Designation: B 279 – 04

Standard Test Method for Stiffness of Bare Soft Square and Rectangular Copper and Aluminum Wire for Magnet Wire Fabrication[1]

This standard is issued under the fixed designation B 279; 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, known as the low-stress elongation (LSE) test, covers the procedure for determining the stiffness of bare soft square and rectangular copper and aluminum wire in terms of the permanent elongation resulting from the application of a tensile stress.

1.2 The SI values for the mass of the specimen are regarded as the standard. For all other properties, the inch-pound values are to be regarded as standard and the SI units may be approximate.

2. Referenced Document

2.1 The following document forms a part of this test method to the extent referenced herein:

2.2 *ASTM Standards:* [2]

E 4 Practices for Force Verification of Testing Machines

3. Significance and Use

3.1 This test method is designed as an inspection or acceptance test of new bare soft square and rectangular wire intended for subsequent fabrication into magnet wire.

NOTE 1—Since the applied unit stress and the time of application are constant for all wire sizes, the test enables comparisons of stiffness to be made between wires of the same or different size on the basis of the permanent elongation resulting from the application of a low unit stress.

4. Apparatus

4.1 Tensile testing machines used for the low-stress elongation test shall conform to the requirements of Practices E 4.

5. Test Specimens

5.1 The test specimens shall be taken from the finished reel or coil with a minimum amount of handling and distortion, retaining the original curvature of the package to the greatest extent possible. Test specimens having the full cross-sectional area of the wire shall be used. The standard gage length for the measurement of elongation of wire shall be 10 in. (254 mm). The total length of the specimens shall be at least equal to the gage length plus the length of wire required for the full use of the grips employed.

6. Procedure

6.1 Straighten the test specimens carefully by hand with a minimum amount of distortion or cold work. Improperly prepared test specimens often cause unsatisfactory test results.

6.2 Cut off a test specimen of sufficient length as described in 5.1. Measure the length to the nearest 0.01 in. (0.25 mm) with any measuring device accurate to 0.1 % (Note 2). Measure the mass of this specimen to the nearest 0.01 g on a balance accurate to 0.1 %. The load required to apply a stress to the specimen equal to 15 000 psi (103 MPa) for copper, and 8 000 psi (55 MPa) for aluminum shall be obtained from the following:

$$P = \frac{KW}{L}$$

where:

P = Required load, lbs (N),
W = mass of specimen, g,
L = length of specimen, in., and
K = 102.74 for copper specimens, length in in., required load in lb, or
K = 11 612.7 for copper specimens, length in mm, required load in N, or
K = 180.5 for aluminum specimens, length in in., required load in lb, or
K = 20 401.9 for aluminum specimens, length in mm, required load in N.

NOTE 2—Where a large number of specimens are to be tested, the calculation of the required load (P) can be simplified by careful cutting of all test specimens to equal lengths. The use of a jig or a pair of vices with jaws set at a predetermined length apart can facilitate the cutting of equal length specimens. With all specimens having an equal length, the specimen mass becomes the only variable and the required load (P) will vary proportionately specimen to specimen with the specimen mass.

Where the mass of the test specimen exceeds the capacity of the available balance, a shorter length specimen may be used to determine the

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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.

mass of the test specimen. The shorter specimen shall be cut from the same coil or reel immediately adjacent to where the test specimen was cut. The length of the short specimen shall be measured with an accuracy of at least 0.2 % and the mass of the short specimen shall be determined in accordance with the requirements of 6.2. The mass of the test specimen may be calculated by multiplying the ratio of the test specimen length divided by the short specimen length by the mass of the short specimen.

6.3 Mark the 10-in. (254-mm) gage marks by any suitable method that will eliminate the possibility of fracture at the gage marks.

6.4 Place the test specimen, properly marked with 10-in. (254-mm) gage marks, in the tensile testing machine and slowly and uniformly apply the load determined in 6.2. Hold the load for 30 s and then remove the load.

6.5 After the load has been removed, measure the permanent elongation of the test specimen between the gage marks to the nearest 0.01 in. (0.25 mm) using dividers and scale or other suitable means.

7. Low-Stress Elongation

7.1 The low-stress elongation shall be recorded as the increase in length of the gage length, expressed in percent.

8. Precision and Bias

8.1 *Precision*—This test method has been in use for many years. No statement of precision has been made and no work has been planned to develop such a statement.

8.2 *Bias*—This test method has no bias because the value for (tensile) stiffness of wire is determined solely in terms of this test method.

9. Keywords

9.1 aluminum wire; copper wire; soft square and rectangular aluminum wire; soft square and rectangular copper wire