Designation: A 720/A 720M – 02 (Reapproved 2007)

Standard Test Method for Ductility of Nonoriented Electrical Steel[1]

This standard is issued under the fixed designation A 720/A 720M; 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 determination of ductility utilizing Epstein test strips and a bending device for bending the strip over a predetermined radius. It is intended for commercial silicon-bearing steel sheet or strip of nonoriented types in the thickness range from 0.010 to 0.031 in. [0.25 to 0.79 mm], inclusive.

1.2 The values and equations stated in customary (cgs-emu and inch-pound) or SI units are to be regarded separately as standard. Within this test method, SI units are shown in brackets. The values stated in each system may not be exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems may result in nonconformance with this test method.

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]

A 34/A 34M Practice for Sampling and Procurement Testing of Magnetic Materials

A 677 Specification for Nonoriented Electrical Steel Fully Processed Types

A 683/A 683M Specification for Nonoriented Electrical Steel, Semiprocessed Types

E 290 Test Methods for Bend Testing of Material for Ductility

3. Summary of Test Method

3.1 A test strip is placed in the special test apparatus designed to clamp one end of the specimen securely while the other end is free to move, but held in tension by a spring. The specimen is repeatedly bent through 180° reversals until a crack appears at the bend or until sudden failure occurs by complete rupture. The number of reversals until failure is taken as a measure of the ductility.

4. Significance and Use

4.1 This is a specialized bend test for nonoriented electrical steel not covered under the provisions of Test Methods E 290.

4.2 This test is applicable to nonoriented silicon steel such as described in Specifications A 677/A 677M and A 683/A 683M in commercial thicknesses.

4.3 It is not intended to be applied to steels considered inherently ductile.

5. Apparatus

5.1 The apparatus, Fig. 1, consists of a set of stationary jaws and a movable arm to which is attached another set of jaws and a spring.

5.1.1 The stationary jaws shall have working edges with radii of approximately 0.2 in. [5 mm] over which the test specimen is bent. Stationary jaws shall be of the quick-clamping type.

5.1.2 The jaws attached to the movable arm shall allow the specimen to move freely during bending.

5.1.3 The spring clamped to the free end of the specimen shall provide sufficient tension in the specimen to localize the bend.

5.1.4 Design of the movable arm shall permit a rotation of approximately 180°.

6. Sampling

6.1 Select samples from at least two well separated locations in each test lot or lift.

6.1.1 The test specimens may be cut from samples used for the core loss or other tests in accordance with the practice in Practice A 34/A 34M.

6.1.2 Cut test specimens from near each end of each sample coil and from the middle and the end of each sample sheet.

7. Test Specimen

7.1 The test specimens shall be about 1.2 in. [30 mm] in width and not less than 6 in. [150 mm] in length.

[1] This test method is under the jurisdiction of ASTM Committee A06 on Magnetic Properties and is the direct responsibility of Subcommittee A06.01 on Test Methods.

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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* volume information, refer to the standard's Document Summary page on the ASTM website.

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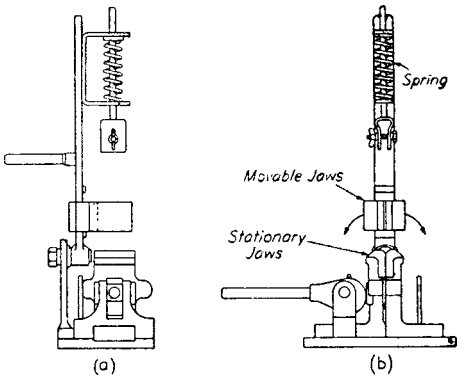

FIG. 1 Apparatus for Bend Test

7.2 The number of test specimens representing each test lot shall not be less than ten.

7.2.1 The long axis of at least five test specimens shall be in the direction of rolling and at least five at right angles to the direction of rolling.

7.2.2 When width of the material prevents cutting specimens at right angles to the direction of rolling, all specimens shall be cut in the direction of rolling, and this shall be reported with the test results.

7.3 Edges of the test specimens shall be practically free of burrs; filing or machining to remove burrs is permissible.

8. Procedure

8.1 The specimen strips shall be at a temperature of 25 ± 5°C at the start of the test.

8.2 Clamp the specimen tightly in the stationary jaws of the bend test machine, Fig. 1, and place in tension by stretching the spring during clamping.

8.3 Bend the specimen through 90° by use of the movable arm and jaws, Fig. 2; then bend it through 180° in the reverse direction. Again bend the specimen through 180° in the first direction and continually through 180° reversals until a crack appears at the bend or until sudden failure occurs by complete rupture.

8.4 Each full 180° bend, including the first 90° bend, shall be counted as one bend in determining the number of bends withstood by the specimen.

9. Calculations

9.1 Express the ductility of the test lot or lift as the average of the number of bends withstood by the test specimens from that test lot or lift.

10. Precision and Bias

10.1 The procedure in this test method has no bias because the ductility rating determined is defined only in terms of this method. Although no rigorous interlaboratory comparisons of this test method have been conducted, it is estimated that the reproducibility standard deviation would not exceed 1 bend.

11. Keywords

11.1 ductility; electrical; nonoriented; silicon; steel

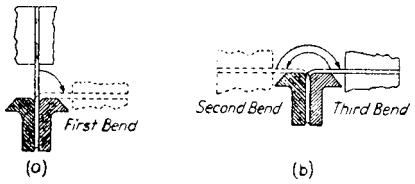

FIG. 2 Diagram Illustrating Method of Making Bends

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