Designation: D 4543 – 04

Standard Practices for Preparing Rock Core Specimens and Determining Dimensional and Shape Tolerances[1]

This standard is issued under the fixed designation D 4543; 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 specifies procedures for laboratory specimen preparation and determining the length and diameter of rock core specimens and the conformance of the dimensions with established standards.

1.2 Rock is a complex engineering material which can vary greatly as a function of lithology, stress history, weathering, and other natural geologic processes. As such, it is not always possible to obtain or prepare rock core specimens which satisfy the desirable criteria given in this practice. Most commonly, this situation presents itself with weaker, more porous, and poorly cemented rock types and rock types containing significant structural features. For these and other rock types which are difficult to prepare, all reasonable efforts shall be made to prepare a sample in accordance with this practice. However, when it has been determined by trial that this is not possible, prepare the rock specimen to the highest standard practicable and consider this to be the best effort and report it as such, with all appropriate size and dimensional measurements reported as in Section 6. For curatorial issues refer to Practices D 5079.

1.3 This practice also prescribes tolerance checks on the straightness of the elements on the cylindrical surface, the flatness of the end bearing surfaces, and the perpendicularity of the end surfaces with the axis of the core.

1.4 The requirement for specifying the moisture condition of the test specimen at the time of the test is also stated.

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

1.6 For definitions of terms relating to rock specimen preparation and measurement refer to Terminology D 653.

1.7 *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.*

1.8 *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 judgement. 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:* [2]

C 617 Practice for Capping Cylindrical Concrete Specimens

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

D 2113 Practice for Rock Core Drilling and Sampling of Rock for Site Investigation

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

D 2664 Test Method for Triaxial Compressive Strength of Undrained Rock Core Specimens without Pore Pressure Measurements

D 2936 Test Method for Direct Tensile Strength of Intact Rock Core Specimens

D 2938 Test Method for Unconfined Compressive Strength of Intact Rock Core Specimens

D 3148 Test Method for Elastic Moduli of Intact Rock Core Specimens in Uniaxial Compression

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 4341 Test Method for Creep of Cylindrical Hard Rock Core Specimens in Uniaxial Compression

D 4405 Test Method for Creep of Cylindrical Soft Rock Core Specimens in Uniaxial Compression

D 4406 Test Method for Creep of Cylindrical Rock Core

[1] These practices are under the jurisdiction of ASTM Committee D18 on Soil and Rock and is the direct responsibility of Subcommittee D18.12 on Rock Mechanics.

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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.**

Specimens in Triaxial Compression
D 5079 Practices for Preserving and Transporting Rock Core Samples

3. Significance and Use

3.1 The dimensional, shape, and surface tolerances of rock core specimens are important for determining rock properties of intact specimens. Dimensional and surface tolerance checks are required in the test methods listed in 2.1. To simplify test procedures in laboratories, the parts of those procedures that are common to the test methods are given in this standard.

4. Apparatus

4.1 *Flat Surface*—The tolerances of a flat test surface on which a rock specimen is rolled, a V-block placed, or the end of a rock core is placed shall not depart from a plane by more than 0.0005 in. (13 μm).

4.2 *V-block*—The V-block shall be machinist quality with all bearing faces surfaces ground flat, smooth to within 0.0005 in. (13 μm) and with a 90° included angle.

4.3 *Dial Gage*—The sensitivity of the dial gage shall be at least 0.001 in. (25 μm) for measurement of cylindrical surfaces. The measurement contact tip of the dial gage shall be round in shape. A dial gage readable to 0.0001 in. (2.5 μm) is required for measurements on the end surfaces.

4.4 *Feeler Gage*—The feeler gage 3 in. (76 mm) "leaves" must include sizes beginning at 0.0015 in. (38 μm).

4.5 *Surface Grinder*—A manual or automatic machinist's surface grinder equipped with a magnetic flat surface and a V-block.

4.6 *Diamond Saw*—A manual or automatic rock saw equipped with a segmented circular diamond saw blade, and appropriate cooling and cutting agents.

5. Specimens

5.1 Test specimens shall be right circular cylinders within the tolerances specified herein.

5.2 The specimen shall have a length-to-diameter ratio (L/D) of 2.0 to 2.5 and a diameter of not less than 1-⅞ in. (47 mm).

NOTE 1—It is desirable that the diameter of rock test specimens be at least ten times the diameter of the largest mineral grain. For weak rock types which behave more like soil (for example, weakly cemented sandstone), the specimen diameter should be at least six times the maximum particle diameter. It is considered that the specified minimum specimen diameter of approximately 1-⅞ in. (47 mm) will satisfy this criterion in the majority of cases. When cores of diameter smaller than the specified minimum must be tested because of the unavailability of larger diameter core or prohibitive large drilling equipment siting costs, as is often the case in the mining industry, suitable notation of this fact shall be made in the report.

5.3 The sides of the specimen shall be generally smooth and free of abrupt irregularities, with all the elements straight to within 0.020 in. (0.50 mm) over the full length of the specimen, as determined by 6.1.

5.4 The ends of the specimen shall be cut parallel to each other and at right angles to the longitudinal axis. The end surfaces shall be surface ground or lapped flat to a tolerance not to exceed 0.001 in. (25 μm), as determined by 6.2.[3]

5.5 Sections 5.6 and 5.7 describe laboratory core drilling and cutting specimens from blocks of rock samples. Practice D 2113 describes rock core drilling and sampling of rock for site investigations. Water is normally a suitable fluid for rock cutting and grinding operations. However, some rock materials are sensitive to water and thus alternate suitable cooling and flushing fluids should be used. In sections 5.8 and 5.9 an air-cooled grinding unit with a dust collector is recommended for weak rocks and rocks that may react to fluids.

5.6 *Core Drilling Block Samples*—At least a 10 horsepower drill, with a GFI for electrical powered drills is recommended. A thin walled core barrel with a water swivel and adaptors for hooking up the drill are recommended. Surface set diamond thin-wall bits are suited for soft rock. Impregnated diamond thin-wall bits are better suited for hard rock. Install the thin-wall bit into the drill press chuck. Give the end of the thin-wall bit a tap with a rubber mallet to ensure it is snug. Lower the thin-wall bit to the drill table and mark the bit core barrel for reference for sufficient drilling depth. Connect the cooling fluid hose to the swivel and tie it out of the way. Place a sheet of ½ in. (12.7 mm) plywood on the drill table, then clamp the rock block securely to the table with clamping devices such as chain vise locks. Block with wood wedges as necessary to ensure the rock is secure and has a relatively flat drilling surface. Turn on the cooling fluid with sufficient flow to cool the bit and to flush the cuttings. With the bit raised off the sample, turn on the drill using a slow speed. Lower the bit slowly onto the sample using a slow rotation speed until a groove is started. Use enough down force to prevent chatter but do not allow the motor to slow so much as to buzz. A loss of drill cooling fluid and the reference position mark indicates the end of the run. After breaking through, back the bit out of the hole and turn off the drill. If the core is not completely drilled through, remove the block and tap the bottom gently, then remove the core. Code and store the core.

5.7 *Specimen Cutting*—Use a segmented diamond saw for cutting core. Apply cooling fluid continuously to cool the blade and flush cuttings from the cut. Automatic feed diamond saws are recommended for cutting large rock specimens. Clamp the specimen in the jig. Turn on the saw and manually or automatically cut the specimen perpendicular to its axis (see 5.2 and 5.4) slowly avoiding blade chatter. Once the specimen is cut, back off the blade and turn off the saw. Remove, code and store the specimen. When cutting weak or friable rock such as potash, shale, etc., it is recommended the core be first encapsulated in polyolefin heat shrink tubing before cutting.

5.8 *Cylindrical Surface Grinding*—The quality of the circumferential surfaces of core specimens is usually acceptable for most rock types, and no further surface finishing is required. If the drilled surface contains abrupt irregularities however, further finishing is recommended. This can be accomplished by surface grinding in a lathe in much the same

[3] Hoskins, J. R., and Horino, F. G., "Effects of End Conditions on Determining Compressive Strength of Rock Samples," *Report of Investigations U.S. Bureau of Mines 7171*, 1968.