

Australian/New Zealand Standard®

Plastics—Glass filament reinforced plastics (GRP)—Methods of test

Method 24: Method for the determination of the initial hoop tensile strength by means of a tensile plate test

1 SCOPE This Standard describes the test procedure to determine the initial hoop tensile strength of a reinforced plastics laminate of cylindrical shape by means of a tensile plate test piece.

2 PRINCIPLE A minimum of three square test specimens are cut from the laminate taking care to ensure correct orientation of the reinforcement. The ends of the specimen are built up with thermosetting resin and then held in a tensile testing machine with the centre-line of the specimen along the loading axis of the testing machine. A strain is applied at a constant rate to cause failure between one and three minutes. The maximum force to cause failure is noted and the individual and average initial hoop wall tensile strengths calculated.

3 APPARATUS The following apparatus is required:

- (a) *Tensile testing machine* Capable of indicating the force applied to the test piece with an accuracy of $\pm 1\%$ of the indicated value.
- (b) *Measuring equipment* Capable of measuring the width and profiled radius of the test piece to an accuracy of 0.1 mm and the winding angle to an accuracy of 0.5° .

4 TEST PIECES The test pieces shall be cut approximately square from the laminate taking care to ensure that the reinforcement in the test pieces is correctly orientated.

The test piece size shall be sufficiently large to ensure that failure occurs across the neck of the test piece (see Figure 1).

The test piece ends shall be built up with thermosetting resin to be flat and parallel (see Figure 2) by the use of a suitable mould. The test piece ends shall be symmetrical about the centre-line of the test piece throat.

Any flash shall be removed and the test piece machined to the dimensions shown in Figure 1.

A minimum of three test pieces is required.

5 TEST CONDITIONS The test shall be carried out at $15 \pm 10^\circ\text{C}$.

6 PROCEDURE The test procedure shall be as follows:

- (a) Measure the width, (w) the radius, (r) and the helical winding angle (ϕ) of the test piece.

- (b) Grip the test piece in the testing machine with the test piece centre-line along the loading axis of the machine.
- (c) Load the test piece by separating the grips at a rate to ensure failure occurs between 1 min and 3 min. Record the maximum force as F .
- (d) Repeat Steps (a) to (c) until three results have been obtained. Discard any test piece that breaks other than across the neck and test additional test pieces until three results are obtained.

7 CALCULATION For each test piece, calculate the initial hoop tensile stress at failure (σ_{wi}), in N/mm², using the following equation:

$$\sigma_{wi} = \frac{F}{w - 2r(\operatorname{cosec} \phi - 1)} \times \frac{1}{t}$$

where

- F = the failure force, in newtons
- w = the gauge width, in millimetres
- r = the notch radius, in millimetres
- ϕ = the winding angle of the reinforcement
- t = thickness of the test piece, in millimetres

NOTE: If the hoop reinforcement is provided wholly by non-continuous fibre take ϕ to be 90°. If two or more helix angles are used for continuous fibre, take ϕ as the largest angle used.

8 REPORT The following information shall be reported:

- (a) Full identification of the laminate, manufacturer's code and date of test.
- (b) The individual values and average value of the initial hoop tensile strength (ϕ_{wi}). (The tensile strength is equivalent to the tensile stress at failure.)
- (c) The test temperature.
- (d) Reference to this test method i.e. AS/NZS 3572.24.