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Standard Practice for Indentation Hardness of Metallic Materials by Comparison Hardness Testers[1]

This standard is issued under the fixed designation A 833; 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 practice covers the determination of indentation hardness of metallic materials using comparison hardness testers.

~~1.2This practice applies only to those comparison hardness testers, normally portable, that use standardized test blocks in accordance with Test Method E10~~

1.2 This practice applies only to those comparison hardness testers, normally portable, that use comparative test bars that have been standardized according to Test Method E 10 as a basis for comparison.

1.3 Calibration of comparative test bars (rods), used for comparison to determine hardness numbers, is also covered by this practice.

~~1.4The indenting force used during comparison hardness testing is normally an impact load applied by striking a hammer at the appropriate areas as outlined in the manufacturer's instructions. Final indentation diameter in both the comparative test bar and material tested shall be within the range of the comparator used for the instrument.~~

1.4 The impression force used during comparison hardness testing is normally an impact load applied by striking a hammer on the appropriate areas as outlined in the manufacturer's instructions.

1.5 *This standard does not purport to address all of the safety problems, 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]

A 370 Test Methods and Definitions for Mechanical Testing of Steel Products

E 10 Test Method for Brinell Hardness of Metallic Materials

3. Significance and Use

3.1 The comparative hardness test is an empirical dynamic indentation hardness test. Comparative hardness tests provide useful information about metallic materials. This information may correlate to tensile strength, wear resistance, ductility, heat treatment condition, or other physical characteristics of metallic materials, and may be useful in quality control and selection of materials.

3.2 Comparative hardness testing at a specific location on a part may not represent the physical characteristics of the whole part or end product.

4. Apparatus

~~3.1Comparison hardness testers are used principally for testing articles that are too large or unwieldy to be tested in the usual types of testing machines, for testing parts of fixed structures, or for testing under any conditions that require that the indenting force be applied in a direction other than vertical.~~

~~3.1.1Required equipment includes an apparatus that contains the Brinell ball and a slot or spacing to insert the calibration bar, the bar and an impacting tool, normally a hammer. This apparatus is designed to allow a ball impression to be produced on the standard rod simultaneously with one produced on the piece to be tested. Calibration tables (slide rule) are used to compare impression diameters and the hardness of the calibration bar to determine the hardness of the piece.~~

~~[1] This practice is under the jurisdiction of ASTM Committee A01 on Steel, Stainless Steel, and Related Alloys and is the direct responsibility of Subcommittee A01.06 on Steel Forgings and Billets.~~

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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* ~~, Vol 01.03.~~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.**

~~3.1.2This apparatus is designed with a surface directly above the Brinell ball where impact is to occur. The apparatus may also be designed to include an extension for stabilization.~~

~~3.2~~

4.1 Comparison hardness testers are used principally for testing articles that are too large or unwieldy to be tested in the usual types of testing machines, for testing parts of fixed structures, or for testing under any conditions that require that the indenting force be applied in a direction other than vertical.

4.1.1 Required equipment includes an apparatus that contains the impression ball and a slot or spacing to insert the comparative test bar (rod), the comparative test bar, a structure to apply the impact (anvil), and an impacting tool, normally a hammer. This apparatus is designed to allow a ball impression to be produced on the standard rod simultaneously with one produced on the piece to be tested. Comparison of the impression diameters together with the hardness of the comparative bar (rod) is used to determine hardness of the part.

4.1.2 The structure to convey the impact to the test bar, impression ball, and part being tested is designed with the striking surface for the impacting tool centered directly above the location of the impression ball.

4.1.3 The apparatus may also be designed to include an extension for stabilization.

4.1.4 The Brinell hardness of the comparison test bar (rod) used should be within ±15% of the anticipated Brinell hardness of the part being tested, and of the same general type of material.

4.1.5 *Impression Ball*:

4.1.5.1 The diameter of the impression ball shall be 10 ± 0.01 mm.

4.1.5.2 The ball shall be made from hardened steel and shall be capable of being used in a reasonable number of tests without incurring damage that could affect the results. Use of a tungsten carbide ball may result in fracture or spalling of the ball.

4.1.5.3 The ball shall be inspected regularly according to the equipment manufacturer's recommendations to ensure accuracy.

4.2 *Measuring Microscope*—The divisions of the micrometer scale ~~on~~of the microscope, or other measuring devices used for measuring the ~~measurement of the diameter of the impression, shall~~ impression diameter, shall be such as to permit the direct measuring of the diameter to 0.1 mm and the estimation of the diameter to ~~0.02~~0.05 mm. ~~This requirement applies to the construction of the microscope only and is not a requirement for measurement of the impression.~~

~~4.~~5. Test Parts

~~4.1Parts~~5.1 Parts tested by this hardness testing practice vary greatly in form since it is frequently desirable to make the impression upon a part to be used in the finished product rather than upon a sample test specimen.

~~4.1.1~~5.1.1 *Dimensions*—The thickness of the tested part shall be such that no bulge or other marking showing the effect of the load appears on the side of the piece opposite the impression. In any event, the thickness of the part shall be at least ten times the depth of the indentation. The minimum width shall be at least two and one half times the diameter of the indentation.

~~4.1.2~~

5.1.2 *Finish*—When necessary, the surface on which the impression is to be made shall be filed, ground, machined, or polished with abrasive material so that the edge of the impression shall be defined clearly enough to permit the measurement of the diameter to the specified accuracy. Take care to avoid overheating or cold working the surface. Sufficient metal shall be removed to eliminate decarburized metal.

~~4.2~~

5.2 *Support*—All parts to be tested shall be adequately supported to prevent any movement or deflection during application of the impact load.

~~5.Verification of Apparatus and Calibration of Comparative Bars~~

~~5.1*Verification*—The hardness-testing apparatus and test bars shall be calibrated in accordance with Test Method E10 prior to use when new, upon replacement of the ball indentor, and periodically during usage as deemed necessary.~~

~~5.2*Comparative Bars*—Hardness of comparative bars (rods) shall be determined by the manufacturer on at least one face at approximately the mid-length of the bar. The ends of the bar shall be permanently marked with the hardness number by the manufacturer prior to shipment. The user shall check the hardness on each additional face to be used prior to testing in accordance with Test Method E10. If the hardness of a face is not within ±2% of the marked hardness number, the face shall not be used for part testing.~~

6. Verification of Apparatus and Calibration of Test Bars

6.1 *Verification of Apparatus*—The hardness-testing apparatus (including test bars) shall be verified by performing tests on Brinell blocks that have been standardized according to the requirements of Test Method E 10.

6.1.1 Full verification of the apparatus shall be performed prior to use when new, and upon replacement of the impression ball. The full verification shall include testing at least one Brinell test block 3 times. The average of the three measurements shall be within ±5 % of the Brinell value of the test block.

6.1.2 Periodic verifications are recommended at the beginning of each day the comparative tester is used, or during usage as deemed necessary. Periodic verifications should be performed using Brinell test blocks within ±15 % of the expected Brinell hardness of the parts being tested. One measurement is satisfactory for periodic testing. The result of the periodic test measurement