Designation: B 820 – 98

Standard Test Method for Bend Test for Formability of Copper Alloy Spring Material[1]

This standard is issued under the fixed designation B 820; 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 testing of thin copper alloy strip to determine its formability or its ability to resist cracking when forming around a specific radius. The criterion for failure is the occurrence of cracks found on the outer radius of curvature (convex).

1.2 This bend test is limited to strip 0.003 to 0.031 in. thick. (0.076 to 0.79 mm).

1.3 The size of the forming radii used in this test shall be 0.005 to 0.250 in. (0.127 to 6.35 mm).

1.4 The values stated in inch-pounds are to be regarded as the standard. The values given in parentheses are for information only.

1.5 *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 The following documents in the current issue of the *Annual Book of ASTM Standards* form a part of this specification to the extent referenced herein:

2.2 *ASTM Standards:*

E 6 Terminology Relating to Methods of Mechanical Testing[2]

E 290 Test Method for Semi-Guided Bend Test for Ductility of Metallic Materials[2]

3. Terminology

3.1 The following terms are defined in Terminology E 6, and are illustrated in Fig. 1.

3.1.1 angle of bend, and

3.1.2 radius of bend.

3.2 *Description of Terms Specific to This Standard:*

3.2.1 *longitudinal bend (or good way bend)*—The axis of the bend is at an angle of 90° to the direction of rolling, drawing or extrusion as shown in Fig. 2.

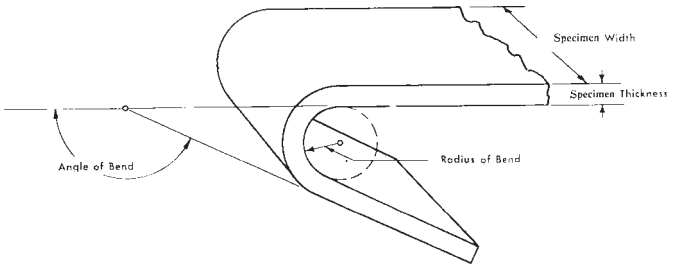

FIG. 1 Illustration of Terminology

3.2.2 *transverse bend (or bad way bend)*—The axis of the bend is a plane parallel to the direction of rolling, drawing or extrusion as shown in Fig. 2.

NOTE 1—The usage of these two terms is consistent with Test Method E 290.

4. Summary of Test Method

4.1 The bend test is made by applying a force transversely to the length of the specimen in the portion being bent, usually at midlength. These 90° bending forces are applied through an arrangement illustrated in Fig. 3, while 180° bending forces are applied through an arrangement illustrated in Fig. 4. When complete fracture does not occur, the convex surface of the specimen is examined for cracks. In general, the test using a 180° bend angle is a more severe test than the test using a 90° bend angle.

5. Significance and Use

5.1 This bend test provides information as to the formability or the ability of copper alloy spring material to resist cracking when being formed.

5.2 This test method can be used as a quality control tool to determine if a spring material is capable of forming to a given radius.

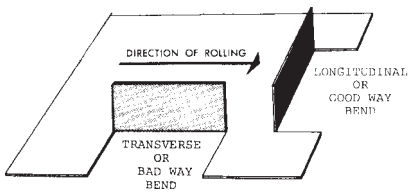

FIG. 2 Direction of Bending

[1] This test method is under the jurisdiction of ASTM Committee B-5 on Copper and Copper Alloys and is the direct responsibility of Subcommittee B05.06 on Methods of Test.

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[2] *Annual Book of ASTM Standards*, Vol 03.01.

***A Summary of Changes section appears at the end of this standard.**

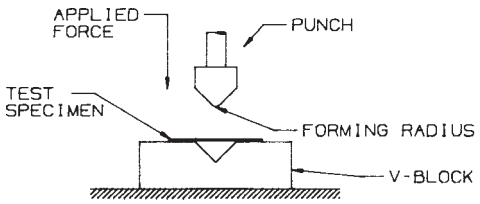

FIG. 3 V-Block and Punch for 90° Bend Test

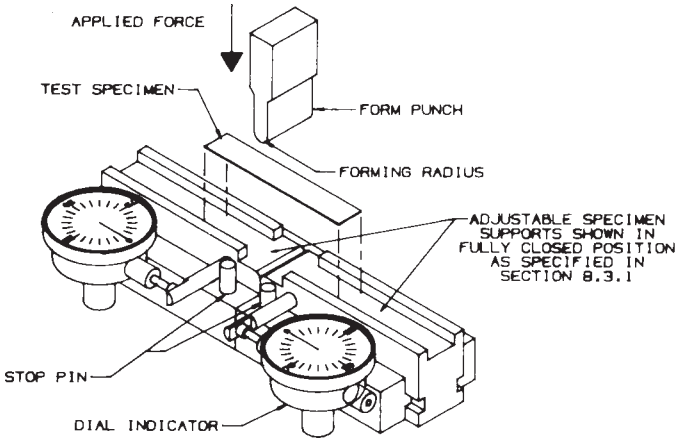

FIG. 4 Fixture for 180° Bend Test

5.3 This test method is also useful in research and development to provide data for use in selecting a spring material that will safely form to the geometry of a given part.

5.4 The results are suitable for direct application in design and manufacturing, only when all factors such as the geometry of the part, punch and die design, lubrication, stamping speed, and other material properties are known.

6. Apparatus

6.1 Various devices are suitable for 90° or 180° bend testing. The apparatus shall provide these features:

6.1.1 *90° Bend Test Fixture*—An illustration of this test fixture is shown in Fig. 3. A specimen rests on a pair of pins, rollers, or radiused flat supports; a pin, mandrel, or 90° V-block punch of a given bend radius for applying the bending force directly at the midlength.

6.1.2 *180° Bend Test Fixture*—An illustration of this test fixture is shown in Fig. 4. A specimen rests on a pair of pins, rollers, or radiused flat supports; a pin, mandrel, or 180° punch of a given bend radius for applying the bending force directly at the midlength. Dial indicators with a precision of 0.0005 in. (0.013 mm) or better are necessary to accurately position the two supports.

6.2 The radius of the single pin, mandrel, or punch applying the bend force at the midlength shall differ not more than +5 % from the nominal value.

6.3 The length of all pins, rolls, mandrels, and radius flats must exceed the width of the specimen; they must be strong enough and sufficiently rigid to resist significant deformation.

7. Test Specimens

7.1 Five specimens are required for this test.

7.2 The test specimens may be prepared by cutting, shearing, or stamping.

7.3 The test specimens shall have a width of ½ ± 1⁄16 in. (12.7 ± 1.57 mm) and of any convenient length greater than ½ in. unless specified otherwise by purchaser.

7.4 *Direction of Specimen:*

7.4.1 The bending characteristics of a metal vary with the orientation of the bends to the direction of rolling. A longitudinal or good way bend will take a sharper bend radius than a transverse bend. This characteristic becomes more pronounced as the metal thickness increases.

7.4.2 In a longitudinal or good way bend specimen, its length shall be parallel to the direction of rolling as indicated in Fig. 2.

7.4.3 In a transverse bend (or bad way bend) specimen, its length shall be at an angle of 90° to the direction of rolling as indicated in Fig. 2.

7.4.4 Unless stated otherwise, the length and width of rectangular specimens shall be in the plane of the two major dimensions of the product.

7.5 The specimen thickness shall be measured using a micrometer to a precision of 0.0005 in. (0.013 mm).

8. Procedure

8.1 *Direction of Test*—All tests shall be performed with the axis of the bend at 90° to the specimen length.

8.2 *90° Bend Test:*

8.2.1 Place the specimen between the supports and apply the bend force until an angle of bend of 90° is reached. Release the force and examine the specimen.

8.3 *180° Bend Test:*

8.3.1 Adjust the specimen supports using the dial indicators. Move each support away from the test punch center line (fully closed position) by a distance equal to twice the strip thickness plus the punch radius, plus 0.0005 in. (0.013 mm).

8.3.2 Place the specimen between the supports and apply the bend force until an angle of bend of 180° is reached. Release the force and examine the specimen.

8.4 *Pass/Fail Criterion*—To pass either the 90° or 180° bend test, all five specimens must not exhibit any cracks when examined at a magnification of 10×. (The appearance of orange peel or roughened surface does not constitute a crack.)

9. Report

9.1 The results shall be reported as a minimum bend ratio (smallest passing bend test radius/strip thickness). It should be referenced with the degree of bend (90° or 180°) and test direction (longitudinal or transverse).

10. Retest

10.1 If one out of the five test specimens fails, a retest is permitted. If more than one specimen fails, no retesting is permitted.

10.2 A retest requires an additional five test specimens. All of these specimens must pass the bend test.

11. Precision and Bias

11.1 No information is presented about either precision or bias of Test Method B 820 for measuring formability of copper alloy spring material since the test result is nonquantitative.

12. Keywords

12.1 bend test; copper spring test; formability test

SUMMARY OF CHANGES

Committee B-5 has identified the location of selected changes to this standard since the last issue, B 820 – 92, that may impact the use of this standard.

(*1*) No changes have been made.