

Australian Standard™

Methods of testing flexible cellular polyurethane

Method 12: Determination of compression fatigue

PREFACE

This Standard was prepared by the Standards Australia Committee PL/36, Flexible Polyurethane, to supersede AS 2282.12 — 1991.

The purpose of a fatigue test for cellular polyurethane is to determine the following:

- (a) A loss of load-bearing properties, or other characteristics as may be specified.
- (b) A loss of thickness.
- (c) Structural breakdown, as assessed by visual examination.

METHOD

1 SCOPE This Standard sets out two methods for determining resistance to compression fatigue of flexible cellular polyurethane. Method A is a static compression test and Method B is a dynamic roller compression test.

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

2282.8 Method 8: Determination of force deflection

3 METHOD A — STATIC COMPRESSION FATIGUE (CONSTANT DEFLECTION) TEST

3.1 Principle A test specimen is compressed between two flat parallel plates in the standard conditions specified in AS 2282.1, for a specified time while under constant deflection, to determine the effect on load-bearing properties.

3.2 Apparatus The apparatus shall consist of two rigid flat parallel plates, larger than the test piece, used with spacer bars to produce a uniform constant deflection of the test specimen.

3.3 Sample preparation

3.3.1 Test specimen The single test specimen shall be $380 +10, -0 \text{ mm} \times 380 +10, -0 \text{ mm} \times 50 \pm 3 \text{ mm}$.

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

3.4 Procedure The procedure shall be as follows:

- (a) Measure the test specimen thickness and indentation force characteristics in accordance with AS 2282.8, Method A.
- (b) With the spacer bars set to provide a deflection of 75 ± 1.5 percent, i.e. the test specimen is compressed to 25 percent of its original thickness (d_1), place the test specimen between the parallel plates for 17 h.
- (c) Remove the test specimen from the test apparatus and rest it in the standard conditioning atmosphere of AS 2282.1 for 30 ± 5 min.
- (d) Measure the thickness (d_2) and the load-bearing characteristics in accordance with AS 2282.8, Method A, without further conditioning or preflexing.

4 METHOD B—DYNAMIC ROLLER COMPRESSION FATIGUE (CONSTANT DEFLECTION) TEST

4.1 Principle A test specimen is compressed to a definite percentage of its original thickness for a given number of cycles in the standard conditions specified in AS 2282.1.

4.2 Apparatus The following apparatus is required:

- (a) *Compression apparatus*—a machine with a perforated baseplate and offset roller, one of which is adjustable with respect to the other, to produce the specified deflection of the test piece. The baseplate and roller shall be so mounted that one moves reciprocally back and forth with respect to the other, at a rate of 27.5 ± 1.5 cycles per minute. The length of the stroke shall be $300 \pm 10 \text{ mm}$.
The baseplate shall be larger than the test specimen and perforated with $6 \pm 1 \text{ mm}$ diameter holes in rows and spaced at $20 \pm 1 \text{ mm}$ centres.
The roller shall be at least 460 mm long and nominally 75 mm in diameter, and mounted in an offset position of 15 ± 1 degrees from the vertical plane.
- (b) *Cotton sheeting*—a set of four pieces, 50 mm to 75 mm wide, and at least 50 mm longer than each side of the test specimen.
- (c) *Adhesive*—solvent type or water emulsion type.

4.3 Sample preparation

4.3.1 Test specimen The test specimen shall be $380 +10, -0 \text{ mm} \times 380 +10, -0 \text{ mm} \times 50 \text{ mm} \pm 3 \text{ mm}$.

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

4.4 Procedure The procedure shall be as follows:

- (a) Determine the original thickness and indentation force on deflection in accordance with AS 2282.8, Method A.
- (b) Bond the cotton sheeting strips to the bottom surface of the test specimen and allow to dry. Allow 50 mm of the width of each strip to extend beyond the edges of the test specimen so that the test piece can be securely held in place on the baseplate by metal retaining straps. Alternative methods for holding the test specimen securely to the base plate are acceptable as long as the test specimen remains stationary during the rolling flex cycles.

In the case of test specimens of low tear resistance it may be necessary to cover the top surface fully with a cotton fabric that extends down the sides and under the holding clamp. Such fabric shall be of plain weave and be of not more than 150 grams per square metre mass. Adhesive may be used on the sides of the test piece but not on the top. Such assembly of the test specimen and the cotton cloth shall not impose any strain or compression on the test piece during the compression cycles. The fabric cover shall be removed before the final testing of the test specimen.

- (c) Mount the test specimen on the baseplate so that the specimen is centralized with the stroke and roller of the apparatus.
- (d) Adjust the testing machine to obtain a constant deflection of 65 ± 1 percent of the original thickness of the test specimen. Calculate the deflection from d_2 , i.e. the test specimen thickness after pre-flexing determined in the indentation force on deflection test in accordance with AS 2282.8, Method A.
- (e) Flex the test specimen for the required number of cycles. A standard test consists of 20 000 cycles (40 000 flexures).
- (f) Remove the test specimen from the test apparatus and rest it in the standard atmosphere specified in AS 2282.1 for 30 ± 5 min after completion of the fatigue testing.
- (g) Measure the thickness (d_2) and the load-bearing characteristics in accordance with AS 2282.8, Method A, without further conditioning or pre-flexing.

5 CALCULATIONS

5.1 Height loss The height loss shall be calculated from the following equation:

$$h_t = \frac{d_1 - d_2}{d_1} \times 100 \quad \dots 5(1)$$

where

h_t = percentage height loss

d_1 = thickness, when measured with a force of $5 \pm 0, -2$ N on the indenter before fatigue testing, in millimetres

d_2 = thickness, when measured with a force of $5 \pm 0, -2$ N on the indenter after fatigue testing, in millimetres

5.2 Loss in load-bearing characteristics The loss in load-bearing characteristics shall be calculated at 40 percent deflection by the following equation:

$$LF = \frac{F_o - F_f}{F_o} \times 100 \quad \dots 5(2)$$

where

LF = percentage loss of force deflection at 40 percent deflection

F_o = original force deflection value at 40 percent deflection, in newtons

F_f = final force deflection at 40 percent deflection, in newtons

NOTES:

- 1 Where the loss in thickness is greater than 10 percent, no useful purpose will be served by carrying out any tests to determine the physical properties after fatigue testing.
- 2 Loss in load-bearing characteristics may be calculated at other specific deflections, if so desired.