

# Validating a Density Profiling System for Asphalt Compaction Assessment

## What Is the Density Profiling System (DPS)?

The DPS is a nondestructive evaluation (NDE) technology designed to assess asphalt compaction. The DPS uses ground-penetrating radar to measure the dielectric constant of a newly constructed asphalt pavement. A dielectric constant measures a material's ability to store electric energy by separating opposite polarity charges in space.<sup>(1)</sup> Research has shown a strong correlation between the dielectric constant of an asphalt mixture and its density or air void content.<sup>(2)</sup> Generally, a higher dielectric constant corresponds to a higher pavement density or a lower air void content.<sup>(3)</sup>



Source: FHWA.  
A DPS mobile unit.<sup>(4)</sup>

## Why Does DPS Matter to State Departments of Transportation (DOTs)?

Proper asphalt compaction directly influences the long-term durability of roadway pavements and pavement performance. With insufficient compaction, asphalt surfaces can degrade quicker,

leading to deterioration that can be hazardous to drivers and increase the cost of roadway maintenance. One key quality assurance metric is the in-place pavement density.

Current compaction assessment relies on drilling and testing cores or using a nuclear gauge, both of

which provide spot assessments of a large paving surface. As an alternative, DPS has the potential to provide a full coverage of density information in near realtime for a large paving area.

State highway agencies are interested in improving asphalt pavement

compaction quality assurance. The Federal Highway Administration (FHWA), in collaboration with 16 State DOTs, initiated the Transportation Pooled Fund project TPF-5(443) to explore how innovative tools, such as the DPS, can benefit construction practices.<sup>(5)</sup>

## FHWA NDE Research Program Assesses DPS

The NDE Research Program at FHWA's Turner-Fairbank Highway Research Center provides technical support for understanding, evaluating, and validating DPS for asphalt compaction assessment. The FHWA NDE Research Program has performed extensive investigations to validate and

assess DPS. Completed work includes testing the sensitivity of DPS to differing temperature and moisture conditions, exploring the fundamental mechanisms of using DPS in both laboratory and field settings, and documenting lessons learned from the research.

## Key Findings

Important things to know when using DPS:

- DPS was mildly sensitive to temperature. Dielectric measurement slightly increased with rising temperature from 100 °F (38 °C) to 130 °F (54 °C). However, the increment was within the limit of 0.08 specified

by the American Association of State Highway and Transportation Officials (AASHTO).<sup>(3)</sup>

- DPS was sensitive to surface moisture. Dielectric measurements increased with the amount of applied surface moisture.
- The scanning boundary of DPS was identified to be near the pavement surface. A 2.0 GHz antenna's penetration depth is less than 2 inches or 5 cm. The scanning boundary depends on an antenna's specification.
- The edge effect from a cylindrical asphalt sample can impact its dielectric measurements using the laboratory testing method.<sup>(7)</sup> The asphalt sample should be higher



Source: FHWA.

DPS shows promising advantages in obtaining continuous density measurements for large paving areas at near realtime.<sup>(6)</sup>



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than 4.5 inches or 115 mm and wider than 6 inches or 152.4 mm.

- A linear regression is effective to model the correlation between the dielectric constant measured by DPS and the density of an asphalt mixture for quality control applications.

### About The Report

The report *Validating a Density-Profiling System for Asphalt*

*Compaction Assessment* highlights research contributed by the FHWA NDE Research Program.<sup>(8)</sup> Civil engineers, construction managers, and policymakers may find the information beneficial as they seek to adopt more advanced and effective methods for compaction quality management. Additionally, researchers and academics in transportation engineering can leverage the detailed analysis

presented in the report to further explore and refine nondestructive testing techniques for asphalt pavement compaction assessment. This report may also be helpful for industry stakeholders and equipment manufacturers aiming to improve compaction assessment product offerings and better meet the demands of modern roadway construction and maintenance.

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## For More Information

Please visit this link <https://highways.dot.gov/turner-fairbank-highway-research-center/labs/nondestructive>

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