

Australian Standard®

AS 1141.40:2017

Methods for sampling and testing aggregates

Method 40: Polished aggregate friction value— Vertical road-wheel machine

PREFACE

This Standard incorporates Amendment No. 1 (December 2018). The changes required by the Amendment are indicated in the text by a marginal bar and amendment number against the clause, note, table, figure or part thereof affected.

1 SCOPE

This Standard sets out the method for determining the polished aggregate friction value (PAFV) of naturally occurring or artificially produced materials which are intended to be used as, or to be a source of, pavement surfacing material. The aggregate is polished using a vertical road-wheel machine. Following accelerated polishing of the material by this Method, the PAFV is determined by method AS 1141.42.

2 REFERENCED DOCUMENTS

The following documents are referred to in this Standard:

AS

1141 Methods for sampling and testing aggregates

1141.42 Method 42: Pendulum friction test

A1 | [Text deleted]

AS/NZS

4518 Bonded abrasives—Determination and designation of grain size distribution

A1 | [Text deleted]

ISO

8486 Bonded abrasives—Determination and designation of grain size distribution

8486-1 Part 1: Macrogrits F4 to F220

8486-2 Part 2: Microgrits F230 to F2000

BS EN

1097 Tests for mechanical and physical properties of aggregates

1097-8 Part 8: Determination of the polished stone value

3 DEFINITIONS

For the purpose of this Standard, the definitions below apply.

3.1 Dummy specimens

Specimens that have been polished and tested, which would otherwise be discarded. They are used to make up the number of specimens to 14 when less than 12 test specimens are to be polished.

3.2 Polished aggregate friction value (PAFV)

The friction value obtained for specimens prepared, polished and tested in accordance with this Standard.

3.3 Reference material

Aggregate from an endorsed source for which the unpolished and polished friction values are known (see Appendix A).

3.4 Reference specimens

Specimens incorporating a reference material prepared in accordance with Appendix A.

NOTE: Two unused reference specimens are included in each test run and are polished and tested at the same time as the test specimens. Their function is to indicate whether the polishing and testing procedures have been correctly carried out.

3.5 Test specimens

Specimens incorporating aggregate prepared from a material for which the PAFV is required.

4 APPARATUS

4.1 Basic apparatus

A1 | The following apparatus, conforming to the relevant provisions of AS 1141.2 and the requirements given below, is required:

(a) *Vertical road-wheel machine* (See Figures 1 and 2) rigidly mounted on a firm level base, and comprised and constructed as follows:

- (i) *Road-wheel* A road-wheel to accommodate 14 specimens clamped on its periphery to form a surface 45 mm wide and 406 mm in diameter of exposed aggregate particles. The road-wheel is rotated at 320 ± 5 r/min.
- (ii) *Rubber-tyre wheel* Replaceable rubber-tyred wheels not exceeding 225 mm in diameter, 35 mm to 37 mm wide with a Shore A rubber hardness 60 ± 5 . Two rubber tyres are required for each polishing run, one for use with the silicon carbide grit and the other with the aluminium oxide powder. A tyre shall be discarded if it shows signs of irregular wear, or its hardness falls outside of the above limits or the diameter becomes less than 210 mm.

The rubber-tyred wheel shall be capable of being brought to bear on the surface of the specimens, mounted on the road wheel, with a total force of 390 ± 5 N. When in use, the rubber-tyre shall be flat on the specimens, and shall show minimum sideways movement and eccentricity.

NOTE: The 390 N force is normally achieved by hanging a weight of approximately 11 kg mass on the end of the supporting arm of the rubber-tyred wheel.

(iii) *Wheel positions* Both wheels have to be mounted vertically, aligned accurately with each other and free to rotate without play in the bearings. The following limits apply:

- (A) The axes of rotation of the two wheels in both the horizontal and vertical planes shall not be more than 20 min of arc out of parallel (1 mm in 200 mm).
- (B) The planes of rotation through the centres of the two wheels (tracking planes) shall not be more than 0.8 mm apart, measured at the two axes of rotation.

- (iv) *Grit feeder* Abrasive grit feeder and water feed control for delivering abrasive and water between the road wheel and the rubber-tyred wheel (see Figures 1 and 2) to the following specifications:

- (A) A chute into which is fed—
- (1) water by gravity at an adjustable rate; and
 - (2) abrasive (silicon carbide or aluminium oxide powder) through a suitable feed mechanism.
- (B) The chute shall be positioned and the feed rates controlled such that—
- (1) the mixture of abrasive and water is continuously fed directly onto the road-wheel near, and ahead of, the point of contact with the rubber-tyred wheel; and
 - (2) the abrasive and water are uniformly spread over the surface of the specimens when contact is made with the tyre.

- (v) *Metering device* To achieve prescribed feed rates.

NOTE: Advice on metering devices can be obtained from State road authorities.

- (b) *Clock or timing device* For periods of 2 h, preferably with an alarm.
- (c) *Moulds* Metal, accurately machined, in which are prepared the longitudinally curved specimens, to the following specifications:
- (i) Radius of curvature of the outer face—203 mm.
 - (ii) Radius of curvature of the inner face the same as that of the periphery of the road-wheel.
 - (iii) Outer face curved length—90 mm.
 - (iv) Width—45 mm.
 - (v) Thickness—not less than 12 mm.

Each mould and its ends (where detachable) shall be stamped with an identifying number.

- (d) *Ovens* Thermostatically controlled with good air circulation and capable of maintaining a temperature within the range of 105°C to 110°C and 45°C to 50°C.
- (e) *Sieve* 300 mm diameter, 9.50 mm aperture size.
- (f) *Slotted sieve* Complying with the following aperture requirements:
- (i) Length of about 40 mm.
 - (ii) Width 6.8 ± 0.1 mm.

4.2 Additional apparatus for specimen preparation

4.2.1 Sand-cement mortar

The following is required:

- (a) *Wire*—about 1 mm diameter, three lengths of 75 mm for each specimen.
- (b) *Straightedge steel screeding block*—about 200 mm in length.
- (c) *Water spray bottle*.
- (d) *Spatula, stiff bristle brush, fine-haired brush, oil, tray, rubber bands, thin plastic sheeting*.

4.2.2 Resin

The following is required:

- (a) *Disposable cups.*
- (b) *Metal plate*—accurately formed to the inner radius of the metal mould, a little larger than the mould and with holes drilled in it.
- (c) *Weight*—(mass 2 kg minimum) or clamp.
- (d) *Two fine-haired brushes*—about 3 mm size.
- (e) *Metal blade.*

5 MATERIALS

Materials shall include the following:

- (a) *Reference material*—a Standard Reference Aggregate (see Appendix A). The material for two unused reference specimens for polishing and testing as a check on the test procedure.
- (b) *Conditioning specimens*—a used Panmure specimen with a PAFV between 48 and 54 is required unsoaked to condition new rubber sliders (refer to AS 1141.42) and 14 used Panmure specimens with a PAFV between 48 and 54 may be required to condition new rubber tyres (see Clause 6).

NOTE: AS 1141.42 requires a set of friction tester control specimens already polished, tested and validated, to be available for checking the friction tester.

- A1 | (c) *Silicon carbide grit F320/29 (black silicon carbide No. 320)*—polishing abrasive, oven-dried at a minimum temperature of 105°C to free-flowing condition, complying with ISO 8486-2. (see Note to Item (d)).

- A1 | (d) *Fused aluminium oxide powder F600/9 (optical emery No. 600)*—fine polishing abrasive, oven-dried at a minimum temperature of 105°C to free-flowing condition, complying with ISO 8486-2.

NOTE: AS/NZS 4518.2:1997, which was withdrawn in 2017, was identical to ISO 8486-2:1996. ISO 8486-2 was revised in 2007, introducing technical changes, principally around approved testing methods, and many text changes. These changes mean that AS/NZS 4518.2:1997 is no longer identical to the ISO standard and should not be used as a reference. However, the grain size distribution specifications for the F320 and F600 microgrits have not changed.

- (e) *Fine sand*—all passing a 300 µm sieve.
- (f) *If using sand-cement mortar*—fresh high alumina cement.
- (g) *If using resin:*
 - (i) Polyester resin or epoxy resin, hardener and suitable filler.
 - (ii) Release agent—such as liquid car polish or light oil.
 - (iii) Solvent—such as a mixture of 90 percent acetone and 10 percent kerosene (by volume) to clean apparatus.

6 CONDITIONING NEW RUBBER TYRES

New rubber tyres shall be conditioned in accordance with the following procedure:

- (a) Make up a road-wheel of 14 used Panmure specimens with a PAFV value between 48 and 54. Avoid looseness of fit and ensure that the outer surface of the specimens is essentially continuous [see Clause 8(c)].

- (b) Assemble the accelerated polishing machine and run as described in Clause 8(d) for the tyre required for coarse polishing, and as described in Clause 8(g) for the tyre required for fine polishing. Mark the direction of rotation of the tyres with an arrow.

7 TEST SPECIMENS

7.1 Test material preparation

Test material shall be prepared as follows:

- (a) Obtain a representative portion of the test material containing about 5 kg of material passing the 9.50 mm sieve for each sample of four test specimens.

NOTE: The road wheel accommodates 14 test specimens, including two reference specimens at each polishing run.

- (b) Sieve the sample over the 9.50 mm sieve and discard the particles retained.
- (c) Sieve the material passing the 9.50 mm sieve over the slotted sieve and discard the passing material.
- (d) Wash the particles retained on the slotted sieve to remove surface dust, and dry the particles in an oven at a temperature not exceeding 50°C.
- (e) Discard any particles that are very rough or very smooth in comparison with the rest of the sample and any elongated particles longer than 20 mm.

NOTE: The surface texture of the particles that are to be exposed to the polishing action of the tyre should be typical of the average surface texture of the material under test. A few particles with very rough or very smooth surface texture may occur in almost any sample.

With non-homogeneous materials, particles for test specimens shall be selected so that they are as representative as possible of the material under test.

7.2 Specimen preparation

Prepare four test specimens per sample as follows:

- (a) Select four moulds and record their identifying numbers against the sample number.
- (b) Place selected particles, with their flattest face downwards, in the bottom of each mould. Place the particles close together to form a stone mosaic; avoid regularity of pattern. Usually the specimen will require from 35 to 50 particles.
- (c) Fill all interstices between the particles to roughly half of their depth with fine sand.
- (d) If using sand and cement mortar, continue as follows:
 - (i) Spray the assembly with a fine spray of water until the sand is thoroughly wet.
 - (ii) Lightly oil the internal surfaces of the mould, after the aggregates have been placed and sand is poured, down to the level of the sand.
 - (iii) Partially fill the mould with mortar, made from equal portions by mass of fine sand and high alumina cement mixed with sufficient water to a free-flowing consistency, able to penetrate easily between the particles.
 - (iv) Lay three pieces of wire, longitudinally and evenly spaced, in the mould as reinforcement and fill the mould to overflowing.
 - (v) After the mortar has set sufficiently (between 3 h and 6 h) to be worked without tearing, but is firm enough to retain its shape when not under pressure, use the steel block to screed the mortar so that the surface becomes smooth and accurately level with the curved sides of the mould.
 - (vi) Cover the surface of the mortar in the mould with a water-saturated cloth and cure for at least 24 h.

- (e) If using resin continue as follows:
- (i) Level the sand with the fine-haired brush.
 - (ii) Lightly oil with another fine-haired brush the top edges of the mould, all exposed internal metal surfaces and the backing plate.
 - (iii) Mix the hardener with the resin in the disposable cup; the proportions shall be in accordance with the manufacturer's recommendations. The consistency of the compound shall permit it to flow freely around the particles; to ensure this, the compound may be thinned with acetone.

NOTE: Synthetic resins may constitute a health risk particularly with prolonged exposure. Moulds should only be prepared in a well ventilated room. Skin contact with the resin should be avoided, and gloves and protective clothing should be worn when preparing the resin. Safety instructions provided by the manufacturer of the resin should be followed carefully.
 - (iv) Fill the mould to overflowing with the mixed resin. Immediately press the metal plate against the mould, squeezing the surplus resin out through the holes in the plate. Remove the surplus with the metal blade.
 - (v) To prevent distortion of the resin during setting, press the metal plate against the mould using the 2 kg weight or the clamp. Allow the resin to set and cool (about 30 min from mixing).
- (f) Mark the sample number on the specimens with waterproof crayon or ink and remove them from the moulds. Use a stiff bristle brush and running water to remove sand from the interstices between the particles. If resin or mortar has penetrated through to the surface of a specimen it shall be discarded and a replacement shall be prepared.
- (g) Cure resin specimens in air for at least 30 min and mortar specimens under water with the particle surface downwards for about four days.
- (h) Clean the specimens thoroughly.
- (i) Soak under water for 30 min.
- (j) Test each specimen in accordance with Clause 9. If the friction value of any reference specimen before polishing falls outside the defined range for the particular reference material (see Appendix A) it shall be discarded, and a replacement specimen shall be prepared and checked.

For each set of four test specimens, the range of specimen mean values (SMV) shall not exceed 5 units. If the range does exceed 5 units, additional specimens shall be prepared until a set of four specimens is available within the range of not more than 5 units. If more than two additional specimens have to be prepared, the process of preparation shall be examined carefully.

8 POLISHING

Specimens shall be polished in the following manner:

- (a) Ensure that at least two unpolished reference specimens, prepared by the method given in Appendix A, are available and that the tyres of the rubber-tyred wheels have been conditioned and are useable (see Clause 6).
- (b) Number the 14 specimens for the road wheel as follows:
 - (i) Two reference specimens—numbers 13 and 14.
 - (ii) If specimens from three samples are being polished—consecutively for each sample, 1 to 4, 5 to 8, 9 to 12.