Designation: C 805 – 02

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 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 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:*

C 125 Terminology Relating to Concrete and Concrete Aggregates[2]

C 670 Practice for Preparing Precision and Bias Statements for Test Methods for Construction Materials[2]

E 18 Test Methods for Rockwell and Rockwell Superficial Hardness of Metallic Materials[3]

3. Terminology

3.1 *Definitions:*

3.1.1 For definitions of terms used in this test method, refer to Terminology C 125.

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 regions in a structure of poor quality or deteriorated concrete, and to estimate in-place strength development.

5.2 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[4] for additional information on developing the relationship and on using the relationship to estimate in-place strength.

5.3 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.

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

5.5 This test method is not intended as the basis for acceptance or rejection of concrete because of the inherent uncertainty in the estimated strength.

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

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[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] *Annual Book of ASTM Standards*, Vol 04.02.

[3] *Annual Book of ASTM Standards*, Vol 03.01.

[4] ACI 228.1R-95, "In-Place Methods to Estimate Concrete Strength," *ACI Manual of Concrete Practice-Part 2, 2000*, American Concrete Institute, 38800 Country Club Drive, Farmington Hills, MI 48331.

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

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.

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

6.3 *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 66 ± 2 HRC as measured by Test Methods E 18. An instrument guide is provided to center the rebound hammer over the impact area and keep the instrument perpendicular to the surface.

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 test anvil described in 6.3. During verification, support the test anvil on a bare concrete floor or slab. The manufacturer shall report the rebound number to be obtained by a properly operating instrument when tested on an anvil of specified hardness.

NOTE 2—Typically, a rebound hammer will result in a rebound number of 80 ± 2 when tested on the anvil described in 6.3. The test anvil needs to be supported on a rigid base to obtain reliable rebound numbers. Verification on the test anvil does not guarantee that the hammer will yield repeatable data at other points on the scale. The 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 3). 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 3). Do not compare results from ground and unground surfaces.

NOTE 3—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.[5] Dry concrete surfaces give higher rebound numbers than wet surfaces. The presence of surface carbonation can also result in higher rebound numbers.[6] 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 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 must exercise professional judgment when testing carbonated concrete.

7.3 Do not test frozen concrete.

NOTE 4—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[7].

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.

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

NOTE 5—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. 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 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.

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.

10. Report

10.1 Report the following information for each test area:

10.1.1 Date and time of testing.

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

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

10.1.2.2 Design strength of concrete tested.

10.1.3 Description of the test area including:

10.1.3.1 Surface characteristics (trowelled, screeded) of area,

10.1.3.2 If surface was ground and depth of grinding,

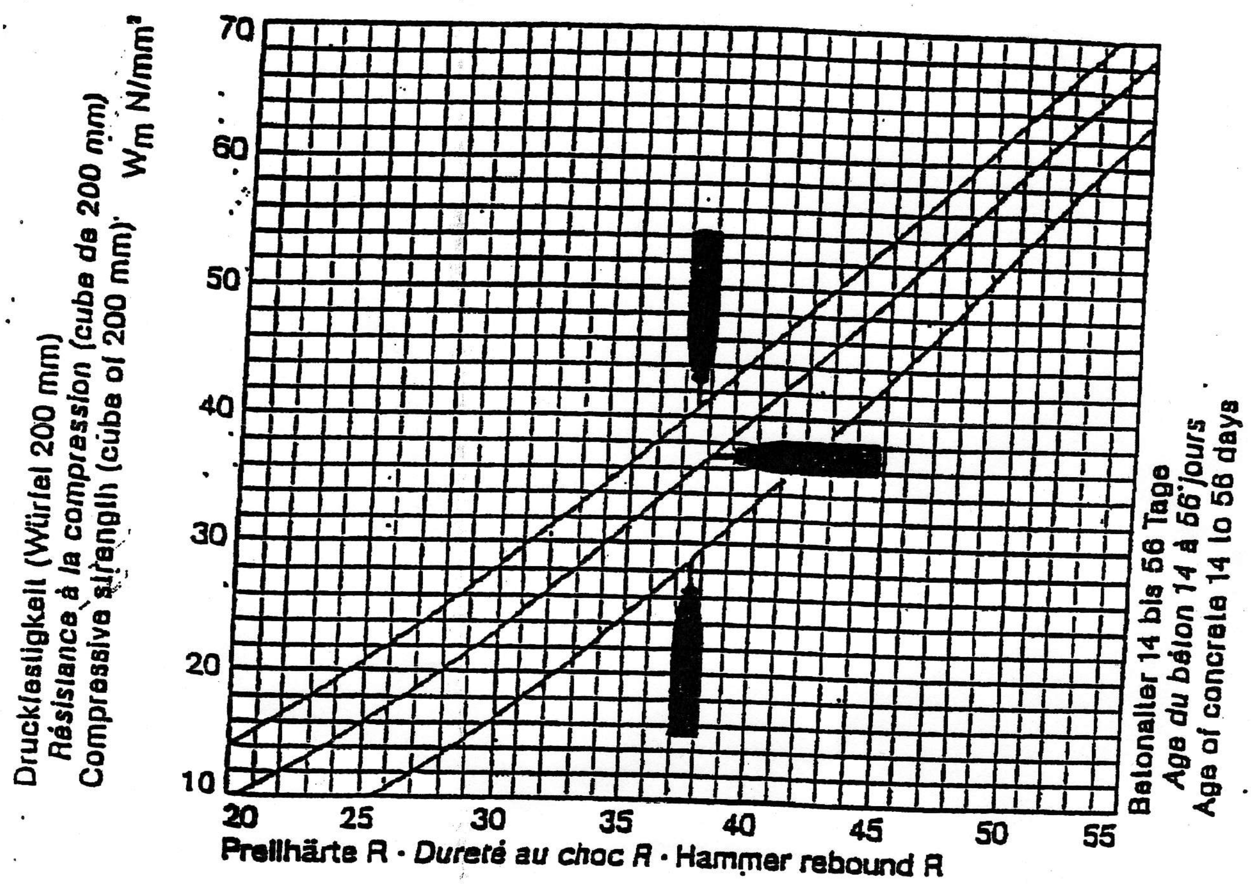
[5] Gaynor, R. D., "In-Place Strength of Concrete—A Comparison of Two Test Systems," and "Appendix to Series 193," National Ready Mixed Concrete Assn., TIL No. 272, November 1969.

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

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

Fig. 3 Cube Compressive Strength in N/mm²
plotted against the Rebound Number

Type N Test Hammer



The curves apply to compact Portland cement concrete with good quality gravel/sand aggregate. Age 14 to 56 days. Smooth and dry concrete surface.

Cube Compressive Strength TYPE N Test Hammer

Degree -90°			Degree 0°			Degree +90°		
Rebound (R)	Strength (N/mm^2)	Strength (kgf/cm^2)	Rebound (R)	Strength (N/mm^2)	Strength (kgf/cm^2)	Rebound (R)	Strength (N/mm^2)	Strength (kgf/cm^2)
20	14.0	142.7	20	10.0	101.9	20	-	-
21	15.5	157.9	21	11.0	112.1	21	-	-
22	16.5	168.1	22	12.0	122.3	22	-	-
23	18.0	183.4	23	13.5	137.6	23	-	-
24	19.5	198.7	24	14.5	147.8	24	-	-
25	21.0	214.0	25	16.0	163.0	25	-	-
26	22.0	224.2	26	17.5	178.3	26	10.5	107.0
27	23.5	239.5	27	18.5	188.5	27	12.0	122.3
28	25.5	259.8	28	20.0	203.8	28	13.5	137.6
29	26.5	270.0	29	21.5	219.1	29	15.0	152.9
30	28.5	290.4	30	23.5	239.5	30	16.5	168.1
31	30.0	305.7	31	25.0	254.8	31	18.0	183.4
32	31.5	321.0	32	26.5	270.0	32	19.5	198.7
33	33.0	336.3	33	28.0	285.3	33	21.0	214.0
34	35.0	356.7	34	30.0	305.7	34	23.0	234.1
35	36.5	371.9	35	31.5	321.0	35	24.5	249.7
36	38.0	387.2	36	33.0	336.3	36	26.0	264.9
37	40.0	407.6	37	35.0	356.7	37	28.0	285.3
38	41.5	422.9	38	37.0	377.0	38	29.5	300.6
39	43.0	438.2	39	38.5	392.3	39	31.0	315.9
40	45.0	458.6	40	40.5	412.7	40	33.0	336.3
41	47.0	478.9	41	42.0	428.0	41	35.0	356.7
42	48.5	494.2	42	44.0	448.4	42	37.0	377.0
43	50.5	514.6	43	46.0	468.7	43	39.0	397.4
44	52.0	529.9	44	47.5	484.0	44	41.0	417.8
45	54.0	550.3	45	49.5	504.4	45	43.0	438.2
46	55.5	565.5	46	51.0	519.7	46	45.0	458.6
47	57.5	585.9	47	53.5	545.2	47	47.0	478.9
48	59.5	606.3	48	55.0	560.5	48	49.0	499.3
49	61.0	621.6	49	57.0	580.8	49	51.0	519.7
50	63.5	647.1	50	59.0	601.2	50	53.0	540.1
51	65.0	662.4	51	61.0	621.6	51	55.0	560.5
52	67.0	682.7	52	63.0	642.0	52	57.0	580.8
53	69.0	703.1	53	65.0	662.4	53	59.0	601.2
54	70.0	713.3	54	67.0	682.7	54	61.5	626.7
55	-	-	55	68.5	698.0	55	63.5	647.1