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## Standard Specification for Welded Copper-Nickel Pipe<sup>1</sup>

This standard is issued under the fixed designation B467; 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 ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

### 1. Scope

~~1.1 This specification covers welded copper-nickel alloy pipe for general engineering purposes. The following alloys are covered:\*~~

1.1 This specification establishes the requirements for welded copper-nickel alloy pipe for general engineering purposes. The following alloys are covered:<sup>2</sup>

Copper Alloy UNS No. <sup>2</sup> <del>Previously Used</del> Designation	Copper	Nominal Composition, %
Copper	Type of Metal	
C70600	706	
<u>C70620</u>	90-10 copper-nickel (Modified for Weld- ing)	
C71500	715	
<u>C71520</u>	70-30 copper-nickel (Modified for Weld- ing)	

~~1.2 The values stated in inch-pound units are to be regarded as the standard. The values given in parentheses are for information only.~~

1.2 Units—The values stated in either inch-pound units or SI units are to be regarded separately as standard. Within the text, the SI units are shown in brackets. The values stated in each system are not exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems could result in nonconformance with the specification.

### 2. Referenced Documents

~~2.1 The following documents of the issue in effect on date of material purchase form a part of this specification to the extent referenced herein:~~

~~2.2~~

2.1 ASTM Standards:<sup>3</sup>

B153 Test Method for Expansion (Pin Test) of Copper and Copper-Alloy Pipe and Tubing

B601

B601 Classification for Temper Designations for Copper and Copper Alloys Wrought and Cast

B846 Terminology for Copper and Copper Alloys

E8 Test Methods for Tension Testing of Metallic Materials

E29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications

<sup>1</sup> This specification is under the jurisdiction of ASTM Committee B05 on Copper and Copper Alloys and is the direct responsibility of Subcommittee B05.04 on Pipe and Tube.

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<sup>2</sup> The UNS system for copper and copper alloys (see Practice E527) is a simple expansion of the former standard designation system accomplished by the addition of a prefix "C" and a suffix "00." The suffix can be used to accommodate composition variations of the base alloy.

<sup>3</sup> 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.

~~E75 Test Methods for Chemical Analysis of Copper-Nickel and Copper-Nickel-Zinc Alloys~~ 54 Test Methods for Chemical Analysis of Special Brasses and Bronzes

~~E62 Test Methods for Chemical Analysis of Copper and Copper Alloys (Photometric Methods)~~

~~E243 Practice for Electromagnetic (Eddy-Current) Examination of Copper and Copper-Alloy Tubes~~

~~E255 Practice for Sampling Copper and Copper Alloys for the Determination of Chemical Composition~~

~~E527 Practice for Numbering Metals and Alloys in the Unified Numbering System (UNS)~~

~~2.3-478 Test Methods for Chemical Analysis of Copper Alloys~~

~~2.2 Other Documents:~~

~~American Welding Society Specification A5.6<sup>4</sup>~~

~~American Welding Society Specification A5.7<sup>4</sup>~~

### 3. Terminology

~~3.1 Definitions:~~

~~3.1.1 welded pipe—product made from sheet, strip, or plate with a seam made by welding.~~

~~3.1.2 flash or bead—weld metal that protrudes beyond the normal wall, both inside and outside.~~

~~3.1.3 scarfing—the removing of flash or bead by a cutting operation.~~

~~3.2 Definitions of Terms Specific to This Standard:~~

~~3.2.1 capable of—as used in this specification, the test is not mandatory under the terms of this specification unless definitely specified in the purchase order; however, should subsequent testing by the purchaser establish that the material does not meet these requirements, the material may be rejected.~~

~~3.1 For the definitions of terms related to copper and copper alloys, refer to Terminology B846.~~

### 4. Types of Welded Pipe

~~4.1 As-Welded—Pipe that has been welded with no further work performed other than straightening or cutting to length, or both.~~

~~4.2 Welded and Annealed—Welded pipe that has been annealed to produce a uniform grain size appropriate to the specified annealed temper.~~

~~4.3 Welded and Cold Drawn—Welded pipe with internal flash removed by scarfing, and subsequently cold drawn to conform to the specified temper.~~

~~4.4 Fully Finished—Welded pipe with internal and external flash removed by scarfing and the pipe or tube subsequently cold drawn over a mandrel and annealed as necessary to conform to the specified temper.~~

### 5. Ordering Information

~~4.1 Orders for material under this specification shall include the following information:~~

~~4.1.1 Copper Alloy UNS No. (Section~~

~~5.1 Include the following information when placing orders for product under this specification, as applicable.~~ <sup>b467-09</sup>

~~5.1.1 ASTM designation and year of issue,~~

~~5.1.2 Copper Alloy UNS No. (Section 1 and Table 1),~~

~~4.1.2 Temper (Section 9~~

~~5.1.3 Temper (Section 8),~~

~~4.1.3 Radiographic examination (Section~~

~~5.1.4 Dimensions: diameter and wall thickness (12.2 and 12.3),~~

~~5.1.5 Lengths: whether specific or stock (12.4),~~

~~5.1.6 Quantity of each size,~~

~~5.1.7 If the product is to be subsequently welded,~~

~~5.1.8 Packaging and Package Marking (Section 23).~~

~~5.2 The following options are available and, when required, are to be specified in the contract or purchase order at the time of placing the order.~~

~~5.2.1 Heat identification or traceability requirements, or both (see 14.2.1.4).~~

~~5.2.2 Certifications (see Section 21).~~

~~5.2.3 Test report (see Section 22).~~

~~5.2.4 Radiographic examination: whether or not required (see Section 11),~~

~~4.1.4 Dimensions: diameter and wall thickness (see 12.3, section 12.4, and section 12.5);~~

~~4.1.5 Lengths: whether specific or stock (see section 12.6);~~

~~4.1.6 Quantity of each size;~~

~~4.1.7 If the product is to be subsequently welded (see Table 1 and Footnote D), and~~

~~4.1.8 Packing and marking (Section 20)~~

<sup>4</sup> Available from The American Welding Society (AWS), 550 NW LeJeune Rd., Miami, FL 33126, <http://www.aws.org>.

**TABLE 1 Chemical Requirements**

Copper Alloy UNS No <sup>A</sup>	Nickel <sup>C</sup>	Lead, <sup>D</sup> max	Iron	Zinc, <sup>D</sup> max	Manganese, max	Sulfur, max	Ph	
Copper Element	Copper (incl silver)	Nickel (incl Cobalt)	Lead, max	Iron	Zinc, max	Manganese	Other Named Elements	
C70600 C70600 <sup>A</sup> 0.020-02	remainder Remainder <sup>D</sup>	9.0–11.0 9.0–11.0 86.5 min	0.05 0.05 9.0–11.0	1.0–1.8 1.0–1.8 .02	1.0 1.0 1.0–1.8	1.0 1.0 .50	1.0	C .05 max P .02 max S .02 max
C70620-02	<sup>A</sup>	86.5 min	9.0–11.0	.02	1.0–1.8	.50	1.0	C .05 max P .02 max S .02 max
C71500 C71500 <sup>A</sup> 20-02	remainder Remainder <sup>D</sup>	29.0–33.0 29.0–33.0 65.0 min	0.05 0.05 29.0–33.0	0.40–1.0 .40–1.0 .02	1.0 1.0 .40–1.0	1.0 1.0 .50	0.0 1.0	C .05 max P .02 max S .02 max
C71520-02	<sup>A</sup>	65.0 min	29.0–33.0	.02	.40–1.0	.50	1.0	C .05 max P .02 max S .02 max

<sup>A</sup> Cu + Sum of New designation established in accordance with Practice E527.

<sup>B</sup> Silver counting as copper.

<sup>C</sup> Cobalt counting as nickel.

<sup>D</sup> When the product is for subsequent welding applications and so specified by the purchaser, zinc shall be 0.99.50% max, lead 0.02% max, and carbon 0.05% max.

5.2.5 Source inspection: Whether or not required (19.2),

5.2.6 Hydrostatic test (see 11.3),

5.2.7 When product is ordered for ASME Boiler & Pressure Vessel Code Application<sup>5</sup>,

5.2.8 Type of flash to be furnished (6.3),

5.2.9 Pneumatic Test (see 11.3.2).

## 5. Types of Welded Pipe

5.1 *As-Welded*—Pipe that has been welded with no further work performed other than straightening or cutting to length, or both.

5.2 *Welded and Annealed*—Welded pipe that has been annealed to produce a uniform grain size appropriate to the specified annealed temper.

5.3 *Welded and Cold Drawn*—Welded pipe with internal flash removed by scarfing, and subsequently cold drawn to conform to the specified temper.

5.4 *Fully Finished*—Welded pipe with internal and external flash removed by scarfing and the pipe or tube subsequently cold drawn over a mandrel and annealed as necessary to conform to the specified temper.

## 6. Chemical Composition

6.1 The material shall conform to the chemical requirements specified in Table 1.

6.2 These specification limits do not preclude the presence of other elements. Limits for unnamed elements may be established by agreement between manufacturer or supplier and purchaser.

6.2.1 For copper alloys in which copper is specified as the remainder, copper may be taken as the difference between the sum of all the elements analyzed and 100%.

6.2.1.1 When all the elements in Table 1 are analyzed, their sum shall be 99.5% minimum.

## 7. Flash

7.1 If the pipe is made by the high-frequency welding process, the external flash shall always be removed. The internal flash shall be treated as one of the following:

7.1.1 *Materials and Manufacture*

6.1 *Material:*

6.1.1 The material of manufacture shall be strip of one of the Copper Alloy UNS Nos. listed in 1.1 of such purity and soundness as to be suitable for processing into the products prescribed herein.

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

6.2 *Manufacture:*

<sup>5</sup> Available from American Society of Mechanical Engineers (ASME), ASME International Headquarters, Three Park Ave., New York, NY 10016-5990, <http://www.asme.org>.

6.2.1 The product shall be manufactured by forming the material into a tubular shape and welded on a suitable forming mill.

6.3 Flash :

6.3.1 If the pipe is made by the high-frequency welding process, the external flash shall always be removed. The internal flash shall be treated as one of the following:

6.3.1.1 *IFI*—Internal flash to remain in the “as-welded” condition,

7.1.2

6.3.1.2 *IFR*—Internal flash to be removed by scarfing, or

7.1.3

6.3.1.3 *IFD*—Internal flash to be displaced.

7.2 Unless otherwise specified, the IFI condition will be furnished.

**8. Filler Material**

8.1 Filler material, if used in the welding process, shall conform to classification ECuNi of AWS Specification A5.6 or RCuNi of AWS Specification A5.7.

**9.**

6.3.2 Unless otherwise specified, the IFI condition will be furnished.

6.4 Filler Material

6.4.1 Filler material, if used in the welding process, shall conform to Classification ECuNi of AWS Specification A5.6 or RCuNi of AWS Specification A5.7.

**7. Chemical Composition**

7.1 The material shall conform to the chemical requirements specified in Table 1.

7.2 These specification limits do not preclude the presence of other elements. Limits for unnamed elements may be established by agreement between manufacturer or supplier and purchaser.

7.2.1 For copper alloys in which copper is specified as the remainder, copper may be taken as the difference between the sum of all the elements analyzed and 100 %.

7.2.1.1 When all the elements in Table 1 are analyzed, their sum shall be 99.5 % minimum.

**8. Temper**

9.1 The pipe shall be supplied in any one of the following tempers as specified and shall meet the mechanical requirements of 8.1 Tempers, as defined in Classification B601 and this specification, are as follows:

8.1.1 The pipe shall be supplied in any one of the following tempers as specified and shall meet the mechanical requirements of Table 2, Table 3, and, or Table 4:

9.1.1 As welded from annealed sheet, strip, or plate (WM50);

9.1.2 As welded from cold-worked sheet, strip, or plate (WM00, WM01, WM02, etc.);

9.1.3 Welded and annealed (WO50);

9.1.4 Welded and cold drawn in either light drawn (Copper Alloy UNS No. C70600 only) or hard drawn, stress relieved (WR00), (WR04), or

**TABLE 2 Mechanical Requirements of As-Welded and Fully Finished Pipe When Furnished in the Annealed Temper (WO61)**

Copper Alloy UNS No.	Outside Diameter, in. ([mm])	Tensile Strength, min, ksi <sup>A</sup> ([MPa <sup>B</sup> ])	Yield	Elongation in 2 in. ([50.8 mm]), min, %
			Strength at 0.5 % Extension Under Load, min, ksi <sup>A</sup> ([MPa <sup>B</sup> ])	
G70600	up to 4½ (114), incl	40 (275)	15 (105)	25.0
C70600	up to 4½ [114], incl	40 [275]	15 [105]	25.0
	—over 4½ (114)	38 (260)	13 (90)	25.0
C70620	up to 4½ [114], incl	40 [275]	15 [105]	25.0
	—over 4½ [114]	38 [260]	13 [90]	25.0
G71500	up to 4½ (114), incl	50 (345)	20 (140)	30.0
	up to 4½ [114], incl	50 [345]	20 [140]	30.0
C71500	—over 4½ (114)	45 (310)	15 (105)	30.0
	—over 4½ [114]	45 [310]	15 [105]	30.0
C71520	up to 4½ [114], incl	50 [345]	20 [140]	30.0
	—over 4½ [114]	45 [310]	15 [105]	30.0

<sup>A</sup> ksi = 1000 psi.

<sup>B</sup> See Appendix X2.

**TABLE 3 Mechanical Requirements of Welded and Cold-Drawn and Fully Finished Pipe in Drawn Tempers**

Copper Alloy UNS No.	Outside Diameter, in.-( [mm] )	Tensile Strength, min, ksi <sup>A</sup> ([MPa <sup>B</sup> ])	Yield Strength at 0.5 % Extension Under Load, min, ksi <sup>A</sup> ([MPa <sup>B</sup> ])	Elongation in 2 in. ([50.8 mm]), min, %
C71500	up to 2 (50.8), incl. for wall thicknesses up to 0.048 (1.21 mm), incl.	72 (495)	50 (345)	12.0
C71500	up to 2 [50.8], incl. for wall thicknesses up to 0.048 [1.21 mm], incl.	72 [495]	50 [345]	12.0
	for wall thicknesses over 0.048 in. (1.21 mm)	72 (495)	50 (345)	15.0
	for wall thicknesses over 0.048 in. [1.21 mm]	72 [495]	50 [345]	15.0
C71520	up to 2 [50.8], incl. for wall thicknesses up to 0.048 [1.21 mm], incl.	72 [495]	50 [345]	12.0
	for wall thicknesses over 0.048 in. [1.21 mm]	72 [495]	50 [345]	15.0

<sup>A</sup> ksi = 1000 psi.

<sup>B</sup> See Appendix X2.

**TABLE 4 Mechanical Requirements of As-Welded Pipe**

Copper Alloy UNS No.	Condition	Outside Diameter, in.-( [mm] )	Tensile Strength, min, ksi-( [MPa] )	Yield Strength at 0.5 % Extension Under Load, min, ksi ( [MPa] )
C70600	welded from annealed strip	up to 4½ (114), incl.	45 (310)	30 (205)
C70600	welded from annealed strip	up to 4½ [114], incl.	45 [310]	30 [205]
	welded from cold-rolled strip	up to 4½ (114), incl.	54 (375)	45 (310)
	welded from cold-rolled strip	up to 4½ [114], incl.	54 [375]	45 [310]
C70620	welded from annealed strip	up to 4½ [114], incl.	45 [310]	30 [205]
	welded from cold-rolled strip	up to 4½ [114], incl.	54 [375]	45 [310]

<https://standards.iteh.ai/catalog/standards/sist/e4e6c39c-9d54-4d76-8663-8a2aff90efe5/astm-b467-09>

9.1.5 Fully finished as annealed (WO61) light drawn (Copper Alloy UNS No. C70600 only), or hard drawn, stress relieved (WH00, WH04):

8.1.1.1 As welded from annealed sheet, strip, or plate (WM50),

8.1.1.2 As welded from cold-worked sheet, strip, or plate (WM00, WM01, WM02, etc.).

8.1.1.3 Welded and light annealed (WO50),

8.1.1.4 Welded and cold drawn in either light drawn, eight hard (Copper Alloy UNS No. C70600 and C70620 only) or hard drawn and stress relieved (WR00), (WR04), or

8.1.1.5 Fully finished welded and annealed (WO61).

## 9. Mechanical Property Requirements

### 9.1 Tensile Strength Requirements:

9.1.1 Product furnished under this specification shall conform to the tensile and yield strength requirements prescribed in Table 2, Table 3, or Table 4 when tested in accordance with Test Method E8

## 10. Dimensions and Permissible Variations

10.1 For purposes of determining conformance with the dimensional requirements prescribed in this specification, any measured value outside the specified limiting values for any dimension may be cause for rejection. Performance Requirements

### 10.1 Expansion Test Requirements:

10.1.1 The annealed pipe shall be capable of (see 8.1.1.1 and 8.1.1.3) being expanded in accordance with Test Method B153 to 30 % of its outside diameter. Pipe supplied in the "as welded" condition shall be expanded to 20 % of its outside diameter.

10.1.2 The annealed ends of pipe furnished end annealed shall be capable of being expanded 30 % of its outside diameter in accordance with Test Method B153.

10.1.3 The expanded tube area shall be free of defects, but blemishes of a nature that do not interfere with the intended application are acceptable.

10.1.4 Pipe furnished in other tempers is not subject to this test

10.2 Flattening Test Alternative:

10.2.1 As an alternative to the expansion test for product over 4 in. [102 mm] in diameter, the flattening test described in the Test Method section may be performed.

10.2.2 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.

**11. Nondestructive Tests for Pipe**

11.1 *Radiographic Examination*—Radiographic examination of the welds shall be as agreed upon.

11.2 *Eddy-Current Test*—Each pipe of nominal outside diameter within the capabilities of the eddy-current tester shall be subjected to an eddy-current test. Testing shall follow the procedures of Practice E243. The pipe shall be passed through an eddy-current testing unit adjusted to provide information on the suitability of the material for the intended application.

11.2.1 Notch depth standards rounded to the nearest 0.001 in. [0.025 mm] shall be 22 % of the nominal wall thickness. The notch depth tolerance shall be  $\pm 0.0005$  in. [0.013 mm].

11.2.1.1 Pipe that does not actuate the signaling device of the eddy-current tester shall be considered as conforming to the requirements of this test. Pipe with discontinuities indicated by the testing unit may be reexamined or retested, at the option of the manufacturer, to determine whether the discontinuity is cause for rejection. Signals that are found to have been caused by minor mechanical damage, soil, or moisture, shall not be cause for rejection of the pipe, provided the dimensions are still within prescribed limits and the pipe is suitable for its intended application.

11.2.2 As an alternate to the Eddy Current test, the manufacturer shall have the option to perform a Hydrostatic Test (11.3.1)

11.3 *Hydrostatic Test Alternative*—As an alternative to the eddy current test for tubes above 2.000 in. [50.8 mm], the manufacturer shall have the option to perform the hydrostatic test to the tests described in 11.3.1 and 11.3.2.

11.3.1 *Hydrostatic Test*—When specified, the pipe shall withstand, without showing weakness or defects, an internal hydrostatic pressure sufficient to subject the material to a fiber stress of 7000 psi [48 MPa], determined by the following equation for thin hollow cylinders under tension. The pipe need not be tested at a hydrostatic pressure of over 1000 psig (7 MPa), unless so specified.

$$P = 2St/(D - 0.8t) \quad (1)$$

where:

- $P$  = hydrostatic pressure, psig [or MPa],
- $t$  = wall thickness of the pipe, in. [or mm],
- $D$  = outside diameter of the pipe, in. [or mm], and
- $S$  = allowable stress of the material.

11.3.2 *Pneumatic Test*—When specified, the pipe shall be subjected to an internal air pressure of 60 psig [400 kPa] minimum for 5 s without showing evidence of leakage. The test method used shall permit easy visual detection of any leakage, such as by having the pipe under water or by the pressure-differential method. Any evidence of leakage shall be cause for rejection.

**12. Dimensions, Mass, and Permissible Variations**

12.1 For purposes of determining conformance with the dimensional requirements prescribed in this specification, any measured value outside the specified limiting values for any dimension may be cause for rejection.

NOTE 1—Blank spaces in the tolerance tables indicate that the material is not generally available or that no tolerance has been established (see Appendix X1).

~~10.2~~

12.2 Outside Diameter Tolerances :

~~102.2.1~~ The outside diameter for ~~round~~ pipe furnished “as-welded,” “as-welded and drawn,” and “as-welded fully finished” shall conform to the tolerances in Table 5 except as noted in ~~10.2.2~~12.2.2.

~~10.2.2~~

12.2.2 These outside diameter tolerances shall not apply to the “as-welded” pipe when measured across that portion which contains the weld zone.

~~10.3~~

12.3 Wall Thickness Tolerances:

~~102.3.1~~ The wall thickness of pipe furnished in drawn tempers or as fully finished shall conform to the tolerances shown in Table 6, except as noted in ~~10.3.2~~12.3.2 and ~~10.3.3~~12.3.3.

~~10.3.2~~

12.3.2 The tolerances of Table 6 shall not apply to that portion of the “as-welded” wall which contains the weld flash or bead.

~~10.3.3~~

12.3.3 The tolerances of Table 6 shall be increased by 100 % for that portion of the “as-welded” wall which contains the weld zone.