Designation: D4992 – 07

Standard Practice for Evaluation of Rock to be Used for Erosion Control[1]

This standard is issued under the fixed designation D4992; 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 practice covers the evaluation of rock to be used for erosion control. The complexity and extent of this evaluation will be governed by the size and design requirements of the individual project, the quantity and quality of rock required, and the potential risk for property damage or loss of human life.

1.2 It is not intended that all of the evaluations listed in this practice be addressed for every project. For some small, less critical jobs, a visual inspection of the rock may be all that is necessary. Several of the evaluations listed may be necessary on large, complex, high-hazard projects. The intensity and number of evaluations made on any one project must be determined by the designer.

1.3 Examination of the rock at the source, evaluation of similar rock exposed to the environment at any field installations, as well as laboratory tests may be necessary to determine the properties of the rock as related to its predicted performance at the site of intended use (**1**, **2**, **3**, **4**, **5**, **6**).[2]

1.4 The examination of the rock at its source is essential to its evaluation for erosion control and aids in the planning of the subsequent laboratory examinations. Very large pieces of rock up to several tons weight are used in the control of erosion; thus great care must be taken with the field descriptions and in the sampling program to assure that zones of impurities or weaknesses that might not occur in ordinary size specimens are recorded and evaluated for their deleterious potential under the conditions of intended use. It is necessary that the intended method of rock removal be studied to ascertain whether the samples taken will correspond to the blasting, handling, and weathering history of the rock that will finally be used (**3**).

1.5 The specific procedures employed in the laboratory examinations depend on the kind of rock, its characteristics, mineral components, macro and micro structure, and perhaps most importantly, the intended use, size of the pieces, and the exposure conditions at the site of use (**1**, **2**, **3**, **4**).

1.6 It is assumed that this practice will be used by personnel who are qualified by education and experience to plan the necessary evaluations and to conduct them so that the necessary parameters of the subject rock will be defined. Therefore, this practice does not attempt to detail the laboratory techniques required, but rather to mention them and only detail those properties that must be of special concern in the course of the examination for rock to be used for erosion control.

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

1.8 *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.*

1.9 *This practice offers a set of instructions for performing one or more specific operations. This document cannot replace education or experience and should be used in conjunction with professional judgment. Not all aspects of this practice may be applicable in all circumstances. This ASTM standard is not intended to represent or replace the standard of care by which the adequacy of a given professional service must be judged, nor should this document be applied without consideration of a project's many unique aspects. The word "Standard" in the title of this document means only that the document has been approved through the ASTM consensus process.*

2. Referenced Documents

2.1 *ASTM Standards:*[3]

C88 Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate

C127 Test Method for Density, Relative Density (Specific Gravity), and Absorption of Coarse Aggregate

C294 Descriptive Nomenclature for Constituents of Concrete Aggregates

[1] This practice 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] The boldface numbers in parentheses refer to the list of references at the end of this standard.

[3] 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**

C295 Guide for Petrographic Examination of Aggregates for Concrete
C535 Test Method for Resistance to Degradation of Large-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
D653 Terminology Relating to Soil, Rock, and Contained Fluids
D3967 Test Method for Splitting Tensile Strength of Intact Rock Core Specimens
D5121 Practice for Preparation of Rock Slabs for Durability Testing
D5240 Test Method for Testing Rock Slabs to Evaluate Soundness of Riprap by Use of Sodium Sulfate or Magnesium Sulfate
D5312 Test Method for Evaluation of Durability of Rock for Erosion Control Under Freezing and Thawing Conditions
D6473 Test Method For Specific Gravity And Absorption of Rock For Erosion Control

3. Terminology

3.1 Definitions for terms in this practice are in accordance with Terminology D653 except as noted in 3.2.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *rock mass properties*—lithologic properties of rock and its discontinuities that must be evaluated on a macroscopic scale in the field.

3.2.2 *rock material properties*—lithologic properties of rock that can be evaluated using an in-hand sample either in the field or in the laboratory.

3.2.3 *shot rock*—(synonym for quarry run); unprocessed stone produced from a source primarily by blasting. The term does not indicate stone size or gradation.

4. Significance and Use

4.1 The field examination and petrographic examination in this practice along with appropriate laboratory testing may be used to determine the suitability of rock for erosion control. It should identify and delineate areas or zones of the rock, beds, and facies of unsuitable or marginal composition and properties due to weathering, alteration, structural weaknesses, porosity, and other potentially deleterious characteristics.

4.2 Both the rock mass properties and the rock material properties must be evaluated.

4.2.1 The rock mass properties are the lithologic properties of the in situ rock that must be evaluated on a macroscopic scale in the field. These would include features such as fractures, joints, faults, bedding, schistosity, and lineations, as well as the lateral and vertical extent of the rock unit.

4.2.2 The rock material properties are those lithologic properties that may be evaluated using small specimens and thus can be subject to meaningful laboratory testing. These properties would include mineral composition, grain size, rock hardness, degree of weathering, porosity, unit weight, and many others.

4.3 Rock proposed for use in erosion control applications will normally be classified as either filter bedding stone, riprap stone, armor stone, or breakwater stone. However, these procedures may be also extended to rocks used in groin and gabion structures.

5. Planning

5.1 A plan and schedule of the field examination and subsequent laboratory examination should include a review of all available information about the source rock and the purpose for which it is intended. State geological surveys, geological divisions of state transportation departments, and geology/environmental departments of universities near the source to be examined are generally good sources of information. A local engineering geologist should also be consulted, to gain all collateral information that might be useful in examining the source site and any project installations, and in the planning of the laboratory test requirements.

5.2 This review may provide the name of the rock unit and key to lithologic descriptions, previous examinations, and structural and compositional characteristics affecting the rock in its intended use, as well as test data. The information may further assist in planning the examinations and alternatives to problems such as vertical quarry faces.

6. Materials and Equipment for Examinations

6.1 Equipment for the field examination will be at the investigator's discretion. A checklist of equipment may include, but not be limited to, the following:

6.1.1 *Geologists's Pick or Hammer.*
6.1.2 *Hand Lens.*
6.1.3 *Sledge Hammer.*
6.1.4 *Bottle of Dilute Hydrochloric Acid (3 parts water, 1 part HCl).*
6.1.5 *Tape or Scale.*
6.1.6 *Rock Scratching Tool, Knife, or Dissecting Needle.*
6.1.7 *Brunton Compass.*
6.1.8 *Camera.*
6.1.9 *Note Book.*
6.1.10 *Sample Bags.*
6.1.11 *Marking Pens or Spray Paint.*

6.2 *Apparatus and Supplies for Petrographic Examination:*

6.2.1 The apparatus and supplies listed for petrographic examination in Practice C295 will be those required for this standard practice except that some of the equipment for handling the large pieces of rock should be of larger size as outlined below.

6.2.1.1 *Circular Diamond Saw,* of the type described in Practice D5121.

NOTE 1—Some laboratories have fabricated reciprocating saws that cut with diamond powder in a slurry. Such saws can be made capable of cutting almost any size rock specimen.

6.2.1.2 *Horizontal Grinding Wheel,* minimum of 400 mm (16 in.) diameter.

6.2.1.3 *Polishing Wheel,* minimum of 400 mm (16 in.) diameter.

NOTE 2—When the first saw cut is smooth, as when fabricated with a smooth edged circular diamond saw running in an oil bath, vibrating laps may be substituted for the horizontal grinding wheel and the polishing lap.

These laps may be obtained in sizes up to 675 mm (27 in.) in diameter. These large vibratory laps will be a useful addition and will completely substitute for the polishing lap. Considerable effort must be expended to keep vibratory laps clean and the abrasives free of contamination.

6.2.1.4 *Stereoscopic Microscope*—The stereoscopic microscope shall have a zoom lens from 10 to 120×. The microscope shall be mounted on an arm that can swing over the specimen or alternatively have a specially constructed stage of large size to facilitate the handling of the large specimen slabs that will be required.

6.2.1.5 *Petrographic Microscope,* shall be as described in Practice C295. Optionally, for the detection of very small microcracks, it may be equipped with incident ultraviolet light for use with thin sections impregnated with a fluorescing dye (**7**).

NOTE 3—Special types of thin sections will probably require additional preparation equipment. An example is given in Ref (**7**).

6.3 *Thin Section Fabrication:*

6.3.1 Laboratories may find that they can obtain good, rapid, individualized service from a geological laboratory that specializes in the fabrication of thin sections. When choosing such a laboratory, considerations should include the following.

6.3.1.1 Time between sending off the rock fragments or prepared chips and return of the finished sections.

6.3.1.2 Will adjacent rock fragments or slices be returned for further examination or archival use, or both?

6.3.1.3 Costs involved.

6.3.1.4 Charges and any extra time required for specially prepared sections: special large size, epoxy impregnated, impregnated with special dyes, and thin sections thinned to less than the standard 30 µm (10 to 15 µm required for fine grained rock and for detection of fine microcracking, certain deleterious textures and substances).

6.3.1.5 Workload.

6.3.1.6 Quality of work.

6.3.2 Laboratories should consider obtaining their own thin-section equipment whenever workload, space, and financial considerations permit if experienced personnel are available or obtainable to fabricate the sections. In-house equipment allows for much greater versatility of operation. As the knowledge of the rock material accumulates through examination of finely lapped slabs and hand specimens, and from the results of laboratory testing, it will invariably be found that the first estimate of the proper number, location of "chips" and types of thin sections requires amending.

6.4 *Photographic Facilities Should Be Capable of Producing the Following:*

6.4.1 Photographs of quarries and other rock sources, in use placements of rock and natural outcrops of rocks under the proposed conditions of exposure,

6.4.2 Close-up photographs of rock specimens, cores, chunks, and slabs,

6.4.3 Photographs taken through the stereoscopic microscope (easily usable equipment can be obtained from the microscope manufacturer), and

6.4.4 Photographs taken through the petrographic microscope (easily usable equipment can be obtained from the microscope manufacturer).

7. Field Examination

7.1 The field examination is an integral part of the total evaluation of the rock for its use in erosion control projects. The geologic scientist conducting the field examination must have knowledge of the intended use of the rock and of the size pieces that will be required and the environment to which the rock will be subjected. The scientist must also be familiar with the laboratory tests that are most apt to be conducted in order that appropriate samples may be obtained.

7.2 During the field examination determine the following:

7.2.1 The type of quarry and its development plan. The blasting procedures that are or will be employed. Note blasting hole diameter, hole depth, spacing, angle, amount of overburden, types of explosives, distribution, and sequences. The expected `curing time,' the interval between blasting or other removal from the bedrock, and the size sorting and final inspection and evaluation for use in the intended placement (**1**, **2**, **3**, **4**, **8**, **9**, **10**).

7.2.2 The general lithology and, if possible, geologic unit and age.

7.2.3 Homogeneity throughout the proposed source. In particular note the stratigraphic facies, metamorphic and weathering phases, and lateral extent of each.

7.2.4 Dip and strike of the bedding, lineation, or both, should be noted as well as the dip and strike of any structural features, zones of brecciation, partings, solution features, schistosity, foliation, diastrophic joints, faults, folds, dikes, veins, and etc. Any joints due to overburden-relief must be recorded.

7.2.5 The thickness of the bedding, and the presence and distance between any poorly indurated beds or facies. The distance between any regular zones of weakness such as joints, weakly filled veins, etc. must be recorded as this will be a major control of the size fragments available.

7.2.6 Special note shall be taken of any fragments of the rock that have been exposed to weather for a long period of time. If these are not available at the proposed site of rock removal, an effort shall be made to find such weathered examples of this rock at other sites.

7.2.7 Any examples of this rock in use in a manner similar to the proposed use shall be investigated for evidence of durability. In conjunction with this examination, natural occurrences of this rock at sites similar to the proposed use shall be sought and examined; for example, a natural outcrop on a river bank, or even better, an outcrop as a local base-level at the rapids of a stream.

7.3 Observations made during the field examination shall be recorded in writing using standard nomenclature (**8**, **9**, **11**), in a designated field notebook in a manner that will allow future reference.

7.4 Photographs shall be taken.

8. Sampling

8.1 Practice D4992 provides guidance on sampling a source of rock.

8.2 The sampling plan and labeling plan shall be designed to identify the location from which the sample was derived, the