

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

Method 2: Determination of chemical resistance of glass filament reinforced plastics

1 SCOPE

This Standard sets out a method* for determining the chemical resistance of glass filament reinforced plastics.

This method is intended for use as a relatively rapid test to evaluate the chemical resistance of glass filament reinforced plastics under anticipated service conditions. It provides for the determination of changes in surface hardness, appearance and flexural strength of the test specimens after exposure to various reagents.

The method is applicable for broad characterization of chemical resistance of glass filament reinforced plastics.

2 REFERENCED DOCUMENTS

The following documents are referred to in this Standard:

AS

2132 Methods for the determination of flexural properties of plastics

3572 Plastics —Glass filament reinforced plastics (GRP) —Methods of test

3572.1 Method 1: Preparation of glass filament reinforced plastics test specimens

3 GUIDELINES IN MATERIALS SELECTION

Selection of materials in terms of their long-term corrosion and erosion resistance should be established by tests or proven by documentation of past experience.

In assessing the relevance of tests results, and past experience, consideration should be given to the following:

- (a) Unstressed dip coupon testing of sample laminates will not necessarily give a valid indication of the long-term resistance of the material to the actual internal and external chemical and physical environment.
- (b) Relatively small changes in the concentration of organic solvents and any fluctuations in the operating temperatures can have marked effect on the chemical resistance of a GRP laminate.
- (c) Glass filament reinforced plastics may be subject to occasional applied loads or impacts, which are not part of the normal operating conditions, and may not be simulated in a laboratory by immersion tests.

* This test method is based on ASTM C 581, *Standard practice for determining chemical resistance of thermosetting resins used in glass fibre reinforced structures, intended for liquid service.*

4 APPARATUS

The following apparatus is required:

- (a) *Micrometer* A micrometer of accuracy ± 0.02 mm.
- (b) *Containers*:
 - (i) Wide-mouth glass jars of sufficient capacity, fitted with plastics-lined metal screw caps for low temperature tests involving solutions or solvents of low volatility.
 - (ii) Containers of sufficient capacity, each fitted with standard taper joints and reflux condenser attachment for use with volatile solutions or solvents.
 - (iii) Containers as described in Items (i) and (ii) having an inert coating on their inner surfaces, or containers made of an inert material suitable for use with solutions which attack glass.
- (c) *Constant temperature apparatus* A temperature oven or liquid bath capable of maintaining temperature within a range of $\pm 2^\circ\text{C}$.
- (d) *Flexural testing apparatus* Flexural testing apparatus in accordance with the testing machine described in AS 2132.
- (e) *Hardness impressor* Hardness impressor in accordance with an appropriate test method for the anticipated hardness.
- (f) *Balance* A balance having adequate capacity and capable of weighing to an accuracy of ± 0.001 g.
- (g) *Desiccator*

5 REAGENTS

The test media shall consist of the reagents, solutions, or products to which the resin system is to be exposed in service.

The reagents recommended characterize the general chemical resistant nature of a resin system. Chemicals used in this test shall be of technical grade or greater purity. All solutions shall be made with distilled or demineralized water.

The recommended standard reagents for basic evaluation of resin-glass systems are as follows:

Sulphuric acid (H_2SO_4), 25%

Hydrochloric acid (HCl), 15%

Nitric acid (HNO_3), 5%

Acetic acid (CH_3COOH), 25%

Ammonium hydroxide (NH_4OH) concentrate

Toluene

Methyl ethyl ketone

Carbon tetrachlorid

Distilled or demineralized water

Additional reagents for extended characterization should be chosen from the following:

Phosphoric acid (H_3PO_4), 15%

Sodium chloride (NaCl), saturated solution

Sodium hypochlorite (NaOCl), 5% (replace with fresh solution at 48 h intervals)

Sodium carbonate (Na_2CO_3), 10

Aluminium potassium sulphate ($\text{KAl}(\text{SO}_4)_2 \cdot 12\text{H}_2\text{O}$), 5%

Ethyl acetate

Monochlorobenzene

Perchloroethylene

Kerosene

Ethanol, 95%

n-Heptane

Hydrogen peroxide, 5%

NOTE: Solution strengths are stated in terms of weight percent (absolute). Approximately 100 mL are required for each exposure period.

6 TEST SPECIMENS

Test specimens shall be prepared in accordance with Clause 3 of AS 3572.1 and be 100 mm × 125 mm in size. The number of test specimens required depends on the number of test solutions to be employed, the number of different temperatures at which testing is performed, and the frequency of test intervals. In addition, 10 specimens shall be stored as controls for reference after the immersion testing, and five specimens shall be required for surface hardness and flexural strength testing prior to immersion.

NOTE: At the completion of immersion testing, the control specimens are to be tested in accordance with Clauses 9(h) and 9(i), to determine any changes due to natural ageing.

The total number of test specimens shall be calculated from the following equation:

$$N = 5(S \times T \times I) + 15 \quad \dots (1)$$

where

N = number of test specimens

S = number of solutions

T = number of test temperatures

I = number of test intervals

NOTE: Where anisotropic materials are to be tested, additional specimens may be required to determine the immersion effect on anisotropy. However, where anisotropy is not critical in the materials application, additional specimens are not required, provided that the test report identifies the anisotropy of the test laminate and the direction from which specimens were taken.

7 CONDITIONING

Test specimens shall be conditioned in accordance with AS 3572.1. Control specimens shall be placed in a sealed container and stored at $23 \pm 2^\circ\text{C}$.

8 TEST CONDITIONS

The test conditions shall simulate, as closely as possible, the chemical environment imposed by the anticipated service conditions.