Data Quality Management Plan
for Pavement Condition
National Highway Performance Program

Oregon Department of Transportation
Pavement Services Unit

Version 1.1
October 2, 2018

Table of Contents

List of Tables

Document Revision Log

The following log includes significant revisions to this document.

Version Number	Date of Issue	Author(s)	Brief Description of Change
0.1	1/16/18	John Coplantz / Sophia Burkhart	Preliminary draft
0.2	3/26/18	Linda Pierce, Nick Weitzel	Draft Consultant updates
0.3	4/9/18	John Coplantz, Sophia Burkhart	Accepted Consultant updates with comments
0.4	4/17/18	Linda Pierce, Nick Weitzel	Address agency comments
0.5	5/3/18	John Coplantz, Sophia Burkhart	Added missing sections and made multiple revisions
0.6	5/4/18	Linda Pierce	Address agency edits and comments
0.7	5/9/18	John Coplantz, Sophia Burkhart	Draft final edits
1.0	5/9/18	John Coplantz, Sophia Burkhart	Final version for submittal
1.1	10/2/18	Linda Pierce, John Coplantz	Edits made in response to FHWA comments

Acronyms

The following acronyms are used in this document.

Term	Definition
AASHTO	American Association of State Highway and Transportation Officials
ACP	Asphalt concrete pavement
APM	Agency project manager
CFR	Code of Federal Regulations
CRCP	Continuously reinforced cement concrete pavement
DCV	Data collection vehicle
DMI	Distance measuring instrument
DQMP	Data quality management plan
FAST Act	Fixing America's Surface Transportation Act
FHWA	Federal Highway Administration
GPS	Global positioning systems
HPMS	Highway Performance Monitoring System
IRI	International Roughness Index
JPCP	Jointed plain concrete pavement
LRS	Linear reference system
MAP-21	Moving Ahead for Progress in the 21st Century Act
NHPP	National Highway Performance Program
NHS	National Highway System
PM2	Performance Measure Number 2
PMS	Pavement management system
PSR	Pavement Serviceability Rating
QC	Quality control
QM	Quality management
SOP	Standard operating procedure

1: Introduction

Background

The National Highway Performance Program (NHPP), implemented under the Moving Ahead for Progress in the 21st Century Act (MAP-21) and continued through the Fixing America's Surface Transportation (FAST) Act, established performance measures for pavements and bridges on the National Highway System (NHS)[1]. This legislation is published in 23 Code of Federal Regulations (CFR) Part 490[2]. The pavement and bridge performance measures are also referred to as Performance Measure Number 2 (PM2). The PM2 pavement performance measures are summarized in Table 1.

Table 1. PM2 Pavement Performance Measures

Interstate System	Non-Interstate NHS
Percentage of pavements of the Interstate System in **Good** condition	Percentage of pavements of the non-Interstate NHS in **Good** condition
Percentage of pavements of the Interstate System in **Poor** condition	Percentage of pavements of the non-Interstate NHS in **Poor** condition

The pavement performance measures are determined from pavement data elements in the Highway Performance Monitoring System (HPMS). These data elements (or metrics) are collected at 0.1-mile increments and compared to threshold values to establish a score for each data element. Various combinations of scores, based on the pavement surface type (asphalt concrete pavement [ACP], jointed plain concrete pavement [JPCP], or continuously reinforced concrete pavement [CRCP]), determine the overall condition for the 0.1-mile increments. Finally, the conditions for each 0.1-mile segment are assessed over the NHS to determine the pavement condition measures shown in Table 1. The specific pavement data elements include[3]:

- International Roughness Index (IRI).
- Cracking_Percent.
- Rutting (asphalt pavement only).
- Faulting (jointed concrete pavement only).
- Present Serviceability Rating (PSR), may be used as an alternative to the above where posted speed limit is less than 40 mph.

As part of the overall implementation of the new performance measures, § 490.319 subpart (c) requires each State DOT to develop and utilize a Data Quality Management Plan (DQMP). The rule requires each State DOT to submit a DQMP by May 20, 2018 to the Federal Highway Administration (FHWA) for review and approval. After that date, any significant changes to the DQMP must be submitted to and approved by FHWA prior to implementing the change.

[1] https://www.fhwa.dot.gov/Planning/national_highway_system/.
[2] https://www.federalregister.gov/d/2017-00681.
[3] https://www.fhwa.dot.gov/policyinformation/hpms/fieldmanual/.

Guidance

In 2013, the FHWA developed a guidance document, *Practical Guide for Quality Management of Pavement Condition Data Collection* (*Practical Guide*)[4] to assist agencies in the development of their DQMP's. The *Practical Guide* provides information for developing and implementing a DQMP and was used extensively for developing this DQMP for the Oregon DOT (ODOT). The *Practical Guide* includes an extensive Glossary of Terms that is a good reference for many of the terms and acronyms used in this document.

According to the *Practical Guide*, a DQMP defines the acceptable level of data quality and describes how the data collection process will ensure this level of quality in its deliverables and processes. Quality management (QM) activities ensure data meets agreed-upon standards and requirements, work processes are performed as documented, and non-conforming data are identified and appropriate corrective actions taken. The *Practical Guide* also indicates that DQMP's should include quality control (QC) activities to monitor data quality and resolve errors as they arise, and acceptance criteria to verify data collection deliverables meet defined quality standards.

The *Practical Guide* suggests that the DQMP be considered a "living" process, with periodic assessment and improvement over time. As staffing and equipment changes occur, changes in the DQMP may be warranted. This will be the case for Oregon's DQMP as well. The state of data collection technology is advancing rapidly and procedures and processes will need to be adjusted to adapt to these advancements.

Oregon DQMP Scope

The DQMP describes the processes and procedures for ensuring pavement condition data collected for the NHPP is in accordance with the required standards and quality. The DQMP will be used by ODOT to manage the quality of the pavement data reported in the HPMS for the NHPP PM2.

The requirements for the DQMP are included in § 490.319(c). According to the regulation, the program must address "…the quality of all data collected, regardless of the method of acquisition, to report the pavement condition metrics, discussed in § 490.311…" These specific requirements contained in the legislation were used to define the scope of Oregon's DQMP described herein. Accordingly, the following items are within the scope of the DQMP:

Pavement network where PM2 applies (§ 490.303)

- Mainline highways.
  - Interstate routes.
  - Non-Interstate NHS routes.

Pavement condition metrics on PM2 routes (§ 490.311)

- IRI.
- Cracking_Percent.
- Rutting.
- Faulting.
- PSR.

[4] https://www.fhwa.dot.gov/pavement/pub_details.cfm?id=864.

Additionally, § 490.319(c) requires the DQMP to include, at a minimum, methods and processes for the following items:

- Data collection equipment calibration and certification.
- Certification process for persons performing manual data collection.
- Data QC measures to be conducted before data collection begins and periodically during the data collection program.
- Data sampling, review and checking processes.
- Error resolution procedures and data acceptance criteria.

Plan Contents and Organization

This DQMP is organized into six sections. A brief description of each section and its contents follows:

Section 1. Introduction	Describes new federal legislation mandating the program, minimum program requirements, and scope of ODOT's program.
Section 2. Deliverables, Protocols, and Quality Standards	Lists the data collection elements subject to the DQMP, protocols used to collect the data, and quality requirements for the data, as defined by the *HPMS Field Manual* requirements and ODOT's pavement management system (PMS) needs. Evaluates data against these criteria for acceptance.
Section 3. Quality Control	Describes the QC activities to be conducted before, during, and after data collection to verify data are of acceptable quality and are complete and correct.
Section 4. Acceptance	Outlines the acceptance processes and criteria that will be used to determine if data is fit for use. Includes data sampling, review, and checking processes, and error resolution procedures for data not meeting criteria.
Section 5. Roles and Responsibilities	Identifies the quality-related responsibilities of the data collection team, including Agency and Data Collection Contractor members.
Section 6. Tracking and Reporting	Outlines the documentation expected for QM activities, and format for QM logging, tracking and reporting.

2: Deliverables, Protocols, and Quality Standards

Deliverables

The deliverables associated with the pavement data collection efforts include data items needed for ODOT's PMS as well as pavement data items needed for the HPMS submittal. For the Interstate and non-Interstate NHS, ODOT contracts with a Data Collection Contractor who specializes in this type of work. Deliverables associated with the pavement distress collection and reporting include:

- Location reference data
- Images, including forward right-of-way and downward pavement images
- Sensor data including IRI, rut depth, and faulting
- Summarized distress data in accordance with ODOT and HPMS data collection protocols
- PSR (not collected at this time and will be added to the DQMP if it becomes a deliverable)

All Contractor deliverables are submitted to ODOT for acceptance. Location reference and GPS data are used to establish Contractor routing and to ensure all collected data items and images are tied to ODOT's Linear Reference System (LRS). The Contractor sensor and distress data is populated into an ODOT-provided data shell with specified routing, lane, and milepoint increments so that the data meets both HPMS and ODOT requirements.

Protocols

The Contractor is required to perform data collection, extract the data, and populate ODOT's data shell in conformance with contract requirements and the Contractor's internal protocols. The data collection contract specifies that the Contractor must collect and provide data in accordance with ODOT's *Pavement Data Collection Manual*[5] and the 2016 *HPMS Field Manual*. Data collection standards are included in these documents and the intention is for all pavement data elements to be collected in accordance with the *HPMS Field Manual* and applicable AASHTO standards.

Quality Standards

Data quality standards define, when applicable, the resolution, accuracy, and repeatability or other specified requirements that will be used to determine the quality of each deliverable. Data deliverables will be summarized in increments no greater than 0.1-mile.

Applicable deliverables, protocols, and quality standards are summarized in Table 2.

[5] http://www.oregon.gov/ODOT/Construction/Documents/pavement_data_collection_manual.pdf.

Table 2. Deliverables, Protocols, and Quality Standards

Deliverable	Protocols	Resolution	Accuracy	Repeatability
IRI (left, right, and average)	ODOT *Pavement Data Collection Manual* AASHTO R 43-13[1] AASHTO R 56-14[1] AASHTO R 57-14[1] AASHTO M 328-14[1]	1 inch/mile	ProVAL cross correlation accuracy score ≥ 0.90 (5 repeat runs) compared to ODOT Surpro	ProVAL cross correlation repeatability score ≥ 0.92 (5 repeat runs)
Rut depth (left, right, average, and maximum)	AASHTO R 88-18[1] AASHTO R 87-18[1] AASHTO R 48-10[1]	0.01 inch	± 0.10 inch compared to ODOT survey	± 0.05 inch run to run (3 repeat runs)
Joint faulting (JPCP)	AASHTO R 36-13[1]	0.01 inch	± 0.06 inch compared to ODOT survey	± 0.06 inch (3 repeat runs)
Fatigue cracking (ACP)	ODOT *Pavement Data Collection Manual* AASHTO R85-18[1] AASHTO R 86-18[1]	N/A	Length ± 20 percent compared to ODOT values (by severity level)	N/A
Longitudinal cracking (all pavement types)	ODOT *Pavement Data Collection Manual* AASHTO R 85-18[1] AASHTO R 86-18[1]	N/A	Length ± 20 percent compared to ODOT values	N/A
Transverse cracking and potholes (ACP)	ODOT *Pavement Data Collection Manual*	N/A	Count ± 3 compared to ODOT values, and zero when ODOT is zero	N/A
Corner breaks, shattered slabs, no. slabs, and no. cracked slabs (JPCP)	ODOT *Pavement Data Collection Manual*	N/A	Count ± 3 compared to ODOT values, and zero when ODOT is zero	N/A
Punchouts (CRCP)	ODOT *Pavement Data Collection Manual*	N/A	Count ± 3 compared to ODOT values, and zero when ODOT is zero	N/A
Patching (all pavement types)	ODOT *Pavement Data Collection Manual*	N/A	Area ± 20 percent compared to ODOT values	N/A
Milepoint	N/A	0.005 mile	± 0.03 mile of actual location shown in ODOT straight line logs	N/A
Forward view images	N/A	1920 x 1080, Signs legible, proper exposure and color balance	N/A	N/A
Pavement images	AASHTO R 86-18	Visible 0.08-inch wide crack, 13-foot minimum width	N/A	N/A

[1] In accordance with the HPMS Field Manual.

3: Quality Control

Overview

The data collection contract requires the Contractor to prepare and implement a QC plan that assures data collected accurately reflects actual highway conditions, within the precision and accuracy specified in the contract.

Data Collection Equipment

The Contractor is responsible for proper calibration of all data collection systems. All equipment shall be calibrated according to the manufacturer's recommendations before the initiation of data collection activities. Calibration checks shall be performed at regular intervals (weekly on Contractor selected verification sites and monthly on ODOT approved control sites) to assure that the equipment remains properly calibrated and functional throughout the course of the collection phase. In the event that any major DCV components such as laser or accelerometer sensors, LCMS cameras, or electronic hardware require repair or replacement, the equipment shall be re-calibrated and must pass all calibration checks before it may be returned to service on the project. If multiple data collection vehicles (DCV) are used, each vehicle must employ identical technology and configuration, and must be approved separately.

Equipment calibration and checks will ensure the equipment remains within acceptable precision and bias limits, and that the data is being collected and stored properly by the onboard computer system.

The QC work plan must include and meet the requirements summarized in Table 3.

Table 3. QC Requirements

Deliverable	Quality Expectations	Activity	Frequency
Vehicle Configuration	• Profiler, crack measurement system, location referencing, and cameras meet requirements • Tire pressure check • Bounce and block tests, crack measurement system height check, and photo imagery review	Check	Pre-collection
	• Inspect and clean laser apertures, windshield, and cameras • Inspect hardware and mountings • Verify test signals are received by the on-board computer • Verify all components are working properly	Check	Daily
	• Perform calibration checks	Check	Weekly
	• Image lane placement • Image focus, color, luminance quality • Monitor collection system errors • Data completeness	Check	During collection
DMI Pulse Counts	• ≤ 0.1% difference (multiple runs)	Validate	Pre-deployment
IRI	• Bounce test ≤ 3 inches/mile (static) and ≤ 8 inches/mile (dynamic) • Block check ± 0.01 inch of appropriate height • ProVAL cross correlation repeatability score ≥ 0.92 (5 runs)	Validate	Pre-deployment and Weekly

Table 3. QC Requirements (continued)

Deliverable	Quality Expectations	Activity	Frequency
Rutting	• ± 0.05 inch (3 runs)	Validate	Pre-deployment and monthly
Faulting	• ± 0.06 inch (3 runs)	Validate	Pre-deployment and monthly
Distress	• Std. dev. ≤ 10 percent (3 runs and/or historical average)	Validate	Pre-deployment and monthly
Data Reduction	• Review sample images for clarity, color, and luminance • Review bounce test output • Review power spectral density anomalies • Process and review sample of crack measurement system for anomalies • Post-process all GPS data	Validate	Daily
	• Confirm route start and stop points • Confirm data completeness • Confirm images meet requirements • Adjust unacceptable images • Check crack measurement system data for null and invalid values • Calibrate automated distress algorithms • Manual review and correction of automated distress extraction results when image analysis computer software is in error • Review distress data for consistency between raters • Perform data reasonableness checks	Check	Daily during collection
Data Delivery	• Confirm correct LRS coding and lane • Milepoint ± 0.03 mile of actual location • Confirm correct pavement type • Confirm images meet quality requirements • Confirm events marked as required • No missing values without valid exclusion and reason codes • IRI: 20 ≤ IRI ≤ 800 inches/mile • Rutting: 0.00 ≤ Rut ≤ 2.00 inches • Faulting: 0.00 ≤ Fault ≤ 1.00 inches • Distress within range (see Appendix A)	Check	Prior to data submittal

Control Sites

ODOT has established control sites to calibrate and monitor the precision and bias of the roughness and rut depth information. Control site testing consists of pre-survey calibration testing, weekly verification testing, monthly verification testing, and post-survey exit controls. The ODOT sites near Salem serve as the location for pre- and post-survey testing, as well as monthly verification testing. Weekly verification testing will be conducted at a location determined by ODOT. Pre-production testing and Agency distress calibration sites must be completed and accepted by ODOT prior to production work.

ODOT reserves the right to change or modify the location and extent of the control sites, and will notify the Contractor prior to production data collection. Control site locations are shown in Table 4.

Table 4. Control Site Locations

Route	City	Location	Pavement Type[1]	Condition Evaluated
I-5 Frontage Road	Salem/Albany	As marked in field	ACP	IRI
OR-34 (HWY 210) EB	Corvallis/Lebanon	MP -0.10 to 6.40 MP 10.06 to 18.13	ACP	Rutting and Distress
OR-34 (HWY 210) EB	Corvallis/Lebanon	MP 6.40 to 10.06	JPCP	Faulting and Distress
I-5 (HWY 001) NB	Albany	MP 228.20 to 233.14	CRCP	Distress

[1] ACP – asphalt concrete pavement; JPCP – jointed plain concrete pavement; CRCP – continuously reinforced concrete pavement.

IRI

For each data collection year, ODOT certifies all DCV's (and certified operator) for IRI on the I-5 Frontage Road control site location using ODOT Surpro reference profiler in accordance with ODOT TM 769-13 (see Appendix C for additional details), AASHTO R 56-14, AASHTO R 57-14, AASHTO M 328-14, and the *HPMS Field Manual*. Reference IRI values are determined based on five repeat runs of the ODOT Surpro reference profiler. Contractor-determined longitudinal profiles are collected on a minimum of five repeat runs and are submitted to ODOT for analysis of repeatability and accuracy using the ProVAL software. Contractor repeatability and accuracy must meet the criteria specified in Table 5 prior to production data collection.

Rut Depth

For each data collection year, ODOT conducts rut depth verification at the OR-34 (HWY 210) EB control site location using an ODOT transverse profiler, and in accordance with AASHTO R 48-10, AASHTO R 87-18, AASHTO R 88-18, and the *HPMS Field Manual*. Reference rut depth values are determined based on three repeat runs of the ODOT transverse profiler. Contractor-determined rut depth values are based on a minimum of three repeat runs and are submitted to ODOT for analysis. Comparisons of average rut depth for each wheel path are made on a 0.10 mile basis. Contractor results must meet the criteria specified in Table 5 prior to production data collection.

Faulting, and Distress

ODOT is developing additional control site selection criteria to be used in the next data collection contract (scheduled for 2020) that currently is envisioned to include:

- ODOT to measure and establish faulting reference values.
- Contractor assessment of faulting using the DCV.
- ODOT to measure and establish manual pavement distress reference values.
- Contractor assessment of pavement distress using the DCV.
- ODOT comparison of Contractor and Agency results, confirming:
  - Each DCV meets all control site criteria prior to production data collection.
  - Any differences are investigated and agreed upon prior to production data collection.

Control Site Criteria

Proposed control site criteria are summarized in Table 5.

Training

By the next data collection contract, ODOT will develop rater training requirements for manual rating personnel. The rater training will be based on the ODOT *Pavement Data Collection Manual* and this DQMP.

Contractor Rater Certification

ODOT will also develop a rater certification program by the next data collection contract. Contractor personnel will be assessed on their ability to correctly identify and categorize the type, severity, and extent of each distress. Only personnel certified by the examination process will be permitted to perform ratings.

Table 5. Proposed Control Site Criteria

Deliverable	Protocol	Criteria
Location Reference and Descriptive Information		
LRS, Lane, Milepoint, Event Codes, Exclusion Codes and Reason	N/A	• Correct LRS coding and lane • Milepoint ± 0.03 mile of actual location shown in ODOT straight line logs • Events marked per contract requirements • Exclusion codes and reason marked per contract requirements
Sensor Data		
IRI	ODOT TM 769-13[1] AASHTO R 43-13[2] AASHTO R 56-14[2] AASHTO R 57-14[2] AASHTO M 328-14[2]	• ProVAL cross correlation repeatability score ≥ 0.92 for 5 repeat runs • ProVAL cross correlation accuracy score ≥ 0.90 for 5 repeat runs as compared to ODOT Surpro
Rutting	AASHTO R 88-18 AASHTO R 87-18 AASHTO R 48-10	• ± 0.05 inches run to run for 3 repeat runs • ± 0.10 inches compared to ODOT survey
Faulting	AASHTO R 36-13	• ± 0.06 inches run to run for 3 repeat runs • ± 0.06 inches compared to ODOT survey
Distress Data		
Fatigue cracking (ACP)	ODOT *Pavement Data Collection Manual* AASHTO R 85-18 AASHTO R 86-18	• Length ± 20 percent compared to ODOT values (by severity level)
Longitudinal cracking (all pavement types)	ODOT *Pavement Data Collection Manual* AASHTO R 85-18 AASHTO R 86-18	• Length ± 20 percent compared to ODOT values
Transverse cracking and potholes (ACP)	ODOT *Pavement Data Collection Manual*	• Count ± 3 compared to ODOT values, and zero when ODOT is zero
Corner breaks, shattered slabs, No. slabs, and No. cracked slabs (JPCP)	ODOT *Pavement Data Collection Manual*	• Count ± 3 compared to ODOT values, and zero when ODOT is zero
Punchouts (CRCP)	ODOT *Pavement Data Collection Manual*	• Count ± 3 compared to ODOT values, and zero when ODOT is zero
Patching (all pavement types)	ODOT *Pavement Data Collection Manual*	• Area ± 20 percent compared to ODOT values

Table 5. Proposed Control Site Criteria (continued)

Deliverable	Protocol	Criteria
Images		
Forward view images	N/A	• Minimum resolution 1920 x 1080 • Free of distortion and obstructions; proper lighting, exposure and focus • Correct Header Information • Sufficiently clear to identify patching, raveling, and longitudinal cracking ahead of vehicle • Synchronized to pavement images • No more than 5 of 100 consecutive images shall be of inferior quality
Pavement images	AASHTO R 86-18	• Intensity and range images provide continuous view of road surface • Minimum 13' transverse width with either centerline or edge stripe visible in the images • Artificial light source providing consistent illumination of images • Sufficient resolution to identify 0.08-inch (2 mm) crack width at normal highway speeds • Synchronized to forward images • No more than 5 of 100 consecutive images shall be of inferior quality

[1] http://www.oregon.gov/ODOT/Construction/Doc_ManualofFieldTestProcedures/2017/03_ODOT_test_methods.pdf.
[2] In accordance with the HPMS Field Manual.

4: Acceptance

ODOT conducts a rigorous review of the Contractor-submitted data and images. All data and images are subject to review for acceptance. Each week, the Contractor must submit the previous week's sensor data and images and ODOT checks these weekly submittals for correct routing, LRS coding, direction, lane, and image quality. This process ensures that all DCV test runs meet project requirements and will be suitable for use, and the timely review and feedback to the contractor ensures any unacceptable tests runs can be re-collected before the DCV leaves the project.

Post-processed sensor and distress data and images are submitted by the Contractor in batches by District. ODOT performs a series of global database checks on all data submittals to ensure data is complete, within acceptable ranges, and missing data is properly coded and accounted for. Each data submittal is loaded into ODOT's quality assurance database which has numerous data queries and checking routines to assure that data is complete and fit for use. As part of the process, ODOT conducts independent range checks of all data as described under the Data Delivery item in Table 3 and Appendix A. The 0.1-mile segment data is also aggregated and averaged to PMS sections of uniform condition, history and traffic to allow for time series comparisons of current year data with historic trends and current year windshield ratings. When PMS section averages fall outside expected values that cannot be explained by the construction or maintenance history, all 0.1-mile segment data within the PMS section are flagged and reviewed for potential issues. After all batch deliveries have been reviewed and issues resolved, the Contractor is required to submit a pre-final delivery with all data for acceptance. If widespread issues still remain in the final delivery, a subsequent final delivery may be requested to ensure the data is corrected as agreed upon between ODOT and the Contractor.

Table 6 summarizes the data and image acceptance criteria (see Appendix B for additional details).

Table 6. Acceptance Criteria

Deliverable (& Frequency)	Acceptance	Checks Performed	Action If Criteria Not Met
Route, lane, direction, LRS (Weekly)	100 percent	Review previous week's images for correct routing, LRS coding, lane, and begin and end mile locations	Reject deliverable; Re-collect route
Images - Forward and pavement (Weekly)	Max. 5 of 100 consecutive images with inferior quality	Review previous week's images for coverage and quality (lighting, exposure, obstructions, focus)	Reject deliverable; Re-collect route
Pavement Type (By District)	100 percent	Check for discrepancies against Agency provided pavement type. No more than two 0.1-mile segments within any 1-mile section	Resolve all discrepancies prior to final distress rating
Data Completeness (By District)	99 percent	Total collection miles (excludes areas closed due to construction, behind gates, or where access cannot be reasonably achieved)	Reject deliverable; re-collect route
	100 percent	No blank distress data fields without exclusion code and reason	Return deliverable for correction
	100 percent	No data outside the allowable ranges	
	90 percent	Bridge events, construction detours, and lane deviations marked correctly	

Table 6. Acceptance Criteria (continued)

Deliverable (& Frequency)	Acceptance	Checks Performed	Action If Criteria Not Met
Sensor data - IRI, rut, and faulting (By District)	100 percent	Compliant with Control site and Verification testing requirements	Reject all data since last passing verification; Re-calibrate DCV and re-collect affected routes
	95 percent	Data within expected values based on year over year time series checks: • IRI ± 10 percent from previous • Rut ± 0.10 inch from previous • Fault ± 0.05 inch from previous	Flag discrepancies and investigate; Re-collect if wet weather or traffic congestion create issues that can reasonably be avoided; Accept data on case by case basis if differences are due to construction/ maintenance, or deterioration more than expected, or where data appears reasonable based on visual observation of road surface
	95 percent	Comparison with ODOT's DCV on sample of routes: • IRI ± 20 percent • Rut ± 0.20 inch	Flag discrepancies and investigate; Approve data on a case-by-case basis if differences can be reasonably explained ; When significant differences exist and cause cannot be reasonably determined, verify calibrations for all DCV's, review data for systematic errors, re-collect if equipment issues are found
Distress ratings (By District)	100 percent	Compliant with Control site testing requirements	Return deliverable for re-evaluation
	Interstate: 95 percent Non-Interstate: 90 percent All Routes: No more than 10 percent of 0.1-mile segments within a PMS section rated incorrectly	Compare current year versus previous year (considering recent construction and maintenance) and flag: • Good/fair/poor category changes • Sections where current year overall index difference exceeds +5 or -15 points from previous year Compare overall index with windshield rating and flag: • Sections with ± 10 points difference	Flag discrepancies and investigate; Compare distress quantities and review severities, check distresses are within lane limits, check distress length and area measurements marked on pavement images and summarized in shell table; Report incorrect distress ratings and return deliverable for correction; Accept the data if the current year distress ratings appear valid, regardless of previous year's ratings

5: Roles and Responsibilities

Table 7 summarizes the specific quality-related responsibilities for each party of the data quality management team.

Table 7. Roles and Responsibilities

Team Role	Assigned Resource	Quality Management Responsibilities
Oregon DOT	Agency's Project Manager (APM)	• Set quality standards, acceptance criteria, and corrective actions. • Coordinate and schedule meetings and work sessions with internal Agency staff and Contractor. • Review and approve Contractor's QC Plan. • Identify control site locations and approve verification sites • Consolidate all review comments and provide to Contractor. • Approve each deliverable per quality standards. • Approve resolution of quality issues. • Maintain records of control and verification site testing. • Document quality issues and compile acceptance log. • Recommend improvements to quality processes.
Data Collection Contractor	Project Manager	• Develop and follow approved QC plan. • Monitor schedule adherence. • Communicate weekly with Agency to provide status and schedule updates. • Ensure DCV meets specified criteria at all times during the project by conducting daily, weekly, and monthly equipment checks as appropriate. • Conduct in-office checks of data collected and troubleshoot and resolve any identified issues. • Conduct data delivery checks and troubleshoot and correct data errors prior to submittal. • Submit all deliverables to APM. • Make revisions to address Agency review comments and submit revised deliverable(s) to APM. • Document quality issues and compile QC logs.

6: Tracking and Reporting

QC and acceptance activities will be documented using tracking logs and reports. The Contractor will be required to monitor and document the QC activities for each delivery submitted to ODOT, and ODOT will document and log deliverable review and acceptance activities. All logs and supplemental documentation will be archived and stored with the project files.

During data collection, the Contractor will be required to submit weekly QC logs to ODOT as confirmation of the Contractor's QC activities. The quality expectations and activities in Table 3 would be the basis for completing the QC log. Related reports (such as weekly calibration checks) would be attached to the submittal, as appropriate. The Contractor is expected to record any issues found with the DCV equipment, images or data that potentially impact quality and document resolution activities in the QC Log submitted to ODOT. Although the Contractor will be free to determine documentation format and content, the QC log shown in Table 8 would be an acceptable method. The 'Resolution' and 'Resolution Date' columns are used only if an error is found that requires resolution.

Table 8. Quality Control Log

Deliverable Name	Delivery Date	Status / Findings	Resolution	Resolution Date

In conjunction with data delivery, the Contractor may provide additional tables describing specific issues and LRS locations where "exceptions" occur. These exceptions may include:

- Segments with different wearing course types than those defined in the initial ODOT file.
- Segments actively under construction during data collection.
- Segments with lane deviations based on lane closure or conditions prohibiting regular collection.
- Segments scheduled to be delivered but were omitted from the delivery.
- Segments that were delivered short of the length defined in the initial ODOT file.

ODOT will prepare acceptance logs as shown in Table 9 to confirm acceptability of each deliverable and document any errors requiring resolution by the Contractor. ODOT will review the deliverables against the criteria shown in Table 6 to either accept or note what aspect of the deliverable is in error requiring resolution. The acceptance log is provided with a feedback report to the Contractor, and the responses from the Contractor are necessary to determine resolution.

Table 9. Acceptance Log

Deliverable Name	Delivery Date	Review Date	Comments / Problems / Concerns	Resolution	Resolution Date

Appendix A – Distress Data Range Requirements

The minimum for all distress values is zero (no distress) in the respective units.

Pavement Type	Distress	Acceptable Range
ACP	Fatigue cracking	Length ≤ 1,056 feet per 0.10 mile
	Longitudinal cracking	Length ≤ 1,584 feet per 0.10 mile (non-wheel path)
	Patches	Area ≤ 6,336 square feet per 0.10 mile
	Potholes	Plan dimension ≥ 6 inches and count ≤ 44 per 0.10 mile
	Raveling	Length ≤ 1,584 feet per 0.10 mile
	Transverse cracking	Each crack ≥ 6 feet in length and count ≤ 44 per 0.10 mile
JPCP	Corner breaks	Count ≤ 36 per 0.10 mile
	Longitudinal cracking	Length ≤ 1,584 feet per 0.10 mile (non-wheel path) Length ≤ 1,056 feet per 0.10 mile (wheel path)
	Patches	Area ≤ 6,336 square feet per 0.10 mile
	Shattered slabs	Count ≤ 36 per 0.10 mile
	Transversely cracked slabs	Count ≤ number of slabs per 0.10 mile
CRCP	Longitudinal cracking	Length ≤ 1,584 feet per 0.10 mile (non-wheel path) Length ≤ 1,056 feet per 0.10 mile (wheel path)
	Punchouts	Count ≤ 36 per 0.10 mile
	Patches	Area ≤ 6,336 square feet per 0.10 mile

Appendix B – ODOT Data and Image Acceptance Criteria

General

- All 0.1-mile segments must not have any distress data fields left blank, or outside the allowable ranges for that data element.
- All 0.1-mile segments within a PMS section must not have more than 10 percent of the segments rated incorrectly, as determined by ODOT's review of the data.
- No more than two 0.1-mile segments within any one-mile section with a pavement type discrepancy.

As-Collected Images – Weekly Checks

1. Review initial weekly submittals of as-collected images, synchronized with location and GPS references.
2. Record any items that are not complete or correct according to requirements and definitions, including:
    a. Correct routing, direction, and LRS identification.
    b. Begin and end locations match PMS sections.
    c. Milepoint equations and overlapping mileages sequences.
    d. Proper collection lane.
    e. Forward perspective video log image quality (photo exposure, lighting, obstructions, and focus) and sufficiently clear to identify patching, raveling, and longitudinal cracking ahead of vehicle.
    f. Downward perspective pavement intensity and range images provide continuous view of road surface at proper width, consistently illuminated, and have sufficient resolution to identify 0.08-inch (2 mm) crack width at normal highway speeds.
    g. Downward perspective image and forward perspective image synchronization with location references.
    h. Locations with observed speed concerns or out of lane deviations (identified from the forward perspective images) marked appropriately in the data.
3. Within 2 weeks of the Contractor weekly submittal, provide reports to the Contractor that identify PMS sections where images or location references were identified to be unacceptable, and require re-collection.

Sensor Data – Weekly Checks

1. Contractor provides weekly submittal of IRI control and verification site data in ERD format.
    a. Agency loads data into ProVAL and performs repeatability and accuracy determination checks with ProVAL software.
    b. Export output from ProVAL as pdf file and send to Contractor.
2. If DCV equipment fails the control or verification site requirements:
    a. Contractor must stop using DCV for data collection.
    b. Contractor must inspect DCV, repair as necessary, and re-calibrate DCV equipment.
    c. DCV must pass control site requirements before returning to service on the project.
    d. All data collected since the last successful verification must be re-collected by the Contractor with calibrated and verified equipment.

Data Completeness, Location, and Pavement Type – Checks by District

1. Check for overall identification information completeness and correctness for each 0.10 mile segment.
    a. Descriptive road information provided (road ID, roadway ID, mileage type, overlap mileage code, segment begin milepoint, segment end milepoint, segment length, travel direction, lane number, wearing course).
    b. Surveyor information provided (data collection date, surveyor ID).
    c. Structures coded properly:
        i. Ensure identified structures (bridges, tunnels, below grade railroad under-crossings, at grade railroad crossings, and cattle guards) are in correct locations and extents.
        ii. Ensure structures are not missing from records.
        iii. Ensure small culverts are not recorded as bridges.
    d. Construction detour lane deviations coded properly.
2. Check for sensor and distress data completeness according to ODOT *Pavement Data Collection Manual* and within *HPMS Field Manual* data requirements. Evaluate segments by pavement wearing course type (ACP, CRCP, or JPCP). Identify any fields that are missing or do not meet data requirements, and submit feedback reports to the Contractor by District.
3. Check pavement wearing course type against Agency pre-filled type in data shells:
    a. Investigate all discrepancies jointly with Contractor and make final determination of wearing course to be used for rating.
    b. Incorporate wearing course changes due to new construction as appropriate.
    c. Confirm asphalt blade patching or overlay less than 0.3 mile long on portland cement concrete pavements are recorded as a patch, not a wearing course change.
    d. Confirm short concrete pavement segments such as weigh in motion panels or intersection approaches are not recorded as a surface type change unless approved.

Sensor Data – Checks by District

1. Load sensor data shell into Sensor quality assurance database and run all checking queries
2. Perform global database checks to ensure data completeness, range checks, proper codes for missing data, and discrepancies between left and right IRI or rut.
3. Perform year to year time series checks of data averaged by PMS section considering recent construction and maintenance and flag sections exceeding thresholds below:
    a. IRI – average of left and right wheel path ± 10 percent of previous value and confirm value is reasonable based on visual observation of road surface.
    b. Rutting – average of left and right wheel paths ± 0.10 inch of previous value and confirm data is reasonable in severity based on visual observation of road surface.
    c. Faulting – average right wheel path faulting for all transverse joints ± 0.05 inch of previous value and confirm values are reasonable.
4. Investigate flagged sections:
    a. Re-collect sections where data collection issues such as wet weather, excessive lane deviations, excessive traffic congestion start/stop or slow speed issues are the cause and can reasonably be avoided.
    b. Accept data on case by case basis if differences are due to construction or maintenance, or deterioration more than expected, or where data appears reasonable based on visual observation of road surface.
5. Run ODOT's DCV on approximately 2 to 5 percent sample of routes run by the Contractor and make data comparisons by PMS section.

a. Investigate sections with IRI differences beyond 20 percent or rut differences beyond 0.20 inch.
b. Approve data on a case-by-case basis if differences can be reasonably explained.
c. When significant differences exist and cause cannot be reasonably determined:
    i. Verify calibration for all DCV's.
    ii. Review data for systematic errors.
    iii. Re-collect data if equipment issues are found.

Distress Data – Checks by District

1. Review District submittals of post-processed images in conjunction with a review of sensor and distress data.
2. Load distress data shell into Distress quality assurance database and run all checking queries
3. Perform global database checks to ensure data completeness, range checks, proper codes for missing data, and anomalies in the data.
4. Calculate weighted average indices and distress quantities by PMS section, and then compare the values to previous year's data, current year's windshield ratings, and reviewer's own observations from images considering recent construction and maintenance. Parameters used for comparison are:
    a. Good/Fair/Poor Rating – Flag sections which change condition category from previous year.
    b. Overall Index – Flag sections > +5 or < -15 from previous year or ± 10 from current year windshield ratings.
    c. Rut Index and overall average rut depth.
    d. Fatigue Index and overall fatigue crack quantity (ACP) or overall longitudinal crack quantity (JCP and CRCP).
    e. Patch Index and overall patch quantity.
    f. Ravel Index and overall raveling quantity.
    g. No Load Index and overall transverse crack quantity.
    h. Pothole, punchout, and bleeding quantities.
5. Based on flagged sections, investigate where indices do not follow expected pavement deterioration models or known new paving or construction:
    a. Compare distress quantities with previous year's data and current year's windshield ratings to aid in determining which distress(es) have changed. Be sure to compare not only total distress quantity but also quantities of higher severity distresses.
    b. Ensure distresses recorded are within the identified lane limits.
    c. Compare length and area measurements of distresses recorded in the Contractor-submitted tables with distresses marked by the Contractor on pavement images (such as crack length and patch dimensions) using a to-scale length measurement tool.
    d. Document distresses with measurements that differ from the distress data shell, and distresses that do not meet data collection requirements for Contractor notification per Step 9.
    e. Accept the data if the current year distress ratings appear valid, regardless of previous year's ratings.
6. ACP pavement type:
    a. Fatigue cracking – severity and length (confirm longitudinal cracks in the wheel path are rated as fatigue, and the linear feet per severity does not exceed 1,056 feet per 0.10 mile).

   b. Longitudinal cracking – non-wheel path – severity and length (confirm the cracks are outside of the wheel path zones, are predominantly parallel to the centerline, the severity is correct, and the maximum length per severity does not exceed 1,584 feet per 0.10 mile).
   c. Transverse cracking – severity and count (confirm transverse cracks are predominantly perpendicular to the pavement centerline, individual cracks are at least 6 feet in length, the maximum number of cracks per 0.10 mile is 44, and individual cracks are rated as the highest severity present over 10 percent of the crack).
   d. Patches – severity and area (confirm the maximum area is 6,336 square feet per 0.10 mile, distresses in the patch are included in the severity rating, utility patches/patches not caused by distress and continuous full lane with inlays or overlays that appear to have been placed with a paver and exceed approximately 0.50 mile in length are not included, and large patches with different severity levels are rated separately).
   e. Potholes – severity and count (confirm the minimum plan dimension of a pothole is 6 inches, the maximum number of potholes is 44 per 0.10 mile, the severity is correct, and long potholes/strings of potholes greater than 12 feet long are counted as multiple potholes).
   f. Raveling – severity and length (confirm raveling is measured in the left and right wheel path and center lane zones, chip seal aggregate loss is rated as low severity, the severity is correct, and the maximum length is 528 feet per zone and 1,584 feet per 0.10 mile).
   g. Bleeding – presence (confirm if two or more areas of 25 square feet or larger are present per 0.10 mile).
7. JPCP pavement type:
   a. Corner breaks – severity and count (confirm the cracks intersect the adjacent transverse and longitudinal joints, does not include cracks within 1 foot of the edge and less than 1 foot long, the severity is correct, and the maximum does not exceed 36 per 0.10 mile).
   b. Longitudinal cracking – wheel path – severity and length (confirm the cracks are inside of the wheel path zones, are predominantly parallel to the centerline, the severity is correct, and the maximum length per severity does not exceed 1,056 feet per 0.10 mile).
   c. Longitudinal cracking – non-wheel path – severity and length (confirm the cracks are outside of the wheel path zones, are predominantly parallel to the centerline, the severity is correct, and the maximum length per severity does not exceed 1,584 feet per 0.10 mile).
   d. Transverse cracking – severity and count (confirm cracks are perpendicular to the pavement centerline, the overall slab severity is the highest transverse crack severity present, and the number of cracks does not exceed the number of slabs per 0.10 mile).
   e. Shattered slabs – severity and count (confirm the slab is broken into four or more pieces, corner breaks are not counted in the pieces, slab sections are not counted if divided by one or more transverse cracks, and the maximum number of cracks does not exceed 36 per 0.10 mile).
   f. Patches – severity and area (confirm the maximum area is 6,336 square feet per 0.10 mile, the severity is correct, and applications of sealant without aggregate are not included).
   g. Joint conditions – transverse, lane, and shoulder severity (confirm the severity is correct and all joints are rated).

8. CRCP pavement type:
    a. Longitudinal cracking – wheel path – severity and length (confirm the cracks are inside of the wheel path zones, are predominantly parallel to the centerline, the severity is correct, and the maximum length per severity does not exceed 1,056 feet per 0.10 mile).
    b. Longitudinal cracking – non-wheel path – severity and length (confirm the cracks are outside of the wheel path zones, are predominantly parallel to the centerline, the severity is correct, and the maximum length per severity does not exceed 1,584 feet per 0.10 mile).
    c. Punchouts – severity and count (confirm punchouts are localized separations of blocks of concrete from the rest of the slab, severity is correct, the longitudinal cracks outlining the punchout are also counted as longitudinal cracking, punchouts that have been completely repaired are not included, and the maximum number does not exceed 36).
    d. Patch – severity and area (confirm punchouts repaired to their visible boundaries are rated patches, applications of sealant without aggregate are not included, the severity is correct, and the maximum area does not exceed 6,336 square feet per 0.10 mile).
    e. Joint conditions – lane and shoulder severity (confirm the severity is correct and all joints are rated).
9. Within 3 weeks of the Contractor District submittal, provide reports to the Contractor of any sections that are determined to be incorrectly rated, and require rerating to correct errors in distresses type, severity, location, and extent as required.

Appendix C – ODOT TM 769-13 Method of Test for Certification of Inertial Profiling Equipment

ODOT TM 769-13

Method of Test for

Certification of Inertial Profiler Equipment

1. SIGNIFICANCE

1.1 This test method describes the procedure for measuring the vertical and horizontal accuracy of an Inertial Profiler for purposes of certification under Oregon Department of Transportation (ODOT) Quality Assurance Program. The profiler will be tested on a calibration course of known International Roughness Index (IRI) for accuracy and repeatability.

2. SCOPE

2.1 This test method covers Inertial Profilers employing automated data collection of pavement profile for the purpose of determining IRI. Measurements are made using non-contact sensing systems from a moving platform meeting the requirements of Section 4, equipment and AASHTO M 328.

3. REFERENCED DOCUMENTS

3.1 AASHTO M 328
3.2 AASHTO R56
3.3 AASHTO R 57
3.4 ProVAL User Manual

4. EQUIPMENT

4.1 An Inertial Profiler, triggering equipment, and calibration equipment meeting the requirements of AASHTO M 328 and AASHTO R 57. Note: Submit documentation detailing the specifications of the equipment to be used and the manufacturer's recommended calibration and calibration check procedures.

4.2 The device must be capable of reporting elevations with a resolution of 0.001 inches or finer at a sampling interval of 2 inches or less within the operating speed of the profiler. The device must provide a means to field calibrate and measure the horizontal distance traveled.

4.3 The device must be equipped with software capable of generating, displaying, storing, and reporting IRI at 0.10 mile intervals. The profiler software will be capable of generating an ERD file that contains the profile data in ERD format and a PPF file that contains the data in PPF format.

4.4 The Inertial Profiler must be equipped with auto triggering equipment and a printer for hard copies of data output.

4.5 Lateral laser spacing of 69 to 71.5 inches is required.

4.6 Maintain the low pass filter at 0.000 feet and the High Pass filter at 200.000 feet for all calibration and certification testing.

5. OPERATOR REQUIREMENTS

5.1 The operator shall be proficient in the calibration and operation of the profiler per the manufacturers' recommended procedures. The certification of the profiling system is tied to the operator. All prospective operators must go through the certification procedure with the equipment with acceptable results to be certified. Certification documentation will show which operators are approved for each profiler.

6. CERTIFICATION REFERENCE SITE

6.1 The certification reference site will be designated by the ODOT, Pavement Services Unit. The reference site will include a Distance Measurement Instrument (DMI) verification section and a section for determining the accuracy and the repeatability of the profiler.

7. REFERENCE VALUE DETERMINATION

7.1 The profile of the reference site will be determined by the ODOT, Pavement Services Unit using an accepted reference device. The IRI will be computed from the collected data.

7.2 The section for DMI Verification will be established by the ODOT, Pavement Services Unit. The start and the end locations of the section will be marked.

8. EQUIPMENT CALIBRATION VERIFICATION

8.1 *Distance Measurement Instrument (DMI) Verification:* The DMI of the profiler shall be set to report distance in feet. The operator will guide the profiler over the DMI section length as laid out by ODOT. The DMI must be triggered by the auto triggering equipment at the start and at the end of the DMI section, and the DMI readout recorded. The operator shall make two additional runs following the same procedure. Each run and distance readout will be observed by an ODOT representative. The average of the three absolute differences (between the DMI readout and actual length of section) must be less than 0.10% of the known distance.

8.2 If the profiler's DMI does not pass the above requirement, then the operator shall calibrate the DMI to the known distance specified by ODOT, and repeat the three runs as stated above.

Note: The DMI reading is affected by the tire pressure. Hence, operators should make sure that the tire pressure is set to the manufacturers' recommended value and the tires are sufficiently warmed-up before calibrating the profiler and performing the required runs.

8.3 *Bounce test:* Perform according to the manufacturer's recommendations. If the profiler manufacturer does not have a procedure, then perform the following:

Position the vehicle on a flat and level surface. Place a smooth, flat, non-glossy material plate under each sensor (the base plate used for the block check can be used). Using the equipment's normal data collection software, initiate a data collection run using a simulated travel speed at the midpoint of the manufacturer's recommended data collection speed range.

(The only difference between a bounce test and a normal data collection run is that there is an artificial longitudinal travel signal supplied and the vehicle is not actually travelling along the road. The bounce test utilizes the same data collection software and routines used during normal data collection).

Allow the profiler to collect a minimum of 528 ft of static profile with the host vehicle as motionless as possible. Next, the sensor(s) should be moved vertically for a total displacement of approximately 1-2 in. (a yardstick may be helpful until the operator gets used to the procedure). This movement must continue until a minimum of 528 ft of simulated longitudinal distance has been covered. The typical method for full size high speed host vehicles is to push the mounting system (bumper) down an inch or so and let the vehicle suspension rebound to create the total vertical travel of 1-2 in. The typical method for light-weight, slow-speed host vehicles is to stand toward the center of the vehicle platform and hop up and down such that all four corners of the vehicle suspension travel approximately 1-2 in. vertically. Stop the test after a minimum of 528 ft of bounce profile is collected.

The IRI during the static portion of the test must be less than 3 in/mile and the IRI during the bounce portion must be less than 10.0 in/mile or the manufacturer's recommended maximum, whichever is less. This requirement shall be met for each sensor. If the IRI value is greater than the stated values, provide documentation explaining why to the ODOT's Pavement Services Unit. The Pavement Services Unit will determine either acceptance or failure of this test based on the documentation provided. An ODOT representative will observe and record the IRI value from the bounce test.

Note: Some profiling systems require a warm-up period before use. The system should be turned on for a minimum of fifteen minutes prior to calibration verification, or per the manufacturer's recommendations.

8.4 *Vertical height test:* The height sensor will be checked with blocks of a known thickness of 0.25-in, 0.50-in and 1.00-in. A smooth base plate will be placed under the height sensor height measurements will be taken, or the vertical height will be zeroed. A 0.25-in block will be placed on top of the base plate under the height sensor and height measurements will be taken. The 0.25-in block will be removed and replaced with the 0.50-in block on top of the base plate and height measurements will be taken. The 0.50-in block will be removed and replaced with the 1.00-in block on top of the base plate and height measurements will be taken.

The average height of the base plate will be calculated for those systems that cannot be zeroed. This height will be subtracted from the measured height readings for the 0.25-in block, the 0.50-in block and the 1.00-in block to calculate the measured thickness of each block. The error in calculated thickness will be determined from the average of the absolute values of the difference between the calculated thickness and the known thickness for the measurements. To pass the height test, the average of the absolute differences must be less than or equal to 0.01-in for each block.

An ODOT representative will observe the measured height values of the base plate and blocks.

8.5 *Calibration Verification Log:* Maintain a log book which records the inertial profiler's history of all calibrations and equipment repairs or replacement. This log shall be made available to ODOT employees at any time on ODOT projects.

9. EQUIPMENT CERTIFICATION PROCEDURE

9.1 *Dynamic Test:* After meeting the requirements of Section 8, the Operator will use the Inertial Profiler to collect profile data on the designated certification reference track. The certification reference track will be a minimum of 528 feet in length.

The Operator will make a minimum series of five runs over the certification reference track. Set the horizontal measurement interval and the reporting interval on the Inertial Profiler to not greater than 2.00 inches. The data collection must be triggered by the automated triggering equipment. Terminate data collection at the end of the designated section. A minimum of five repeat runs of the profiler will be made on each section, and the IRI values computed for each run. The profiler will be operated at the speed that will be used for normal data collection, within the speed range recommended by the manufacturer of the profiler and typical of the data collection speed for contract smoothness measurement.

(Note: Make sure that the tires on the profiler are warmed up before doing the Dynamic test. If they are not warmed up, that can affect the DMI between runs and can significantly affect the Repeatability and Accuracy Scores that are computed in Section 9.3).

9.2 *Data Format:* Profile data will be collected, stored, and reported in a format recognized by the latest version of ProVAL (FHWA smoothness software available at www.roadprofile.com), and given to the ODOT representative for evaluation as described in Section 9.3.

9.3 *Repeatability and Accuracy:* The latest version of the ProVAL Profiler Certification Module will be used for cross correlation, to evaluate the five runs. For these computations, the following settings will be used in the In ProVAL Profiler Certification Module: (1) basis or comparison filter will be set to IRI without the 250 mm filter applied and (2) the comparison runs filter will be set to IRI with the 250 mm filter applied. A Repeatability score of 90% and an Accuracy score of 88% will be required for both wheel paths for certification.

10. EQUIPMENT REQUIREMENTS

10.1 All of the following conditions must be met for certification of the Inertial Profiler:

- Pass all Equipment Calibration Verifications -- Section 8.
- Meet Repeatability requirement-- Section 9.3.
- Meet Accuracy requirement-- Section 9.3.

11. CERTIFICATION OF OPERATORS AND EQUIPMENT

11.1 The ODOT Pavement Quality Engineer will make the final determination as to the acceptability of the Equipment for purposes of certification. The certification is good for 365 days, provided the there are no software updates, equipment is not damaged or reconfigured and no significant changes are made to the profiling equipment or the host vehicle per the judgment of the Engineer.

Notice of Certification: Upon successful completion of this test method, written notice of certification will be issued by ODOT and include the following:

- Identification of the profiler certified (make, model, serial number, software version, and owner)
- Identification of the operator(s)
- Date of certification
- Low & High Pass filter settings at the time of the certification runs
- Repeatability results
- Verification of IRI using cross correlation results.
- Acceptable operation speed