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Standard Test Method for Hydrostatic Compressive Strength of Glass-Reinforced Plastic Cylinders[1]

This standard is issued under the fixed designation D 2586; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reapproval.

This standard has been approved for use by agencies of the Department of Defense. Consult the DoD Index of Specifications and Standards for the specific year of issue which has been adopted by the Department of Defense.

$^{\epsilon 1}$ NOTE—New sections 11 and 12 were added editorially in April 1990.

1. Scope

1.1 This test method covers the determination of the compressive strength properties of filament-wound glass reinforced plastic cylinders of standard size in hydrostatic compression. This test method is generally applicable to hollow cylinders made of glass reinforced plastics, and particularly those formed by filament winding. This test method may be applied to both unidirectional and orthotropic laminates, but is limited to constructions containing greater than 50 % by weight of glass reinforcement.

1.2 The values stated in inch-pound units are to be regarded as the standard. The values in parentheses are for information only.

1.3 *This standard may involve hazardous materials, operations, and equipment. This standard does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Summary of Test Method

2.1 A cylinder is fabricated with glass-filament reinforcement, which has been impregnated with a resin binder. Fabrication is accomplished by machine filament winding, or hand-layup techniques, or both. Following fabrication, the cylinder is cured, according to the schedule required for the particular resin-reinforcement system.

2.2 The cured cylinder is then sectioned and finish machined into a specimen of the specified standard size and dimensional tolerances.

2.3 The finished specimen is mounted between end-plate fixtures (see Fig. 1) and positioned within the bore of a pressure chamber capable of exerting the necessary hydrostatic pressure. The specimen is located within the pressure chamber so as to allow free flow of the test fluid around the closed-end test specimen (see Fig. 2). The specimen is compressed to failure by raising the pressure of the fluid surrounding the specimen. The interior of the specimen is normally vented to the atmosphere. In those cases where it is desirable to minimize the catastrophic collapse of high-strength cylinders, it is acceptable to fill the interior of the specimen to the atmosphere through a flow-control valve (see Fig. 2). Compressive strength is calculated using the maximum pressure at rupture, and the specimen dimensions.

3. Significance and Use

3.1 Compressive strength values determined by this method provide a convenient "figure of merit" for comparing a spectrum of filament-wound laminates. The method provides a means of interpreting the influences of glass and resin contents, filament dispersion, winding pattern, and cure cycles. In addition, the aforementioned figure of merit can be used as a measure of quality control between different batches of identical cylinders. Reproducibility is approximately ±5 % for glass-reinforced plastic materials tested under comparable conditions. Compressive strength values may vary significantly between specimens of different constructions, resin contents, and differences in the rate of loading specified in Section 7.

4. Apparatus

4.1 *Pressure Vessel*—Tests may be performed within the base of any pressure chamber of sufficient size and rated capacity. The chamber must be equipped with appropriate pumping equipment in order that the maximum required pressures can be reached easily, and at a constant pressurization rate. A reliable pressure-sensing device such as bourdon tube pressure gage must be used in conjunction with the vessel to measure the pressure at specimen rupture. Gage accuracy shall be ±1 % for full scale. Figure 2 shows such a system schematically including performance specifications for the high-pressure components. All of the high-pressure components are commercially available with the exception of the high-pressure chamber. Care must be taken to assure proper location of the gage within the system. Series element pressure snubbers and flow control valves shall be used to minimize pressure surges during pressurization of the vessel. Any suitable pressure fluid may be used as the pressurization medium. Care should be taken to assure that the pressurization fluid does not degrade or swell the test specimen.

4.2 *Specimen End Plate Closure*—The closures used at each end of the specimen are illustrated in Fig. 1. Each closure consists of a close fitting plug which is bolted to an

[1] This test method is under the jurisdiction of ASTM Committee D-30 on High Modulus Fibers and Their Composites and is the direct responsibility of Subcommittee D30.04 on High-Performance Fibers and Composites.

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