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GB/T 1458-2023

Replacing GB/T 1458-2008

**Test method for mechanical properties of ring of
filament-winding reinforced composites**

纤维缠绕增强复合材料环形试样力学性能试验方法

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1 Scope

GB/T 1458-2023 is the Chinese national standard on test method for mechanical properties of ring of filament-winding reinforced composites, in the field of rubber and plastic industries. The /T suffix marks it as a recommended standard: it is not compulsory by itself, but it becomes binding as soon as a contract, a tender or a customer specification calls it up - which in practice is how most foreign buyers meet it. It was issued on 7 September 2023 by the State Administration for Market Regulation; Standardization Administration of China, and has been in force since 1 April 2024. Classification: ICS 83.120, CCS Q23. This page is published from the official record of the standard held by the Chinese standards administration: the identification, the dates, the classification and the issuing body are taken from there. The clause text, the tables and the numeric limits are in the document itself, which is delivered complete in English translation.

This document specifies the method and principle, specimen preparation, shear test, tensile test and test report for mechanical properties of ring of filament-winding reinforced composites. This document is applicable to the determination of interlaminar shear strength, tensile strength, tensile elastic modulus, fiber tensile strength of unidirectional ring of filament- winding reinforced composites, and hoop tensile strength of filament-winding reinforced composite tubes.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

GB/T 1446, Fiber-reinforced plastics composites -- The generals for determination of properties

GB/T 2577, Test method for resin content of glass fiber reinforced plastics

GB/T 3855, Test method for resin content of carbon fiber reinforced plastics

3 Terms and definitions

There are no terms or definitions that require definition in this document.

4.1 Specimen preparation method

4.1.1 Overview The ring of filament-winding reinforced composites is made by single-ring winding method or cylindrical ring cutting method. These two methods can be wet winding or prepreg winding. The two winding processes are shown in Figure 1 and Figure 2 winding machine according to the specified inner diameter size, and then undergoes curing, external surface processing, and demolding to produce a ring-shaped specimen.

4.1.3 Cylindrical ring cutting method The cylindrical ring cutting method uses a cylindrical core mold to wind the specimen into a cylinder on a winding machine according to the specified inner diameter size of the specimen. After curing, outer surface processing, demolding and cutting, a ring-shaped specimen is made.

4.2 Shear test method The specimen is loaded by three-point bending. The load is applied at a specified loading rate until the specimen fails. The failure load is recorded. The shear strength is calculated.

4.3 Tensile test method Place the specimen on the tensile plate of the testing machine. Apply tensile load at a specified loading rate until the specimen fails. Record the failure load. Calculate the tensile strength.

5.1 Equipment

5.1.1 Winding machine The winding machine consists of a yarn frame, a rubber groove, a tension control device, a wire guide hole and a driving mechanism.

5.1.2 Mold and core mold Single ring mold is shown in Figure

3. Appropriate connecting shafts should be left at both ends of the core mold of the cylindrical ring cutting method to facilitate the assembly of the mold on the winding machine.

5.1.3 Demolding device A suitable press can be used.

5.1.4 Curing device The curing device should have an appropriate controllable temperature range. The temperature control accuracy is $\pm 2^{\circ}\text{C}$. The fiber is drawn out from the yarn ball, passes through the guide roller, and enters the glue groove with a heating device. When the fiber is pulled out from the glue groove, the excess glue is removed by a device such as a glue squeeze roller or a scraper while minimizing the wear of the fiber.

5.3.4 Tension control The impregnated fibers are passed through a series of guide rollers to apply the required tension to the fibers. Winding tension. 5%~8% of the fiber breaking strength for glass fibers; 3%~4% of the fiber breaking strength for aramid fibers; and carbon fibers according to process requirements, preferably without damaging the fibers.

5.3.5 Yarn arrangement The fiber arrangement should be uniform, without accumulation, separation, etc. The fiber should be evenly impregnated, with stable tension. The winding speed should not exceed 60 r/min (the linear speed is 28 m/min).

5.3.6 Curing After the annular specimen is wound, it shall be cured according to the prescribed curing system. The storage time of the annular specimens wound in the same batch before curing shall not exceed 8 h.

5.3.7 Processing and demolding For the solidified single-ring specimen, first remove the outer molds on both sides, string them together and perform surface processing by grinding or fine turning. After processing, remove the middle mold by a press. After solidification, the cylinder is first ground or precision turned for surface processing, and then the ring is cut and demolded.

5.4 Prepreg winding process specimen preparation The procedure for preparing the specimen by the prepreg method is basically the same as the wet winding process. However, the preheating temperature of the mold and the baking conditions, winding tension, winding speed, etc. of the prepreg tape must be determined according to the technical conditions specified for the prepreg tape.

5.5 Filament-winding reinforced composite tube specimen The specimens are cut directly from the filament-winding reinforced composite tube and then machined. The two reduction planes are at a distance of 180° . The cross section is at the center relative to the width of the specimen.

5.6 Type and size of test specimen

7.3.4 Install the specimen on the fixture. Align the scribe line of the unidirectional ring of filament-winding reinforced composites or the reduced surface of the filament-winding reinforced composite tube specimen with the gap of the tension plate. The contact surface between the specimen and the fixture should be lubricated.

7.3.5 Apply load to the specimen evenly and continuously until failure. Record the failure load.

7.3.6 The tensile elastic modulus of unidirectional ring of filament-winding reinforced composites shall be measured in accordance with the provisions of Annex A.

7.3.7 The fiber volume content of glass fiber specimens shall be determined in accordance with the provisions of GB/T 2577. The fiber volume content of carbon fiber specimens shall be determined in accordance with the provisions of GB/T 3855.

7.4 Calculation

7.4.1 Tensile strength Tensile strength is calculated according to formula (2). Where, σ - tensile strength of reinforced composite material, in megapascals (MPa); P_b - destructive load, in Newtons (N); b - specimen width, in millimeters (mm); h - specimen thickness, in millimeters (mm).

7.4.2 Tensile elastic modulus of unidirectional ring of filament-winding reinforced composites The calculation of tensile elastic modulus shall be carried out in accordance with the provisions of Annex A.

7.4.3 Fiber tensile strength of unidirectional ring of filament-winding reinforced composites The fiber tensile strength is calculated according to formula (3). Where, σ_f - fiber tensile strength, in megapascals (MPa); P_b - destructive load, in Newtons (N); b - specimen width, in millimeters (mm); h - specimen thickness, in millimeters (mm); V_f - fiber volume content, %.

7.5 Test results The test results shall be in accordance with the provisions of GB/T 1446.

8 Test report

The test report shall include the following contents.

- a) Name of the test item and the number of this document;
- b) Type and specification of raw materials;
- c) Ambient temperature and relative humidity when making the ring specimen;
- d) Winding tension and speed;
- e) Mold material;
- f) Curing system;
- g) Personnel and date of specimen making;
- h) Type, number, shape, size, appearance quality and quantity of the specimen;
- i) Test temperature, relative humidity and specimen state adjustment;
- j) Model, range and use of test equipment and instruments;