Designation: B 598 – 98 (Reapproved 2004)

Standard Practice for Determining Offset Yield Strength in Tension for Copper Alloys[1]

This standard is issued under the fixed designation B 598; 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.

1. Scope*

1.1 This practice establishes the requirements for determining offset yield strength (0.01 %, 0.02 %, and 0.05 % offset) at room temperature. It is intended for copper alloys in tempers commonly used for spring applications, and materials thicker than 0.010 in. (0.25 mm).

1.1.1 The primary application of this practice is intended for flat strip materials that are used for springs; however, this practice can be used for other product forms, such as wire, rod, and bar.

1.2 The values stated in inch pound units are the standard. The SI values given in parentheses are for information only.

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 The following documents in effect on the date that the material is tested form a part of this practice, to the extent referenced herein:

2.2 *ASTM Standards:* [2]

E 4 Practices for Force Verification of Testing Machines

E 6 Terminology Relating to Methods of Mechanical Testing

E 8 Test Methods for Tension Testing of Metallic Materials

E 74 Practice for Calibration of Force Measuring Instruments for Verifying the Load Indication of Testing Machines

E 83 Practice for Verification and Classification of Extensometers

3. Terminology

3.1 The definitions of terms relating to mechanical testing in Terminology E 6 apply.

4. Summary of Practice

4.1 To determine the offset yield strength, it is necessary to acquire data (autographic or numerical) from which a stress-strain diagram may be drawn. The stress at which a specified deviation of strain from the linear portion of the stress-strain curve occurs is the yield strength at that particular offset.

5. Significance and Use

5.1 This practice may be used for approximating a limiting design stress at room temperature and, in some cases, for approximating the range of elastic behavior. Elastic limit, or the greatest stress that a material is capable of sustaining without any permanent strain remaining upon complete release of the stress, is a more technically accurate design parameter; however, the elastic limit is extremely difficult to measure in routine testing. Caution should be used in applying such values to predict the behavior of flat or wire springs in bending, torsion or other stress modes, or at temperatures other than that at which the determination is made.

6. Apparatus

6.1 Standard testing machine of adequate capacity, conforming to the requirements of Practices E 4 and E 74.

6.2 *Class B-1 or more accurate Extensometers,* conforming to the requirements of Practice E 83 and suitable to the tension test specimen required for the application.

6.3 *Extensometer Calibrator,* or similar device accurate to 0.00002 in. (0.0005 mm).

7. Test Specimen

7.1 Tension test specimens shall be selected from Test Methods E 8 as appropriate for the product form.

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[1] This practice is under the jurisdiction of ASTM Committee B05 on Copper and Copper Alloys and is the direct responsibility of Subcommittee B05.06 on Methods of Test.

Current edition approved May 1, 2004. Published May 2004. Originally approved in 1974. Last previous edition approved in 1998 as B 598 – 98.

[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.

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

8. Procedure

8.1 Follow the accepted practices for preparation to perform a tension test in accordance with Test Methods E 8. Special care in the preparation of thin-gage samples, including contour and edge preparation should be used.

8.2 Select the load range so that the yield strength falls within the upper half of the chart load range used. Choose a strain magnification so that the 0.0001, 0.0002 or 0.0005-in./in. (or mm/mm) increment of strain can be readily determined from the chart.

8.3 Apply a preload of nominally 10 % of the known or anticipated offset yield strength to the test specimen to align the grips and to remove all slack and curvature from the specimen.

8.4 Seat the extensometer firmly on the test specimen while maintaining the preload. Apply the load uniformly until the desired testing speed is attained. The rate of stress application shall not exceed 100 000 psi/min (12 MPa/s). Take care that the recording equipment is functioning correctly and indicating the load properly.

8.5 Remove the extensometer when the curve indicates adequate departure from linear behavior to reveal the desired offset, without stopping the test.

8.6 Determine the offset yield strength from the stress-strain diagram as described in Test Methods E 8.

9. Calculation and Report

9.1 Determine the load where the offset line intersects the stress-strain curve. This load in pounds divided by the original cross section area is the yield strength and is reported as yield strength (offset value).

10. Precision and Bias

10.1 *Precision*—The following parameters are reported to impact upon the precision of this practice:

10.1.1 Characteristics of the specimen such as orientation of grains relative to the axial stress, grain size, residual stress, previous strain history, dimensions, and eccentricity.

10.1.2 Testing conditions such as alignment of the specimen, speed of testing, temperature, temperature variations, conditions of test equipment, ratio of error in load to the range in load values, and ratio of error in extension measurement to the range in extension values.

10.1.3 Interpretation of data such as whether graphical or digital data were taken, calibration of recording or data-logging device, number of data pairs used to obtain slope of stress-strain curve.

10.2 *Bias*—A statement of bias of this practice requires reference standard values for one or more materials based on many measurements or round-robin test data. Such standard reference values or test data are presently not available.

11. Keywords

11.1 offset yield; tensile test; yield strength

SUMMARY OF CHANGES

This section identifies the principle changes to this practice that have been incorporated since the 1992 issue as follows.

(*1*) The practice has been extensively, editorially revised. No technical changes have been made.

(*2*) Section 1.1.1 was added for amplification.

(*3*) Sections 1.2, 4, 5, and 7 were reworded for clarification.