Designation: C805/C805M – 13a

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.

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 metal plunger in contact with a concrete surface. Either the distance that the hammer rebounds is measured or the hammer speeds before and after impact are measured. The test result is reported as a dimensionless rebound number.

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 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

[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 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 metal plunger in contact with the concrete surface. The spring-loaded hammer must travel with a consistent and reproducible speed. The rebound number is based on the rebound distance of the hammer after it impacts the plunger, or it is based on the ratio of the hammer speed after impact to the speed before impact. Rebound numbers based on these two measurement principles are not comparable.

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 A means shall be provided to display the rebound number after each test.

NOTE 5—Methods of displaying rebound number include mechanical sliders and electronic displays. Instruments are available that will store the rebound numbers, which can then be transferred to a computer for analysis.

6.1.2 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 6). 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 6—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 7—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 8). 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 8). Do not compare results from ground and unground surfaces. Remove free surface water, if present, before testing.

NOTE 8—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 9—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

[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.