



Designation: C1666/C1666M – 08 (Reapproved 2023)

Standard Specification for Alkali Resistant (AR) Glass Fiber for GFRC and Fiber- Reinforced Concrete and Cement¹

This standard is issued under the fixed designation C1666/C1666M; 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.

1. Scope

1.1 This specification covers minimum requirements for alkali resistant (AR) glass fibers intended for use in glass fiber-reinforced concrete (GFRC) by spray-up, glass fiber-reinforced concrete premix, fiber-reinforced concrete, and other cementitious based products.

1.2 This specification provides for AR glass fiber types and configurations that can be readily incorporated into concrete mixes, typical physical properties, minimum zirconia content, and prescribes testing procedures to establish conformance to these requirements.

1.3 This specification does not address the types of coatings or lubricants used in the manufacturing process of the fibers.

1.4 In the case of conflict between a more stringent requirement of a product specification and a requirement of this specification, the product specification shall prevail. In the case of a conflict between a requirement of the product specification or a requirement of this specification and a more stringent requirement of the purchase order, the purchase order shall prevail. The purchase order requirements shall not take precedence if they, in any way, violate the requirements of the product specification or this specification; for example, by the waiving of a test requirement or by making a test requirement less stringent.

1.5 The values stated in either SI units or inch-pound units are to be regarded separately as standard. Within the text, the inch-pound units are shown in brackets. The values stated in each system may not be exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems may result in non-conformance with the standard.

1.6 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appro-*

priate safety, health, and environmental practices and determine the applicability of regulatory limitations prior to use.

1.7 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*²

D578/D578M Specification for Glass Fiber Strands
D1577 Test Methods for Linear Density of Textile Fibers
D2256/D2256M Test Method for Tensile Properties of Yarns by the Single-Strand Method
D3800 Test Method for Density of High-Modulus Fibers
D4963/D4963M Test Method for Ignition Loss of Glass Fiber Strands and Fabrics

2.2 *ISO Standards:*³

ISO 1887 Textile Glass—Determination of Combustible-Matter Content
ISO 1888 Textile Glass—Staple Fibres or Filaments—Determination of Average Diameter
ISO 1889 Reinforcement Yarns—Determination of Linear Density
ISO 3341 Textile Glass Yarns—Determination of Breaking Force and Breaking Elongation

2.3 *EN Standards:*⁴

EN 14649 Precast Concrete Products—Test Method for Strength Retention of Glass Fibre in Cement and Concrete

2.4 *Japanese Industrial Standards:*⁵

JISR 3420 Testing Methods of Textile Glass Products

¹ This specification is under the jurisdiction of ASTM Committee C27 on Precast Concrete Products and is the direct responsibility of Subcommittee C27.40 on Glass Fiber Reinforced Concrete.

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² For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

³ Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, <http://www.ansi.org>.

⁴ Available from European Committee for Standardization (CEN), 36 rue de Stassart, B-1050, Brussels, Belgium, <http://www.cenorm.be>.

⁵ Available from Japanese Standards Organization (JSA), 4-1-24 Akasaka Minato-Ku, Tokyo, 107-8440, Japan, <http://www.jsa.or.jp>.

3. Terminology

3.1 Definitions of Terms Specific to This Standard:

3.1.1 *alkali resistant (AR) glass fiber, n*—a glass fiber product that is resistant to the alkaline conditions that exist in matrices such as those based on Portland cement, and that are used for the reinforcement of cement, mortar, and concrete products. The resistance is due mostly to the specific composition of the glass.

3.1.2 *chopped strands, n*—strands, as defined in 3.1.9, chopped to discrete lengths, usually between 3 and 50 mm [0.125 and 2 in.].

3.1.3 *filament, n*—a single glass fiber, sometimes referred to as monofilament.

3.1.4 *GFRC, n*—glass fiber-reinforced concrete, sometimes referred to as GRC.

3.1.5 *matrix, n*—the concrete (or mortar) without the glass fiber reinforcement.

3.1.6 *roving, n*—a number of parallel, continuous, not twisted, strands wound together to form a cylindrical package.

3.1.7 *scrim or net, n*—glass fiber roving or yarn strands laid in two directions at 90° and then bonded together to form a non-woven stable structured textile fabric.

3.1.8 *size, n*—coatings applied to filaments during manufacture that facilitate the processing of glass fibers and bond the filaments together. Different sizings can provide different performance characteristics of the fibers.

3.1.9 *strand, n*—several parallel filaments of consistent diameter, bonded together with a size.

3.1.10 *tex, n*—the weight in grams of one kilometre of strand or roving.

3.1.11 *woven roving, n*—glass fiber roving products that are produced by weaving into a structured textile fabric.

3.1.12 *yarn, n*—glass fiber strands that are twisted together.

4. Classification

4.1 AR glass fibers are available in three forms as follows:

4.1.1 *Type I, Roving*—A variety of different roving are manufactured with different processing characteristics, which makes them suitable for particular applications such as chopping and spraying, weaving and scrim manufacture, filament winding, and chopped strand production.

4.1.2 *Type II, Chopped Strands*—Available in lengths from 3 mm [0.125 in.] to 50 mm [2.0 in.]. Chopped strands are designed to remain either as integral bundles of filaments (usually referred to as integral strands) or to breakdown into individual filaments (filamentize) during mixing (usually referred to as water dispersible strands).

4.1.3 *Type III, Textiles*—Available as woven, knitted, or non-woven fabrics.

5. Ordering Information

5.1 It shall be the responsibility of the purchaser to specify all requirements that are necessary for the product under this specification. Such requirements to be considered include, but are not limited to, the following:

5.1.1 ASTM designation and year of issue.

5.1.2 Quantity in kilograms [pounds or tons] for rovings or chopped strands or in square metres [square feet or square yards] for textiles.

5.1.3 Type or types permissible (see 4.1).

5.1.4 Manufacturer's product code, if not included in code, tex shall be specified for roving, length shall be specified for chopped strands, and weight/unit area or number of strands/unit length shall be specified for textiles.

5.1.5 Whether certificate of analysis by the manufacturer is required.

6. Materials and Manufacture

6.1 The materials and manufacturing methods used shall be such that the fibers produced conform to the requirements in this specification.

7. Chemical Composition

7.1 Alkali resistant glass fiber shall have a minimum of 16 % by mass of zirconium dioxide.

8. Mechanical Properties

8.1 The AR glass fiber roving or chopped strands shall be deemed to comply with the requirements of this specification if the results obtained on test samples comply with the values specified in Table 1.

9. Performance Requirements

9.1 The strength of AR glass fiber shall be measured according to EN 14649.

TABLE 1 Test Requirements

Property	Specification Value	Method of Test
Zirconia content (ZrO ₂)	16 % min	X-ray fluorescence ^A
Density	2.68 ± 0.3 g/cm ³ [167.0 ± 19 lb/ft ³]	ASTM D3800
Tensile Strength	1.0–1.7 GPa [145 × 10 ³ –246 × 10 ³ psi]	ASTM D2256/ D2256M, ISO 3341, JISR 3420
Range of Filament Diameters	8–30 µm [31 × 10 ^{−5} –118 × 10 ^{−5} in.]	ASTM D578/D578M, ISO 1888, JISR 3420
Roving tex	±10 % of manufacturer's nominal	ASTM D1577, ISO 1889, JISR 3420
Strand length	±3 mm [±0.118 in.] of manufacturer's nominal	Caliper—Average of 20 measurements
End count	±20 % of manufacturer's nominal	Physical count
Loss on ignition	<3 %	ASTM D4963/ D4963M, ISO 1887, JISR 3420
Strength retention	Minimum value after 96 ± 1 h in water at 80 ± 1°C [176 ± 2 °F] ≥250 MPa [36 250 psi] for water dispersible strands ≥350 MPa [50 750 psi] for integral strands	EN 14649

^AAny party that is interested in doing this test should contact an AR glass fiber manufacturer before running it so as to avoid possible erroneous results.