Designation: E 110 – 82 (Reapproved 1997)ε2

Standard Test Method for Indentation Hardness of Metallic Materials by Portable Hardness Testers[1]

This standard is issued under the fixed designation E 110; 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.

ε[1] NOTE—Sections 3, 4, and 5 were corrected editorially in January 1998.
ε[2] NOTE—The term *load* was changed to *force* editorially throughout in May 1999.

1. Scope

1.1 This test method covers determination of the indentation hardness of metallic materials by means of portable hardness testers.

1.2 This test method applies only to those portable hardness testers which apply the same nominal forces and use the same indenters as are used in the methods listed in Section 2.

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 10 Test Method for Brinell Hardness of Metallic Materials[2]

E 18 Test Methods for Rockwell Hardness and Rockwell Superficial Hardness of Metallic Materials[2]

E 92 Test Method for Vickers Hardness of Metallic Materials[2]

E 140 Hardness Conversion Tables for Metals (Relationship Between Brinell Hardness, Vickers Hardness, Rockwell Hardness, Rockwell Superficial Hardness, and Knoop Hardness)[2]

NOTE 1—Test Methods E 10, E 18, and E 92 will be referred to in this test method as the" standard methods."

NOTE 2—The standard methods of making the three hardness tests do not preclude the use of portable hardness testers. However, the machines usually used, and considered preferable for these tests, are generally designed so that the magnitude of the indenting force is fixed by dead weights acting on a small piston connected to a hydraulic loading cylinder, or by dead weights acting through a multiple lever system. Portable hardness testers of the types covered in this method do not employ dead weights to fix the indenting forces. This imposes certain limitations and necessitates certain precautions, which are set forth in this test method. All requirements of the standard methods except those modified by the following sections shall apply to the use of portable hardness testers.

3. Apparatus

3.1 Portable 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 which require that the indenting force be applied in a direction other than vertical. In order that they may be portable and also in order that the indenting forces may be applied in any direction, these testers are designed in such a way that dead weights are not used in applying or limiting the indenting force.

3.2 The indenting force may be applied by means of a hydraulic cylinder with a pressure gage to indicate the magnitude of the force. The hydraulic cylinder may also be equipped with a spring-forceed relief valve to fix the magnitude of the force. Alternatively the indenting force may be applied by means of a screw through a calibrated spring with a dial gage or other means of measuring the deflection of the spring to indicate the magnitude of the force.

3.3 Portable hardness testers are generally provided with various means of holding the indenter in contact with the surface to be tested. The testers may be clamped to the object to be tested, attached to an adjacent fixed object or attached to the surface to be tested by a magnet. For testing inside a cavity the tester may be placed against one wall of the cavity to make a test on the opposite wall.

4. Procedure

4.1 Whatever means is used to hold the tester to the piece being tested, make sure that there is no relative motion between the tester and the piece when the force is applied. This is particularly true for the portable Rockwell type tester. Mount the tester in such a position that the axis of the indenter is normal to the surface to be tested.

[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.

4.2 *Application of Force, Portable Brinell Test*—Portable Brinell testers generally apply the force by means of a hydraulic cylinder equipped with both a pressure gage and a spring forceed relief value. With this arrangement it is not possible to maintain the force at the point where the relief valve opens for any appreciable time. Therefore bring up the force several times to the point where the pressure is released. It has been determined that for steel, when testing with a 3000-kgf force, three force applications are equivalent to holding the force 15 s as required in the standard method. For other materials and other forces, make comparison tests to determine the number of force applications required to give results equivalent to the standard method. Bring the force up gradually each time without jerking.

4.3 *Application of Force, Portable Rockwell Type Test*—Portable Rockwell type testers generally apply the force through a calibrated spring by means of a screw and are generally equipped with two indicators, one a dial gage that measures deflection of the spring to indicate the force, and the other a dial gage or micrometer screw to indicate the depth of penetration. Apply the preliminary test force as shown by the force indicator. Set the index on the depth indicator to the proper point. Then apply the total test force. Turn the loading screw in the opposite direction until the preliminary test force is again indicated on the force dial. Then read the hardness on the depth indicator as the difference between the readings at the minor force before and after application of the major force. Bring the force up gradually without jerking. Exercise care not to exceed either the preliminary or the total test forces. Complete the removal of the total test force within 2 s after it has been completely applied.

4.4 *Application of Force, Vickers Type Tester*—Portable Vickers type testers generally apply the force by means of a hydraulic cylinder equipped with a pressure gage. Bring the indenter just in contact with the test surface and check the zero reading of the pressure gage. Then bring the force up to the required value as shown on the pressure gage. Bring the force up gradually without jerking and take care that the required force is not overrun. Maintain the full force for at least 15 s, unless otherwise specified, and then release.

5. Calibration of Apparatus

5.1 Portable hardness testers shall be used only with applied forces at which the force measuring device has been calibrated.

5.2 Portable hardness testers shall also be checked for error periodically by the comparison method or by test blocks as described in the standard methods.

6. Precision and Bias

6.1 *Precision*—The precision of this test method has not been established because of the wide variety of portable hardness testers and metals for which it is used. When required, hardness tolerances for specific applications can be empirically established for a given portable hardness test using standardized reference hardness blocks. The precision of a given portable hardness test, whether involving a single operator, multiple operators, or multiple laboratories, can be established by employing statistical methods.

6.2 *Bias*—The bias of a portable hardness testing machine depends on the bias of the test force, indenter, and the device used to measure the indentation. Although standardized reference hardness blocks are available from hardness tester manufacturers, it is impractical to establish the bias of this test method because of the wide variety of portable hardness testers available, the many types of metallic materials tested by this method and the variations possible within a test specimen. The bias of a given portable hardness tester can be established empirically using such standardized reference hardness blocks by employing statistical methods.

7. Keywords

7.1 metallic; portable hardness tester