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*Standard Method of Test for*  
TOUGHNESS OF ROCK<sup>1</sup>



ASTM Designation: D 3 - 18

ADOPTED, 1908; REVISED, 1918.

Reapproved in 1958 Without Change.

This Standard of the American Society for Testing Materials is issued under the fixed designation D 3; the final number indicates the year of original adoption as standard or, in the case of revision, the year of last revision.

NOTE.—This method was editorially revised and rearranged in 1939.

**Scope**

1 This method of test covers the procedure for determining the toughness of rock.

**Toughness**

2. Toughness, as applied to rock, is the resistance offered to fracture under impact, expressed as the final height of blow required of a standard hammer to cause fracture of a cylindrical test specimen of given dimensions.

**Apparatus**

3. Any form of impact machine which will comply with the following essentials may be used in making the test:

(a) A cast-iron anvil weighing not less than 50 kg, firmly fixed upon a solid foundation.

(b) A hammer weighing 2 kg, arranged

so as to fall freely between suitable guides.

(c) A plunger made of hardened steel and weighing 1 kg, arranged to slide freely in a vertical direction in a sleeve, the lower end of the plunger being spherical in shape with a radius of 1 cm.

(d) Means for raising the hammer and for dropping it upon the plunger from any specified height from 1 to not less than 75 cm, and means for determining the height of fall within approximately 1 mm.

(e) Means for holding the cylindrical test specimen securely on the anvil without rigid lateral support, and under the plunger in such a way that the center of its upper surface shall, throughout the test, be tangent to the spherical end of the plunger at its lowest point.

**Sampling**

4. Quarry samples of rock from which test specimens are to be prepared shall measure at least 6 in. on a side and at

<sup>1</sup> Under the standardization procedure of the Society, this method is under the jurisdiction of the ASTM Committee D-4 on Road and Paving Materials.

least 4 in. in thickness, and when possible shall have the plane of structural weakness of the rock plainly marked thereon. Samples should be taken from freshly quarried material, and only from pieces which show no evidences of incipient fracture due to blasting or other causes. The samples should preferably be split from large pieces by the use of plugs and feathers and not by sledging. Commercial stone-block samples from which test specimens are to be prepared shall measure at least 3 in. on each edge.

#### Test Specimens

5. Specimens for test shall be cylinders 25 mm in height and from 24 to 25 mm in diameter, prepared as described in Section 6. Three specimens shall constitute a test set. The ends of the specimen shall be plane surfaces at right angles to the axis of the cylinder.

#### Preparation of Test Specimens

6. One set of specimens shall be drilled perpendicular and another parallel to the plane of structural weakness of the rock, if such plane is apparent. If a plane of structural weakness is not apparent, one set of specimens shall be drilled at random. Specimens shall be drilled in a manner that will not subject the material to undue stresses and which will insure the specified dimensions.<sup>2</sup> The ends of

<sup>2</sup> The form of diamond drill described in *Bulletin No. 347*, U. S. Department of Agriculture, pp. 6-7, is recommended, and should prove satisfactory if the instructions are strictly followed.

the cylinders may be sawed by means of a band or diamond saw,<sup>3</sup> or in any other way which will not induce incipient fracture, but shall not be chipped or broken off with a hammer. After sawing, the ends of the specimens shall be ground plane with water and carborundum or emery on a cast-iron lap until the cylinders are 25 mm in height.

#### Procedure

7. The test shall consist of a 1-cm fall of the hammer for the first blow, a 2-cm fall for the second blow, and an increase of 1-cm fall for each succeeding blow until failure of the test specimen occurs.

#### Report

8. The height of the blow in centimeters at failure shall be reported as the toughness of the test specimen. The individual and the average toughness of three test specimens shall be reported when no plane of structural weakness is apparent. In cases where a plane of structural weakness is apparent, the individual and average toughness of the three specimens in each set shall be reported and identified. Any peculiar condition of a test specimen that might affect the result, such as the presence of seams, fissures, etc. shall be noted and recorded with the test result.

<sup>3</sup> A satisfactory form of diamond saw is described in *Bulletin No. 347*, U. S. Department of Agriculture, pp. 7-9.