

COMMENTARY TO AG:PT/T122 - TORSIONAL RECOVERY OF POLYMER MODIFIED BINDERS

PREFACE

This test method was prepared by the Bituminous Surfacing Research Reference Group on behalf of the Austroads. Representatives of Austroads, ARRB Group and the Australian Asphalt Pavement Association have been involved in the development and review of this test method.

FOREWORD

Polymer modified binders (PMBs) are thought to provide benefits due to their increased elastic behaviour. A simple means of determining the elastic properties of a PMB is to measure its torsional recovery. The torsional recovery test is simple and can be readily utilised for routine quality control purposes.

SCOPE

This test method sets out the procedure for the determination of torsional recovery of PMBs using a simple bolt and cup assembly.

Further Development

There are no further plans for the development of this test method.

TORSIONAL RECOVERY OF POLYMER MODIFIED BINDERS

1 REFERENCED DOCUMENTS

The following documents are referred to in this method:

AUSTROADS

AG:PT/T101 Method of sampling polymer modified binders, polymers and crumb rubber

AG:PT/T102 Protocol for handling polymer modified binders in the laboratory

AS /NZS

2341 Methods of testing bitumen and related roadmaking products.

2341.12 Method 12: Determination of penetration.

E 1 Standard specification for ASTM thermometers.

2 PRINCIPLE

The torsional recovery apparatus operates by manually rotating an aluminium bolt, previously embedded in a cup of modified binder, through an angle of 180 degrees and measuring the extent of recovery of the original applied rotation. The initial 180 degree twist is applied with a spanner over a 10 second period. The recovery after 30 seconds is reported.

3 APPARATUS

The following apparatus is required:

- a. Bolt assembly - a cylindrical headed aluminium bolt assembly, as illustrated in Fig. 1, with a total mass of 45 ± 5 g. The bolt has a cylindrical head with a diameter of 28.6 mm and a thickness of 9.52 mm. The threaded shank of the bolt is 44.5 mm long. A metal "spider", with three radial pins and two nuts, can be used to centre the assembly. A pointer is required for angle measurements in the absence of the spider. See Fig. 1 for details of this assembly and the optional components.
- b. Sample tin - sample tin of 80 to 85 mL capacity and internal diameter 51 to 52 mm. A penetration can, as defined in AS2341.12, is suitable.
- c. Angle measuring device - angle measuring device and sample clamp assembly, or an alternative means of clamping the sample/bolt assembly and determining the initial and recovered angle. The recommended device provides a scale, of 80 mm radius and graduated in degrees around at least half its circumference, and a clamp capable of holding the sample cup within 3 mm of its centre and without deforming the cup by more than 3 mm in any direction.
- d. Water bath - capable of operating at $25 \pm 0.5^\circ\text{C}$, fitted with an appropriate thermometer.

Note: A suitable thermometer is an IP 39 C, or ASTM 90C, as specified in ASTM E 1.

- e. Forced convection oven - capable of operating in the range 60°C to 200°C, with a setpoint accuracy of $\pm 5^\circ\text{C}$.
- f. Stop-watch
- g. Spanner - to suit the bolt assembly.

4 PROCEDURE

4.1 General

PMBs are complex mixtures of polymers and a variety of petroleum products. If handled in accordance with the directions of the suppliers, there should be no significant risk. The hazard of burns with PMBs is greater than with standard bitumens, due to the (normally) higher handling temperatures. It is recommended that notices, describing the action to be taken in the event of bitumen or PMB burns, should be displayed in the laboratory in the areas where bitumen and PMBs are handled. A suitable warning could be as follows:

WARNING: HOT BITUMEN & PMBs CAN CAUSE BURNS

The following precautions should be taken when handling bitumen, or PMBs:

- a. Eye protection, such as safety glasses and/or face shields, shall be worn when handling hot bitumen or PMBs.
- b. Heat-resistant gloves, with close-fitting cuffs, and other suitable protective clothing, shall be worn when handling hot bitumen or PMBs.
- c. There shall be no smoking while handling hot bitumen or PMBs.
- d. While the material is still cold, loosen the lid of the sample container (invert the can and warm the lid, if necessary), or punch a hole in the lid.
- e. Examine the cold sample for the presence of water. If water is thought to be present, drain most of it out, or blow with clean compressed air to evaporate the free water.

4.2 Sample Preparation

Samples for testing shall be provided in accordance with AG:PT/T101 and AG:PT/T102.

4.3 Measurement

- a. Assemble the bolt, spider and nuts to position the surface of the bolt head 8 ± 2 mm below the top of the sample cup.
- b. Preheat the assembly and cup to 180°C.
- c. Pour the modified binder into the cup assembly, until it begins to form a meniscus on the top surface of the bolt.

- d. Allow the assembly to cool for one hour by leaving it to stand at room temperature ($25 \pm 3^\circ\text{C}$). Adjust the assembly height to keep the top surface of the bolt flush with the sample surface.
- e. Place the assembly into the 25°C water bath and allow it to stabilise for one hour (see Note 1).
- f. Adjust the spider to a position 7 ± 2 mm above the rim and return the assembly to the bath.
- g. Place the sample assembly on the base-plate and fit the pointer to the 180 degree position without disturbing the sample.
- h. Using the spanner, turn the bolt moving the pointer from the 180 degree position to the zero position using a steady motion for 10 seconds (see Note 2).
- i. Release the bolt when the pointer reaches the zero position and commence timing (see Note 3).
- j. Record the recovered angle after 30 seconds as A.

5 CALCULATION

The Torsional Recovery is given by the following equation:

$$\text{Torsional Recovery, \%} = 100 \frac{A}{180}$$

where

$$A = \text{recovered angle, in degrees.}$$

6 INFORMATION TO BE REPORTED

Report the Torsional Recovery as the mean of two results, together with the temperature of the test and the Recovery Time.

7 PRECISION

No inter-laboratory testing has been conducted on the range of PMBs currently available.

Notes

1. The test should be conducted in an air conditioned laboratory at $25 \pm 3^\circ\text{C}$. Alternatively, the test can be conducted within the water bath.
2. The rate at which the torque is applied to the sample is critical for reproducible results. The objective is to apply 180 degrees of rotation in 10 seconds. Figure 2 presents a practical scale marked from zero (0 degrees) to 10 (180 degrees) to help with this task.
3. The spider assembly should not come into contact with the rim of the cup at any time during the recovery phase.

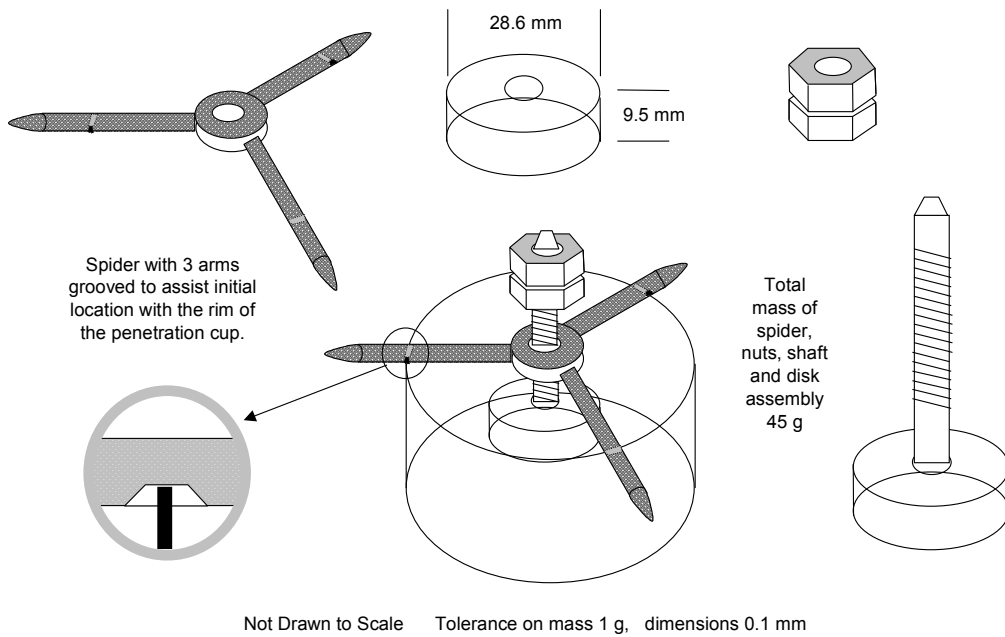


Fig. 1 Cylindrical headed aluminium bolt assembly

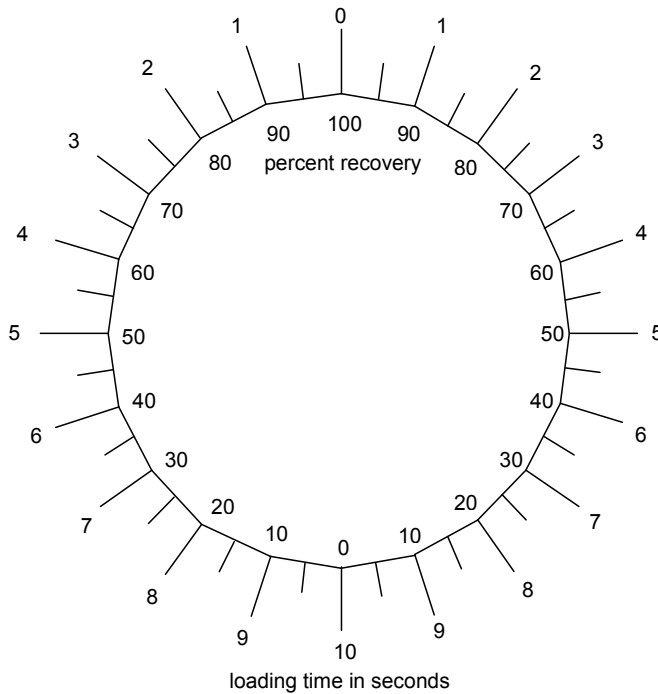


Figure 2 Practical Scale marked from 0 To 10 seconds (0 To 100 percent recovery)

AMENDMENT RECORD

Amendment No.	Clauses amended	Action	Date
1	Commentary Page	New	June 2005
	Footer and header	Format	
	Applied revised test method number	Format	
	Applied new styles	Format	
2	Applied new test method numbers	Substitution	March 2006
	Moved notes to end of method	Format	

Key

Format	Change in format
Substitution	Old clause removed and replaced with new clause
New	Insertion of new clause
Removed	Old clauses removed