Standard Test Method for
Indentation Hardness of Aluminum Alloys by Means of a
Webster Hardness Gage[1]

1. Scope

1.1 This test method covers the determination of indentation hardness of aluminum alloys with a Webster hardness gage, Model B.

1.2 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

1.2.1 *Exception*—The values given in parentheses are for information only.

Note 1—Two other models, A and B-75, are in use, but are not covered in this test method. Model A does not provide numerical values of hardness and Model B-75 covers only a part of the range of interest for aluminum alloys.

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:*[2]

E6 Terminology Relating to Methods of Mechanical Testing

E10 Test Method for Brinell Hardness of Metallic Materials

E18 Test Methods for Rockwell Hardness of Metallic Materials

E177 Practice for Use of the Terms Precision and Bias in ASTM Test Methods

E691 Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method

3. Terminology

3.1 *Definitions*—The definitions of terms relating to hardness testing appearing in Terminology E6 shall be considered

as applying to the terms used in this test method.

4. Significance and Use

4.1 The Webster hardness gage is portable and therefore useful for in situ determination of the hardness of fabricated parts and individual test specimens for production control purposes. It is not as sensitive as Rockwell or Brinell hardness machines; see 10.2.

4.2 This test method should be used only as cited in applicable material specifications.

5. Apparatus (Fig. 1)

5.1 The Webster hardness gage, Model B, consists of three main parts: the frame, operating handle, and penetrator housing assembly. The penetrator housing assembly includes the principal working parts, including the penetrator, loading spring, adjusting nut, penetrator housing, housing key, return spring, and dial indicator.

5.2 The indentor is a hardened steel truncated cone.

5.3 The dial indicator is graduated from 1 to 20, and is actuated by the penetrator so that the higher the reading, the higher is the hardness of the test material.

5.4 The configuration of the Webster hardness gage is such that it is operated like a pair of pliers.

5.5 The clearance between the penetrator and the anvil is about 6 mm (¼ in.), limiting the thickness of sample that can be tested.

6. Test Parts or Specimens

6.1 Any part or piece of material greater than 1 mm (0.04 in.) in thickness and equal to or less than 6 mm (¼ in.) in thickness and with a clear flat area at an edge approximately 25 by 25 mm (1 by 1 in.) in size is suitable for test.

6.2 The surfaces shall be essentially parallel, smooth, clean, and free of mechanical damage. The test surface may be lightly polished to eliminate scratches or die lines.

6.3 The clear, flat area shall be such that there will be a clear distance of at least 3 mm (⅛ in.) from the edge of the part or specimen.
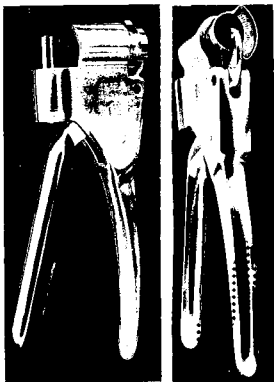
FIG. 1 Webster Hardness Gage, Model B

6.4 Parts or specimens with a slight taper or curvature may also be tested if a round anvil is used, as described in 8.1.1 and Fig. 2.

7. Calibration

7.1 *Zero Adjustment:*

7.1.1 Operate the instrument against the bare anvil and note whether or not the indicator gives the zero (full-scale) reading.

7.1.2 A correction in zero reading is normally not needed except for one of the reasons listed below:

7.1.2.1 A new penetrator has been installed,

7.1.2.2 The dial indicator is changed from one instrument to another, or

7.1.2.3 Excessive wear has taken place.

7.1.3 If an adjustment in zero is needed, turn the zero adjustment screw below the indicator dial slowly (Fig. 3), while operating the tester against the bare anvil and maintaining handle pressure, until the hand of the dial indicator rests on the zero line (which is located at the full-scale reading of 20).
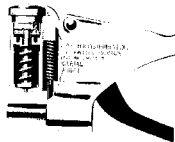

FIG. 3 Zero Adjustment Screw, A (indicated by arrow)

7.1.4 The zero adjustment should never be used to make the indicator read correctly on a standard sample.

7.2 *Load Spring Adjustment:*

7.2.1 Measure the hardness of a standard sample of medium to low hardness, either one furnished with the tester or one developed from reference stock; the dial should show the reading indicated for the standard within ±0.5.

7.2.2 If the readings on the standard or the bare anvil, or both, do not indicate the proper values, adjust the load spring with the special wrench provided until agreement is reached (Fig. 4).

8. Procedure

8.1 Place the test part or specimen between the penetrator and the anvil, and apply pressure to the handle.
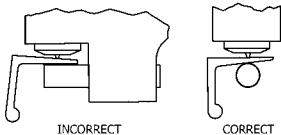

INCORRECT   CORRECT

FIG. 2 Making the Test

FIG. 4 Adjusting Load on Load Spring

8.1.1 If the test part or specimen has a slight taper or curvature, use a round anvil and apply the gage in such a way that the penetrator is applied normal to the test surface until the anvil bears along a line that is parallel to the surface in contact with the penetrator, as illustrated in Fig. 5.

8.2 Apply sufficient pressure to cause the flat face of the penetrator housing to come in contact with the surface of the test part or specimen.

NOTE 2—Excess pressure on the handle is not harmful and does not affect the reading, but neither is it necessary, as the hardness reading is determined solely by the spring deflection.

8.3 Read the hardness from the dial indicator. Report the reading to the nearest 0.5.

NOTE 3—For relatively soft materials, the dial may indicate some drift toward lower numbers with time, after the initial pressure. It is recommended that readings be made quickly and that the highest observed value be used.

9. Report

9.1 The report shall include the following:
9.1.1 Identification of material tested,
9.1.2 Model and serial number of hardness gage,
9.1.3 Number of readings taken,
9.1.4 Average of hardness values, rounded to the nearest half division, and
9.1.5 Date of test.

10. Precision and Bias

10.1 The Webster hardness gage, Model B, is useful for hardness measurements of material in the range from 3003-0 to 7075-T6 representing a range in Rockwell hardness from about 5 HRE to 110 HRE.

10.2 The application of portable impressors, such as the Webster, will produce greater variation in hardness readings than standard fixed frame procedures, such as Test Methods E10 and E18. Further, since the scale of the Webster hardness gage, Model B, has 20 divisions compared to 110 for the Rockwell E scale, it is also less sensitive than the Rockwell scale.

10.3 The variation in readings that results from the application of the Webster hardness impressor has not yet been established.

10.4 The precision of this test method is based on an interlaboratory study of B647, conducted in 2008. Each of five laboratories tested a total of four alloys. Every "test result" represents the average of three individual determinations. Three test results (9 total test readings) from every laboratory were analyzed in order to determine the precision statistics listed below. Practice E691 was followed for the design and analysis of the data; the details are given in ASTM Research Report No. B07-1001.[3]

10.4.1 *Repeatability limit (r)*—Two test results obtained within one laboratory shall be judged not equivalent if they differ by more than the "r" value for that material; "r" is the interval representing the critical difference between two test results for the same material, obtained by the same operator using the same equipment on the same day in the same laboratory.

10.4.1.1 Repeatability limits are listed in Table 1 below.

10.4.2 *Reproducibility limit (R)*—Two test results shall be judged not equivalent if they differ by more than the "R" value for that material; "R" is the interval representing the critical difference between two test results for the same material, obtained by different operators using different equipment in different laboratories.

10.4.2.1 Reproducibility limits are listed in Table 1 below.

10.4.3 The above terms (repeatability limit and reproducibility limit) are used as specified in Practice E177.

10.4.4 Any judgment in accordance with 10.4.1 and 10.4.2 would normally have an approximate 95 % probability of being correct, however the precision statistics obtained in this ILS

TABLE 1 Summary Statistics for Webster Hardness (Webster Scale Units) From Tests On Several Materials

Material	Average[A]	Repeatability Standard Deviation	Reproducibility Standard Deviation	Repeatability Limit	Reproducibility Limit
	X̄	S_r	S_R	r	R
3003-02	4.639	0.078	1.128	0.218	3.157
5052-H32	10.356	0.546	1.665	1.529	4.663
6061-T6	16.172	0.286	0.380	0.801	1.063
7075-T6	19.028	0.096	0.096	0.269	0.269

[A] The average of the laboratories' calculated averages.

must not be treated as exact mathematical quantities which are applicable to all circumstances and uses. The limited number of materials tested and laboratories reporting results guarantees that there will be times when differences greater than predicted by the ILS results will arise, sometimes with considerably greater or smaller frequency than the 95 % probability limit would imply. Consider the repeatability limit and the reproducibility limit as general guides, and the associated probability of 95 % as only a rough indicator of what can be expected.

10.5 *Bias*—At the time of the study, there was no accepted reference material suitable for determining the bias for this test method, therefore no statement on bias is being made.

10.6 The precision statement was determined through statistical examination of 60 results, from five laboratories, on four alloys, described in:

3003-02 - Alcoa Rolled Plate 0.250" x 12" x 12" from 48" wide production
5052-H32- Alcoa Rolled Plate 0.250" x 12" x 12" from 48" wide production
6061-T6 - Kaiser Rolled Plate 0.250" x 12" x 12" from 48" wide production
7075-T6 - Kaiser Rolled Plate 0.250" x 12" x 12" from 48" wide production