2018 South Eastern States Pavements Conference

Data Quality Management Programs

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Outline

- Pavement Condition Metrics for National Pavement Performance Measures
- Data Quality Management Program Minimum Requirements
- FHWA Guidelines for Development and Approval of States DQMP
- Data Management Resources

Pavement Condition Metrics for National Pavement Performance Measures (23 CFR 490.309)

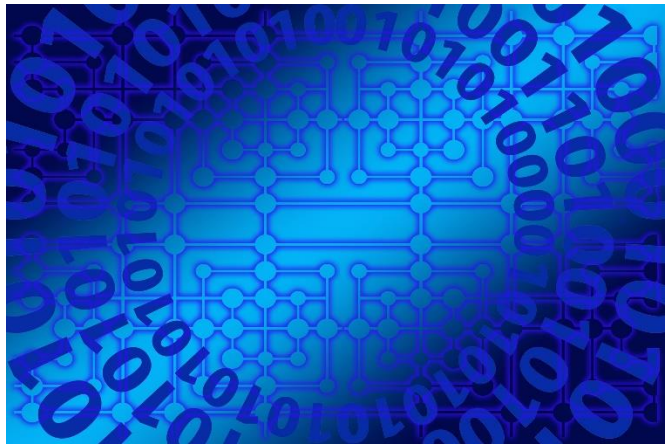
- International Roughness Index (IRI)
- Rutting (flexible pavements only)
- Percent Cracking
- Faulting (rigid pavements only)
- Present Serviceability Rating (PSR) – only where posted speed limit < 40 mph

Note: The metrics shall be collected and reported following FHWA's HPMS Field Manual.

Pavement Performance Measurement

Depends on:

- Complete data
- Quality data
- Timely HPMS reporting
  - Interstate: April 15 (annually)
  - Non-Interstate NHS: June 15 (biennial)*



* Beginning on 2020

Data Quality Management Program (23 CFR 490.319 (c))

- Addresses the quality of all data collected to report the pavement condition metrics
- Applies to manual and automated data acquisition methods
- States submitted their proposed DQMP to FHWA for approval on May 21.
- States shall submit to FHWA any significant changes to the proposed program following its first submittal.

Data Quality Management Program Minimum Requirements

- Data collection equipment calibration and certification
- Certification process for persons performing manual data collection
- Data quality control 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

Missing, Invalid and/or Unresolved Data

- Excessive missing, invalid and/or unresolved data may result in misrepresenting conditions
  - Examples: invalid codes, mismatched section lengths, values outside allowed ranges
- These are excluded from performance measure calculations
  - Percent of lane miles with missing, invalid and/or unresolved data not exceed 5% of the total mileage.
  - Sections with bridges and other pavement types are excluded from the calculations

FHWA Guidelines for Development and Approval of State DOTs DQMP

PM2 rule pavement condition metrics testing protocols

Pavement Condition Metric	Protocol
IRI	• IRI collection device in accordance with AASHTO Standards M328-14. • Collection of IRI data in accordance with AASHTO Standard R57-14. • Quantification of IRI data in accordance with AASHTO Standard R43-13. • Certification of IRI data in accordance with AASHTO Standard R56-14.
Percent Cracking	• Collection of pavement surface images in accordance with AASHTO Standard PP 68-14. • Quantification of cracking from pavement surface images in accordance with AASHTO Standard PP 67-14. • Quantification of cracking in asphalt pavement surfaces, both in wheelpath and non-wheelpath areas with AASHTO Standard R 55-10. • Computation of Cracking Percent for each pavement type in accordance with the HPMS Field Manual.

PM2 rule pavement condition metrics testing protocols (continue)

Pavement Condition Metric	Protocol
Rutting (AC pavements)	• Collection of Rut Depth values conforming to AASHTO Standard R48-10 with the modifications specified in the HPMS Field Manual. • Collection of transverse pavement profiles in accordance with AASHTO Standard PP 70-14. • Quantification of Rut Depth values in accordance with AASHTO Standard PP 69-14, with the modifications specified in the HPMS Field Manual.
Faulting (JCP pavements)	• Faulting computed based on AASHTO Standard R36-13 with the parameters specified in the HPMS Field Manual.
Present Serviceability Rating (PSR)	• Determine based on the criteria and parameters specified in the HPMS Field Manual.

Example - Data collection equipment calibration and certification Criteria

Data Element	Required Minimum Accuracy	Required Resolution (Measure to the Nearest)	Required Minimum Repeatability
IRI	± 5 percent compared to a reference profiler	1 in/mi (0.02 m/km)	± 5 percent run to run for three repeat runs
Rut Depth	± 0.08 in (2.0 mm) compared to manual survey	0.01 in (0.25 mm)	± 0.08 in (2.0 mm) run to run for three repeat runs
Faulting	± 0.08 in (2.0 mm) compared to manual survey	0.01 in (0.25 mm)	± 0.08 in (2.0 mm) run to run for three repeat runs
Distress Rating	± 10 percent compared to agency ratings	N/A	N/A
GPS Coordinates	0.00005 degrees compared to agency provided coordinates	0.000001 degree	N/A

Best Practices for certification of persons performing manual data collection

- A pavement condition survey manual that describes its pavement condition rating methodology.
- Manual Data Collectors attend an annual visual pavement condition rating training. The intention is to teach all the proper methods for identifying and quantifying all tracked distresses on the road surface and is based around the State DOT's Pavement Condition Survey Manual and the proper methods for recording distresses documented in the State DOT Pavement Condition Survey Manual.
- After significant classroom instruction, the students conduct manual condition surveys on roadways with known distress ratings. Through an iterative process of rating and discussing results, students learn to calibrate their distress rating skills on pavements with different types of distresses.

Best Practices for certification of persons performing manual data collection (cont.)

- Students take and must pass a written exam demonstrating overall understanding of the visual rating process, procedures, categorization, quantification, and data input of distresses according to the State DOT Pavement Condition Survey Manual.
- State DOT issues a certification to students that meet their manual data collection requirements.
- Manual Data Collectors are recertified annually.

Data quality control measures

- Training automated distress collection crews and distress raters.
- Equipment setup and calibration.
- Field testing control and verification sites.
- Real-time data checks.
- Internal validity checks.
- Random sample audits, inter-rater reproducibility, and repeat test checks.
- Quality checks during data reduction.
- Corrective action.
- Periodic reports covering equipment and key personnel used during data collection.
- Schedule adherence and the reasons for any changes.

Data quality control measures (continues)

- Documentation of initial and continuing calibration/ checks/ maintenance for field equipment, any equipment problems, and corrective actions taken.
- Documentation of collection procedures and protocols used.
- Reporting of any variances in standard operating procedures or changes in collection methods made in the field.
- Applicable guidance documents.
- Reporting of all control, verification, and blind site testing and results.
- Documentation of all QC activities.
- Analysis of all rater checks and intra- or inter-rater comparisons.
- Log of all quality issues identified through QC activities and corrective actions taken.
- Copies of all correspondences.

Deliverable	Quality Expectations	Activity	Frequency
Vehicle Configuration	Meet profiler, crack measurement system, orientation system, and camera criteria	Check and certify	Pre-deployment
	• Inspect and clean laser apertures, windshield, and cameras • Inspect hardware and mountings • Check tire pressure • Bounce and block test, crack measurement system height check, and photo imagery review • Collect small sample route	Check	Pre-collection
	• GPS accuracy ≤ 3 meters • Image quality and lane placement • Monitor collection system errors • Data completeness • Crack measurement system height comparable to previous day.	Check	During collection/ Daily
Profiler	• Bounce test ≤ 8 inch/mile • Block check ± 0.01 inch of appropriate height	Calibration	Daily check/ Pre-deployment
DMI Pulse Counts	• ≤ 0.1 difference (five runs)	Validation	Pre-deployment
Location of Segment	• Mileage - 100% compliance with Standards	Validation	Daily
IRI	• Std. dev. ≤ 5% (ten 0.1 mile runs) • Std. dev. ≤ 10% (historical average) • Symmetrical appearance of multiple runs • Power Spectral Density peaks ~10ft/cycle	Validation	Pre-deployment
	• ≥ 30 inch/mile IRI ≤ 400 inch/mile • Left and right IRI values differ ≤ 50 inch/mile	Check	Daily
Rutting	• Std. dev. ≤ 0.40 inch (ten 0.1 mile runs) • Std. dev. ≤ 0.40 inch (historical average)	Validation	Pre-deployment
	• Values ≤ 0.35 inch • Left and right rutting values differ ≤ 0.25 inch	Check	Daily
Percent Cracking	• Std. dev. ≤ 15% total length (ten 0.1 mile runs) • Std. dev. ≤ 15% (historical average)	Validation	Pre-deployment
	• AC pavement values ≤ 50% • JPCP pavement values ≤ 100% • CRCP pavement values ≤ 100%	Check	Daily
Faulting	• Values ≤ 1.0 inch • Faulting values > 0 when joints are present	Check	Daily
Imagery	• 98 % compliance with standards • Focus, color, luminance quality	Check Uploaded Images	Weekly
		Validation	Prior to delivery

Data sampling, review and checking processes

Statistical analysis should be able to determine the quality of the entire batch of data from which the sample was taken.

Data sampling can be:

- Random
- Systematic
- Stratified
- Clustered
- or some combination of those above

When conducting sampled checks, a key consideration that must be addressed is the size of the sample for adequate representation of the population and verification of required measurement accuracy.

Data sampling, review and checking processes

For network-level pavement condition data collection, sample size typically ranges from 2 to 20 percent. Factors that could influence this are the sampling rate:

- Size of the network
- Experience with the data collector
- Risk tolerance
- Variability of surface types and distresses
- Cost

Data Element	Sampling	Expected Range	Annual Variability	Checking Process
Ride (IRI)	100 percent	< 250 in/mile	-5 and +10 in/mile	Automated data check
Rut Depth	100 percent	• 0 to 1 in. • Rutting should not be reported in Rigid Pavements.	-0.05 and +0.1 in	Automated data check
Faulting	100 percent	• 0 to 1 in. • Faulting shall not be reported in Flexible Pavements.	-0.04 and +0.08 in	Automated data check
Percent of Cracking	10 percent of network	• 0 to 60 percent for Flexible Pavements. • 0 to 100 percent for Rigid Pavements.	-5 and +10 percent	Automated data check
Surface Type	10 percent Network	No unpaved surfaces.		Visual
GPS	100 percent	• Mileage review • Comparison w/ master route file.		Visual
Missing Pavement Data	10 percent of network	Pavement data shall not be missing in more than 10 consecutive 0.1-mile long pavement sections, or no more than 2 percent of the extent of a certain route.		Visual
Pavement Images	10 percent of uploaded images per batch	No more than 5 consecutive images failing to meet criteria		Visual or image analyzing software.

Error resolution procedures and data acceptance criteria

Error resolution procedure and data acceptance criteria shall include corrective action(s) to be taken if data don't do not meet established quality requirements and defined data acceptance criteria.

Data errors may be caused by:

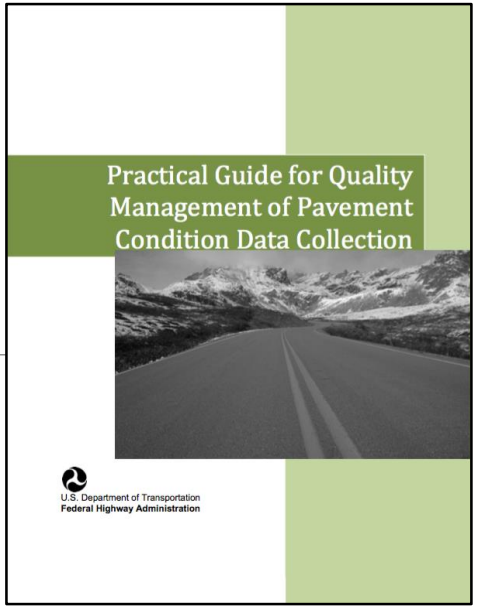
- Procedural errors – such as the use of the wrong method to calculate pavement condition metrics such as IRI, Rutting, etc. This type of error typically occurs during the post-processing procedure used on the raw data to summarize the test results.
- Data quality and omission error – this may be caused by poor image quality, poor accuracy due to equipment failures or lack of calibration.
- Data correctness error – such as collecting the wrong condition metric or using an incorrect standard for data collection.

Error resolution procedures and data acceptance criteria (continue)

- The error resolution process may require the Data Collector to maintain error logs and conduct corrective actions that may include re-collect, re-calibrate equipment, re-analyze the raw data or re-train the staff responsible for data collection or data analysis. It is important that the agency and Data Collector (when applicable) discuss and agree upon the error resolution actions upfront rather than waiting until a problem is discovered.
- The State shall specify the acceptance tolerances that describes quality standards that the pavement condition survey deliverables shall meet.

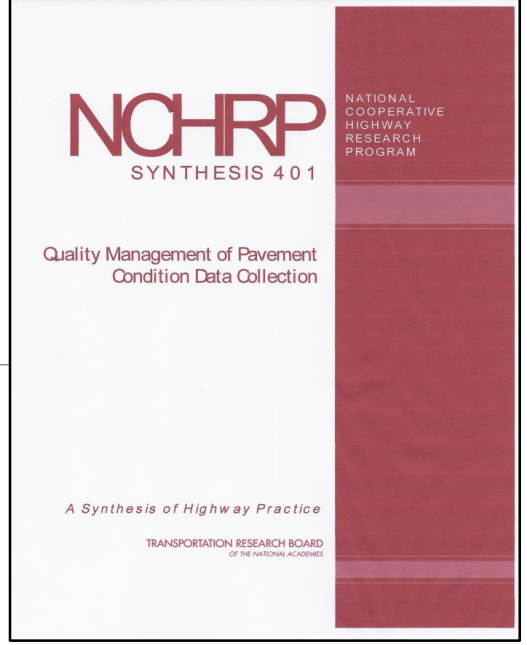
Deliverable	Acceptance	Testing	Action if Criteria Not Met
Data completeness	98 percent	Total network miles (excludes areas closed to construction)	Return deliverable for re-collection
	100 percent	Delivered data accurately populated with description information (system, route, direction, and begin and end latitude/longitude	Return deliverable for correction
	98 percent	Delivered data accurately populated with required data elements. Excludes areas with expected limitations (e.g., IRI in low-speed areas)	Return deliverable for correction
	98 percent	Delivered data with no more than ten consecutive fixed missing segments (500 feet total)	Return deliverable for correction
IRI, rut depth, and faulting	95 percent	Must be compliant with the verification testing requirements	Return deliverable for re-collection
Distress ratings	95 percent	Must be compliant with the verification testing requirements	Return deliverable for re-collection
Route number, direction, begin mile, end mile, GPS coordinates, District, and date collected	100 percent	Database check of accuracy and completeness	Return deliverable for correction
Photolog and pavement images	100 percent	Review of 20 percent random sample. Must be compliant with the verification testing requirements	Return deliverable for re-collection

Data Management Resources



- FHWA Guidelines
  - 2018 DQMP Guidelines
    - https://www.fhwa.dot.gov/pavement/management/pubs/dqmp.pdf
  - 2015 Practical Guide for QMP
    - https://www.fhwa.dot.gov/pavement/management/qm/data_qm_guide.pdf
- FHWA Interstate Baseline Project
  - https://www.fhwa.dot.gov/pavement/management/pubs/hif18032.pdf

Data Management Resources



- NCHRP Synthesis 401
  - http://www.trb.org/Publications/Blurbs/162632.aspx
- HPMS materials
  - HPMS Field Manual - 2016
    - https://www.fhwa.dot.gov/policyinformation/hpms/fieldmanual/
  - Division Review Guidelines – 2017
    - https://www.fhwa.dot.gov/policyinformation/hpms/reviewguide.cfm

Questions

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