Designation: C805/C805M – 13

Standard Test Method for Rebound Number of Hardened Concrete[1]

This standard is issued under the fixed designation C805/C805M; 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.

This standard has been approved for use by agencies of the Department of Defense.

1. Scope*

1.1 This test method covers the determination of a rebound number of hardened concrete using a spring-driven steel hammer.

1.2 The values stated in either SI units or inch-pound units are to be regarded separately as standard. The values stated in each system may not be exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems may result in non-conformance with the standard.

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]

C42/C42M Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete

C125 Terminology Relating to Concrete and Concrete Aggregates

C670 Practice for Preparing Precision and Bias Statements for Test Methods for Construction Materials

E18 Test Methods for Rockwell Hardness of Metallic Materials

3. Terminology

3.1 *Definitions:*

3.1.1 For definitions of terms used in this test method, refer to Terminology C125.

4. Summary of Test Method

4.1 A steel hammer impacts, with a predetermined amount of energy, a steel plunger in contact with a surface of concrete, and the distance that the hammer rebounds is measured.

5. Significance and Use

5.1 This test method is applicable to assess the in-place uniformity of concrete, to delineate variations in concrete quality throughout a structure, and to estimate in-place strength if a correlation is developed in accordance with 5.4.

5.2 For a given concrete mixture, the rebound number is affected by factors such as moisture content of the test surface, the type of form material or type of finishing used in construction of the surface to be tested, vertical distance from the bottom of a concrete placement, and the depth of carbonation. These factors need to be considered in interpreting rebound numbers.

5.3 Different instruments of the same nominal design may give rebound numbers differing from 1 to 3 units. Therefore, tests should be made with the same instrument in order to compare results. If more than one instrument is to be used, perform comparative tests on a range of typical concrete surfaces so as to determine the magnitude of the differences to be expected in the readings of different instruments.

5.4 Relationships between rebound number and concrete strength that are provided by instrument manufacturers shall be used only to provide indications of relative concrete strength at different locations in a structure. To use this test method to estimate strength, it is necessary to establish a relationship between strength and rebound number for a given concrete and given apparatus (see Note 1). Establish the relationship by correlating rebound numbers measured on the structure with the measured strengths of cores taken from corresponding locations (see Note 2). At least two replicate cores shall be taken from at least six locations with different rebound numbers. Select test locations so that a wide range of rebound numbers in the structure is obtained. Obtain, prepare, and test cores in accordance with Test Method C42/C42M. If the rebound number if affected by the orientation of the instrument during testing, the strength relationship is applicable for the same orientation as used to obtain the correlation date (see

[1] This test method is under the jurisdiction of ASTM Committee C09 on Concrete and Concrete Aggregates and is the direct responsibility of Subcommittee C09.64 on Nondestructive and In-Place Testing.

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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**

Note 3). Locations where strengths are to be estimated using the developed correlation shall have similar surface texture and shall have been exposed to similar conditions as the locations where correlation cores were taken. The functionality of the rebound hammer shall have been verified in accordance with 6.4 before making the correlation measurements.

Note 1—See ACI 228.1R[3] for additional information on developing the relationship and on using the relationship to estimate in-place strength.

Note 2—The use of molded test specimens to develop a correlation may not provide a reliable relationship because the surface texture and depth of carbonation of molded specimens are not usually representative of the in-place concrete.

Note 3—The use of correction factors to account for instrument orientation may reduce the reliability of strength estimates if the correlation is developed for a different orientation than used for testing.

5.5 This test method is not suitable as the basis for acceptance or rejection of concrete.

6. Apparatus

6.1 *Rebound Hammer,* consisting of a spring-loaded steel hammer that when released strikes a steel plunger in contact with the concrete surface. The spring-loaded hammer must travel with a consistent and reproducible velocity. The rebound distance of the steel hammer from the steel plunger is measured on a linear scale attached to the frame of the instrument.

Note 4—Several types and sizes of rebound hammers are commercially available to accommodate testing of various sizes and types of concrete construction.

6.1.1 The manufacturer shall supply rebound number correction factors for instruments that require such a factor to account for the orientation of the instrument during a test. The correction factor is permitted to be applied automatically by the instrument. The manufacturer shall keep a record of test data used as the basis for applicable correction factors.

6.2 *Abrasive Stone,* consisting of medium-grain texture silicon carbide or equivalent material.

6.3 *Verification Anvil,* used to check the operation of the rebound hammer. An instrument guide is provided to center the rebound hammer over the impact area and keep the instrument perpendicular to the anvil surface. The anvil shall be constructed so that it will result in a rebound number of at least 75 for a properly operating instrument (see Note 5). The manufacturer of the rebound hammer shall stipulate the type of verification anvil to be used and shall provide the acceptable range of rebound numbers for a properly operating instrument. The anvil manufacturer shall indicate how the anvil is to be supported for verification tests of the instrument, and shall provide instructions for visual inspection of the anvil surface for surface wear.

Note 5—A suitable anvil has included an approximately 150 mm [6 in.] diameter by 150 mm [6 in.] tall steel cylinder with an impact area hardened to an HRC hardness value of 64 to 68 as measured by Test Methods E18.

6.4 *Verification*—Rebound hammers shall be serviced and verified annually and whenever there is reason to question their proper operation. Verify the functional operation of a rebound hammer using the verification anvil described in 6.3. During verification, support the anvil as instructed by the anvil manufacturer.

Note 6—Typically, a properly operating rebound hammer and a properly designed anvil should result in a rebound number of about 80. The anvil needs to be supported as stated by the anvil manufacturer to obtain reliable rebound numbers. Verification on the anvil does not guarantee that the hammer will yield repeatable rebound numbers at other points on the scale. At the user's option, the rebound hammer can be verified at lower rebound numbers by using blocks of polished stone having uniform hardness. Some users compare several hammers on concrete or stone surfaces encompassing the usual range of rebound numbers encountered in the field.

7. Test Area and Interferences

7.1 *Selection of Test Surface*—Concrete members to be tested shall be at least 100 mm [4 in.] thick and fixed within a structure. Smaller specimens must be rigidly supported. Avoid areas exhibiting honeycombing, scaling, or high porosity. Do not compare test results if the form material against which the concrete was placed is not similar (see Note 7). Troweled surfaces generally exhibit higher rebound numbers than screeded or formed finishes. If possible, test structural slabs from the underside to avoid finished surfaces.

7.2 *Preparation of Test Surface*—A test area shall be at least 150 mm [6 in.] in diameter. Heavily textured, soft, or surfaces with loose mortar shall be ground flat with the abrasive stone described in 6.2. Smooth-formed or troweled surfaces do not have to be ground prior to testing (see Note 7). Do not compare results from ground and unground surfaces. Remove free surface water, if present, before testing.

Note 7—Where formed surfaces were ground, increases in rebound number of 2.1 for plywood formed surfaces and 0.4 for high-density plywood formed surfaces have been noted.[4] Dry concrete surfaces give higher rebound numbers than wet surfaces. The presence of surface carbonation can also result in higher rebound numbers.[5] In cases of a thick layer of carbonated concrete, it may be necessary to remove the carbonated layer in the test area, using a power grinder, to obtain rebound numbers that are representative of the interior concrete. Data are not available on the relationship between rebound number and thickness of carbonated concrete. The user should exercise professional judgment when testing carbonated concrete.

7.3 Do not test frozen concrete.

Note 8—Moist concrete at 0 °C [32 °F] or less may exhibit high rebound values. Concrete should be tested only after it has thawed. The temperatures of the rebound hammer itself may affect the rebound number. Rebound hammers at -18 °C [0 °F] may exhibit rebound numbers reduced by as much as 2 or 3 units[6].

7.4 For readings to be compared, the direction of impact, horizontal, downward, upward, or at another angle, must be the same or established correction factors shall be applied to the readings.

[3] ACI 228.1R, "In-Place Methods to Estimate Concrete Strength," American Concrete Institute (ACI), P.O. Box 9094, Farmington Hills, MI 48333-9094, http://www.concrete.org.

[4] Gaynor, R. D., "In-Place Strength of Concrete—A Comparison of Two Test Systems," and "Appendix to Series 193," National Ready Mixed Concrete Assn., TIL No. 272, November 1969.

[5] Zoldners, N. G., "Calibration and Use of Impact Test Hammer," *Proceedings* , American Concrete Institute, Vol 54, August 1957, pp. 161–165.

[6] National Ready Mixed Concrete Assn., TIL No. 260, April 1968.

7.5 Do not conduct tests directly over reinforcing bars with cover less than 20 mm [0.75 in.].

NOTE 9—The location of reinforcement may be established using reinforcement locators or metal detectors. Follow the manufacturer's instructions for proper operation of such devices.

8. Procedure

8.1 Hold the instrument firmly so that the plunger is perpendicular to the test surface. Record the orientation of the instrument with respect to horizontal to the nearest 45 degree increment. Use a positive angle if the instrument points upward and a negative angle if it points downward with respect to horizontal during testing (see Note 10). Gradually push the instrument toward the test surface until the hammer impacts. After impact, maintain pressure on the instrument and, if necessary, depress the button on the side of the instrument to lock the plunger in its retracted position. Read and record the rebound number to the nearest whole number. Take ten readings from each test area. The distances between impact points shall be at least 25 mm [1 in.], and the distance between impact points and edges of the member shall be at least 50 mm [2 in.]. Examine the impression made on the surface after impact, and if the impact crushes or breaks through a near-surface air void disregard the reading and take another reading.

NOTE 10—Digital angle gages are available that can be attached to the body of the instrument to allow quick measurement of the angle with respect to horizontal. The recorded orientation would be 0 degrees (horizontal), ±45 degrees (inclined), or ±90 (vertical). For example, if the instrument points vertically down during a test, the angle would be reported as –90 degrees. If the angle is measured to be 55 degrees upward from horizontal, the recorded angle to the nearest 45 degree increment would be +45 degrees.

9. Calculation

9.1 Discard readings differing from the average of 10 readings by more than 6 units and determine the average of the remaining readings. If more than 2 readings differ from the average by 6 units, discard the entire set of readings and determine rebound numbers at 10 new locations within the test area.

9.2 If necessary, apply the correction factor to the average rebound number so that the rebound number is for a horizontal orientation of the hammer. Interpolation is permitted if corrections factors are not given for ±45 degrees.

10. Report

10.1 Report the following information, if known, for each test area.

10.1.1 General information:

10.1.1.1 Date of testing,

10.1.1.2 Air temperature and time of testing,

10.1.1.3 Age of concrete, and

10.1.1.4 Identification of test location in the concrete construction and the size of member tested.

10.1.2 Information about the concrete:

10.1.2.1 Mixture identification and type of coarse aggregate, and

10.1.2.2 Specified strength of concrete.

10.1.3 Description of test area:

10.1.3.1 Surface characteristics (trowelled, screeded. formed),

10.1.3.2 If applicable, type of form material used for test area,

10.1.3.3 If surface was ground and depth of grinding,

10.1.3.4 If applicable, curing conditions, and

10.1.3.5 Surface moisture condition (wet or dry).

10.1.4 Hammer information:

10.1.4.1 Hammer identification or serial number, and

10.1.4.2 Date of hammer verification.

10.1.5 Rebound number data:

10.1.5.1 Name of operator,

10.1.5.2 Orientation of hammer during test,

10.1.5.3 On vertical surfaces (walls, columns, deep beams), relative elevation of test region,

10.1.5.4 Individual rebound numbers,

10.1.5.5 Remarks regarding discarded readings,

10.1.5.6 Average rebound number,

10.1.5.7 If necessary, corrected rebound number for a horizontal orientation of the instrument, and

10.1.5.8 If applicable, description of unusual conditions that may affect test readings.

11. Precision and Bias

11.1 *Precision*—The single-specimen, single-operator, machine, day standard deviation is 2.5 units (1s) as defined in Practice C670. Therefore, the range of ten readings should not exceed 12.

11.2 *Bias*—The bias of this test method cannot be evaluated since the rebound number can only be determined in terms of this test method.

12. Keywords

12.1 concrete; in-place strength; nondestructive testing; rebound hammer; rebound number

SUMMARY OF CHANGES

Committee C09 has identified the location of selected changes to this test method since the last issue, C805 – 08, that may impact the use of this test method. (Approved January 1, 2013)

(1) Revised 5.1, 6.3, and 8.1.
(2) Modified sections 5.2 and 5.3; previous section 5.2 moved to 5.4.
(3) New Notes 2, 3, 5, and 10 added.
(4) Added 6.1.1, 9.2, 10.1.5.1, and 10.1.5.7.
(5) Some information from previous 6.4 moved to 6.3.