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

This standard is issued under the fixed designation C 805; 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 specification 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 SI units are to be regarded as 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:*

E 177 Practice for Use of the Terms Precision and Bias in ASTM Test Methods[2]

3. Summary of Test Method

3.1 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.

4. Significance and Use

4.1 This test method may be used to assess the in-place uniformity of concrete, to delineate regions in a structure of poor quality or deteriorated concrete, and to estimate in-place strength development.

4.2 To use this test method to estimate strength requires establishing a relationship between strength and rebound number. The relationship shall be established for a given concrete mixture and given apparatus. The relationship shall be established over the range of concrete strength that is of interest. To estimate strength during construction, establish the relationship by performing rebound number tests on molded specimens and measuring the strength of the same or companion molded specimens. To estimate strength in an existing structure, establish the relationship by correlating rebound numbers measured on the structure with the strengths of cores taken from corresponding locations. See ACI 228. 1R[3] for additional information on developing the relationship and on using the relationship to estimate in-place strength.

4.3 For a given concrete mixture, the rebound number is affected by factors such as moisture content of the test surface, the method used to obtain the test surface (type of form material or type of finishing), and the depth of carbonation. These factors need to be considered in preparing the strength relationship and interpreting test results.

4.4 Because of the inherent uncertainty in the estimated strength, this test method is not intended as the basis for acceptance or rejection of concrete.

5. Apparatus

5.1 *Rebound Hammer*, consisting of a spring-loaded steel hammer which 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 1—Several types and sizes of rebound hammers are commercially available to accommodate testing of various sizes and types of concrete construction.

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

5.3 *Test Anvil*, Approximately 150-mm (6-in.) diameter by 150-mm (6-in.) high cylinder made of tool steel with an impact area hardened to Brinell 500 or Rockwell 52 C. An instrument guide is provided to center the rebound hammer over impact area and keep the instrument perpendicular to the surface.

6. Test Area

6.1 *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. Areas exhibiting honeycombing, scaling, or high porosity should be avoided. The form material against which the concrete was placed should be similar (Note 2). Troweled surfaces generally

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[2] *Annual Book of ASTM Standards*, Vol 14.02.

[3] ACI 228. 1R-89, "In-Place Methods for Determination of Strength of Concrete," *ACI Manual of Concrete Practice-Part 2, 1994*, American Concrete Institute, 38800 Country Club Drive, Farmington Hills, MI 48331.

exhibit higher rebound numbers than screeded or formed finishes. If possible, structural slabs should be tested from the underside to avoid finished surfaces.

6.2 *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 smooth with the abrasive stone described in 5.2. Smooth-formed or troweled surfaces do not have to be ground prior to testing (Note 2).

NOTE 2—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] The effects of drying and surface carbonation can be reduced by thoroughly wetting the surface for 24 h prior to testing. In cases of a thick layer of carbonate 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 cabonated concrete. The user must exercise professional judgement when testing carbonated concrete.

6.2.1 Ground and unground surfaces should not be compared.

6.3 Other factors that may affect the results of the test are as follows:

6.3.1 Concrete at 0°C (32°F) or less may exhibit very high rebound values. Concrete should be tested only after it has thawed.

6.3.2 The temperatures of the rebound hammer itself may affect the rebound number.

NOTE 3—Rebound hammers at − 18°C (0°F) may exhibit rebound numbers reduced by as much as 2 or 3.[6]

6.3.3 For readings to be compared the direction of impact, horizontal, downward, upward, etc., must be the same or established correction factors shall be applied to the readings.

6.3.4 Different hammers of the same nominal design may give rebound numbers differing from 1 to 3 units and therefore, tests should be made with the same hammer in order to compare results. If more than one hammer is to be used, a sufficient number of tests must be made on typical concrete surfaces so as to determine the magnitude of the differences to be expected.

6.3.5 Rebound hammers shall be serviced and verified semiannually and whenever there is reason to question their proper operation. Test anvils described in 5.3 are recommended for verification.

NOTE 4—Verification on an anvil will not guarantee that the hammer will yield repeatable data at other points on the scale. Some users compare several hammers on concrete or stone surfaces encompassing the usual range of rebound numbers encountered in the field.

7. Procedure

7.1 Hold the instrument firmly so that the plunger is perpendicular to the test surface. 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. Estimate the rebound number on the scale to the nearest whole number and record the rebound number. Take ten readings from each test area. No two impact tests shall be closer together than 25 mm (1 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.

8. Calculation

8.1 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 detemine rebound numbers at 10 new locations within the test area.

9. Report

9.1 Report the following information for each test area:

9.1.1 Date and time of testing.

9.1.2 Identification of location tested in the concrete construction and the type and size of member tested,

9.1.2.1 Description of the concrete mixture proportions including type of coarse aggregates if known, and

9.1.2.2 Design strength of concrete tested.

9.1.3 Description of the test area including:

9.1.3.1 Surface characteristics (trowelled, screeded) of area,

9.1.3.2 If surface was ground and depth of grinding,

9.1.3.3 Type of form material used for test area,

9.1.3.4 Curing conditions of test area,

9.1.3.5 Type of exposure to the environment,

9.1.4 Hammer identification and serial number,

9.1.4.1 Air temperature at the time of testing,

9.1.4.2 Orientation of hammer during test,

9.1.5 Average rebound number for test area, and

9.1.5.1 Remarks regarding discarded readings of test data or any unusual conditions.

10. Precision and Bias

10.1 *Precision*—The single-specimen, single-operator, machine, day standard deviation is 2.5 units (1s) as defined in Practice E 177. Therefore, the range of ten readings should not exceed 12.

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

11. Keywords

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

[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.