



Standard Test Method for Macro-Rockwell Hardness Testing of Metallic Materials¹

This standard is issued under the fixed designation E 1842; 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 procedure for Macro-Rockwell hardness testing of metallic materials, employing the Rockwell depth measuring principle (Test Method E 18), with high test forces and 5 or 10-mm diameter tungsten carbide ball indenters.

1.2 This Macro-Rockwell hardness test method has been developed to satisfy the need for more rapid testing in production environments as compared to conventional Brinell hardness testing. This test method employs the Rockwell test principle of measuring the depth of penetration to determine hardness.

1.3 Values stated in kilogram-force units are to be regarded as standard. SI units are provided for information only.

1.4 *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 4 Practices for Force Verification of Testing Machines²

E 6 Terminology Relating to Methods of Mechanical Testing²

E 18 Test Methods for Rockwell Hardness and Rockwell Superficial Hardness of Metallic Materials²

E 29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications³

E 74 Practice of Calibration of Force-Measuring Instruments for Verifying the Force Indication of Testing Machines²

E 92 Test Method for Vickers Hardness of Metallic Materials²

3. Terminology

3.1 General terminology related to hardness testing can be found in Terminology E 6.

¹ This test method is under the jurisdiction of ASTM Committee E-28 on Mechanical Testing and is the direct responsibility of Subcommittee E28.06 on Indentation Hardness Testing.

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² Annual Book of ASTM Standards, Vol 03.01.

³ Annual Book of ASTM Standards, Vol 14.02.

3.2 Definitions of Terms Specific to This Standard:

3.2.1 *Macro-Rockwell hardness number, HMR*—a number derived from the permanent increase in depth of indentation and denoted by the symbol HMR preceded by the hardness value and followed by numbers representing the ball indenter diameter and the total kilogram test force. The combination of test force and ball diameter indicate the scale. Example: 359 HMR 10/3000 = Macro-Rockwell hardness of 359 measured on the 10/3000 scale. All Macro-Rockwell hardness numbers are to be reported to the nearest whole number, rounding to be in accordance with Practice E 29.

3.2.2 *Macro-Rockwell hardness test*—an indentation hardness test using a verified machine to force a tungsten carbide ball under specified conditions, into the surface of the material under test in two operations, and to measure the difference in depth of the indentation under the specified conditions of preliminary and total test forces.

4. Significance and Use

4.1 The Macro-Rockwell hardness test is an indentation hardness test that provides useful information about metallic materials. This information may correlate to tensile strength, wear resistance, ductility, and other mechanical characteristics of metallic materials.

4.2 Macro-Rockwell hardness testing at a specific location on a part may not represent the mechanical characteristics of the whole part or end product.

4.3 Macro-Rockwell hardness tests are considered satisfactory for acceptance testing of commercial shipments.

General Description and Test Procedure for Macro-Rockwell Hardness Test Methods

5. Apparatus

5.1 *General Principles*—The general principles of the Macro-Rockwell hardness test are illustrated in Fig. 1. Tables 1 and 2 define scales and symbols used in the Macro-Rockwell hardness test.

5.2 The test machine shall be capable of applying predetermined forces as shown in Table 1, and in accordance with Annex A1.

5.3 The tungsten carbide ball indenter shall be in accordance with A1.3.2.

5.4 The measuring device shall be in accordance with A1.3.3.

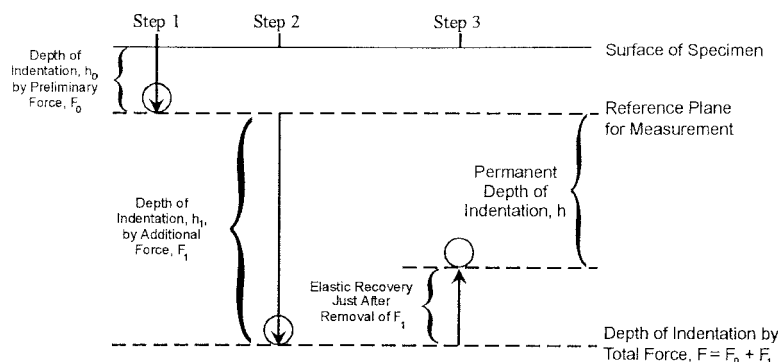


FIG. 1 Macro-Rockwell Hardness Test Method (Schematic Diagram)

TABLE 1 Macro-Rockwell Hardness Scales

Macro-Rockwell Hardness Scale	Indenter Diameter, mm	Preliminary Test Force, F_0 , kgf (kN)	Additional Test Force, F_1 , kgf (kN)	Total Force, F , kgf (kN)	Field of Application Macro-Rockwell Hardness Range, HMR ^A
10/3000	10	200 (1.961)	2800 (27.46)	3000 (29.42)	250–880
10/1500	10	200 (1.961)	1300 (12.75)	1500 (14.71)	425–940
10/1000	10	50 (490.3)	950 (9.317)	1000 (9.807)	300–900
10/500	10	50 (490.3)	450 (4.413)	500 (4.903)	690–950
5/750	5	50 (490.3)	700 (6.865)	750 (7.355)	500–940
5/250	5	50 (490.3)	200 (1.962)	250 (2.452)	600–940

^A The limits of the field of application for different scales are based on experimental results. For some materials they may be different.

TABLE 2 Macro-Rockwell Hardness Symbols

Symbol	Designation
D	Diameter of ball indenter
F_0	Preliminary test force
F_1	Additional test force
F	Total test force
h_0	Depth of indentation under preliminary test force before application of additional test force
h_1	Increase in depth of indentation under additional test force
h	Permanent increase in depth of indentation under preliminary test force after removal of additional test force, mm
HMR	Macro-Rockwell hardness number = $1000 - h/0.001$

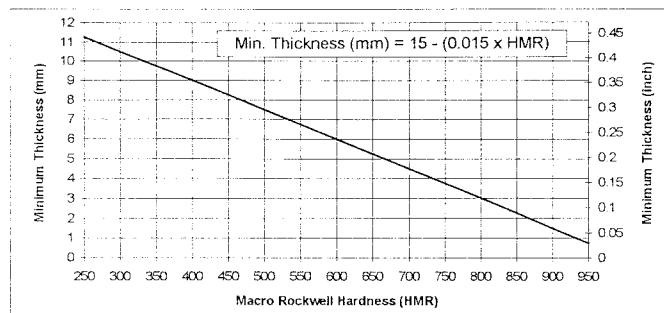


FIG. 2 Minimum Thickness Requirements for Macro-Rockwell Hardness Testing

6. Test Specimens

6.1 The test method should be carried out on a surface that is smooth, even, and generally free of any condition such as carburization, decarburization, oxide scale, foreign matter, and lubricants.

6.2 Preparation shall be carried out in such a way that any alteration of the surface hardness due to heat or cold-working, for example, is minimized.

6.3 The minimum thickness of the test piece or of the layer under test shall be at least 15 times the permanent increase of Depth h (see Fig. 2).

6.4 After the test method, no deformation shall be visible on the surface of the test piece opposite the indentation.

6.5 For test methods on convex and concave surfaces, corrections have to be applied. Such corrections may be determined by comparative measurements, and they are subject to special agreement.

7. Procedure

7.1 Perform the test at ambient temperature within the limits of 10 to 35°C (50 to 95°F).

7.2 Any displacement of the test piece affecting the measured value must be prevented. This usually can be accom-

plished by clamping the test piece with a clamping force that exceeds the total test force by at least 20 %. Other techniques that can be shown to give equivalent results are acceptable. One such technique is to measure the depth of the indentation using the test surface as a reference, thereby eliminating the effect of deflection of the surface on the test results.

NOTE 1—**Caution:** Any movement of the part during the application of the test forces will cause erroneous results.

7.3 Suitably support products such that the test surface is perpendicular within 2° to the centerline of the indenter and to its line of travel.

7.3.1 Use a suitable test support or anvil having sufficient hardness to prevent damage from the test specimen.

7.4 Bring the indenter into contact with the test surface, and apply the preliminary test force F_0 in accordance with Table 1 without shock or vibration. The dwell time for the preliminary test force shall not be less than 0.2 s nor more than 1.0 s.

7.5 Set the measuring device to its datum position, and, without shock or vibration, apply the additional test force (F_1) in accordance with Table 1 in not less than 1 nor more than 2 s.