



Standard Test Methods for Rockwell Hardness of Metallic Materials^{1,2}

This standard is issued under the fixed designation E18; 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 reappraisal. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reappraisal.

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

1. Scope*

1.1 These test methods cover the determination of the Rockwell hardness and the Rockwell superficial hardness of metallic materials by the Rockwell indentation hardness principle. This standard provides the requirements for Rockwell hardness machines and the procedures for performing Rockwell hardness tests.

1.2 This test method includes requirements for the use of portable Rockwell hardness testing machines that measure Rockwell hardness by the Rockwell hardness test principle and can meet all the requirements of this test method, including the direct and indirect verifications of the testing machine. Portable Rockwell hardness testing machines that cannot meet the direct verification requirements and can only be verified by indirect verification requirements are covered in Test Method E110.

1.3 This standard includes additional requirements in the following annexes:

Verification of Rockwell Hardness Testing Machines	Annex A1
Rockwell Hardness Standardizing Machines	Annex A2
Standardization of Rockwell Indenters	Annex A3
Standardization of Rockwell Hardness Test Blocks	Annex A4
Guidelines for Determining the Minimum Thickness of a Test Piece	Annex A5
Hardness Value Corrections When Testing on Convex Cylindrical Surfaces	Annex A6

1.4 This standard includes nonmandatory information in the following appendixes that relates to the Rockwell hardness test.

List of ASTM Standards Giving Hardness Values Corresponding to Tensile Strength	Appendix X1
Examples of Procedures for Determining Rockwell Hardness Uncertainty	Appendix X2

1.5 *Units*—At the time the Rockwell hardness test was developed, the force levels were specified in units of

kilograms-force (kgf) and the indenter ball diameters were specified in units of inches (in.). This standard specifies the units of force and length in the International System of Units (SI); that is, force in Newtons (N) and length in millimeters (mm). However, because of the historical precedent and continued common usage, force values in kgf units and ball diameters in inch units are provided for information and much of the discussion in this standard refers to these units.

1.6 The test principles, testing procedures, and verification procedures are essentially identical for both the Rockwell and Rockwell superficial hardness tests. The significant differences between the two tests are that the test forces are smaller for the Rockwell superficial test than for the Rockwell test. The same type and size indenters may be used for either test, depending on the scale being employed. Accordingly, throughout this standard, the term Rockwell will imply both Rockwell and Rockwell superficial unless stated otherwise.

1.7 *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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.8 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 ASTM Standards:³

- A370 Test Methods and Definitions for Mechanical Testing of Steel Products
- A623 Specification for Tin Mill Products, General Requirements
- A623M Specification for Tin Mill Products, General Requirements [Metric]

¹ These test methods are under the jurisdiction of ASTM Committee E28 on Mechanical Testing and are the direct responsibility of Subcommittee E28.06 on Indentation Hardness Testing.

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² In this test method, the term Rockwell refers to an internationally recognized type of indentation hardness test as defined in Section 3, and not to the hardness testing equipment of a particular manufacturer.

³ 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



- A883** Test Method for Ferrimagnetic Resonance Linewidth and Gyromagnetic Ratio of Nonmetallic Magnetic Materials
- A956/A956M** Test Method for Leeb Hardness Testing of Steel Products
- A1038** Test Method for Portable Hardness Testing by the Ultrasonic Contact Impedance Method
- B19** Specification for Cartridge Brass Sheet, Strip, Plate, Bar, and Disks
- B36/B36M** Specification for Brass Plate, Sheet, Strip, and Rolled Bar
- B96/B96M** Specification for Copper-Silicon Alloy Plate, Sheet, Strip, and Rolled Bar for General Purposes and Pressure Vessels
- B103/B103M** Specification for Phosphor Bronze Plate, Sheet, Strip, and Rolled Bar
- B121/B121M** Specification for Leaded Brass Plate, Sheet, Strip, and Rolled Bar
- B122/B122M** Specification for Copper-Nickel-Tin Alloy, Copper-Nickel-Zinc Alloy (Nickel Silver), and Copper-Nickel Alloy Plate, Sheet, Strip, and Rolled Bar
- B130** Specification for Commercial Bronze Strip for Bullet Jackets
- B134/B134M** Specification for Brass Wire
- B152/B152M** Specification for Copper Sheet, Strip, Plate, and Rolled Bar
- B370** Specification for Copper Sheet and Strip for Building Construction
- B647** Test Method for Indentation Hardness of Aluminum Alloys by Means of a Webster Hardness Gage
- E29** Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications
- E74** Practices for Calibration and Verification for Force-Measuring Instruments
- E92** Test Methods for Vickers Hardness and Knoop Hardness of Metallic Materials
- E110** Test Method for Rockwell and Brinell Hardness of Metallic Materials by Portable Hardness Testers
- E140** Hardness Conversion Tables for Metals Relationship Among Brinell Hardness, Vickers Hardness, Rockwell Hardness, Superficial Hardness, Knoop Hardness, Scleroscope Hardness, and Leeb Hardness
- E384** Test Method for Microindentation Hardness of Materials
- E691** Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method

2.2 *American Bearings Manufacturer Association Standard:*

ABMA 10-1989 Metal Balls⁴

2.3 *ISO Standards:*

ISO 6508-1 Metallic Materials—Rockwell Hardness Test—Part 1: Test Method (scales A, B, C, D, E, F, G, H, K, N, T)⁵

ISO/IEC 17011 Conformity Assessment—General Requirements for Accreditation Bodies Accrediting Conformity Assessment Bodies⁵

ISO/IEC 17025 General Requirements for the Competence of Testing and Calibration Laboratories⁵

2.4 *Society of Automotive Engineers (SAE) Standard:*

SAE J417 Hardness Tests and Hardness Number Conversions⁶

3. Terminology and Equations

3.1 Definitions:

3.1.1 *calibration*—determination of the values of the significant parameters by comparison with values indicated by a reference instrument or by a set of reference standards.

3.1.2 *standardization*—to bring in conformance to a known standard through verification or calibration.

3.1.3 *verification*—checking or testing to assure conformance with the specification.

3.1.4 *Rockwell hardness test*—an indentation hardness test using a verified machine to force a diamond spheroconical indenter or tungsten carbide (or steel) ball indenter, under specified conditions, into the surface of the material under test, and to measure the difference in depth of the indentation as the force on the indenter is increased from a specified preliminary test force to a specified total test force and then returned to the preliminary test force.

3.1.5 *Rockwell superficial hardness test*—same as the Rockwell hardness test except that smaller preliminary and total test forces are used with a shorter depth scale.

3.1.6 *Rockwell hardness number*—a number derived from the net increase in the depth of indentation as the force on an indenter is increased from a specified preliminary test force to a specified total test force and then returned to the preliminary test force.

3.1.7 *Rockwell hardness machine*—a machine capable of performing a Rockwell hardness test and/or a Rockwell superficial hardness test and displaying the resulting Rockwell hardness number.

3.1.7.1 *Rockwell hardness testing machine*—a Rockwell hardness machine used for general testing purposes.

3.1.7.2 *Rockwell hardness standardizing machine*—a Rockwell hardness machine used for the standardization of Rockwell hardness indenters, and for the standardization of Rockwell hardness test blocks. The standardizing machine differs from a regular Rockwell hardness testing machine by having tighter tolerances on certain parameters.

3.1.7.3 *portable Rockwell hardness testing machine*—a Rockwell hardness testing machine that is designed to be transported, carried, set up, and operated by the users, and that measures Rockwell hardness by the Rockwell indentation hardness test principle.

3.1.7.4 *movable Rockwell hardness testing machine*—a Rockwell hardness testing machine that is designed to be

⁴ Available from American Bearing Manufacturers Association (ABMA), 2025 M Street, NW, Suite 800, Washington, DC 20036.

⁵ Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, <http://www.ansi.org>.

⁶ Available from Society of Automotive Engineers (SAE), 400 Commonwealth Dr., Warrendale, PA 15096-0001, <http://www.sae.org>.