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Standard Test Method for Bending Fatigue Testing for Copper-Alloy Spring Materials¹

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1. Scope*

1.1 This test method describes procedures for the determination of the reversed or repeated bending fatigue properties of copper alloy flat-sheet or strip-spring materials by fixed cantilever, constant amplitude of displacement-type testing machines. This method is limited to flat stock ranging in thickness from 0.005 to 0.062 in. (0.13 to 1.57 mm), to a fatigue-life range of 10^5 to 10^8 cycles, and to conditions where no significant change in stress-strain relations occurs during the test.

NOTE 1—This implies that the load-deflection characteristics of the material do not change as a function of the number of cycles within the precision of measurement. There is no significant cyclic hardening or softening.

1.2 The values stated in inch-pound units are to be regarded as the standard. 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 ASTM Standards:

E 206 Definitions of Terms Relating to Fatigue Testing and the Statistical Analysis of Fatigue Data²

E 468 Practice for Presentation of Constant Amplitude Fatigue Test Results for Metallic Materials³

3. Terminology

3.1 For terminology relating to this test method, refer to Definitions E 206 and Practice E 468.

4. Summary of Test Method

4.1 A prepared test specimen of a specific wrought copper alloy flat-sheet or strip-spring material is mounted into a fixed

cantilever, constant-deflection type fatigue testing machine. The specimen is held at one end, acting as a cantilever beam, and cycled by flexure followed by reverse flexure until complete failure. The number of cycles to failure is recorded as a measure of fatigue-life.

5. Significance and Use

5.1 The flexural fatigue test described in this test method provides information on the ability of a copper alloy flat-spring material to resist the development of cracks or general mechanical deterioration as a result of a relatively large number of cycles (generally in the range 10^5 to 10^8) under conditions of constant displacement.

5.2 This test method is primarily a research and development tool which may be used to determine the effect of variations in materials on fatigue strength and also to provide data for use in selecting copper alloy spring materials for service under conditions of repeated strain cycling.

5.3 The results are suitable for direct application in design only when all design factors such as loading, geometry of part, frequency of straining, and environmental conditions are known. The test method is generally unsuitable for an inspection test or a quality control test due to the amount of time and effort required to collect the data.

6. Apparatus

6.1 *Testing Machine*—The fatigue testing machine is a fixed-cantilever, constant-deflection type. In this machine (Fig. 1) the test specimen shall be held as a cantilever beam in a clamp at one end and deflected by a concentrated load applied near the other end of the apex of the tapered section (Fig. 2). Either the clamp or the loading member may be adjusted so that the deflection of the free end of the cantilever is either completely reversed (mean displacement equal to zero) or greater in one direction of bending (mean displacement not equal to zero).

6.2 A suitable counter and monitoring circuit is required to provide a direct readout of the number of cycles to complete failure, that is, separation into two pieces.

7. Test Specimen

7.1 The test specimen shall be of the fixed-cantilever type. Several such specimens which have been used successfully are shown in Fig. 2.

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 Discontinued, see 1986 *Annual Book of ASTM Standards*, Vol 03.01.

³ *Annual Book of ASTM Standards*, Part 03.01.