Designation: D 5312 – 04

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 D 5312; 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 when exposed to freezing and thawing conditions.

1.2 The values stated in inch-pound units are to be regarded as the standard. The SI units given in parenthesis are for information only.

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 and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:* [2]

D 653 Terminology Relating to Soil, Rock, and Contained Fluids

D 2216 Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass

D 3740 Practice for Minimum Requirements for Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction

D 4753 Specification for Evaluating, Selecting, and Specifying Balances and Scales for Use in Soil, Rock, and Construction Materials Testing

D 4992 Practice for Evaluation of Rock to Be Used for Erosion Control

D 5121 Practice for the Preparation of Rock Slabs for Durability Testing

D 6026 Practice for Using Significant Digits in Calculating and Reporting Geotechnical Test Data

3. Terminology

3.1 For definitions of terms used in this guide, see Terminology D 653.

4. Significance and Use

4.1 Rock used for erosion control may consist of several types, depending on potential use. One type may be armor stone weighing from one to three tons or breakwater stone weighing three to twenty tons placed along shorelines or in jetties to protect the shoreline from erosion due to the action of large waves. Another type may be riprap usually weighing less than one ton and placed along river banks or on the slopes of dams to prevent erosion due to run-off, wave action, or stream-flow. A third type may be gabion-fill weighing less than 50 lb (22 kg) and placed in baskets of wire or other suitable materials. These baskets are then tied together to form an integral structure designed to resist erosion along stream banks and around bridge piers. No matter what form it takes, 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, shorelines, and streambanks.

4.2 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 D 4992. 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 dependant upon the competence of the personnel performing it, and the suitability of the equipment and facilities used. Agencies that meet the criteria of Practice D 3740 are generally considered capable of competent and objective testing and sampling. Users of this standard are cautioned that compliance with Practice D 3740 does not in itself assure reliable

[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.

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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.

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

results. Reliable results depend on many factors; Practice D 3740 provides a means of evaluation some of those factors.

5. Apparatus

5.1 *Circular Diamond Saw*, 14-in. (350-mm) diameter, capable of sawing rock, of the type required for Practice D 5121.

5.2 *Freeze-Thaw Chamber or Home Freezer*:

5.2.1 A timer-controlled freeze-thaw chamber specifically designed for timed cycling of 16 h of freezing at 0 ± 5°F (-18 ± 2.5°C) followed by a minimum of 8 h of thawing at 90 ± 5°F (32 ± 2.5°C) on a daily basis is the most desirable option. This type of apparatus can be obtained commercially and allows for the completion of one freeze-thaw cycle every day including weekends and holidays.

5.2.2 If a freeze-thaw chamber is not available, a standard chest-type home freezer capable of reaching the minimum temperatures in accordance with 5.2.1 may be used. The limitations associated with this option are related to the fact that the freeze-thaw cycling must be accomplished manually. The freezing portion of the cycle will begin when the test specimens are manually placed in the freezer at the end of the workday. The test specimens must be removed at the beginning of the workday to begin the thawing portion of the cycle. In addition, only four cycles of freezing and thawing may be accomplished during a normal work week since the 16 h of freezing may be accomplished only on the first through the fourth nights of the workweek (the fifth night of the workweek would go into the weekend). Thawing will then take place from Friday morning to Monday evening. This thawing cycle will not require the use of an oven.

5.3 *Oven*, (if option 5.2.2 is used), capable of holding the test specimen and its container and of maintaining a constant temperature of 90 ± 5°F (32 ± 2.5°C) required for the three thawing cycles during the workweek.

5.4 *Oven*, capable of drying the specimen to a constant mass at a temperature of 230 ± 9°F (110 ± 5°C).

5.5 *Containers*, to hold the specimens partially immersed in an alcohol/water solution, These containers may be stainless steel or polyvinyl chloride (PVC) and may be obtained from a restaurant supply company.

5.6 *Balance*, capable of determining the mass of the specimen to the nearest 0.1 % of the total mass in accordance with Specification D 4753.

5.7 *Camera*, capable of producing good quality, color photographs for “before” and“ after” photographs.

5.8 *Stereomicroscope*, or other suitable magnifying device, capable of at least 20× magnification for examination of the specimen prior to and after testing.

6. Special Solutions

6.1 The special solution required for this test method consists of a 0.5 % isopropyl alcohol/water solution. This solution may be mixed and stored ahead of time. It will be used to replenish the solution as the test proceeds. Commercially available isopropyl alcohol as opposed to reagent grade is suitable.

7. Sampling

7.1 The number and variety of samples from a source will be dependent on the geological complexity of that source and will be left to the judgment of the individual (familiar with test specimen selection) doing the sampling; however, in no case shall the sample consist of less than five pieces per lithologic (rock) unit. Each piece will be of a size such that testing may proceed without further mechanical crushing; however, the pieces chosen shall be as large as the testing laboratory can handle but in no case shall the specimen be less than 5 in. (125 mm) on a side. In all cases, the sample will be representative of the various rock types found at the source.

8. Preparation of Test Specimens

8.1 Saw each test specimen in accordance with Practice D 5121. Cut each specimen 2.5 ± 0.25 in. (64 ± 6 mm) thick and cut normal to bedding or any potential planes of weakness which may be observed in the samples. In no case will the size of the slab be less than 5 in. (125 mm) on a side, excluding the thickness. Prepare a separate test specimen for each orientation of the various planes of weakness unless all such planes can be intersected with one orientation. Include planes of weakness in each sample such that a determination may be made as to the durability of the various planes of weakness and their effect on the overall durability of a rock mass which would contain these planes of weakness.

NOTE 2—Test specimens may also be prepared by cutting a 2.5-in. (64-mm) thick slab from a 6-in. (150-mm) diameter diamond drill core such that any apparent zones of weakness are included.

NOTE 3—The best estimates of rock durability are those estimates that are based on the results of tests performed on the largest possible slabs of rock.

9. Procedure

9.1 Examine each slab both macroscopically and microscopically using a minimum of 20× magnification. Note the presence of bedding planes, microfractures, and other planes of weakness and their condition. Describe each slab in accordance with Practice D 5121.

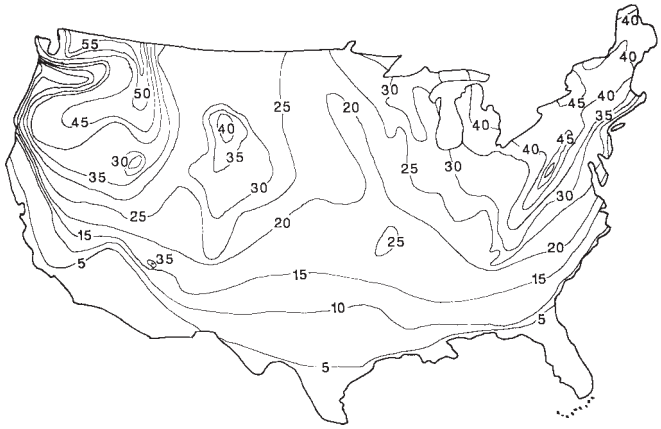

FIG. 1 Isoline Map of the Freeze-Thaw Severity Index

9.2 Label each test specimen with a suitable marker. Photograph each test specimen using color film and in such a way