

Australian Standard®

AS 3706.4—2012

Geotextiles—Methods of test

Method 4: Determination of burst strength— California bearing ratio (CBR)—Plunger method

FOREWORD

This test is a means of judging the resistance of geotextiles to puncture forces, for example from aggregate placed and compacted during road construction. It utilizes the California bearing ratio (CBR) apparatus and principles of the method, to determine burst strength of the geotextile and an approximate indication of the resulting strain.

METHOD

1 SCOPE

This Standard sets out the method for determining the burst strength and deformation properties of geotextiles using the California bearing ratio (CBR) test apparatus for both atmospheric-conditioned and wet-conditioned specimens.*

2 APPLICATION

This Method is generally applicable to non-woven and composite geotextiles, and may also be used for geomembranes. It may be used for woven fabrics but, if the material is anisotropic, care should be taken in the interpretation of the results.

NOTES:

- 1 Being a burst test (the load is applied normal to the plane of the specimen), this Method is specifically applicable to isotropic geotextiles. Where composite fabrics are tested, the face of the fabric that is to be tested needs to be specified.
- 2 This Method may not be suited for some woven fabrics with high tensile strengths exceeding approximately 90 kN/m because of clamping and equipment limitations.

3 REFERENCED DOCUMENTS

The following documents are referred to in this Standard:

AS

- | | |
|------------|---|
| 1289 | Methods of testing soil for engineering purposes |
| 1289.6.1.1 | Method 6.1.1: Soil strength and consolidation tests—Determination of the California Bearing Ratio of a soil—Standard laboratory method for a remoulded specimen |

* This method is based on DIN 54307, *Testing of textiles; plunger puncture test* (CBR). The equipment has been modified to allow the use of a CBR mould that would normally be available in soil-testing laboratories.

AS

- 2103 Dial gauges and dial test indicators (metric series)
- 2193 Calibration and classification of force-measuring systems
- 3704 Geotextiles—Glossary of terms
- 3706 Geotextiles—Methods of test
- 3706.1 Method 1: General requirements, sampling, conditioning, basic physical properties, and statistical analysis

4 PRINCIPLE

A circular specimen is gripped around its entire circumference by clamps in a loading frame. A cylindrical plunger is forced through the centre of the specimen. The force applied by the plunger and the corresponding deformation of the specimen are measured.

5 DEFINITIONS

For the purpose of this Standard, the definitions given in AS 3704 apply:

6 APPARATUS

The following apparatus is required:

- (a) Marking and cutting equipment, such as a template (see Figure 1) of plastic or metal, felt-tip pen, and either scalpel and cutting board or scissors.
- (b) Guide block (see Figure 2) to support the specimens while being clamped.
- (c) Clamping rings (see Figures 3 and 4). The rings shall be grooved and ‘toothed’ concentrically to prevent slipping of the specimen. Matching boltholes shall be capable to locate ‘teeth’ and grooves accurately. The rings shall be clamped by tightening the bolts (see Figure 6).

NOTE: Special adaptors may be necessary for strong fabrics to prevent them from slipping or being damaged in the clamps.

- (d) Suitable means for holding the clamping rings while the specimen is under load (for example, a right cylinder of minimum internal diameter 150 mm and minimum height 150 mm). The lower part of a CBR mould complying with AS 1289.6.1.1 is suitable.
- (e) Constant-rate-of-extension (CRE) tensile testing machine complying with the requirements for a Grade B machine in accordance with AS 2193, and having an extension rate of 50 mm/min, and including an autographic recorder with adequate pen response or an interfaced computer, to properly record the force/elongation curve.

For machines with no autographic recorder, appropriate measuring instruments shall be used to allow readings of the applied force and the corresponding elongation at a number of points up to failure.

- (f) Metal penetration plunger (see Figure 5) with a 50 mm in diameter cylinder and of sufficient length to allow 75 mm of travel towards the specimen, and a shaft for mounting into the loading machine. The edge between the loading face and the cylinder sides shall be rounded off to avoid sharp edges that could cut the fabric (radius 2.5 mm). To avoid damage to this edge when the clamping rings are removed from the mould, the plunger shall be protected by a plastic cap or removed from the loading machine.

NOTE: The plunger for this test is different from the normal CBR plunger for soil testing. The plunger for testing geotextiles should be used only for that purpose. It should also be kept clean and free of sand or soil. A normal CBR plunger for soil testing should not be used for testing geotextiles.

- (g) Dial gauge complying with AS 2103 with a travel of not less than 100 mm, or a scale rule measuring to 1 mm, or a displacement transducer for measuring the depression of the plunger.

7 PREPARATION OF TEST SPECIMENS

7.1 Sampling

A minimum of 10 specimens shall be sampled in accordance with AS 3706.1. Each specimen shall be circular with a minimum diameter of 195 mm. The template shall be used in marking and cutting the test pieces. Care should be taken to prevent pulling or stretching of the specimens during cutting.

7.2 Conditioning

The specimens shall be atmospheric-conditioned or wet-conditioned, as required, in accordance with AS 3706.1.

8 TEST CONDITIONS

The test atmosphere shall be in accordance with AS 3706.1.

Wet-conditioned specimens shall be tested in the apparatus within 20 min after their removal from the water.

9 PROCEDURE

The procedure shall be as follows:

- (a) Set the machine to operate at a plunger penetration speed of 50 mm/min.
NOTE: CBR burst strength has been shown to be practically independent of speed in the range 5 mm/min to 100 mm/min for relatively low-strength fabrics.
- (b) Use the guide block to ensure that the specimen is flat and free of tension and clamp it. The upper face of the lower clamping ring shall be level with the upper face of the guide block. Lay the specimen on this level surface followed by the upper clamping ring (see Figure 6). It is essential that the specimens are consistently flat with the same upward face orientation (even essentially homogeneous geotextiles have recognizable face differences) and free of tension prior to clamping, otherwise variations in results could occur. Tighten the clamp uniformly to ensure no slippage during testing. Mark the sample around the internal edge of the clamping ring with a suitable marker that will in no way damage geotextile.
- (c) Place the specimen and clamping system in the test machine.
- (d) Advance the plunger to the middle of the specimen (see Figure 7) so that the plunger just comes into contact with the specimen. Start the machine, to push the plunger into and through the geotextile. Record the force and plunger movement at regular intervals (maximum 5 mm interval of movement). Where the specimen differs in surface composition (e.g. composite fabrics), record the face of the specimen that was tested.

In some instances appreciable plunger movement will occur before any plunger force is recorded, which is due to seating-in of the specimen in the loading system. Data shall be recorded for this phase of loading at 5 mm intervals as indicated above. The plunger movement at which the plunger force begins to increase from zero force denotes the end of the seating-in phase. The seating-in phase shall be recorded.

- (e) If the specimen slips in the clamps, breaks at the edge of the clamps or within the clamps, reject the result. Test another specimen from the same roll after adoption of one of the following procedures:
 - (i) Padding the face of the clamps (e.g. with felt, cork, cloth, or excess sample fabric).
 - (ii) Coating the specimen under the clamp face area.
 - (iii) Modifying the faces of the clamps.

NOTE: Slippage may be detected by checking displacement of the marked line around the internal edge of the clamping ring.
 - (f) Reject results in accordance with the following criteria, and test other specimens from the same roll for each rejected specimen:
 - (i) If any break occurs outside 20 mm from the plunger circumference, which results in a burst strength below 50% of the average of all other measured burst strengths.
 - (ii) If three or more specimens break within 5 mm of the edge of the clamps.
 - (iii) If an abnormal result occurs in accordance with AS 3706.1.

If the failure outlined in Step (ii) occurs, adopt one of the procedures detailed in Step (e) when testing another specimen.

NOTE: The decision to discard a test result is based on observation of the specimen during the test and upon the inherent variability of the fabric.
 - (g) Repeat Steps (b) to (f) until 10 specimens have been tested.
- NOTE: Further testing may be required in accordance with Steps (e) and (f), and Clause 10.3.

10 CALCULATIONS

10.1 For each specimen

10.1.1 Plotting of results

The force/deformation behaviour shall be plotted from the results as a force/elongation curve for each tested specimen. All collected data points shall be plotted.

NOTES:

- 1 The automatic readout of force/plunger movement does not allow a direct judgement of the elongation behaviour of the specimen.
- 2 In the determination of elongation, the plunger movement should be corrected for seating-in effects [see Clause 9(d)], by subtracting the deformation, which occurs up to the commencement of load take-up from the relevant deformation value being considered.

10.1.2 CBR burst strength

The maximum load as shown on the curve, where available, or else the highest recorded force, shall be taken as the CBR burst strength (L), in newtons.

10.1.3 CBR elongation

The CBR elongation shall be calculated using the following equation:

$$\text{Elongation \%} = \frac{(\sqrt{50^2 + x^2}) - 50}{50} \times 100$$

where

x = plunger displacement

Figure 8 demonstrates conversion of plunger movement to specimen elongation.