



Transport
Roads & Maritime
Services

Test method T177

Pavement deflection measurement
(falling weight deflectometer)

OCTOBER 2012



Revision Summary

Ed/Rev Number	Clause Number	Description of Revision	Authorisation	Date
Ed 1/Rev 0	All	New Method Based on “Austroads” TM and the MRWA Test Method WA 326.2.	D. Hazell	Sept 2008
Ed 2/ Rev 0	All	Reformatted RMS template	J Friedrich	October 2012

Note that Roads and Maritime Services is hereafter referred to as ‘RMS’.

The most recent revision to Test method T177 (other than minor editorial changes) are indicated by a vertical line in the margin as shown here.

Test method T177

Pavement deflection measurement (falling weight deflectometer)

1. Scope

This Test Method sets out the procedure for automatically measuring the deflection at a location on a road using the Falling Weight Deflectometer (FWD).

2. General

- (a) This Test Method is to be read in conjunction with Austroads Test Method AG:AM/T006 with the amendments identified in this Test Method

NOTE: The clause numbering in this Test Method generally parallels the numbering in the Austroads Test Method and not the usual numbering system.

- (b) Referenced documents include:
- (i) Austroads Test Method AG:AM/T006 Pavement Deflection Measurement with a Falling Weight Deflectometer (FWD) (abbreviated as AG:AM/T006) available from:
http://austroads.com.au/pdf/TestMethod1/AGAMT006_Deflection-FWD_survey.pdf
 - (ii) Main Roads Western Australia WA 2060.5 - Calibration of Falling Weight Deflectometers (abbreviated as WA 2060.5)
 - (iii) NATA Supplementary Requirements for Accreditation for Construction Materials Testing

3. Definitions

In accordance with AG:AM/T006 Clause 3.

4. Apparatus

4.1 Minimum Equipment Specification

Amended AG:AM/T006 Clause 4.1:

- (a) A FWD with data acquisition system mounted in a trailer or in a vehicle with equipment requirements and capability described in Clause 4 of AG:AM/T006
- (b) Where required, a vehicle to tow the FWD trailer
- (c) Equipment to record the location of the Test Point (e.g. odometer, GPS)

NOTE: The standard datum for all spatially referenced data must be the Geocentric Datum of Australia (GDA). The plane co-ordinate system shall be the Map Grid of Australia (MGA).

- (i) Distance measurement device to an accuracy of ± 5 m in 1000 m
- (ii) Measure for the lateral offset accurate to ± 100 mm
- (d) A non-contact thermometer (e.g. infra-red, laser) with a measurement range of at least 0 to 100°C readable and accurate to 1°C
- (e) Automated paint marking system for the identification of individual Test Points
- (f) Camera to record pavement condition at the Test Location (optional)

4.2 Automatic data quality checks

In addition to AG:AM/T006 Clause 4.2:

Clauses (a) to (e) unchanged.

- (g) Monitor the performance of all sensors for drift or change in the output outside the acceptable range.
- (h) Monitor the magnitude of the deflection 60 milliseconds after the trigger (i.e. Roll Off)

- (i) Any equipment outside their specified range must be replaced before carrying out any further testing.

4.3 Manual data quality checks

Replaces AG:AM/T006 Clause 4.3:

- (a) The system software must provide the data quality checks in Clause 4.2. However, manual data quality checks must be carried out as part of the audit procedure.

4.4 Electronic data acquisition system

Additional clause after AG:AM/T006 Clause 4.3:

- (a) The electronic data acquisition system of hardware and software must facilitate interaction with the operator to report the following:
 - (i) Heading data
 - (ii) Events against each record
 - (iii) Pavement condition information against each record
 - (iv) Comments against each record
- (b) The FWD software must also automatically:
 - (i) Calibrate the load cell and deflection sensors
 - (ii) Calculate the modulus to assist with the evaluation of suspect data

5. Calibration and Preparation

5.1 Calibration scheme

Replaces AG:AM/T006 Clause 5.1:

- (a) A two part calibration of FWD equipment is required:
 - (i) Reference Calibration
 - (ii) Relative Calibration

NOTE: Validation testing of the FWD may also be specified.

5.2 Reference Calibration

Replaces AG:AM/T006 Clause 5.2:

- (a) At least once every year, perform a Reference Calibration in accordance with WA 2060.5

5.3 Relative Calibration

Replaces AG:AM/T006 Clause 5.3:

- (a) Perform Relative Calibration in accordance with WA 2060.5. However, a Relative Calibration is not required to be carried out within one month of a Reference Calibration that covers all the current sensors. Unless otherwise specified, the frequency must be:
 - (i) Prior to commencing a program of testing
 - (ii) At least once every 4 weeks where testing is for more than 6 weeks duration
- (b) The results of all Relative Calibrations must be recorded and maintained at least until completion of the next Reference Calibration

5.4 Deflection sensor monitoring and replacement

Replaces AG:AM/T006 Clause 5.4:

- (a) If replacement of one or more sensors is necessary then the following applies:
 - (i) If the replacement deflection sensor(s) were certified as part of a currently valid Reference Calibration, then the sensor(s) can be used following the successful completion of a Relative Calibration in accordance with Clause 5.3
 - (ii) Otherwise a Reference Calibration in accordance with Clause 5.2 must be completed prior to the FWD being used

5.5 System validation

Replaces AG:AM/T006 Clause 5.5:

- (a) Validation of distance measurement must be conducted in accordance with the manufacturer's instructions at least once every 6 months
 - (i) Use a 1 km surveyed reference section of road for calibration
 - (ii) Carry out 5 repeat measurements using the distance measuring device
 - (iii) When compared all the results must be within tolerance
- (b) Validate that GPS meets the manufacturer's specification at least once every 6 months
- (c) Temperature devices are to be calibrated in accordance with NATA Supplementary Requirements for Accreditation for Construction Materials Testing

5.6 Test Point Selection

Additional clause after AG:AM/T006 Clause 5.5:

- (a) Locate the Test Point using the specified location reference system and the specified lateral position. Unless otherwise specified, the lateral position must be the Outer Wheelpath

NOTE: The wheelpath is the path usually trafficked by heavy vehicles at the Test Location. Take care to safely position the equipment on the correct location.

- (b) Assess that the pavement under the FWD equipment at the Test Point meets the following requirements:
 - (i) Road that is consistent in surface type and structure (e.g. no trenches, change in surfacing or pavement type)
 - (ii) Road that is an even surface, free of loose particles, and free of deformation (e.g. rutting, shoving, corrugations, etc)
 - (iii) Has no non-pavement features (e.g. pits, access covers, traffic detection systems)
- (c) Where the pavement is assessed as unsuitable, relocate the Test Point once by up to 2 m to provide a more suitable location. Provide the reason as a comment. Measure subsequent locations of Test Points from the original Test Point and not the relocated position
- (d) Visually assess the pavement condition within a 5 m radius around the Test Point and record the following as part of the Condition Report:

NOTE: Only assess the pavement within the lane being tested.

- (i) Identify the type of flexible pavement surface (i.e. seal, asphalt, etc)
- (ii) Deformation reported as 'Yes' if present and 'No' where there is no deformation
- (iii) Patching reported as 'Yes' if present and 'No' where there is no patching
- (iv) Cracking reported as 'Yes' if present and 'No' where there is no cracking

6. Procedure

6.1. FWD Setup

6.1.1 Test Load

Replaces AG:AM/T006 Clause 6.1.1:

Unless otherwise specified, a target applied stress of 700 kPa (corresponding with a load of 50 kN) is to be used. Actual test loads must be within $\pm 4\%$ of the target load level.

NOTE: FWD devices allow for a range of load levels to be used during testing. Specific load levels maybe selected for particular pavement types or strengths, and for use in different types of analysis.

For the Dynatest FWD Equipment, the test load should use four pairs of weights and four rubber buffers.

6.1.2 Deflection sensor spacing

Amended AG:AM/T006 Clause 6.1.2:

Unless otherwise specified, the spacing to be used during testing is for 9 sensors as detailed in Table 4 of AG:AM/T006.

6.2 Deflection Survey

Amended AG:AM/T006 Clause 6.2:

Clauses (a) to (e) unchanged.

- (f) Perform two additional load sequences [6.2(d)]
- (g) For the Test Point record the following test results from the third drop:
 - (i) The impact peak load to a resolution of 0.1 kN
 - (ii) The pavement deflection from each of the nine sensors to a resolution of 1 μm
 - (iii) Ambient and road surface temperatures to the nearest 1°C.
- (h) Compare the deflection results of the second and third test sequences. Report the difference between the deflections for any sensor when it exceeds the following tolerances:
 - $\pm 4 \mu\text{m}$ when the deflection is $< 30 \mu\text{m}$
 - $\pm 6 \mu\text{m}$ when the deflection is $\geq 30 \mu\text{m}$ but $< 100 \mu\text{m}$
 - $\pm 5\%$ when the deflection is $\geq 100 \mu\text{m}$

NOTE: Differences of this magnitude may affect analysis of the data.

- (i) At each Test Point mark the pavement with a 75 mm solid circle of white line marking paint to enable the centre of the load plate used for the test to be located ($\pm 300 \text{ mm}$). The mark must remain clearly visible for at least 6 months. Record any offset to the actual location that is used

6.3 Factors affecting the test

In addition to AG:AM/T006 Clause 6.3:

Clauses (a) and (b) unchanged.

- (c) Before leaving the Test location check for any deviation from the tolerances (e.g. impact peak load), equipment malfunction or unreasonable results (e.g. deflection recorded on each sensor does not decrease with distance from the impact location)
- (d) Where an issue occurs
 - (i) Identify the Test Point data as nonconforming
 - (ii) Where the issue is related to the pavement carry out Step 5.6(c)
 - (iii) When the issue has been resolved repeat Step 6.2 at the Test Point
- (e) Ascertain the extent that previous test results may have been affected and identify the data accordingly

6.4 Data Download

An additional Clause after Clause 6.3:

- (a) Data is to be regularly downloaded to a secure digital media. Ensure that back-up copies of all data is made periodically

7. Calculations

In accordance with AG:AM/T006 Clause 7.

8. Reporting

Replaces AG:AM/T006 Clause 8:

Include the following data and results for each Test Point in the report (computer file):

- (a) Equipment identification (Manufacturer, Model, Serial No)
- (b) Name of operator
- (c) Location of the Test Point as required by the Specification (e.g. Roadloc reference, spatial reference, local reference), Where GPS was used, the equipment details, mode and datum
- (d) Date and time of test point
- (e) Pavement Surface type
- (f) Condition report of the Test Location (refer to Step 5.6(c))
- (g) Target load (kPa and kN)
- (h) Impact peak load measured during the final (i.e. third) loading cycle to the nearest 0.1 kN
- (i) The normalised deflection reading for each deflection sensor to the nearest 1 μm
- (j) The following temperatures for each Test location to the nearest 1°C
 - (i) Ambient temperature
 - (ii) Road surface temperature
 - (iii) Where specified, pavement temperature
- (k) Filtering applied (Yes/No)
- (l) The original raw data files
- (m) Reference to this test method