

Calibration and Specifications for the Falling Weight Deflectometer and Heavy Weight Deflectometer

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Outline

- Terminology
- Equipment
- Standards
- Other references

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Terms To Be Familiar With

- **reference calibration** —term used to describe the calibration of either the FWD load cell or deflection sensors against a separate reference measuring system. For load cell calibration, the reference system is a custom-made reference load cell; and for deflection sensors, it is a precision accelerometer.
- Done at the factory and / or at a Calibration Center

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Terms To Be Familiar With (cont'd)

- **relative calibration** —term used to describe a calibration procedure in which the deflection sensors are calibrated relative to one another. No outside reference system is used; the sensors are compared to each other.
- It is a quick means to periodically verify that the sensors are functioning properly and consistently

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Why are these two terms critical?

- Relative calibration is done at least monthly.
- Reference calibration is done annually at a calibration center, or by a certified technician on location.
- If these are not done how do you know if the data is good?
- Inaccurate data will lead to inaccurate results and designs

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Deflectometer Equipment



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Some Different Deflectometers



Light Weight Deflectometer (LWD)

- While only used on unbound materials these devices also require calibration annually.



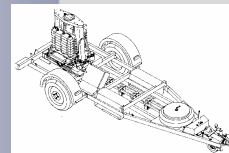
Deflection Measurement

- The load cell and sensors are the critical component to collect accurate data



What is an HWD / FWD?

- Comprised of a tow vehicle and trailer
- Designed to impart a dynamic load to a pavement structure
- Measures deflection of the pavement surface
- Simulates a moving wheel load.



What is it Used For?

- Structural capacity/remaining life estimates
 - Load transfer efficiency between PCC pavement joints
 - Void detection in PCC pavements
 - Network level pavement management
 - Project level pavement investigations
 - Many research applications.
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Standards

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HWD/FWD Calibration

"Think of FWD deflections as shots at a target"

Uncalibrated Sensors **After Reference Calibration** **After Relative Calibration**
May or may not fall within target *Highly scattered* *closer to target*
May or may not be biased *May be close to* *intended target*

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Important Standards

- **Owners Manual for your FWD/HWD**
 - Provides the manufacturer's recommendation on maintenance and calibration
- **ASTM D4694 - Standard Test Method for Deflections with a Falling-Weight-Type Impulse Load Device**
- **ASTM D4695 - Standard Guide for General Pavement Deflection Measurements**

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Important Standards

- **FAA AC 150/5370-11A - USE OF NONDESTRUCTIVE TESTING IN THE EVALUATION OF AIRPORT PAVEMENTS**
 - Section 11 states: "...the NDT equipment sensors should provide accurate and repeatable deflection measurements at each sensor location."

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FAA AC 150/5370-11A - USE OF NONDESTRUCTIVE TESTING IN THE EVALUATION OF AIRPORT PAVEMENTS

- This AC also provides excellent guidance to users for testing procedures on both Asphalt and Portland cement Concrete pavements

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AASHTO R32-09

- The Standard Recommended Practice for Calibrating the Load Cell and Deflection Sensors for a Falling Weight Deflectometer
- The American Association of State Highway and Transportation Officials (AASHTO) developed R32 in January of 2009

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Standard requirements

- The equipment is highly specialized and will be available for a source to be determined
- The site and operators will be trained and certified prior to any calibration being performed.

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R32 Overview

- Defines terminology
- Defines the Method
- Defines the Apparatus to be used
- Defines the setup of the FWD/HWD for the calibration
- Defines the setup of the Reference Load cell and the deflection sensors
- Defines the annual and monthly procedures
- Defines the Report that should be provided after calibration
- Defines the Precision and Bias of the procedure

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Calibration Equipment



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Apparatus

- The calibration facility is defined as indoor space with controlled temperature and a level floor large enough for vehicle and trailer
- The test pad may either be constructed or an existing slab which meets defined criteria for size and deflections

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Test Pad

- Portland Cement Concrete
- Typically 4 by 5 meters and crack free although an existing slab may have hairline cracks no wider than 1.5 mm
- Slab should be isolated from the surrounding floor so transient vibrations are not transmitted into the pad
- Slab deflection of 300 microns with a 70 kN load
- Minimum slab thickness of 125 mm on 200 mm open graded crushed materials
- Subgrade modulus less than 80 MPa
- Bedrock deeper than 7 to 9 meters

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FWD/HWD setup

- FWD/HWD shall be properly maintained and working
- Shall be attached to the tow vehicle if a trailer
- Program a minimum of 3 load levels with a maximum of 80 kN \pm 10%
- 18 to 30 drops in the sequence with the same sequence being used for the load cell calibration and the deflection sensor calibration

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Calibrating a built in FWD



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Results

- Deflections Sensors are acceptable if the slope for an individual sensor is not more than 0.0020
- The trial is acceptable if all sensors are not more than 0.0020
- The calibration software will determine the Reference Gain Factor for the sensor and the RMS difference for all sensors
- If RMS is >0.003 it indicates some sensors may not be repeatable

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Acceptance

- The Final Gain factors are compared to the previous calibration
- The difference shall not be higher or lower than 1% for each sensor and the load cell.
- A change over a number of years greater than 0.1% per year is unacceptable

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Calibration Certificate

- Upon successful completion of the process a Calibration Certificate will be issued for the load cell and deflection sensors on the machine.

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Summary

- The new AASHTO standard will be the foundation of calibration procedures both in the US and the European Road communities.
- Some equipment manufacturer's can now offer Calibrations of the equipment on site thanks to the new procedures and equipment developed by Dr. Irwin and AASHTO

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Summary Cont'd

- Ask your engineering consultants to see the calibration records for their equipment as part of your contract requirements. This will help ensure that your data will be accurate
- Ask to see their testing plan and pattern to ensure it will fully meet your needs and show you that they know what they are doing.

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Web Site Assistance

- www.faa.gov/documentLibrary/media/advisory_circular/150-5370-11A/150_5370_11a.pdf
- www.astm.org (Available in Spanish)
- www.transportation.org/ (AASHTO web site)

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Gracias por su atención

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Questions?

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