Designation: D5731 – 16

Standard Test Method for Determination of the Point Load Strength Index of Rock and Application to Rock Strength Classifications[1]

This standard is issued under the fixed designation D5731; 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 guidelines, requirements, and procedures for determining the point load strength index of rock. This is an index test and is intended to be used to classify rock strength.

1.2 Specimens in the form of rock cores, blocks, or irregular lumps with a test diameter from 30 to 85 mm can be tested by this test method.

1.3 This test method can be performed in either the field or laboratory. The test is typically used in the field because the testing machine is portable, little or minimal specimen preparation is required, and specimens can be tested within a short time frame of being collected.

1.4 This test method applies to medium strength rock (compressive strength over 15 MPa).

1.5 This test method does not cover which type of specimen should be tested or whether anisotropic factors should be considered. The specifics of the point load test program need to be developed prior to testing and possibly even before sampling. Such specifics would be dependent on the intended use of the data, as well as possible budgetary constraints and possible other factors, which are outside the scope of this test method.

1.6 All observed and calculated values shall conform to the guidelines for significant digits and rounding established in Practice D6026.

1.6.1 The procedures used to specify how data are collected/recorded and 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 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 commensurate with these considerations. It is beyond the scope of these test methods to consider significant digits used in analysis methods for engineering design

1.7 The values stated in the SI units are to be regarded as standard.

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.*

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

D5079 Practices for Preserving and Transporting Rock Core Samples

D6026 Practice for Using Significant Digits in Geotechnical Data

D7012 Test Methods for Compressive Strength and Elastic Moduli of Intact Rock Core Specimens under Varying States of Stress and Temperatures

E18 Test Methods for Rockwell Hardness of Metallic Materials

E122 Practice for Calculating Sample Size to Estimate, With Specified Precision, the Average for a Characteristic of a Lot or Process

2.2 *ISRM Standard:*

Suggested Methods for Determining Point Load Strength[3]

[1] This test method is 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.

[3] "Suggested Methods for Determining Point Load Strength", International Society for Rock Mechanics Commission on Testing Methods, *Int. J. Rock. Mech. Min. Sci. and Geomechanical Abstr.*, Vol 22, No. 2, 1985, pp. 51–60.

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

3. Terminology

3.1 *Definitions*—For definitions of common technical terms used in this standard refer to Terminology D653.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *diameter, n—D, for point load tests,* the measured dimension of the specimen between the opposing conical test platens when placed in the test machine

3.2.2 *point load strength anisotropy index, n—$I_{a(D)}$*, the strength anisotropy index is defined as the ratio of mean $I_{s(D)}$ values measured perpendicular and parallel to planes of weakness. That is, the ratio of greatest to least point load strength indices on different axes that result in the greatest and least ratio of point load strengths values.

3.2.3 *size-corrected point load strength index, n—$I_{s(D)}$*, the original point load strength index value multiplied by a factor to normalize the value that would have been obtained with diametral test of diameter (D).

3.2.4 *uncorrected point load strength index, n—(I_s)*, an indicator of strength (see 10.1) obtained by subjecting a rock specimen to an increasingly concentrated point load, applied through a pair of truncated, conical platens, until failure occurs.[3]

4. Summary of Test Method

4.1 This index test is performed by subjecting a rock specimen to an increasingly concentrated load until failure occurs by splitting the specimen. The concentrated load is applied through coaxial, truncated conical platens. The failure load is used to calculate the point load strength index.

4.2 The point load strength index can be used to classify the rocks and provide a preliminary or reconnaissance-level evaluation of spatial variability in rock strength. A common method used is by estimating the uniaxial compressive strength.

5. Significance and Use

5.1 The uniaxial compression test (see Test Method D7012) is used to determine compressive strength of rock specimens. However, it is a time-consuming and expensive test that requires significant specimen preparation and the results may not be available for a long time after the samples are collected. When extensive testing and/or timely information is needed for preliminary and reconnaissance information, alternative tests such as the point load test can be used to reduce the time and cost of compressive strength tests, when used in the field. Such data can be used to make timely and more informed decisions during the exploration phases and more efficient and cost effective selection of samples for more precise and expensive laboratory tests.

5.2 The point load strength test is used as an index test for strength classification of rock materials. The test results should not be used for design or analytical purposes.

5.3 This test method is performed to determine the point load strength index of rock specimens and, if required, the point load strength anisotropy index.

5.4 Rock specimens in the form of either core (the diametral and axial tests), cut blocks (the block test), or irregular lumps (the irregular lump test) are tested by application of concentrated load through a pair of truncated, conical platens. Little or no specimen preparation is needed and can therefore be tested shortly after being obtained and any influence of moisture condition on the test data minimized. However, the results can be highly influenced by how the specimen is treated from the time it is obtained until the time it is tested. Therefore, it may be necessary to handle specimens in accordance with Practice D5079 and to document moisture conditions in some manner in the data collection.

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 and sampling. 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 evaluating some of those factors.

6. Apparatus

6.1 *General*—A basic point load tester (see Fig. 1) consists of a loading system typically comprised of a loading frame, platens, a measuring system for indicating load, P, (required to break the specimen), and a means for measuring the distance, D, between the two platen contact points at the start of testing and after failure. The equipment shall be resistant to shock and vibration so that the accuracy of readings is not adversely affected by repeated testing. Any special operational, maintenance or calibrations instructions provided by the manufacturer for the particular apparatus being used shall be followed.

6.2 *Loading System:*

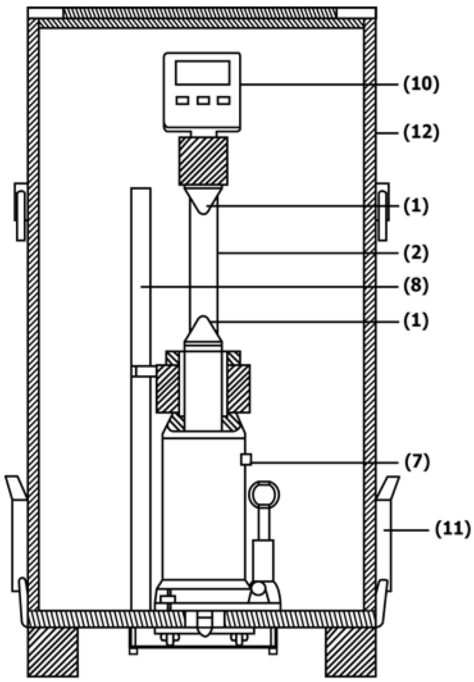
6.2.1 The loading system shall have a loading frame with a platen-to-platen clearance that allows testing of rock specimens in the required size range. Typically, this range is between 30 to 100 mm, or the maximum opening size of the load frame, so that an adjustable distance is available to accommodate both small and large specimens.

6.2.2 The loading capacity shall be sufficient to break the largest and strongest specimens to be tested. Point load strength of rock is usually an order of magnitude lower than the compressive strength of rock.

6.2.3 The load frame shall be designed and constructed so that it does not permanently distort during repeated applications of the maximum test load, and so that the platens remain coaxial within ±0.2 mm throughout testing. No spherical seat or other nonrigid component is permitted in the loading system. Loading system rigidity is advised to avoid slippage when specimens of irregular geometry are tested.

6.2.4 Truncated, conical platens, as shown on Fig. 2, are to be used. The 60° cone and 5-mm radius spherical platen tip shall meet tangentially. The platens shall be of hard material (Rockwell 58 HRC, as explained in Test Method E18) such as tungsten carbide or hardened steel so they remain undamaged during testing.

NOTE 2—It is generally accepted that specimens smaller than 42 mm (BX cores) are not recommended because for smaller diameters the



NOTE 1—Load frame general information (Fig. 1):

(1) Load is applied to the specimens through two standard hardened points
(2) Two column fixed crosshead frame
(3) Scale
(4) Scale pointer
(5) Bolt
(6) Hydraulic pump body
(7) Oil filler cap
(8) Pump handle for hydraulic piston
(9) Pressure release valve for hydraulic piston
(10) Case latched for top cover
(11) Digital pressure readout
(12) Point load tester top cover

FIG. 1 Example of a Light-Weight Point Load Test Apparatus

loading points cannot be considered as theoretical "points" in relation to specimen size.[4]

6.3 *Load Measuring System:*

6.3.1 A load measuring system, for example a load cell or a hydraulic pressure gage, that will indicate failure load, *P*, required to break specimen.

6.3.2 Measurements of failure load, *P*, shall be to a precision of ±5 % or better of full-scale load-measuring system, irrespective of the size and strength of specimen that is tested.

6.3.3 Failure is often sudden, therefore, and a peak load indicator is needed so the failure load can be recorded after each test.

6.3.4 If required, the system should be capable of using interchangeable, mechanical or electronic gauge, load measuring devices in order to be consistent with the estimated strength of rock and have the desired reading accuracy.

6.4 *Distance Measuring System:*

6.4.1 The distance measuring system, an electronic or vernier direct reading scale, should connect to the loading frame for measuring the distance, *D*, between specimen-platen contact points at the start of testing and just prior to failure.

6.4.2 Measurements of *D* shall be to an accuracy of ±2 % or better of distance between contact points, irrespective of the size and strength of specimen that is tested.

6.4.3 The measuring system shall allow a check of the "zero displacement" value when the two platens are in contact and should include a zero adjustment and a means to record or measure any penetration of the specimen by the point load platens during testing.

6.4.4 An instrument such as a caliper or a steel rule is needed to measure the width, *W*, (with an accuracy of ±5 %) of specimens for all but the diametral test.

6.5 *Miscellaneous Items*—Depending on the type of samples (core or non-core) and the type of specimens to be tested (diametral, Block, Axial, and alike), the following items may be needed: diamond saw, chisels, towels, marking pens, and plotting paper.

[4] Bieniawski, Z.T., The Point Load Test in Geotechnical Practice, Engineering Geology (9), pages 1-11, 1975.

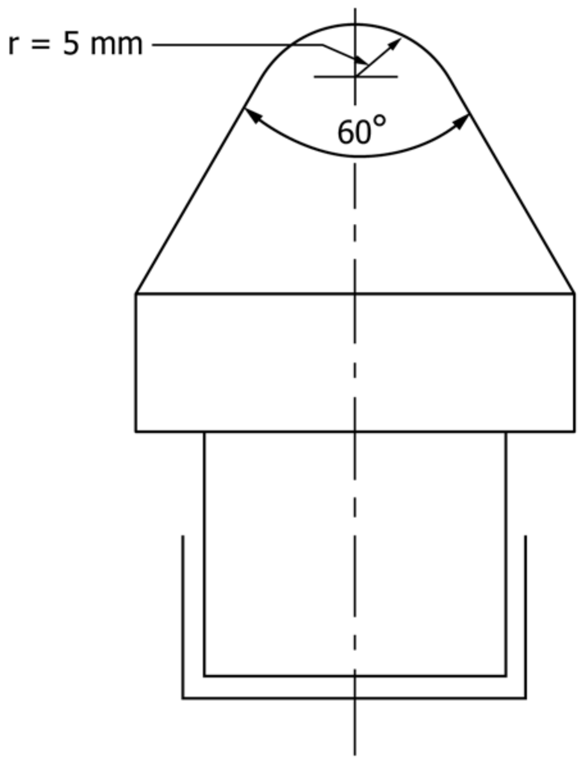


FIG. 2 Truncated, Conical Platen Dimensions for Point Load Apparatus

7. Samples

7.1 Rock samples are grouped on the basis of rock type, test direction if rock is anisotropic, and estimated strength. Specimens are selected from each rock sample for testing. Given the inherent variability in test results, the quantity of specimens tested per sample should follow the guidance provided in 7.2.

7.2 *Sample Size:*

7.2.1 When testing core or block samples at least ten specimens are selected for each sample.

7.2.2 When testing irregular-shaped specimens obtained by other means at least 20 specimens are selected for each sample.

7.2.3 Sample sizes (number of specimens per sample) may need to be larger if the rock is anisotropic or heterogeneous.

7.2.4 If needed, Practice E122 can be used to more precisely determine the sample size.

7.3 Samples in the form of core are preferred for a more precise classification.

7.4 For anisotropic rocks, better results are obtained for core samples when the core axis is perpendicular to the plane of weakness.

8. Test Specimens

8.1 *Test Diameter*—The specimen's external test diameter shall not be less than 30 mm and not more than 85 mm with the preferred test diameter of about 50 mm.

8.2 *Size and Shape*—The size and shape requirements for diametral, axial, block, or irregular lump testing shall conform with the recommendations shown on Fig. 3. The sides of the specimens shall be free from abrupt irregularities that can generate stress concentrations. No specimen preparation is needed, however a rock saw or chisels may be advised for block or irregular specimens. Proper planning of diametral tests on rock cores can produce suitable lengths of core for subsequent axial testing provided they are not weakened by the diametral test. Otherwise, suitable specimens can be obtained from the cores by saw-cutting, or core splitting.

NOTE 3—While there are no established specimen guidelines for grain size versus specimen size this subject is still important and should be included in the testing and use of the data. Concrete testing using a point load tester recommends that a minimum ratio of core diameter to maximum aggregate size of 4 be used.[5] This ratio may be used until guidelines are developed for rock.

8.3 *Water Content*—Water content of the specimen can affect the value of the point load strength. Therefore, the testing plan shall include how water content will be included in the point load testing program. This may include the recording, controlling, and measurement of water content.

8.4 *Marking and Measuring Specimens*—The specimens should be properly marked and measured as shown in Fig. 4.

8.4.1 *Marking*—The desired test orientation of the specimen shall be indicated by marking lines on the specimen. These lines are used for centering the specimen in the testing machine and to make sure of proper orientation during testing, including any issues involving anisotrophic rocks (see Fig. 3). These lines may also be used as reference lines for measuring width, length, and diameter.

8.4.2 *Measuring*—Measure each dimension of a specimen at three different places, and calculate the averages.

9. Procedure

9.1 Develop a testing plan and, if needed, sampling plan to provide specimens for point load testing according to the following procedures for the specific specimen shape (diametral, axial, block or irregular).

9.2 *Diametral Test*

9.2.1 Core specimens with length/diameter ratio greater than one are suitable for diametral testing.

9.2.2 Insert a specimen in the test device and close the platens to make contact along a core diameter. Make sure that the distance, L, between the contact points and the nearest free end is at least 0.5 times the core diameter (see Fig. 3(a) and Fig. 4).

9.2.3 Determine and record the distances D and L (see Fig. 3).

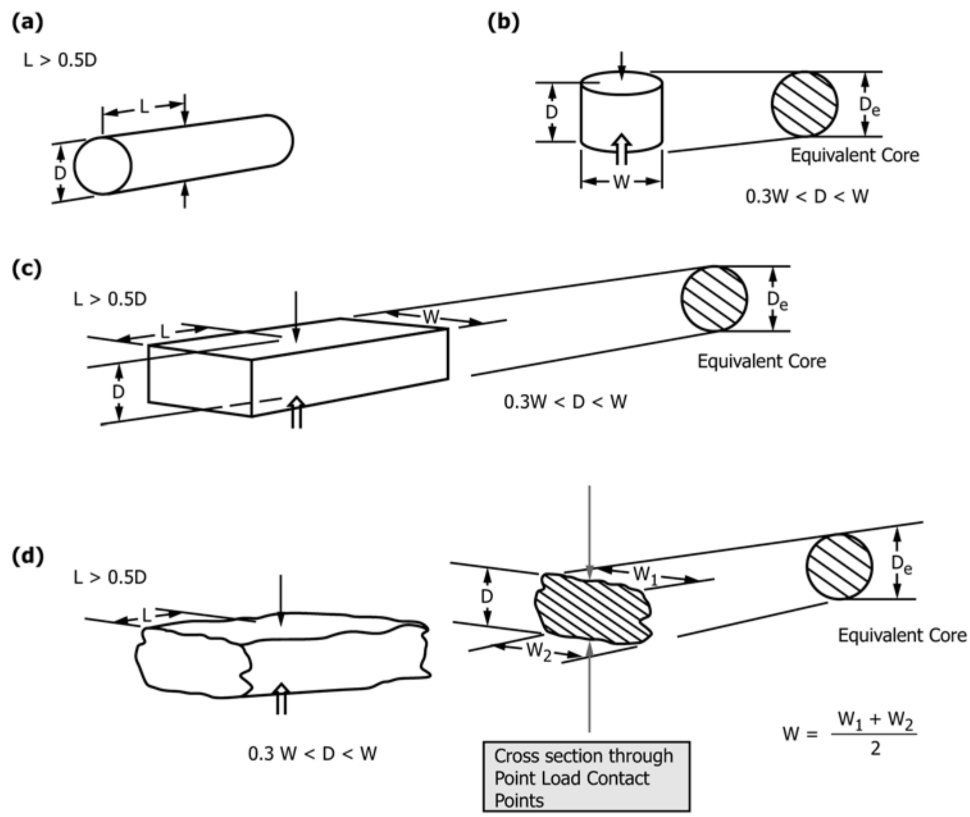
9.2.4 Steadily increase the load such that failure occurs within 10 to 60 s, and record failure load, P. The test should be rejected if the fracture surface passes through only one platen loading point (see Fig. 5(*d*)).

9.2.5 The procedures in 9.2.2 – 9.2.4 are repeated for each specimen of the sample.

9.3 *Axial Test:*

9.3.1 Core specimens with length/diameter ratio of ⅓ to 1 are suitable for axial testing (see Fig. 3(*b*)). Suitable specimens

[5] Robins, P.J., The Point Load Strength Test for Concrete Cores, Magazine of Concrete Research, Vol. 32, No. 111, June 1980.



NOTE 1—Legend: L = distance between contact points and nearest free face, and D_e = equivalent core diameter (see 10.1).

FIG. 3 Load Configurations and Specimen Shape Requirement for (a) the Diametral Test, (b) the Axial Test, (c) the Block Test, and (d) the Irregular Lump Test[3]

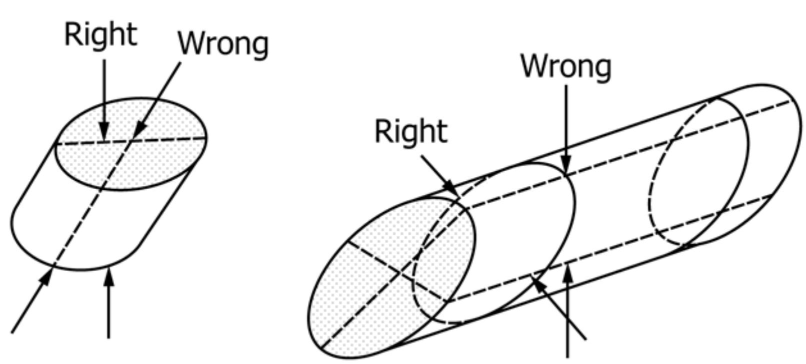


FIG. 4 Anisotropy measurements and testing for maximum and minimum indices

can be obtained by saw-cutting or chisel-splitting the core sample, or by using suitable pieces produced by carefully planned diametral tests (see 9.2).

9.3.2 Insert a specimen in the test machine and close the platens to make contact along a line perpendicular to the core end faces (in the case of isotropic rock, the core axis, but see Fig. 4 and 9.5 for anisotropic rock).

9.3.3 Record the distance, *D*, between platen contact points (see Fig. 3). Record the specimen width, *W*, perpendicular to the loading direction, with an accuracy of ±5 %.

9.3.4 Steadily increase the load such that failure occurs within 10 to 60 s, and record the failure load, *P*. The test should be rejected if the fracture surface passes through only one loading point (see Fig. 5(*e*)).

9.3.5 Procedures 9.3.2 – 9.3.4 are repeated for each test specimen of the sample.

9.4 *Block and Irregular Lump Tests:*

9.4.1 Rock blocks or lumps, 30 to 85 mm, and of the shape shown in Fig. 3(*c*) and (*d*) are suitable for the block and the irregular lump tests. The ratio, *D/W*, should be between ⅓ and 1, preferably close to 1. The distance *L*should be at least 0.5 *W*. Suitable specimens can be obtained by saw-cutting or chisel-splitting larger samples or specimens if needed.

9.4.2 Insert a specimen in the testing machine and close the platens to make contact with the smallest dimension of the lump or block, away from edges and corners (see Fig. 3(*c*) and (*d*).

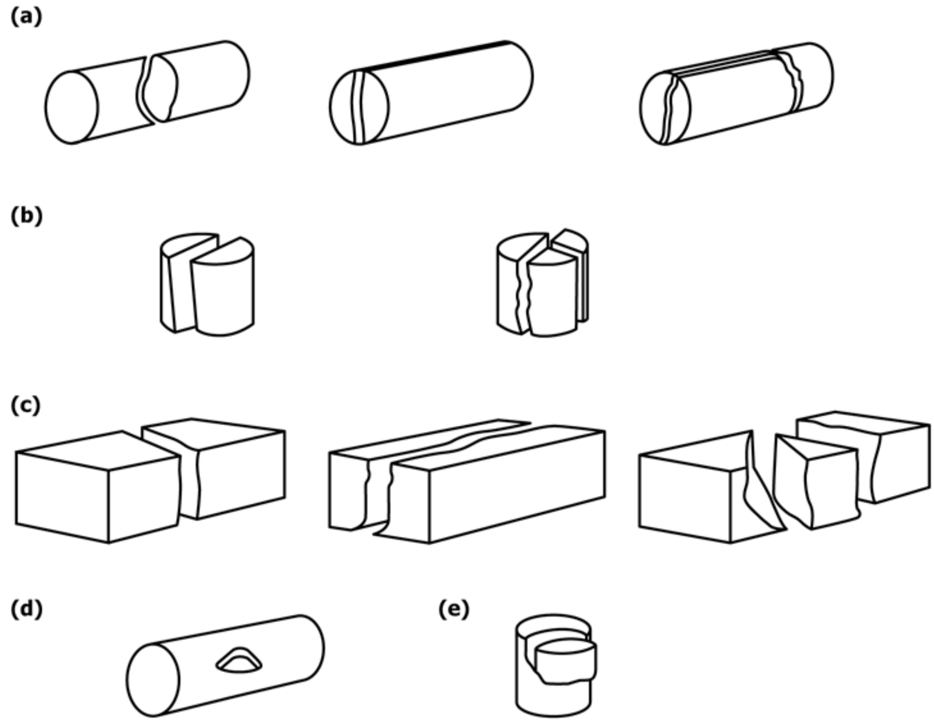


FIG. 5 Typical Modes of Failure for Valid and Invalid Tests—(a) Valid diametral tests; (b) valid axial tests; (c) valid block tests; (d) invalid core test; and (e) invalid axial test (point load strength index test).[3]

9.4.3 Record the distance *D* between platen contact points. Record the smallest specimen width, *W*, perpendicular to the loading direction. If the sides are not parallel, then calculate *W* as $(W_1 + W_2)/2$ as shown on Fig. 3. This width, *W*, is used in calculating point load strength index irrespective of the actual mode of failure (see Fig. 5(*c*).

9.4.4 Steadily increase the load such that failure occurs within 10 to 60 s, and record the failure load, *P*. The test should be rejected if the fracture surface passes through only one loading point (see examples for other shapes in Fig. 5(*d*) or (*e*).

9.4.5 Procedures 9.4.2 – 9.4.4 are repeated for each test specimen in the sample.

9.5 *Anisotropic Rock:*

9.5.1 When a rock sample is shaly, bedded, schistose, or otherwise observably anisotropic, it should be tested in directions that will give the greatest and least strength values, in general, parallel and normal to the planes of anisotropy.

9.5.2 If the sample consists of core drilled through weakness planes, a set of diametral tests may be completed first, spaced at intervals that will yield pieces that can then be tested axially.

9.5.3 Strongest test results are obtained when the core axis is perpendicular to the planes of weakness; therefore, when practicable, the core should be drilled in this direction. The angle between the core axis and the normal to the direction of least strength should preferably not exceed 30°.

9.5.4 For measurement of the point load strength index (I_s) value in the direction of least strength, make sure that load is applied along a single weakness plane. Similarly, when testing for the I_s value in the direction of greatest strength, make sure that the load is applied perpendicular to the direction of least strength (see Fig. 4).

9.5.5 If the sample consists of blocks or irregular lumps, it should be tested as two subsamples, with load first applied perpendicular to, then along the observable planes of weakness. Again, the required minimum strength value is obtained when the platens make contact and are loaded to failure along a single plane of weakness.

9.6 If significant platen penetration occurs, the dimension *D* to be used in calculating point load strength should be the value *D*' measured at the instant of failure, that will be smaller than the initial value suggested in 9.2.3, 9.3.3, and 9.4.3. The error in assuming *D* to be its initial value is negligible when the specimen is large or strong. The dimension at failure may always be used as an alternative to the initial value and is preferred.

9.7 *Water Content:*

9.7.1 For precise measurements, follow Test Method D2216 to determine the water content of each rock specimen and report the moisture condition (see Section 11).

9.7.2 At the minimum, water content shall be recorded as air-dried, saturated, as-received, and alike.

10. Calculation

10.1 *Uncorrected Point Load Strength Index*—The uncorrected point load strength, I_s, is calculated as:

$$I_s = P/D_e^2, \text{ MPa} \quad (1)$$

where:

P = failure load, N,
D_e = equivalent core diameter (see Fig. 3), mm, and is given by:

D_e^2 = D^2 for diametral core tests without penetration, mm^2, or

D_e^2 = $4A/\pi$ for axial, block, and lump tests, mm^2;

where:

A = WD = minimum cross-sectional area of a plane through the platen contact points (see Fig. 3).

NOTE 4—If significant platen penetration occurs in the test, such as when testing weak sandstones, the value of D should be the end value of the separation of the loading points, D'. Measurements of core diameter, D, or specimen width, W, made perpendicular to the line joining the loading points are not affected by this platen penetration and should be retained at the original values. The modified values of D_e can be calculated from:

$$D_e^2 = D \times D' \text{ for cores} = 4/\pi \ W \times D' \text{ for other shapes} \quad (2)$$

10.2 *Size Corrected Point Load Index:*

10.2.1 The point load index, I_s, varies as a function of D in the diametral test, and as a function of D_e in axial, block, and irregular lump tests, so that a size correction should be applied, if the D values for all the specimens are not the same, to obtain an unique point load strength value for the rock specimen and one that can be used for purposes of rock strength classification. See Fig. 6.

10.2.2 The size corrected point load strength index, $I_{s(D)}$, of a rock specimen is defined in this procedure as the value of I_s that would have been measured by a diametral test with D = 50 mm and given the symbol $I_{s(50)}$. The diameter of 50 mm has been the preferred diameter since that diameter is associated with rock quality designations (RQD) and predominance of NX core samples.

10.2.3 When a precise rock classification is advised, the most reliable method of obtaining $I_{s(50)}$ is to conduct diametral tests at or close to D = 50 mm. Size correction is then unnecessary. For example, in case of diametral tests on NX, core diameter = 54 mm and size correction to D = 50 mm is not necessary. Most point load strength tests are in fact performed using other specimen sizes or shapes. In such cases, the size correction described in 10.2.4 or 10.2.5 should be applied.

10.2.4 The most reliable method of size correction is to test the specimen over a range of D or D_e values and to plot graphically the relation between P and D_e. If a log-log plot is used, the relation is a straight line (see Fig. 7). Points that deviate substantially from the straight line may be disregarded (although they should not be deleted). The value of $I_{s(50)}$ corresponding to D_e^2 = 2500 mm^2 (D_e = 50 mm) can be obtained by interpolation and use of the size-corrected point load strength index calculated as shown in 10.2.5.

10.2.5 When neither 10.2.3 nor 10.2.4 is practical (for example when testing single-sized core at a diameter other than 50 mm or if only a few small pieces are available), size correction may be accomplished using the formula:

$$I_{s(50)} = F \times I_s \quad (3)$$

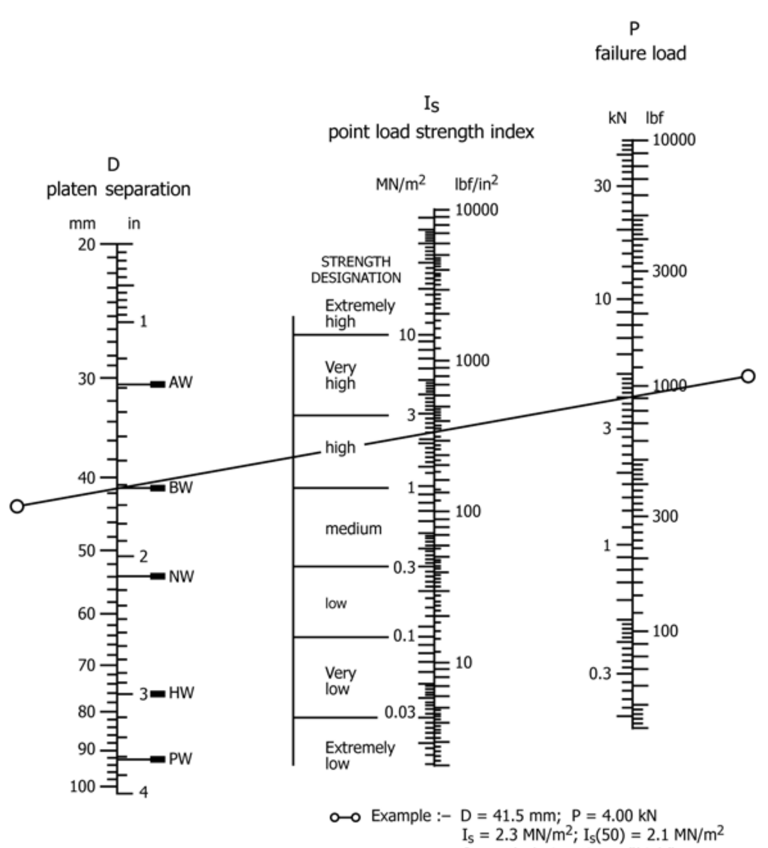


FIG. 6 Example of Descriptive Strength Classification and Using a Nomograph to Compute the Point Load Index. Other Strength Classifications May be Used.

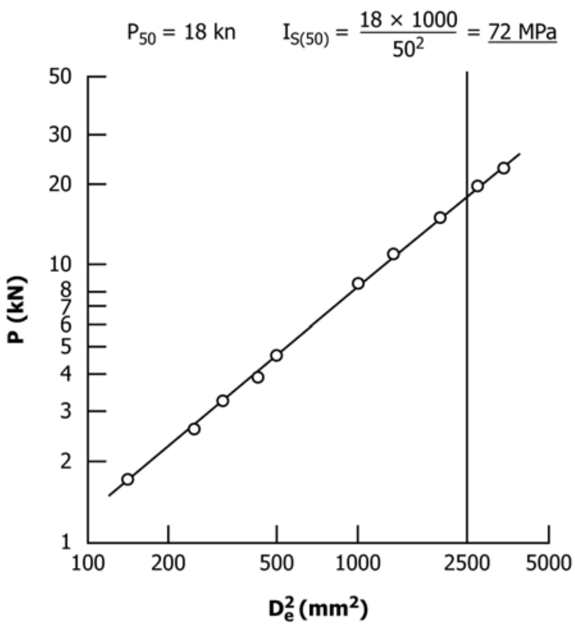


FIG. 7 Procedure for Graphical Determination of $I_{s(50)}$ from a Set of Results at D_e Values Other Than 50 mm [3]

The "Size Correction Factor *F*" can be obtained from the chart in Fig. 8, or from the expression:

$$F = (D_e/50)^{0.45} \tag{4}$$

where:

F = size correction factor

For tests near the standard 50-mm size, only slight error is introduced by using the approximate expression:

$$F = \sqrt{(D_e/50)} \tag{5}$$

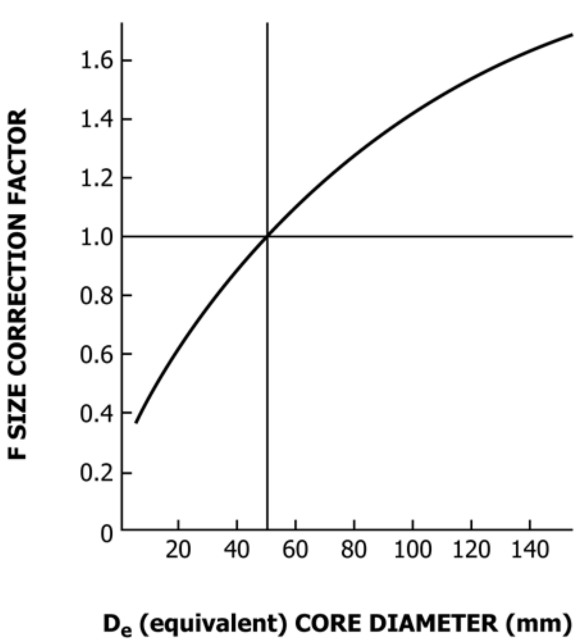


FIG. 8 Size Correction Factor Chart [3]

instead of using the procedure outlined in 10.2.4 and illustrated on Fig. 7.

10.3 *Mean Value Calculation:*

10.3.1 Mean values of $I_{s(50)}$, as defined in 10.3.2, are to be used when classifying samples with regard to their point load strength and point load strength anisotropy indices.

10.3.2 The mean value of $I_{s(50)}$ is to be calculated by deleting the two highest and two lowest values from the ten, or more, valid tests, and calculating the mean of the remaining values. If significantly fewer specimens are tested, only the highest and lowest values are to be deleted and the mean calculated from those remaining.

10.4 *Point Load Strength Anisotropy Index*—The strength anisotropy index $I_{a(50)}$ is defined as the ratio of mean $I_{s(50)}$ values measured perpendicular and parallel to planes of weakness, that is, the ratio of greatest to least point load strength indices. See Fig. 9[6].

10.5 *Estimation of Uniaxial Compressive Strength*—The estimated uniaxial compressive strength can be obtained by using Fig. 9, for NX core, or using the following formula:

$$s_c = K{*}I_s \tag{6}$$

where:

s_c = uniaxial compressive strength, MPa
K = index to strength conversion factor that depends on site-specific correlation between s_c and I_s for a specific specimen with a test diameter (D), MPa and
I_s = uncorrected point load strength index from a specimen with a specific test diameter (*D*).

10.5.1 If site-specific correlation factor "*K*" is not available, the generalized values may be used in Table 1.

10.5.2 If any specimen in a rock type gives a value 20 % under the average, it should be examined for defects and a decision made on the validity of the results.

11. Report: Test Data Sheet(s)/Form(s)

11.1 The methodology used to specify how data are recorded on the test data sheet(s)/form(s), as given below, is covered in 1.6.

11.2 Record as a minimum, the following general information:

11.2.1 Source of sample, including: project name, location, how collected (drill hole, block sample, and alike) and, if known, storage (curatorial history) environment. The location may be specified in terms of borehole number and depth of specimen from the collar of the hole,

11.2.2 Physical description of sample, including: rock type and location and orientation of discontinuities, such as, apparent weakness planes, bedding planes, schistosity, or large inclusions, if any,

11.2.3 Date and personnel involved with sampling, specimen preparation, and testing,

11.2.4 Test apparatus used, model number, and calibrations,

[6] D'Andrea, D.V., Fisher, R.L., and Fogelson, D.E., Prediction of Compressive Strength of Rock from Other Rock Properties, *U.S. Bureau of Mines Rep. Invest.*, 6702, 1965.

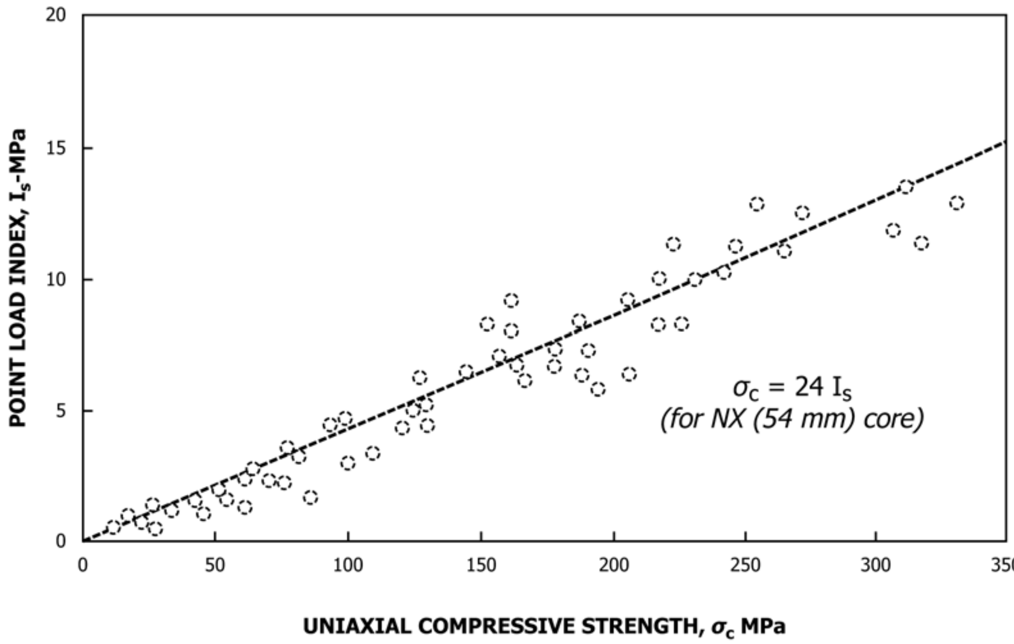


FIG. 9 Relationship Between Point Load Strength Index and Uniaxial Compressive Strength from 125 Tests On Sandstone, Quartzite, Marikana Norite, and Belfast Norite[6]

TABLE 1 Generalized Index to Strength Conversion Factor (K) for[A]

Core Size, mm	Value of "K" (Generalized)
21.5 (EX Core)	18
30	19
42 (BX Core)	21
50	23
54 (NX Core)	24
60	24.5

[A]Bieniawski, Z.T. The Point-Load Test in Geotechnical Practice, Engineering Geology (9) 1-11.

11.3 Record as a minimum, the following test data:

11.3.1 A qualitative indication of the moisture condition of test specimens at the time of testing, such as, saturated, as received, laboratory air dry, or oven dry. In some cases, especially where the results are sensitive to water content, it may be necessary to report the quantitative water content,

11.3.2 Average thickness and average diameter of the test specimen to three significant digits,

11.3.3 The maximum applied load "*P*" to three significant digits,

11.3.4 The distance "*D*" or *D*', or both, if required, to three significant digits,

11.3.5 The minimum cross-sectional area of a plane between the two platen contact points, *A*, to three significant digits,

11.3.6 Equivalent core diameter, D_e, to three significant digits,

11.3.7 Size correction factor, *F*, to three significant digits,

11.3.8 Index to strength conversion factor, *K*, to two or three significant digits,

11.3.9 Direction of loading (parallel to or normal to plane of weakness or anisotrophy directions),

11.3.10 The number of specimens tested and how prepared,

11.3.11 The calculated uncorrected (I_s) and corrected (D=50 mm), $I_{s(50)}$ point load strength index values, to three significant digits,

11.3.12 The estimated value of uniaxial compressive strength (σ_c) and the strength classification, to three significant digits,

11.3.13 The calculated value of strength anisotropy index ($I_{a(50)}$) to three significant digits, and

11.3.14 Type and location of failure, including any photographs of the tested specimens before and after the test.

NOTE 5—Water content determinations conducted in accordance with Test Methods D2216 or other methods may be recorded on the same record/data sheet. This is not a mandatory requirement.

12. Precision and Bias

12.1 *Precision*—nTest data on precision is not presented due to the nature of the rock materials tested by this test method. It is either not feasible or too costly at this time to have ten or more laboratories participate in a round-robin testing program. Also, it is either not feasible or too costly to produce multiple specimens that have uniform physical properties. Any variation in the data is just as likely due to specimen variation as to operator or laboratory testing variation.

12.1.1 The Subcommittee D18.12 is seeking any data from the users of this test method that might be used to make a limited statement on precision.

12.2 *Bias*—There is no accepted reference value for this test method; therefore, bias cannot be determined.

13. Keywords

13.1 compressive strength; index test; point load; rock; rock classification

APPENDIX

(Nonmandatory Information)

X1. SAMPLE DATA SHEET

X1.1 See Fig. X1.1.

POINT LOAD TEST DATA

PROJECT: OPEN CAST SITE
TESTED BY: Jeff Testman, CET
TEST DEVICE: Acme Point Load Model 101
READOUT: ACME DIGITAL GAGE 201

LOCATION: GAMPLETHORPE, USA
DATE: June 6, 2006
Serial Number: #100101
CALIBRATED: May 6, 2006

SAMPLE DETAILS:

Block sample, fine grained pale gray Coal Measure sandstone with numerous coaly streaks along horizontal bedding planes. Specimens 1–6 chisel cut blocks air dried 2 weeks, 7–10 sawn blocks air dried 2 weeks; 11–15 N size cores air dried 2 weeks; 16–20 E size cores air dried 2 weeks. All tested in the laboratory

Speciemen Number	Test Type	Width (w), mm	Diameter (D), mm	Load (P), kN	D_e^2, mm²	D_e, mm	I_s, MPa	F	$I_{s(50)}$, Mpa
1	i ⊥	30.40	17.20	2.687	666	25.8	4.03	0.74	3.00
2	i ⊥	16.00	8.00	0.977	163	12.8	5.99	0.54	3.25
3	i ⊥	19.70	15.60	1.962	391	19.8	5.02	0.66	3.31
4	i ⊥	35.80	18.10	3.641	825	28.7	4.41	0.78	3.44
5	i ⊥	42.50	29.00	6.119	1569	39.6	3.90	0.90	3.51
6	i ⊥	42.00	35.00	7.391	1872	43.3	3.95	0.94	3.70
7	b ⊥	44.00	21.00	4.600	1176	34.3	3.91	0.84	3.30
8	b ⊥	40.00	30.00	5.940	1528	39.1	3.89	0.90	3.48
9	b ⊥	19.50	15.00	2.040	372	19.3	5.48	0.65	3.57
10	b ⊥	33.00	16.00	2.870	672	25.9	4.27	0.74	3.18
11	d //	—	49.93	5.107	—	—	—	—	2.05
12	d //	—	49.88	4.615	—	—	—	—	1.85
13	d //	—	49.82	5.682	—	—	—	—	2.29
14	d //	—	49.82	4.139	—	—	—	—	1.67
15	d //	—	49.86	4.546	—	—	—	—	1.83
16	d //	—	25.23	1.837	—	—	2.89	0.74	2.14
17	d //	—	25.00	1.893	—	—	3.03	0.735	2.23
18	d //	—	25.07	2.118	—	—	3.37	0.735	2.48
19	d //	—	25.06	1.454	—	—	2.32	0.735	1.70
20	d //	—	25.04	1.540	—	—	2.46	0.735	1.81

d = diametrical
a = axial
b = block
i = irregular lamp
⊥ = perpendicular to plane of weakness
// = parallel to plane of weakness

STATISTICS	
Mean $I_{s(50)}$ ⊥	3.37
Mean $I_{s(50)}$ //	2.00
$I_{s(50)}$	1.68

FIG. X1.1 Sample Data Sheet[3]

SUMMARY OF CHANGES

In accordance with Committee D18 policy, this section identifies the location of changes to this standard since the last edition (2008) that may impact the use of this standard. (December 1, 2016)

(1) Removed IP units from 1.4.
(2) Added 1.6 clarifying use of D6026.
(3) Revised 3.1.
(4) Revised 3.2.
(5) Revised 4.2.
(6) Revised 5.1.
(7) Revised 5.4.
(8) Revised Fig. 1.
(9) Moved Note 2.
(10) Revised 6.2.1.
(11) Revised 6.3.1.
(12) Revised 6.4.1.
(13) Revised 6.5.
(14) Revised Section 7 header.
(15) Added clarification to 7.1 about sample size.
(16) Revised 7.2.1 – 7.2.4.
(17) Revised 7.4.
(18) Revised 8.2.
(19) Revised 8.4.1.
(20) Revised 9.2.2.
(21) Revised 9.2.5.
(22) Revised 9.3.2 to correct figure number.
(23) Revised 9.3.4 to correct figure number.
(24) Revised 9.3.5.
(25) Revised 9.5.3.
(26) Revised 9.5.4.
(27) Revised 9.7.2.
(28) Revised 10.1.
(29) Revised 10.2.1.
(30) Revised 10.2.2.
(31) Revised 10.2.3.
(32) Revised 10.2.5.
(33) Revised 10.5.
(34) Revised Table 1.
(35) Revised 11.1.
(36) Revised 11.2.
(37) Revised 11.3.
(38) Revised 12.1.
(39) Added Appendix X1.