Designation: D5312/D5312M – 21

Standard Test Method for Evaluation of Durability of Rock for Erosion Control Under Freezing and Thawing Conditions[1]

This standard is issued under the fixed designation D5312/D5312M; 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 test method covers the procedures for evaluating the durability of rock for erosion control by evaluating the performance of slabs of rock when exposed to freezing and thawing conditions. This weathering test exposes the rock to freezing and thawing cycles similar to natural weather conditions. The rock slabs, prepared in accordance with procedures in Practice D5121, are intended to be representative of erosion control rock and its weaknesses. The test is appropriate for breakwater stone, armor stone, riprap, and gabion sized rock materials.

1.2 The limitations of the test are twofold.

1.2.1 First, the size of the cut rock slab specimens may eliminate some of the internal defects present in the rock structure. The test specimens may not be representative of the quality of the larger rock samples used in construction. Careful examination of the rock source and proper sampling are essential in minimizing this limitation.

1.2.2 Second, the test requires the rock slabs to be exposed to up to 55 freezing-thawing cycles. The test is time intensive and the entire procedure including sample preparation, testing, and analysis may require in excess of two months if automated freezing-thawing equipment is available and in excess of 5 months if the manual method is used. This limitation makes this test most useful as an initial source approval type test and may limit its practical usefulness as a more frequent quality control test during construction.

1.3 The use of reclaimed concrete and other such materials is beyond the scope of this test method.

1.4 *Units*—The values stated in either SI units or inch-pound units [presented in brackets] 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 non-conformance with the standard.

1.4.1 The gravitational system of inch-pound units is used when dealing with inch-pound units. In this system, the pound (lbf) represents a unit of force (weight), while the unit for mass is slugs. The slug unit is not given unless dynamic (F=ma) calculations are involved.

1.4.2 It is common practice in the engineering/construction profession to concurrently use pounds to represent both a unit of mass (lbm) and of force (lbf). This practice implicitly combines two separate systems of units; the absolute and the gravitational systems. It is scientifically undesirable to combine the use of two separate sets of inch-pound units within a single standard. As stated, this standard includes the gravitational system of inch-pound units and does not use/present the slug unit of mass. However, the use of balances and scales recording pounds of mass (lbm) or recording density in lbm/ft 3 shall not be regarded as nonconformance with this standard.

1.5 All observed and calculated values shall conform to the guidelines for significant digits and rounding established in Practice D6026, unless superseded by this test method.

1.5.1 For purposes of comparing measured or calculated value(s) with specified limits, the measured or calculated value(s) shall be rounded to the nearest decimal or significant digits in the specified limits.

1.5.2 The procedures used to specify how data are collected/recorded or calculated, in this standard are regarded as the industry standard. In addition, they are representative of the significant digits that generally should be retained. The procedures used do not consider material variation, purpose for obtaining the data, special purpose studies, or any considerations for the user's objectives; and it is common practice to increase or reduce significant digits of reported data to be commensurate with these considerations. It is beyond the scope of this standard to consider significant digits used in analytical methods for engineering design.

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 appropriate 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*

[1] This test method is under the jurisdiction of ASTM Committee D18 on Soil and Rock and is the direct responsibility of Subcommittee D18.17 on Rock for Erosion Control.

Current edition approved Nov. 1, 2021. Published November 2021. Originally approved in 1992. Last previous edition approved in 2013 as D5312/D5312M – 12 (2013). DOI: 10.1520/D5312_D5312M-21.

*A Summary of Changes section appears at the end of this standard

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]

D653 Terminology Relating to Soil, Rock, and Contained Fluids

D2216 Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass

D3740 Practice for Minimum Requirements for Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction

D4753 Guide for Evaluating, Selecting, and Specifying Balances and Standard Masses for Use in Soil, Rock, and Construction Materials Testing

D4992 Practice for Evaluation of Rock to be Used for Erosion Control

D5121 Practice for Preparation of Rock Slabs for Durability Testing

D6026 Practice for Using Significant Digits and Data Records in Geotechnical Data

E145 Specification for Gravity-Convection and Forced-Ventilation Ovens

3. Terminology

3.1 *Definitions*—See Terminology D653 for general definitions.

3.1.1 *gabion-fill stone, n—in rock*, stone generally less than 22 kg [50 lb] and placed in baskets of wire or other suitable material that is tied together to form an integral structure designed to resist erosion along stream banks and around bridge piers as well as stabilize shorelines, stream banks or slopes as well as retaining walls, noise barriers, temporary flood walls, silt filtration from runoff, for small or temporary/permanent dams, or channel lining.

3.1.2 *slab, n—in rock*, a section of rock having two smooth, approximately parallel faces, produced by two saw cuts spaced such that the thickness of the slab is generally less than the other dimensions of the rock.

3.1.2.1 *Discussion*—The slab will be the rock specimen which will subsequently undergo durability tests. The words "slab" and "specimen" are interchangeable throughout the test method.

4. Summary of Test Method

4.1 Erosion control rock samples are trimmed into saw-cut slab specimens. Each slab is structurally examined macroscopically and under 20× magnification. After being immersed in an alcohol/water solution for a minimum of 12 h, the specimens are exposed to up to 55 freezing-thawing cycles. Each cycle consists of the slab being frozen for a minimum of 12 h then thawed for 8 to 12 h. At the completion of the test, the percent loss by mass for each specimen is determined. A visual examination of the slabs is performed throughout and at the end of testing. The type of deterioration and changes to previously noted planes of weakness are recorded.

5. Significance and Use

5.1 Rock for erosion control consists of individual pieces of natural stone. The ability of these individual pieces of stone to resist deterioration due to weathering action affects the stability of the integral placement of rock for erosion control and hence, the stability of construction projects, structures, shorelines, and stream banks.

5.2 This test method is designed to determine the effects of freezing and thawing action on the individual pieces of rock for erosion control and the resistance of the rock to deterioration. This test method was developed to be used in conjunction with additional test methods listed in Practice D4992. This test method does not provide an absolute value but rather an indication of the resistance to freezing and thawing; therefore, the results of this test method are not to be used as the sole basis for the determination of rock durability.

NOTE 1—The quality of the result produced by this standard is dependent upon the competence of the personnel performing it, and the suitability of the equipment and facilities used. Agencies that meet the criteria of Practice D3740 are generally considered capable of competent and objective testing/sampling/inspection/etc. Users of this standard are cautioned that compliance with Practice D3740 does not in itself assure reliable results. Reliable results depend on many factors; Practice D3740 provides a means of evaluation some of those factors.

6. Apparatus

6.1 *Rock Saw*—A laboratory diamond saw used to cut geological and concrete specimens, or a diamond saw used for lapidary purposes, shall be acceptable. A minimum cut capacity of 18 cm [7 in.] will be needed to obtain the required slab sizes, and often a larger cut capacity will be required. In most cases, the blade will be a circular diamond blade, but a band saw may also be configured to perform the cutting operations.

6.1.1 The rock saw apparatus shall have a fixed or removable vise to hold the samples during the cutting process. An automatic feed (either gravity, hydraulic, or screwfeed operated) that controls the cutting action is preferred; however, a manual feed is also acceptable. The saw shall have a platform to prevent the cut slab from falling and shattering.

6.2 *Freeze-Thaw Chamber or Home Freezer*—A timer-controlled freeze-thaw chamber specifically designed for timed cycling of 16 h of freezing at –18 ± 2.5 °C [0 ± 5 °F] followed by a minimum of 8 h of thawing at 32 ± 2.5 °C [90 ± 5 °F] on a daily basis is the most desirable option. This type of apparatus is commercially available and allows for the completion of one freeze-thaw cycle every day including weekends and holidays.

6.2.1 If a timer-controlled freeze-thaw chamber is not available, a standard chest-type home freezer capable of reaching and maintaining the required freezing temperature range in accordance with 6.2 may be used.

6.2.2 The limitations associated with this option are related to the fact that the freeze-thaw cycling must be accomplished

[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.