Designation: D8448/D8448M – 22

# Standard Specification for Basalt Fiber Strands[1]

This standard is issued under the fixed designation D8448/D8448M; 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 the requirements for basalt fiber, including rovings and chopped strands. This specification is intended to assist ultimate users by designating the general nomenclature for the strand products that are generally manufactured in the basalt fiber industry.

1.2 Basalt fibers are produced by melting naturally occurring volcanic rocks, being primarily basalt or other basaltic rocks. The melt is drawn though a bushing and, typically, a sizing is applied to the fiber as it is cooled.

1.3 Basalt fiber strands have a variety of general uses under specific conditions, such as high physical or chemical stress, high moisture, or high temperature. Property requirements under specific conditions are agreed upon between the purchaser and the supplier.

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

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

1.6 *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]

D123 Terminology Relating to Textiles

D578 Specification for Glass Fiber Strands

D1907/D1907M Test Method for Linear Density of Yarn (Yarn Number) by the Skein Method

D2256/D2256M Test Method for Tensile Properties of Yarns by the Single-Strand Method

D2258/D2258M Practice for Sampling Yarn for Testing

D4963/D4963M Test Method for Ignition Loss of Glass Fiber Strands and Fabrics

D7018/D7018M Terminology Relating to Glass Fiber and Its Products (Withdrawn 2021)[3]

2.2 *ANSI Standard:*

ANSI/ASQC Z1.4 Sampling Procedures for Inspection by Attributes[4]

## 3. Terminology

3.1 For all terminology applying to this specification and related to glass fiber and its products, refer to Terminology D7018/D7018M.

3.1.1 The following terms are relevant to this standard: atmosphere for testing textiles, chopped strand, roving, strand.

3.2 For all other terminology related to textiles, refer to Terminology D123.

## 4. Composition of Basalt Fiber

4.1 Basalt fiber is composed primarily of oxides of silicon, aluminum, calcium, magnesium, titanium, sodium, potassium, and iron with a certified chemical composition.

[1] This specification is under the jurisdiction of ASTM Committee D13 on Textiles and is the direct responsibility of Subcommittee D13.19 on Industrial Fibers and Metallic Reinforcements.

Current edition approved Sept. 1, 2022. Published October 2022. DOI: 10.1520/D8448-22.

[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] The last approved version of this historical standard is referenced on www.astm.org.

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

4.2 The primary certified chemical composition that applies to basalt fiber products used in general applications is summarized in Table 1.

## DESCRIPTION OF BASALT PRODUCTS

## 5. General

5.1 Basalt products are specified using a series of segments of alphabetical or numerical characters.

5.2 For the description of basalt products, SI units and inch-pound units are used.

## 6. Rovings

6.1 *Descriptions of Rovings*—The description of rovings consists of five segments.

| **Segment 1** Product type | **Segment 2** Yarn number | **Segment 3** Filament diameter | **Segment 4** Sizing type | **Segment 5** Type of pull |
|---|---|---|---|---|

6.1.1 *Segment One*—The first segment of the description of basalt rovings represents the product type. The type of roving consists of letters BDR for basalt direct rovings, or BAR for basalt assembled rovings.

6.1.2 *Segment Two*—The second segment of the description defines the yarn number of the roving. For rovings described in SI units, the yarn number is specified in tex. For such rovings described in inch-pound units, the yarn number is specified in yards per pound.

6.1.3 *Segment Three*—The third segment of the description specifies the filament diameter. When using SI units, this segment consists of a number specifying the nominal filament diameter range in micrometres as directed in Table 2. When using inch-pound units, this segment consists of one or two letters as directed in Table 2.

6.1.4 *Segment Four*—The fourth segment of the description of basalt rovings represents the sizing type as defined by a manufacturer's code, providing further identification as necessary by manufacturer to define sizing.

6.1.5 *Segment Five*—The fifth segment of the description of basalt rovings specifies the type of pull. It shall be defined as either internal pull (I) or external pull (E).

6.2 *Example of Descriptions of Rovings:*

6.2.1 *Example of description of rovings using SI units:*

BAR-3000-17-5X1-I

where:

BAR = basalt assembled roving,
3000 = yarn number in tex,
17 = filament diameter in micrometres (μm),
5X1 = codification of the sizing, and
I = internal pull.

**TABLE 1 Primary Chemical Composition of Basalt Fiber Products**

| Chemical | % by Weight |
|---|---|
| $SiO_2$ | 45 to 57 |
| CaO | 5 to 11 |
| MgO | 3 to 7 |
| $Al_2O_3$ | 10 to 19 |
| $Na_2O + K_2O$ | 3 to 6 |
| $TiO_2$ | 0.5 to 4 |
| $Fe_2O_3 + FeO$ | 8 to 16 |

**TABLE 2 Letter Designations for Basalt Strand Filament Diameters**

| Filament Size Designation | | Nominal Range for Filament Diameter Average | |
|---|---|---|---|
| Inch-Pound System, Letter | SI System, Number | in. | μm[A] |
| B | 3.5 | 0.00013 to 0.000159 | 3.30 to 4.05 |
| C | 4.5 | 0.00016 to 0.000189 | 4.06 to 4.82 |
| D | 5 | 0.00019 to 0.000229 | 4.83 to 5.83 |
| DE | 6 | 0.00023 to 0.000269 | 5.84 to 6.85 |
| E | 7 | 0.00025 to 0.000299 | 6.35 to 7.61 |
| F | 8 | 0.00030 to 0.000345 | 7.62 to 8.88 |
| G | 9 | 0.00035 to 0.000399 | 8.89 to 10.15 |
| H | 11 | 0.00040 to 0.000449 | 10.16 to 11.42 |
| J | 12 | 0.00045 to 0.000499 | 11.43 to 12.69 |
| K | 13 | 0.00050 to 0.000549 | 12.70 to 13.96 |
| L | 14 | 0.00055 to 0.000599 | 13.97 to 15.23 |
| M | 16 | 0.00060 to 0.000649 | 15.24 to 16.50 |
| N | 17 | 0.00065 to 0.000699 | 16.51 to 17.77 |
| P | 18 | 0.00070 to 0.000749 | 17.78 to 19.04 |
| Q | 20 | 0.00075 to 0.000799 | 19.05 to 20.31 |
| R | 21 | 0.00080 to 0.000849 | 20.32 to 21.58 |
| S | 22 | 0.00085 to 0.000899 | 21.59 to 22.85 |
| T | 23 | 0.00090 to 0.000949 | 22.86 to 24.12 |
| U | 24 | 0.00095 to 0.000999 | 24.13 to 25.40 |

[A] The low values stated for each micrometre range are exact equivalents to inches, rounded to the nearest hundredth micrometre. The high values stated for each micrometre range are slightly higher than exact equivalents to inches to provide continuation between ranges. They are consistent for inch-pound and SI filament size descriptions commonly used in the industry. In some publications, the SI designation for H filament size has been shown as 10.



6.2.2 *Example of description of rovings using inch-pound units (equivalent to example 6.2.1):*

BAR-165-N-5X1-I

where:

BAR = basalt assembled roving,
165 = yarn number in yards per pound,
N = designation of the filament diameter, average range 0.000 65 to 0.000 699 in.,
5X1 = codification of the sizing, and
I = internal pull.

## 7. Chopped Strands from Continuous Filament Strands

7.1 *Descriptions of Chopped Strands from Continuous Filament Strands*—The description of chopped strands from continuous filament strands consists of four segments.

| **Segment 1** Product type | **Segment 2** Strand length | **Segment 3** Filament diameter | **Segment 4** Sizing type |
|---|---|---|---|

7.1.1 *Segment One*—The first segment of the description of chopped strands from continuous filament strands, represents the product type. The type of product consists of letters BCS for basalt chopped strands.

7.1.2 *Segment Two*—The second segment of the description of the chopped strands specifies the strand length. For chopped strands described in SI units, the nominal chopped length is specified in millimetres. For chopped strands described in inch-pound units the nominal chopped length is specified in inches.

7.1.3 *Segment Three*—The third segment of the description specifies the filament diameter. When using SI units, this segment consists of a number specifying the nominal filament

diameter range in micrometres as directed in Table 2. When using inch-pound units, this segment consists of one or two letters as directed in Table 2.

7.1.4 *Segment Four*—The fourth segment of the description of basalt chopped strands represents the sizing type as defined by a manufacturer's code, providing further identification as necessary by manufacturer to define sizing.

7.2 *Example of Descriptions of Chopped Strands from Continuous Filament Strands:*

7.2.1 *Example of description of basalt chopped strands using SI units:*

BCS-16-17-5X1

where:

BCS = basalt chopped strand,
16 = length of chopped strands in millimetres (mm),
17 = strand diameter in micrometres (μm), and
5X1 = codification of the sizing.

7.2.2 *Example of description of basalt chopped strands using inch-pound units (equivalent to example 7.2.1):*

BCS-5/8-N-5X1

where:

BCS = basalt chopped strand,
5/8 = length of chopped strands in inches (in.),
N = designation of the filament diameter, average range 0.000 65 to 0.000 699 in., and
5X1 = codification of the sizing.

## 8. Ordering Information

8.1 The purchase order or other agreement shall specify: specification conformance number, title, and year of issue; designation of strand construction; product quantity; and any special provisions.

## REQUIREMENTS

## 9. Material

9.1 The fibers shall be free of any free alkali metal oxides, such as soda or potash, and from foreign particles, dirt, and other impurities. The basalt classification shall be agreed upon between the purchaser and the supplier in an applicable material specification or other agreement. The composition of the basalt fiber shall be within the limits specified in Table 1 as agreed upon between the purchaser and supplier.

## 10. Workmanship

10.1 As agreed upon between the purchaser and the supplier, the defects listed in Table 3 shall be considered cause for rejection of the package in which they occur. The Acceptance Quality Limit (AQL) shall be agreed upon between the purchaser and the supplier.

## 11. Physical Properties

11.1 The nominal and physical properties of basalt fiber strands shall conform to the requirements of Table 4. The tolerances shall be subject to the tolerances as agreed upon between the purchaser and the supplier. However, the following maximum tolerances apply:

**TABLE 3 Visual Examination of Strands**

| Visual Characteristic | Defect |
|---|---|
| Appearance and Workmanship | Any cut, chaf, damage, or excessive filamentation, affecting serviceability[A]<br>Finish other than specified<br>Spot or stain[A]<br>Embedded foreign matter[A]<br>Excessive deposits of sizing[A] |
| Put-up (Package/ Bobbin Build) | Any defect or package abnormality affecting the free unhampered unwinding of strand or affecting the secure holding of strand winds on the bobbin or package<br>Not put up on bobbin or package as specified |

[A] Clearly visible at normal inspection distance of approximately 1 m [3 ft].

11.1.1 *Tex [Yards per Pound], Individual Value*—The maximum tolerance shall be plus or minus 10 % for both direct and assembled rovings.

11.1.1.1 The tex [yards per pound] as determined in Section 21 is the bare basalt nominal. A commercial strand normally has a size (binder) treatment which will increase tex [decrease yards per pound] in proportion to the amount of size.

11.1.2 *Breaking Strength*—No individual break shall be less than the specified minimum requirement in Table 4.

11.1.3 *Tensile Modulus*—The minimum tensile modulus of elasticity of basalt fibers shall be as specified in Table 4.

11.2 When required for roving and chopped strand, the nominal and physical properties shall be agreed upon between the purchaser and the supplier in an applicable material specification or other agreement, subject to the requirements of 11.1.

## 12. Ignition Loss (Organic Content)

12.1 The ignition loss (organic content) shall be within the tolerances as agreed upon between the purchaser and the supplier, or as specified in an applicable material specification or other agreement.

## 13. Packaging

13.1 The basalt fiber strand shall be put up on packages, and in containers whose dimensions shall be agreed to between the purchaser and supplier.

13.2 Each package of strand, put up as specified, shall be further packaged to afford adequate protection against physical damage during shipment from the supply source to the receiving activity. The supplier will use their standard practice when it meets this requirement.

13.3 For government procurement, the contracting instrument shall specify the put up (see 8.1) and AQL (see 10.1).

## 14. Marking

14.1 Each package of strand shall be marked to show the construction designation of the basalt fiber strand as specified in Sections 5 – 7. Each container of packages shall be marked as agreed upon between the purchaser and supplier.

## 15. Sampling, Inspection, and Number of Specimens

15.1 *Lot Size*—A lot shall consist of each shipment, date code, or consignment of a single strand designation. This shall

**TABLE 4 Mechanical Properties of Basalt Fibers**

| Filament Diameter[A] | | Minimum Breaking Strength | | Minimum Tensile Modulus | |
|---|---|---|---|---|---|
| Number (SI System) | Letter (Inch-Pound System) | MPa | ksi | GPa | Msi |
| <11 | <H | 2650 | 384 | | |
| 11-14 | H-L | 2600 | 377 | | |
| 14-17 | L-N | 2550 | 370 | 80 | 11.6 |
| >17 | >N | 2500 | 363 | | |

[A] Refer to Table 2 for the letter designations for basalt strand filament diameters.

constitute all or part of any one customer order. The lot size is the total number of packages of strand in the incoming shipment date code, or consignment.

15.1.1 Any time a significant change takes place during the production of the fiber, the current lot shall be interrupted, and a new lot shall begin after the change is effective. Examples that shall cause the interruption of a lot include, but are not limited to, the change of a batch of constituents, the use of new equipment, the change of production parameters (such as speed or temperature), etc.

NOTE 1—An adequate specification or other agreement between the purchaser and the supplier requires taking into account the variability between packages of strand and between test specimens from a package of strand to produce a sampling plan with meaningful producer's risk, consumer's risk, acceptable quality level, and limiting quality level.

15.2 *Lot Sample*—As a lot sample for acceptance testing, take at random the number of shipping units specified in Practice D2258/D2258M. Consider shipping cases or other shipping units to be the primary sampling units.

15.3 *Laboratory Sample*—As a laboratory sample for acceptance testing, take at random from each shipping unit in the lot sample the number of packages or ends directed in 15.3.1 and 15.3.2. Preferably, take the same number of packages from each shipping unit in the lot sample. If differing numbers of packages are to be taken from shipping units in the lot sample, determine at random which shipping units are to have each number of packages drawn.

15.3.1 *Workmanship*—Take at random the number of packages or ends of strand as directed in ANSI/ASQC Z1.4. Select an acceptable quality level (AQL) that is agreeable to both the purchaser and the supplier.

15.3.2 *Other Properties*—Take at random the number of bobbins or packages of strand specified in Table 5.

15.4 *Test Specimens*—Proceed as follows:

15.4.1 *Workmanship*—Use the packages of strand in the laboratory sample as the specimens. Evaluate the results of inspecting the specimens using ANSI/ASQC Z1.4, normal inspection, and an acceptable quality level agreed upon between the purchaser and the supplier.

15.4.2 *Other Properties*—Take the number of specimens per laboratory sampling unit specified in the applicable test method.

**TABLE 5 Sample Size Determination**

| Lot Size, Packages per Lot | Sample Size, Number of Packages |
|---|---|
| 15 or less | 2 |
| 16 to 40 | 3 |
| 41 to 110 | 5 |
| 111 to 300 | 7 |
| 301 to 500 | 10 |
| 501 or more | 15 |

## 16. Reports and Documentation

16.1 Each lot may be documented with a report as agreed upon between the purchaser and supplier which may include the following points:

16.1.1 Lot identification;

16.1.2 Filament diameter;

16.1.3 Yarn number;

16.1.4 Breaking strength;

16.1.5 Tensile modulus of elasticity;

16.1.6 Any other property as agreed upon between the purchaser and supplier.

16.2 The report shall be sent along with the material.

# TEST METHODS

## 17. Conditioning

17.1 Condition the laboratory samples without preconditioning for a period of at least 5 h in the atmosphere for testing basalt textiles, unless otherwise specified.

## 18. Material

18.1 Upon prior agreement, verify that the fiber is the specified filament type during testing for strand construction as directed in Section 20. Determine the freedom from undesirable impurities during inspection for workmanship as directed in Section 19.

## 19. Workmanship

19.1 Examine the outer surface of each package of strand in the laboratory sample by counting the defects listed in Table 3 regardless of their proximity to one another, except where two or more defects represent a single local condition. In such cases, count only the most serious defect.

## 20. Strand Construction

20.1 Verify the number of single strands and the number of plied strands on each package of strand in the laboratory sample.