

Australian Standard™

Methods of testing flexible cellular polyurethane

Method 8: Determination of force deflection

PREFACE

This Standard was prepared by the Standards Australia Committee PL/36, Flexible Polyurethane to supersede AS 2282.8 — 1991.

The magnitude of the force required to deform cellular polyurethane is an indication of the hardness or deformation resistance of that material. This may be determined either by measuring the force required to deflect the test piece by a stated percentage of its original thickness using a circular indenter, or by measuring the force required to compress the whole area of a test piece by a stated percentage of its original thickness.

In the comparison of the indentation characteristics of different cellular polyurethanes, the results will be inconsistent if test pieces of the same size and thickness are not used.

METHOD

1 SCOPE This Standard sets out two methods for determining the deflection force of flexible cellular polyurethane. Method A provides the indentation force on deflection and Method B gives the compression force on deflection.

2 REFERENCED DOCUMENTS The following documents are referred to in this Standard:

AS
2282 Methods for testing flexible cellular polyurethane
2282.1 Method 1: Sampling and conditioning of test specimens

3 TESTS

3.1 Method A — Indentation force on deflection test

3.1.1 Principle The force required to indent a test piece to a stated percentage of its original thickness is determined by a suitable compression testing machine using a circular flat indenter.

3.1.2 Apparatus The following apparatus is required:

- (a) A testing machine, capable of indenting the test piece by means of an indenter or baseplate moving vertically at a uniform rate of 25 mm/min to 380 mm/min, having a means of measuring the force required to produce the specified indentation within an error of ± 1 percent, or ± 1 N, whichever is the greater.

The test piece shall be supported on a smooth, flat, horizontal and rigid surface, larger than the test piece and suitably vented, with 6 ± 1 mm diameter holes in rows spaced at 20 ± 1 mm centres, to allow the escape of air from below the test piece.

The machine shall be capable of measuring the test piece thickness under force within an error of ± 0.2 mm. It shall be capable of applying an initial force of 5 ± 1 N and also of maintaining the specified degree of indentation within an error of ± 0.2 mm for a period of 60 ± 3 s. The machine shall be capable of compressing the test piece to 75 to 80 percent of its thickness.

- (b) An indenter consisting of a circular flat plate, mounted on a ball joint free from vertical movement, having a diameter of 203 ± 1 mm. The radius of the lower edge of the indenter shall be not larger than 1 mm. The surface shall be smooth, but not necessarily polished.

3.1.3 Sample preparation

3.1.3.1 Test pieces The standard size for the test pieces is $380 +10, -0$ mm $\times$ $380 +10, -0$ mm $\times$ 50 ± 3 mm, with the shortest side parallel to the direction of cell 'rise'.

NOTE: The measured indentation force value will vary for the same material, depending on the thickness and area of the test piece.

The thickness shall be not less than 20 mm. Where thicknesses other than 50 mm are tested under special circumstances, the thickness shall be reported. Test pieces may be plied together without adhesives to obtain a desirable thickness.

Where moulded or profile-cut shapes are being tested, the test may be carried out on the whole article. Profile-cut surfaces and cavities shall be placed downwards on the flat perforated plate.

3.1.3.2 Conditioning The test specimens shall be conditioned in accordance with AS 2281.1.

3.1.4 Procedure The procedure shall be as follows:

- (a) Place the indenter in the one position and as near as possible to the centre of the test piece.
- (b) Measure the test piece thickness (d_1) after applying a total force of 5 ± 1 N to the area under the indenter foot.
- (c) Pre-flex the test piece twice at its centre, by 75 percent to 80 percent of the test piece thickness (d_1) under the indenter foot, operating the indenter at a speed of 25 mm/min to 380 mm/min. Before proceeding, allow the test piece to rest for 10 ± 2.5 min after pre-flexing.
- (d) Measure the test piece thickness, as described in Item (b) above, after pre-flexing (d_2).
- (e) Immediately indent the test piece by 25 percent of the thickness d_2 , i.e. to 75 percent of the thickness d_2 , at the rate of 50 ± 5 mm/min. Record the force, in newtons, after holding the indenter in this position for 60 ± 3 s. Report this as the 25 percent indentation force (IF_{25}).
- (f) Thereafter, and without removing the test piece, immediately increase the deflection to 40 percent of the thickness d_2 at the rate of 50 ± 5 mm/min. Record the force, in newtons, after holding the indenter in this position for 60 ± 3 s. Report this as the 40 percent indentation force (IF_{40}).
- (g) Thereafter, and without removing the test piece, immediately increase the deflection to 65 percent of the thickness d_2 at the rate of 50 ± 5 mm/min. Record the force, in newtons, after holding the indenter in this position for 60 ± 3 s. Report this as the 65 percent indentation force (IF_{65}).

- (h) Raise the indenter to permit a deflection of 25 percent of the thickness d_2 at the rate of 50 ± 5 mm/min. Record the force, in newtons, after holding the indenter in this position for 60 ± 3 s. Report this as the 25 percent indentation force (IF_{25}) on recovery.
- (i) If repeat tests on the same test piece are required, allow a recovery period of not less than 24 h.

3.1.5 Test report The report shall include the following information:

- (a) The 25 percent indentation force (IF_{25}), 40 percent indentation force (IF_{40}), and 65 percent indentation force (IF_{65}).

NOTE: The indentation force (IF) values up to 100 N should be quoted to the nearest unit and values over 100 N should be quoted to the nearest 5 N.

- (b) The 25 percent indentation force (IF_{25}) on recovery. This is defined as a recovery.
- (c) Report the ratio of 65% to 25% IFD value.
- (d) The thickness of the test piece after pre-flexing (d_2).
- (e) Reference to this test method, i.e. AS 2282.8, Method A.

If the tests were carried out on a non-standard test piece, the following additional information shall be reported:

- (i) The dimensions and shape of the test piece.
- (ii) The position of the test area.

3.1.6 Precision The reproducibility of this method between laboratories has been found to be ± 5 percent at 25 percent indentation force (IF_{25}) and ± 10 percent at 65 percent indentation force (IF_{65}).

3.2 Method B — Compression force on deflection (CFD) test

3.2.1 Principle The force required to compress a test piece to 50 percent of its original thickness is determined by a suitable compression testing machine, using the entire top area of the test piece.

3.2.2 Apparatus A compression testing machine that complies with Clause 3.1.2 shall be used, except that the machine shall be capable of applying a force of 2.5 ± 0.5 N over the surface area of the test piece when measuring the initial thickness.

3.2.3 Sample preparation

3.2.3.1 Test pieces The test pieces shall be prepared as follows:

- (a) The test pieces shall measure 125 ± 2 mm $\times$ 125 ± 2 mm $\times$ 25 ± 2 mm thick. Specimens less than 25 mm thick shall be plied together, without using adhesives, to make a test piece thickness of not less than 25 mm.
- (b) The test pieces for moulded or profile-cut shapes, if less than 25 mm thick, shall have minimum dimensions of 125 ± 2 mm $\times$ 125 ± 2 mm $\times$ the full part thickness, including top or bottom skin or surface condition. Samples greater than 25 mm thick shall be 125 ± 2 mm $\times$ 125 ± 2 mm, are cut back to 25 mm thick, and shall be tested with the top surface skin on top of the test piece. Profile-cut surfaces shall be placed downwards on the flat perforated table.

3.2.3.2 Conditioning The test specimens shall be conditioned in accordance with AS 2282.1.

3.2.4 Procedure The procedure shall be as follows:

- (a) Place the test piece onto the supporting plate of the apparatus centrally under the indenter foot.