cones to start & stop data collection and indicate locations of exclusions. GPS triggering shall not be used.
 - 3.2.2.5 Profilers used for Smoothness Acceptance Testing shall be capable of collecting profiles at a speed of at least 15 mph. LWPs may operate at a speed less than 15 mph for Process Control testing only.

4. OPERATOR CERTIFICATION

4.1 Operators shall attend the CDOT Profiler Operator Certification. The CDOT Profiler Operator Certification will include the following:

4.1.1 A course on the CDOT smoothness specification and basic profiler operations. |

4.1.1.1 Pass a written test on the CDOT smoothness specification with a score of at least 80%.

4.1.2 The operator will demonstrate proficiency in the operation of his profiler by successfully demonstrating the following:

- Height sensor calibration checks. (CDOT garage)
- Accelerometer calibration checks (CDOT garage)
- Distance calibration
- Bounce test. (CDOT garage)
- Setting triggering and collecting a profile with the triggering.
- Data submittal

4.2 The CDOT Profiler Operator Certification will expire on June 30th of the following year. |

5. REFERENCE SITE SELECTION

5.1 The Department will select a site to perform the Profiler Certification with the following requirements:

5.1.1 Shall be relatively straight, level, and smooth.

5.1.2 Shall have a sufficient distance for two consecutive 0.1-mile sections and sufficient distance to safely start & stop with a 300 ft. lead-in. |

5.1.3 The 0.1-mile sections shall have an average IRI value between 30 & 90 in/mile.

5.1.4 Shall be on a surface where the surface texture will have a minimal impact on data collection.

5.1.5 Shall be free of cracks in the traveled wheel paths.

5.1.6 Shall be on a relatively stable base with minimal traffic.

6. REFERENCE VALUE DETERMINATION

6.1 The device for determining the reference values shall be an ICC SurPRO 3500.

6.2 The reference site will be painted with a dot at least every 10 feet in the wheel paths.

6.3 The reference device will perform one closed-loop and two open loop data collection runs for each wheel path in the intended direction of travel. |

- 6.4 ProVAL will be used to determine the cross-correlation value for the closed-loop run in each wheel path. A minimum cross-correlation value of 0.95 will be required to accept each wheel path.
- 6.5 If the cross-correlation values for a wheel path are less than 0.95 it shall be retested according to Subsection 6.3.
- 6.6 The profile from one of the three reference runs for each 0.1-mile section for each wheel path will be used as the reference values for the certification. These values will not be shared with the participants.

7. PROFILER CERTIFICATION PROCEDURE

- 7.1 Before the profilers start collecting certification data, the profiler's subsystems shall pass the manufacturer's calibrations checks for the height sensor, accelerometer, and bounce test. These checks will be performed at the CDOT Central Lab.
- 7.2 Before the profilers start collecting certification data, the profiler's distance measuring instrument shall be calibrated following the manufacturer's procedures using the distance calibration site at the profiler certification site.
- 7.3 The operator shall install the triggers appropriate for their profiler's triggering system at the beginning and end of the certification course if the already installed triggers do not trigger their profiler. GPS triggering shall not be allowed.
- 7.4 The operator shall collect twelve profiles in the intended direction of travel at a minimum speed of at least 15 MPH.
- 7.5 The operator shall provide the Department the raw data files and data files that can be opened in ProVAL (ERD or PPF).
- 7.6 Data files for the twelve profiles shall be submitted to the Department on a thumb drive immediately after the completion of the twelve profiles. The media may not be returned to the operator.
- 7.6.1 Filenames shall be in the following format:
COMPANY NAME_Run_XX.PPF(or ERD)
- 7.7 The data files will be analyzed by the Department.

8. ACCEPTANCE DETERMINATION

- 8.1 Repeatability of the profiler will be evaluated using ProVAL. ProVAL will determine the cross-correlation value for the 1st 10 profiles in each wheel path. A minimum cross-correlation value of 0.92 will be required to pass.

- 8.2 Accuracy of the profiler will be evaluated using ProVAL. Each of the 10 profiles will be compared to the reference profile for each wheel path. The accuracy score for each profile in each wheel path will be averaged. Both wheel paths shall have an average accuracy score of at least 0.90.

NOTE 1: Details of the procedures for evaluation of profiles for repeatability and accuracy are detailed in AASHTO M 328

- 8.3 Passing the repeatability and accuracy requirements is required to pass the certification criteria.
- 8.4 If the criteria in Section 8.1 or 8.2 are not met, then the 11th profile will be substituted for the 1st profile, and the analysis will be re-run.
- 8.5 If the analysis in Section 8.4 does not meet the criteria in Section 8.1 or 8.2, the 11th and 12th profile will be substituted for the 1st and 2nd profile and the analysis will be re-run.
- 8.6 If the analysis in Section 8.5 does not meet the criteria in Section 8.1 or 8.2; the profiler's subsystems will need to be rechecked and 12 new profiles collected according to Section 7.
- 8.7 A profiler will only be allowed 2 trials. Profilers that fail to meet the certification criteria shall require repair and/or maintenance from the manufacturer. The profiler will not be allowed to attempt certification until a written statement describing the maintenance or repairs is submitted to the Department. This shall also include documentation that the profiler can pass the repeatability requirement.

9. CERTIFICATION

- 9.1 After a profiler is determined to be acceptable, a Certificate will be issued listing:
- Profiler serial number
 - Profiler VIN #
 - Profiler Make & Model
 - Height sensor serial numbers
 - Accelerometer serial numbers
 - Certification Date
 - Expiration Date
- 9.2 The certification will expire on June 30th of the following year. |
- 9.3 A list of certified profilers and operators is posted on CDOT's web at <https://www.codot.gov/business/designsupport/matgeo/pave-smooth-testing>

10. SUSPENSION OF CERTIFICATION

Note 2: This Section is used when a Contractor's profiler fails to meet the Smoothness Verification Testing acceptance criteria.

- 10.1 The Contractor's profiler shall collect three profiles at a site chosen by the Department. The site will meet the requirements of Section 5.
- 10.2 CDOT profiler will collect three profiles at the site.
- 10.3 The data files for the three profiles shall be submitted to the CDOT in a thumb drive. The media will not be returned to the Contractor.
- 10.4 The Department will determine an average MRI for each 0.1-mile section using the Department's profiler's results.
- 10.5 The Contractor's Profiler's results will be compared to the Department's results.
- 10.6 The Contractor's Profiler will retain its certification if the average MRI for each 0.1-mile section does not vary from the Department's MRI values by more than 6.0 in/mile.
- 10.7 If the Contractor's profiler fails to meet the criteria in Subsection 10.6, the Contractor's profiler will be allowed to collect three additional profiles and then it will be re-evaluated.
- 10.8 If the Contractor's profiler fails to meet the criteria in Subsection 10.6 a second time, the Contractor's profiler's Certification will be suspended.
- 10.9 The Contractor's profiler shall be repaired and/or adjusted/calibrated by the manufacturer.
- 10.10 If the Contractor wants to have his profiler recertified after repairs have been made before the next annual certification, all costs associated with the recertification shall be borne by the Contractor.

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