



Designation: B 577 – 93 (Reapproved 1998)

Standard Test Methods for Detection of Cuprous Oxide (Hydrogen Embrittlement Susceptibility) in Copper¹

This standard is issued under the fixed designation B 577; 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 These test methods describe procedures for determining the presence of cuprous oxide (Cu₂O) in products made from deoxidized and oxygen-free copper.

1.2 Inch-pound units are 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.*

1.4 The test methods appear in the following order:

	Sections
Microscopical Examination without Thermal Treatment	9-11
Microscopical Examination after Thermal Treatment	12-14
Closed Bend Test after Thermal Treatment	15-17
Reverse Bend Test after Thermal Treatment	18-20

2. Referenced Documents

2.1 *ASTM Standards:*

E 3 Methods of Preparation of Metallographic Specimens²

E 883 Guide for Reflected-Light Photomicrography²

3. Terminology

3.1 *Definitions:*

3.1.1 *deoxidized copper*—material produced substantially free of cuprous oxide, by the use of metallic or metalloidal deoxidizers, as determined by metallographic examination at 75× under polarized light.

3.1.1.1 Oxygen may be present as residual deoxidation products.

3.1.2 *embrittlement*—the reduction of the normal ductility in a metal as a result of a physical or chemical change.

3.1.2.1 *Embrittlement*, as it relates to these test methods, is the loss of ductility caused by the reaction of cuprous oxide in

the copper material when exposed at elevated temperatures to a reducing atmosphere.

3.1.3 *oxygen-free copper*—electrolytic copper produced substantially free of cuprous oxide without the use of metallic or metalloidal deoxidizers as determined by metallographic examination at 75× under polarized light,

3.1.3.1 Oxygen may be present up to a maximum of 5 ppm in Copper UNS No. C10100 and 10 ppm in Copper UNS No. C10200.

4. Summary of Test Methods

4.1 The presence of cuprous oxide is determined either by microscopical examination under polarized light or by methods that involve heating the test specimens in a hydrogen-rich atmosphere and rapidly cooling the specimens without undue exposure to air followed by a microscopical examination or a suitable bend test.

5. Significance and Use

5.1 These test methods determine whether copper products will be resistant to embrittlement when exposed to elevated temperatures in a reducing atmosphere.

5.1.1 It is assumed that all who use these test methods will be trained personnel capable of performing these procedures skillfully and safely. It is expected that work will be performed in a properly equipped facility.

6. Apparatus

6.1 *Test Method A*—Metallographic equipment of the type described in Methods E 3 and Guide E 883 suitably equipped with a polarized light illuminating device.

6.2 *Test Methods B, C, and D:*

6.2.1 Metallographic equipment of the type described in Methods E 3 and Guide E 883 provided with normal illumination.

6.2.2 A furnace of sufficient capacity, capable of maintaining the required reducing atmosphere while the specimens are being heated. A rapid cooling device using either water or a reducing atmosphere is required.

6.2.3 A machinist vise with replaceable matching pairs of jaw mandrels of various radii contours.

¹ This specification 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.

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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.