



Summary of Substantive Changes between the 2014 and the 2016 editions of ASTM B88, Seamless Copper Water Tube

Presented to the IAPMO Standards Review Committee on January 9, 2017

General: The changes to this standard may have an impact on currently listed products. The editorial changes are:

- Removed the UNS C10200 from the scope of the copper alloys covered in this standard (see Section 1).
- Included allowance of hot-or-cold working during the annealing process for the materials (see Section 5).
- Changed the grain size requirements for O50 temper in Table 3 and clarified the test standard ASTM E112 for acceptance or rejection based on grain size (see Section 8 and Table 3).
- Included an allowance for blemishes in the performance requirements for the flattening test (see Section 10.2).

Section 1, Scope: Removed the UNS C10200 from the scope of the copper alloys covered in this standard as follows:

1.2 The tube shall be produced from the following coppers, and the manufacturer has the option to supply any one of them, unless otherwise specified.

Copper

| <i>UNS No.</i> | <i>Previously Used Designation</i> | <i>Description</i> |
|-------------------|------------------------------------|--|
| C10200 | OF | Oxygen free without residual deoxidants |
| C12000 | DLP | Phosphorus deoxidized, low residual phosphorus |
| C12200 | DHP | Phosphorus deoxidized, high residual phosphorus |

Section 3, Terminology: Replaced existing definitions with reference to ASTM B846 “Terminology for Copper and Copper Alloys” as follows:

3.1 Definitions: —For definitions of terms related to copper and copper alloys, refer to Terminology B846.

~~3.1.1 coil, n— a length of the product wound into a series of connected turns. The unqualified term “coil” as applied to tube usually refers to a bunched coil.~~

~~3.1.1.1 bunched, n— ...~~

~~3.1.1.2 ...~~

~~...~~

~~...~~



Section 4, Ordering Information: Included additional options available for specification at the time of the order as follows:

4.2 The following options are available and shall be specified at the time of the order, when required:

[4.2.1 Expansion of chemical analysis \(see 6.2\),](#)

4.2.2 Tensile test,

4.2.3 Grain size determination (Section 8),

[4.2.4 Hardness test \(Section 9\),](#)

4.2.5 Expansion test (~~9.1~~[10.1](#)),

[4.2.6 Flattening test \(10.2\),](#)

4.2.7 Microscopical Examination for Hydrogen Embrittlement, Procedure B (~~9.3.2~~[10.3.1.1](#)).

[4.2.8 Heat identification or traceability \(5.1.2\),](#)

[4.2.9 Certification,](#)

[4.2.10 Mill Test Report,](#)

[4.2.11 Product specification number to be shown on package \(see 23.2\).](#)

Section 5, Materials and Manufacture: Updated to include hot-or-cold working during the annealing process as follows:

~~5.1 The material shall be of such quality and purity that the finished product shall have the properties and characteristics prescribed in this specification, and shall be cold drawn to size.~~

~~5.2 The tube shall be finished by such cold working and annealing operations as are necessary to produce the required temper and surface finish~~

~~5.1 Materials:~~

~~5.1.1 The material of manufacture shall be a form of such purity and soundness as to be suitable for processing into the products prescribed herein.~~

~~5.1.2 When specified in the contract or purchase order that heat identification or traceability is required, the purchaser shall specify the details desired.~~

~~NOTE 4—Because of the discontinuous nature of the processing of castings into wrought products, it is not practical to identify specific casting analysis with a specific quantity of finished material.~~

~~5.2 Manufacturer:~~

~~5.2.1 The product shall be manufactured by such hot-working, cold-working, and annealing processes as to produce a uniform wrought structure in the finished product.~~

~~5.2.2 The product shall be hot- or cold-worked to the finished size and subsequently annealed, when required, to meet the temper properties specified.~~

~~5.3~~5.2.3 Tube when furnished in coils shall be annealed after coiling.

~~5.4~~5.2.4 Tube when furnished in straight lengths shall normally be in the drawn temper. Upon agreement between the manufacturer or supplier and the purchaser, the manufacturer shall have the option to supply annealed straight length tubing.



Section 7, Temper: Clarified the annealed and drawn temper requirements as follows:

~~7.1 Seamless copper water tube shall be furnished in the tempers designated below. Current designations as defined in Classification B601 are shown.~~

~~Annealed—O~~

~~Drawn—H~~

The standard tempers for products described in this specification are given in Table 3.

7.1.1 Annealed tempers O60, and O50.

7.1.2 Drawn temper H58.

Section 8, Grain Size for Annealed Tempers: Changed the grain size requirements for O50 temper in Table 3 and clarified the test standard ASTM E112 for acceptance or rejection based on grain size as follows:

8. Grain Size for Annealed Tempers

8.1 When specified in the contract or purchase order, the annealed products furnished under this specification shall conform to the grain requirements prescribed in Table 3.

8.2 Acceptance or rejection based upon grain size shall depend on the average grain size of a test specimen and shall be within the limits prescribed in Table 3 when determined in accordance with Test Methods E112.

9. Mechanical Property Requirements: Clarified the requirements for Tensile Strength and Rockwell Hardness as follows:

~~8.1. The tube shall conform to the mechanical property requirements prescribed in Table 3. Tension tests and grain size determinations need not be made except when indicated by the purchaser at the time of placing the order. A convenient method of indicating that these tests are to be made is to state that "Test Procedure 'T' is required" (see 4.2.1). Where agreement on the Rockwell hardness tests cannot be reached, the tensile strength and grain size requirements of Table 3 shall be the basis for acceptance or rejection.~~

9.1 Tensile Strength Requirements:

9.1.1 The product furnished under this specification shall conform to the tensile requirements prescribed in Table 3, when tested in accordance with Test Method E8/E8M. Actual testing need not be performed unless specified at time of order placement. Acceptance or rejection based upon mechanical properties shall depend on tensile strength.

9.2 Rockwell Hardness Requirement:

9.2.1 When specified in the contract or purchase order, the product shall conform to the Rockwell hardness requirement prescribed in Table 3, when tested in accordance with Test Methods E18.

Section 10.2, Flattening Test: Included an allowance for blemishes in the performance requirements for the flattening test as follows:

10.2.1.1 During inspection, the flattened areas of the test specimen shall be free of defects, but blemishes of a nature that do not interfere with the intended application are acceptable.



Section 15, Number of Tests and Retests: Removed the requirement that the purchaser shall specify the details desired and moved the informative text on processing of castings into wrought products into Section 5, Note 4 as follows:

15.1 Tests:

15.1.1 Chemical Analysis

~~14.1.1.3 Because of the discontinuous nature of the processing of castings into wrought products, it is not practical to identify specific casting analysis with a specific quantity of finished material.~~

~~14.1.1.4 In the event that heat identification or traceability is required, the purchaser shall specify the details desired.~~

Section 16, Test Methods: Moved the Chemical Analyses requirements from table 6 into the body of the standard and clarified the requirements for product furnished for Other Tests as follows:

16.1 Chemical Analyses:

16.1.1 In cases of disagreement, test methods for chemical analysis shall be subject to agreement between the manufacturer or supplier and the purchaser. The following table is a list of published methods, some of which may no longer be viable, which along with other not listed, may be used, subject to agreement:

| <u>Element</u> | <u>ASTM Test Method</u> |
|--------------------|-------------------------|
| <u>Copper</u> | <u>E53</u> |
| <u>Phosphorous</u> | <u>E62</u> |

16.1.2 Test method(s) to be followed for the determination of element(s) resulting from contractual or purchase order agreement shall be as agreed upon between the manufacturer or supplier and purchaser.

~~15.1 The properties enumerated in this specification shall, in case of disagreement, be determined in accordance with the ASTM methods listed in Table 7.~~

16.2 Other Tests:

16.2.1 The product furnished shall conform to specified requirements when subjected to test in accordance with Table 6.

18. Inspection: Revised the requirements for inspections as follows:

~~17.1 The manufacturer shall afford the inspector representing the purchaser, all reasonable facilities, without charge, to satisfy him that the tubes are being furnished in accordance with the specified requirements.~~

18.1 The manufacturer, or supplier, shall inspect and make tests necessary to verify the furnished product conforms to specification requirements.

18.2 Source inspection of the product by the purchaser may be agreed upon between the manufacturer, or supplier, and the purchaser as part of the purchase order. In such case, the nature of the facilities needed to satisfy the inspector, representing the purchaser, that the product is being furnished in accordance with the specification shall be included in the agreement. All testing and inspection shall be conducted so as not to interfere unnecessarily with the operation of the works.

18.3 When mutually agreed upon, the manufacturer, or supplier, and the purchaser shall conduct the final inspection simultaneously.



Section 19, Rejection and Rehearing: Clarified the requirements for rejection and rehearing as follows:

~~18.1 Material that fails to conform to the requirements of this specification is subject to rejection at the option of the purchaser. Rejection shall be reported to the manufacturer or supplier promptly and in writing. When requested by the manufacturer or supplier, a rehearing shall be granted.~~

19.1 Rejection:

19.1.1 Product that fails to conform to the specification requirements when tested by the purchaser or purchaser's agent shall be subject to rejection.

19.1.2 Rejection shall be reported to the manufacturer or supplier promptly. In addition, a written notification of rejection shall follow.

19.1.3 In case of dissatisfaction with results of the test upon which rejection is based, the manufacturer, or supplier, shall have the option to make claim for a rehearing.

19.2 Rehearing:

19.2.1 As a result of product rejection, the manufacturer, or supplier, shall have the option to make claim for a retest to be conducted by the manufacturer, supplier, and the purchaser. Samples of the rejected product shall be taken in accordance with this specification and subject to test by both parties using the test method(s) specified in this specification, or alternatively, upon agreement of both parties, an independent laboratory may be selected for the test(s) using the test method(s) specified in this specification.

Section 20. Certification: Added new certification requirements as follows:

20. Certification

20.1 When specified in the purchase order or contract, the purchaser shall be furnished certification that samples representing each lot have been tested and inspected as directed in this specification and requirements have been met.

Section 21, Mill Test Report The New section for mill test report was added as follows:

21. Mill Test Report

21.1 When specified in the contract or purchase order, a report of test results shall be furnished.

Table 3, Mechanical Property Requirements: Revised the grain size allowance for O50 Temper, Light Anneal from 0.025 min to 0.040 max.

TABLE 3 Mechanical Property Requirements

| Temper Designation | | Form | Rockwell Hardness ^A | | Tensile Strength, min, ksi ^B | Average Grain Size, mm |
|--------------------|--------------|------------------------|--------------------------------|--------|---|------------------------|
| Code | Name | | Scale | Value | | |
| O60 | Soft Anneal | straight lengths/coils | F | 50 max | 30 | 0.040 min |
| O50 | Light Anneal | straight lengths/coils | F | 55 max | 30 | 0.040 max |
| H58 | drawn | drawn | 30 T | 30 min | 36 | ... |



Table 6, Test Methods: Moved the Chemical Analysis Test into the body of the standard and removed the referenced standards ASTM E2 and ASTM E3.

TABLE 6 Test Methods

| Test | ASTM Designation |
|--|------------------------|
| Tension | E8/E8M (also see 16.3) |
| Rockwell Hardness | E18 |
| Grain size | E112 (also see 16.4) |
| Expansion (pin test) | B153 |
| Microscopical Examination Procedure A | B577 (also see 16.4) |
| Microscopical Examination Procedure B | B577 (also see 16.4) |