

# ASTM B466 / ASME SB466

## Standard Specification for Seamless Copper-Nickel Pipe and Tube

This specification establishes the requirements for seamless copper-nickel pipe and tube in straight lengths, suitable for general engineering purposes. The alloys involved are copper alloys UNS Nos. C70400, C70600, C70620, C71000, C71500, C71520, and C72200.

### A. General Requirements :-

The following sections of Specification B251 or B251M constitute a part of this specification:

1. Materials and Manufacture,
2. Dimensions, Mass, and Permissible Variations,
3. Test Specimens,
4. Test Methods.

### B. Chemical Composition :-

1. The material shall conform to the chemical composition requirements in Table 1.
2. When all elements in Table 1 are determined, the sum of results shall be as shown below:

<u>Copper Alloy UNS No.</u>	<u>Copper Plus Named Elements, % min</u>
C70400	99.5
C70600 & C70620	99.5
C71 000	99.5
C71 500 & C71 520	99.5
C72200	99.8

**Table 1**

Copper Alloy UNS Nos.	Copper incl Silver	Nickel incl Cobalt	Lead, max	Iron	Zinc, max	Manganese	Sulfur, max	Phosphorus, max	Chromium	Other Elements
C70400	remainder	4.8-6.2	0.05	1.3-1.7	1	0.30-0.8	0.02	0.02	...	...
C70600	remainder	9.0-11.0	0.05	1.0-1.8	1	1.0max	...	...	...	...
C70620	86.5min	9.0-11.0	0.02	1.0-1.8	0.5	1.0max	0.02	0.02	...	C 0.05 max
C71000	remainder	19.0-23.0	0.05 <sup>A</sup>	0.5-1.0	1.0 <sup>A</sup>	1.0max	0.02	0.02	...	<sup>A</sup>
C71500	remainder	29.0-33.0	0.05	0.4-1.0	1	1.0max	...	...	...	...
C71520	65.0min	29.0-33.0	0.02	0.4-1.0	0.5	1.0max	0.02	0.02	...	C 0.05 max
C72200	remainder	15.0-18.0	0.05 <sup>A</sup>	0.5-1.0	1.0 <sup>A</sup>	1.0max	0.02	0.02	0.30-0.7	<sup>A,B</sup>

<sup>A</sup> When the product is for subsequent welding applications, and so specified by the purchaser, zinc shall be 0.50 % max, lead 0.02 % max, and carbon 0.05 % max.

<sup>B</sup> Silicon 0.03 max, titanium 0.03 max.

### C. Temper :-

The standard tempers for products described in this specification are given in Table 2:

1. Annealed Temper —O60 (soft annealed).
2. Drawn Tempers—H55 (light drawn), H80 (hard drawn), or HE80 (hard drawn and end annealed).

**Table 2**

Temper Code	Temper Name	Copper Alloy UNS Nos.	Tensile Strength, min		Yield Strength, <sup>A</sup> min		Rockwell <sup>B</sup> Hardness 30 T
			ksi	MPa	ksi	MPa	
O60	Soft anneal <sup>C</sup>	C70400	37	255	12	85	45 max
		C70600 & C70620	38	260	13	90	45 max
		C71000	45	310	16	110	48 max
		C71500 & C71520	52	345	18	125	51 max
		C72200	40	275	14	95	45 max
H55	Light drawn	C70400	40	275	30	205	41 to 65
		C70600 & C70620	45	310	35	240	45 to 70
		C72200	48	330	42	290	55 to 70
H80	Hard drawn	C70400	45	310	35	240	60 min
		C70600 & C70620	50	345	40	275	63 min
		C71000	55	380	43	295	67 min
		C71500 & C71520	70	485	45	310	70 min
		C72200	55	380	44	305	67 min

<sup>A</sup> At 0.5 % extension under load.

<sup>B</sup> Rockwell hardness values shall apply only to tube or pipe having a wall thickness of 0.020 in. [0.5 mm] or over and an outside diameter of 5/16 in. [8 mm] or over. For all other tube no Rockwell hardness values shall apply. Rockwell hardness tests shall be made on the inside surface of the tube. When suitable equipment is not available for determining the specified Rockwell hardness, other Rockwell scales and values may be specified subject to agreement between the manufacturer and the purchaser.

<sup>C</sup> Although no minimum grain size is specified, the product must nevertheless have fully recrystallized grain structure.

**D. Mechanical Property Requirements :-**

1. Tensile Strength Requirements—Product furnished under this specification shall conform to the tensile and yield strength requirements prescribed in Table 2 when tested in accordance with Test Methods E8 or E8M.
2. Rockwell Hardness Requirements—Product furnished under this specification shall conform to the Rockwell hardness requirements prescribed in Table 2 when tested in accordance with Test Methods E18.

**E. Performance Requirements :-**

1. Expansion Test Requirements:  
Tube furnished in the O60 (soft anneal) temper and the HE80 (hard drawn and end annealed) shall withstand an expansion to 30 % of the outside diameter when tested in accordance with Test Method B153.
2. Flattening Test Alternative:  
As an alternate to the expansion test for product over 4 in. [100 mm] in diameter, the flattening test described in the Test Method section may be performed.

**F. Non-destructive Test Requirements :-**

1. Electromagnetic (Eddy Current) Test:
  - i. Each tube up to and including 3.125-in. [80-mm] nominal outside diameter shall be subjected to an eddy current test. Testing shall follow the procedures of Practice E243 and the Test Methods section of this specification.
2. Hydrostatic Test—
  - i. As an alternative to the eddy current test for tubes of diameters above 1.25 in. [32 mm], the manufacturer shall have the option to perform the hydrostatic test to the method in the Test Methods section. Each tube shall stand, without showing evidence of leakage, an internal

hydrostatic pressure sufficient to produce a fiber stress of 7000 psi [48 MPa] as determined by the following equation for thin hollow cylinders under tension:

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

where: P = hydrostatic pressure, psi [MPa];  
t = wall thickness of the material, in. [mm];  
D = outside diameter of the material, in. [mm]; and  
S = allowable stress of the material, psi [MPa].

- ii. When the hydrostatic test is specified for tubes of less than 0.50 in. [12 mm] in outside diameter and less than 0.060 in. [1.5 mm] in wall thickness, the manufacturer shall have the option to perform either the hydrostatic test or the pneumatic test.
3. Pneumatic Test:
  - i. When specified in the contract or purchase order, each tube shall be subjected to a minimum internal air pressure of 60 psig [415 kPa] for 5s without showing evidence of leakage.

#### G. Test Methods :-

##### 1. Chemical Analysis:

Composition shall be determined, in case of disagreement, as follows:

Element	Test Method
Carbon	E76
Chromium	E118
Copper	E478
Iron	E54
Lead	E478; atomic absorption
Manganese	E75
Nickel	E478; gravimetric
Phosphorus	E62
Silicon	E54
Sulfur	E76
Zinc	E478; atomic absorption

##### 2. Other Tests:

- i. Tensile Strength —  
Tensile strength shall be determined in accordance with Test Methods E8 or E8M.
- ii. Electromagnetic (Eddy Current) Test—  
Testing shall follow the procedures in Practice E243, except for the determination of “end-effect.”

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