



Designation: D8364/D8364M – 21

Standard Specification for Geosynthetic Cementitious Composite Mat (GCCM) Materials¹

This standard is issued under the fixed designation D8364/D8364M; 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 and properties for geosynthetic cementitious composite mat materials, or GCCM materials, in various applications. The applications where GCCM materials are utilized shall have different required physical properties, which this standard describes.

1.2 The values stated in either SI units or inch-pound units are to be regarded separately as standard. 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 nonconformance with the standard.

1.3 *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.*

1.4 *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

C1185 Test Methods for Sampling and Testing Non-Asbestos Fiber-Cement Flat Sheet, Roofing and Siding Shingles, and Clapboards

C1353/C1353M Test Method for Abrasion Resistance of Dimension Stone Subjected to Foot Traffic Using a Rotary Platform Abraser

D4439 Terminology for Geosynthetics

D4759 Practice for Determining the Specification Conformance of Geosynthetics

D4885 Test Method for Determining Performance Strength of Geomembranes by the Wide Strip Tensile Method

D5199 Test Method for Measuring the Nominal Thickness of Geosynthetics

D5494 Test Method for the Determination of Pyramid Puncture Resistance of Unprotected and Protected Geomembranes

D5641/D5641M Practice for Geomembrane Seam Evaluation by Vacuum Chamber

D5820 Practice for Pressurized Air Channel Evaluation of Dual-Seamed Geomembranes

D5993 Test Method for Measuring Mass per Unit Area of Geosynthetic Clay Liners

D6768/D6768M Test Method for Tensile Strength of Geosynthetic Clay Liners

D7177/D7177M Specification for Air Channel Evaluation of Polyvinyl Chloride (PVC) Dual Track Seamed Geomembranes

D8030/D8030M Practice for Sample Preparation for GCCM

D8058 Test Method for Determining the Flexural Strength of a Geosynthetic Cementitious Composite Mat (GCCM) Using the Three-Point Bending Test

D8173 Guide for Site Preparation, Layout, Installation, and Hydration of Geosynthetic Cementitious Composite Mats

D8329 Test Method for Determination of Water/Cementitious Materials Ratio for Geosynthetic Cementitious Composite Mats (GCCMs) and Measurement of the Compression Strength of the Cementitious Material Contained Within

3. Terminology

3.1 *Definitions*—For definitions of terms related to geosynthetics, refer to Terminology **D4439**.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *cured, adj*—a description of the state of a GCCM or cementitious mixture after hydration for a specific period of time and quantity of water under specified conditions, followed by a period of time when the GCCM is kept under a specified environmental condition during which the cementitious material continues to cure and develop compressive strength.

¹ This specification is under the jurisdiction of ASTM Committee **D35** on Geosynthetics and is the direct responsibility of Subcommittee **D35.06** on Geosynthetic Specifications.

Current edition approved Feb. 15, 2021. Published March 2021. DOI: 10.1520/D8364_D8364M-21.

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.

3.2.2 *uncured, adj*—a description of the state of a GCCM or cementitious mixture prior to hydration.

4. Classification of GCCM Materials in Applications

4.1 Prefabricated geosynthetic cementitious composite mats (GCCMs) covered by this specification shall be classified as Type I, Type II, and Type III. Distinctions between the types is related to the requirements found in **Table 1**. Typically, higher grade types would be expected to be durable and longer lasting than lower grade types in the same application.

4.2 Typical Applications By Classification Type:

4.2.1 Type I GCCM applications have minimal requirements for abrasion and wear; will be exposed to shear stresses of less than 50 kg/m² [10 lb/ft²] and lower flow velocities up to 6 m/s [20 ft/s]; will not be subjected to impact loads, wave action, water over topping or similar forces; and are installed above a dense subgrade capable of supporting them, such as concrete or rock. Applications include but are not limited to: erosion control, weed suppression, slope protection, berm protection, and remediation of concrete hydraulic structures. Slope protection applications of Type I GCCMs shall be limited to slopes of grades lower than 3:1 with slope lengths of less than 50 ft; extensions of this limit are permissible only with the use of suitable intermediate fixings such as percussion anchors. Installations for Type I GCCM applications shall include perimeter fixings to all unjointed edges (leading, trailing, toe, and crest) such as anchor trenches, or fixed mechanically and sealed in such a way that liquid, wind, or both cannot ingress. Intermediate fixings such as metal pegs, earth percussion anchors, mechanical fixings, or check slots

shall be required to limit movement of the GCCM under wind or hydraulic loading conditions or when the recommended slope angle or length is exceeded.

4.2.2 Type II GCCM applications would include all Type I applications, and applications that would have abrasion and wear requirements greater than Type I, will be exposed to shear stresses greater than 50 kg/m² [10 lb/ft²] and flow velocities greater than 6 m/s [20 ft/s], or will be subject to design requirements for impact loads, or have medium dense subgrades. Erosion protection and weed suppression applications of Type II GCCMs include but are not limited to: channel lining, berm protection, armoring, slope protection (any angle and run length), culvert invert lining and concrete overlay, and remediation of concrete hydraulic structures. Installations of Type II GCCM applications shall require all the same securing mechanisms as outlined for Type I GCCM installations.

4.2.3 Type III GCCM applications would include all Type I and Type II applications that require additional flexural strength of the GCCM material due to unsuitable (that is, loose) subgrades. The same securing mechanisms as outlined for Type I or Type II GCCM installations may be required.

4.2.4 A special category of Type I, Type II, and Type III GCCM applications is armoring of containment structures. The containment GCCM systems must meet the requirements for field seam testing as outlined in Practice **D5641/D5641M** or **D5820**, Specification **D7177/D7177M**, or similar.

4.2.5 It is incumbent upon the designer to ensure that the proper GCCM type is specified for the bearing capacity of the subgrade and the application.

4.2.6 Installation requirements are detailed in Guide **D8173**.

TABLE 1 Classifications for GCCMs

Property	Test Method	State of GCCM	Minimum Values Unless Specified		
			Type I	Type II	Type III
Thickness	D5199	uncured cured 24 h	4.5 mm [0.17 in.]	7.0 mm [0.27 in.]	6.4 mm [0.25 in.]
Mass per unit area ^A	D5993	uncured	6.5 kg/m ² [1.33 lb/ft ²]	10.5 kg/m ² [2.15 lb/ft ²]	
Density	D5993/D5199	uncured	1250 kg/m ³ [78 lb/ft ³]		
Flexural strength ^B	Initial breaking load Initial flexural strength Final flexural strength D8058	cured 24 h	625 N/m [3.5 lbf/in.]	1500 N/m [8.5 lbf/in.]	3750 N/m [21 lbf/in.]
			3.5 MPa [500 psi]		
Compressive strength of cementitious mix	D8329	cured 28 days	40 MPa [5800 psi]	50 MPa [7200 psi]	60 MPa [8700 psi]
			4.0 MPa [580 psi]		
Pyramid puncture	D5494 , Type B	cured 28 days	2 kN [450 lbf]	3.5 kN [780 lbf]	4.5 kN [1000 lbf]
Abrasion (maximum value) ^C	C1353/C1353M	cured 28 days	0.3 mm [0.012 in.]/1000 cycles		
Tensile strength ^{B,D,E}	Final D6768/D6768M	uncured	8 kN/m [45 lbf/in.]		
			Initial Final D4885	3.5 kN/m [20 lbf/in.]	6.5 kN/m [36 lbf/in.]
Freeze-thaw ^F	Residual initial flexural strength (D8058) C1185	cured 28 days 200 cycles		10 kN/m [57 lbf/in.]	19 kN/m [108 lbf/in.]
			>80 % (Pass)		

^A See modifications to Test Method **D5993** as given in 7.1.1.

^B GCCM materials are non-isotropic and the values for flexural strength, tensile strength, and initial breaking load shall be measured as the lower of the material machine production direction (length of roll) or material cross-machine production direction (width of roll).

^C See modifications to Test Method **C1353/C1353M** as given in 7.1.3.

^D Tensile strength of the uncured material shall be measured as per Test Method **D6768/D6768M** at the loading rate of 300 mm/min [12 in./min], which is typical of rates which could occur during installation.

^E Tensile strength of the cured material shall be measured as per Test Method **D4885** at a loading rate of 20 mm/min [0.9 in./min] to represent the in-use properties; see 7.1.4.

^F Freeze-thaw applicable in freeze-thaw susceptible regions.

5. Ordering Information and Acceptance Criteria

5.1 When ordering GCCM materials, the following minimum information shall be specified:

- 5.1.1 GCCM type.
- 5.1.2 Material thickness (uncured).
- 5.1.3 Material roll width and roll length.

6. Materials and Manufacture

6.1 GCCMs are a factory-assembled geosynthetic composite consisting of a cementitious material contained within a layer or layers of geosynthetic materials that becomes hardened when hydrated. GCCMs typically include a top and bottom layer and a core layer containing cementitious fill with a matrix of fibers.

6.1.1 Optional bottom layers may contain a polymeric coating, possibly PVC, HDPE, LDPE, LLDPE, or other materials, with a minimum thickness of 0.1 mm [0.004 in.].

6.1.2 The cementitious element shall consist of a formulated cementitious material capable of being field hydrated to cure to the desired properties found in **Table 1** under field application conditions. Alternative cementitious materials may be formulated to achieve specific chemical resistance properties or physical properties.

6.1.3 The fiber materials shall be made of a synthetic material capable of withstanding installation and applications conditions. Typical fibers will include polyester, nylon, and polypropylene, but may include others to achieve the desired property results. Natural fibers may also be used in certain applications.

7. Physical and Mechanical Properties

7.1 The GCCM material shall have the physical properties as shown in **Table 1** per each type and classification. Modifications of testing procedures from published standards for GCCM materials are below.

7.1.1 *Mass per Unit Area*—The mass per unit area of uncured GCCMs shall be determined in accordance with Test Method **D5993** (modified to omit sample preparation stages that require wetting of the sample perimeter and the drying of samples in the oven prior to weighing).

7.1.2 *Density*—The density of the uncured samples shall be calculated by dividing the mass per unit area of the material obtained from Test Method **D5993**, by the uncured thickness obtained from Test Method **D5993** as modified in **7.1.1**.

7.1.3 *Abrasion*—The abrasion of the cured cementitious materials within GCCMs shall be measured in accordance with Test Method **C1353/C1353M**, modified to include a minimum of 8000 cycles, cleaning the wheels after each 1000 cycles, and to record thickness loss instead of mass loss after 8000 cycles is completed. Use H-22 Calibrate wheels and an accessory weight of 1000 g. Record the nearest 1000 cycles to when the top/non-cementitious surface is worn and depth of wear (average cementitious material thickness loss) per 1000 cycles, *T*.

7.1.3.1 Calculate the depth of wear per 1000 cycles:

$$T = \frac{(T_1 - T_2) \times 1000}{n_2 - n_1} \quad (1)$$

where:

- T_1 = thickness at nearest 1000 cycles after the top/non-cementitious surface has worn,
- T_2 = thickness of test specimen after maximum number of revolutions, mm,
- n_1 = number of revolutions at nearest 1000 cycles after the top/non-cementitious surface was worn, and
- n_2 = total number of revolutions.

7.1.4 *Tensile Strength*—The tensile strength of the GCCM materials is important over two different phases of life: installation and final application performance. During installation, GCCM materials are subjected to stressing and dragging that shall occur on the job site. This loading during installation is often at a high strain rate and, therefore, testing under the standard methods described in Test Method **D6768/D6768M** is appropriate. In the final application, the GCCM materials shall be subjected to stressing at perimeter and intermediate fixings resulting from wind, hydraulic, or other external loading. Because strain rates are greatly reduced, the test speed (CRE—constant rate of extension) of Test Method **D4885** should be modified to 20 mm/min [0.8 in./min] for cured samples. To reduce the ratio of specimens failing due to breaks within 5 mm [0.2 in.], 5-mm [0.2-in.] notches shall be cut in the middle of each side of the test specimen to ensure failure in that region.

8. Sampling

8.1 Materials shall be sampled at the production plant or on the job site. Sampling shall be in accordance with Practice **D8030/D8030M**.

9. Number of Tests and Retests

9.1 A summary table of proposed factory production control test frequency is detailed in **Table 2**.

10. Specimen Preparation

10.1 Specimen preparation shall be in accordance with Practice **D8030/D8030M**.

11. Inspection

11.1 Inspection of materials brought to the project site shall include an observation of the wrap to make sure it is intact and that the GCCM has not been prematurely hydrated.

12. Rejection and Rehearing

12.1 Acceptance of materials shall follow Practice **D4759**.

TABLE 2 Factory Production Test Frequency

Property	Test Method	State	Frequency of Testing
Thickness	D5199 , Procedure A	uncured	4000 m ² [43 000 ft ²]
		cured	4000 m ² [43 000 ft ²]
Mass per unit area ^A	D5993	uncured	4000 m ² [43 000 ft ²]
Flexural strength (initial; break at 24 h)	D8058	cured	4000 m ² [43 000 ft ²]

^A See modifications to Test Method **D5993** as given in **7.1.1**.