ASTM B111 Standard Specification for Copper and Copper-Alloy Seamless Condenser Tubes and Ferrule Stock

GNEE's main copper products include copper tubes, copper rods, copper plates, copper wires, copper strips, etc.

Website：chinacopperalloys.com

Email: sales@gneemetal.com

1. Standard Introduction

ASTM B111 is a standard specification developed by ASTM International, which covers the requirements for seamless tubes and ferrule stock made of copper and copper alloys. These materials are primarily used in surface condensers, evaporators, and heat exchangers. The standard ensures that the tubes meet specific chemical, mechanical, and dimensional requirements for reliable performance in industrial applications.

2. Scope

This specification applies to seamless tubes and ferrule stock of copper and various copper alloys with diameters up to 3 1/8 inches (80 mm) inclusive. The tubes are commonly used in heat exchange equipment such as condensers and evaporators. The following UNS designations are included:

UNSNumber	PreviouslyUsedDesignation	Description
C10100	OFE	Oxygen-free electronic
C10200	OF	Oxygen-free without residual deoxidants
C10300	...	Oxygen-free, extra low phosphorus
C10800	...	Oxygen-free, low phosphorus
C12000	DLPA	Phosphorized, low residual phosphorus
C12200	DHPA	Phosphorized, high residual phosphorus
C14200	DPAA	Phosphorized, arsenical
C19200	...	Phosphorized, 1% iron
C23000	...	Red Brass
C28000	...	Muntz Metal
C44300, C44400, C44500	...	Admiralty Metals, B, C, and D
C60800	...	Aluminum Bronze
C61300	...	...
C61400	...	Aluminum Bronze, D
C68700	...	Aluminum Brass, B
C70400	...	95-5 Copper-Nickel
C70600	...	90-10 Copper-Nickel
C71000	...	80-20 Copper-Nickel
C71500	...	70-30 Copper-Nickel
C71640	...	Copper-nickel-iron-manganese
C72200	...	...

3. Chemical Composition Requirements

The chemical composition of the copper and copper alloys must conform to the requirements listed in the table below:

Table: Chemical Composition

UNSNo.	Cu	Zn	Sn	Al	Ni	Fe	Mn	Pb	As	OtherElements
C10100	99.99 min	...	...	...	...	...	...	...	...	...
C10200	99.95 min	...	...	...	...	...	...	...	...	...
C10300	99.95 min	...	...	...	...	...	...	...	...	...
C10800	99.95 min	...	...	...	...	...	...	...	...	...
C12000	99.90 min	...	...	...	...	...	...	...	...	...
C12200	99.90 min	...	...	...	...	...	...	...	...	...
C14200	99.90 min	...	...	...	...	...	...	...	...	...
C19200	98.7 min	...	...	...	...	1.0-2.0	...	...	...	...
C23000	84.0-86.0	Remainder	...	...	...	...	...	0.05	...	...
C28000	59.0-63.0	Remainder	...	...	...	...	...	0.3	...	...
C44300	70.0-73.0	Remainder	0.9-1.2	...	...	0.06	...	0.07	0.02-0.06	...
C44400	70.0-73.0	Remainder	0.9-1.2	...	...	0.06	...	0.07	...	Sb: 0.02-0.06
C44500	70.0-73.0	Remainder	0.9-1.2	...	...	0.06	...	0.07	...	P: 0.02-0.06
C60800	94.0 min	...	...	5.0-6.5	...	...	...	...	...	...
C61300	89.0 min	...	...	6.0-7.5	...	...	...	...	...	...
C61400	90.0 min	...	...	6.0-8.0	...	...	...	...	...	...
C68700	**76.0-79.0**	**Remainder**	...	**1.8-2.5**	...	**0.06**	**0.02-0.06**	**0.07**	**0.02-0.06**	...
C70400	Remainder	1.0 max	...	...	4.8-6.2	1.3-1.7	0.3-0.8	0.05	...	...
C70600	Remainder	1.0 max	...	...	9.0-11.0	1.0-1.8	1.0 max	0.05	...	...
C71000	Remainder	1.0 max	...	...	19.0-23.0	...	...	0.05	...	...
C71500	Remainder	1.0 max	...	...	29.0-33.0	0.4-1.0	1.0 max	0.05	...	...
C71640	Remainder	1.0 max	...	...	29.0-32.0	1.7-2.3	1.5-2.5	0.05	...	...
C72200	Remainder	...	...	...	...	...	...	...	...	...

4. Mechanical Properties

The mechanical properties of the materials must meet the following requirements based on temper designation:

Table: Mechanical Properties

UNSNo.	TemperDesignation	TensileStrengthmin	YieldStrengthmin	Elongationmin (%)	Hardness (HV)
		ksi	MPa	ksi	MPa
C44300	O61 (Annealed)	45	310	15	103
C68700	O61 (Annealed)	50	345	18	125
C70400	H55 (Light-drawn)	38	262	30	207
C70600	O61 (Annealed)	45	310	15	103
C71500	O61 (Annealed)	52	359	18	124
C71640	O61 (Annealed)	63	434	25	172

5. Dimensional Tolerances

Dimensional tolerances for outside diameter, wall thickness, and length are specified in Section 14 of ASTM B111.

5.1 Outside Diameter Tolerances

For Tubes with Wall Thickness from 0.020" to 0.035" (0.51 mm to 0.89 mm):

OutsideDiameter(inch)	Tolerance(±inch)
d ⩽ 0.500	0.003
0.500 < d ⩽ 0.740	0.004
0.740 < d ⩽ 1.000	0.006
1.000 < d ⩽ 1.250	0.009

For Tubes with Wall Thickness ≥ 0.042" (1.07 mm):

OutsideDiameter(inch)	Tolerance(±inch)
d ⩽ 0.500	0.0025
0.500 < d ⩽ 0.740	0.0035
0.740 < d ⩽ 1.000	0.0045
1.000 < d ⩽ 1.250	0.0060
1.250 < d ⩽ 1.375	0.0080
1.375 < d ⩽ 2.000	0.0060
2.000 < d ⩽ 3.125	0.0065

5.2 Wall Thickness Tolerances

For Tubes with Outside Diameter from 0.125" to 1.000" (3.18 mm to 25.4 mm):

WallThickness(inch)	Tolerance(±inch)
0.020 ⩽ t < 0.030	0.003
0.032 ⩽ t < 0.035	0.003
0.035 ⩽ t < 0.058	0.004
0.058 ⩽ t < 0.083	0.0045
0.083 ⩽ t < 0.120	0.005
0.120 ⩽ t < 0.134	0.007

5.3 Length Tolerances

For Lengths in Inch-Pound Units:

Length(feet)	Tolerance(inch)
l ⩽ 15	+3/32
15 < l ⩽ 20	+1/8
20 < l ⩽ 30	+5/32
30 < l ⩽ 60	+3/8
60 < l ⩽ 100	+1/2

6. Manufacturing Process Requirements

The tubes shall be manufactured by processes such as extrusion, drawing, casting, annealing, straightening, and trimming to produce a seamless tube in the specified condition. The material shall be furnished in one of the following tempers:

- Annealed
- Light-drawn
- Hard-drawn
- Hard-drawn and end annealed

Tubes for ferrule stock shall be annealed sufficiently to be fully crystallized.

7. Testing Methods

The following tests are required to ensure compliance with the standard:

- Expansion Test: Conducted in accordance with Test Method B153. The tube must withstand expansion without visible cracking or rupture.
- Flattening Test: The specimen shall be flattened at three places along its length and inspected for defects.
- Residual Stress Test: Required for specific alloys (e.g., C23000, C28000, C44300, C44400, C44500, C60800, C61300, C61400, C68700). Testing may be done using mercurous nitrate test (B154) or ammonia vapor test (B858).
- Nondestructive Testing: Eddy-current testing per Practice E243.
- Hydrostatic Test: Each tube must withstand an internal hydrostatic pressure sufficient to subject the material to a fiber stress of 7000 psi (48 MPa), unless otherwise specified.
- Pneumatic Test: Alternatively, a pneumatic test may be conducted.
- Chemical Analysis: Performed using methods such as E53, E54, E62, E75, E76, E478.
- Tension Test: Conducted per Test Methods E8/E8M.

8. Safety and Environmental Considerations

Mercury is identified as a health hazard in use and disposal. Many regulatory agencies designate mercury as a hazardous substance that can cause serious medical issues. Caution must be exercised when handling mercury and mercury-containing products.

9. Referenced Documents

Key referenced ASTM standards include:

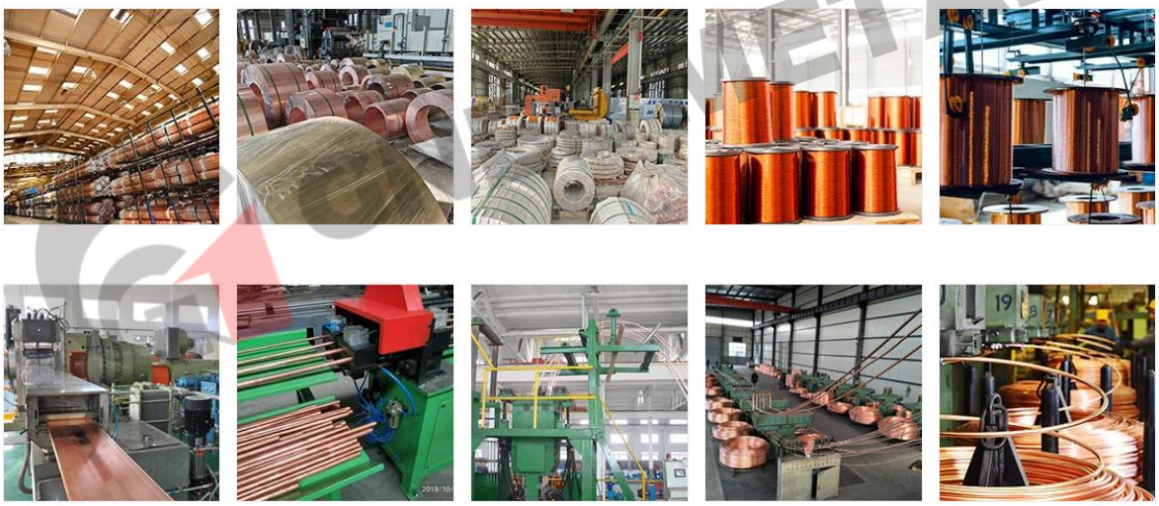
- B153 Test Method for Expansion (Pin Test) of Copper and Copper-Alloy Pipe and Tubing
- B154 Test Method for Mercurous Nitrate Test for Copper and Copper Alloys
- B224 Classification of Coppers
- B858 Test Method for Ammonia Vapor Test for Determining Susceptibility to Stress Corrosion Cracking in Copper Alloys
- E8/E8M Test Methods for Tension Testing of Metallic Materials
- E243 Practice for Electromagnetic (Eddy Current) Examination of Copper and Copper-Alloy Tubes

10. Additional Information

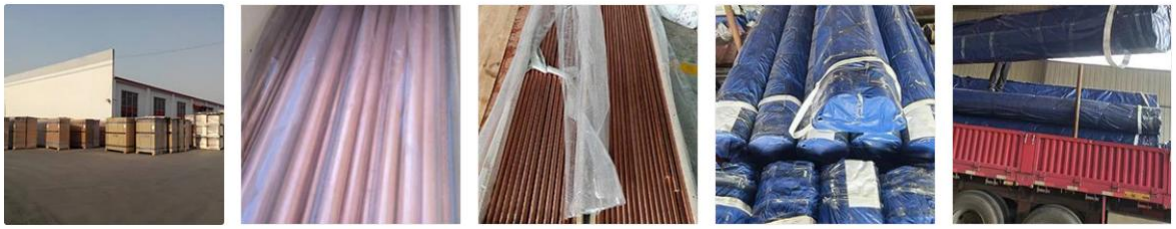
- A metric companion standard, ASTM B111M, is available.
- Tubes are commonly used in applications such as surface condensers, evaporators, and heat exchangers.
- Certification is mandatory for products used in ASME Boiler and Pressure Vessel Code applications.

About Us

Plant And Equipment



Packaging And Shipping



As a professional enterprise dedicated to global copper product trade since 2008, GNEE Metal Group deeply recognizes the quality and responsibility embodied in the ASTM B111 standard. This standard not only specifies chemical composition and mechanical properties but also represents a comprehensive quality commitment spanning manufacturing processes to testing and verification. GNEE solemnly assures global customers that every ASTM B111-standard condenser tube and copper alloy tubing we supply will strictly adhere to its requirements for seamless manufacturing, annealing treatment, eddy current testing, and various mechanical performance tests. If you are interested in our products,please contact us for a quote!

Website：chinacopperalloys.com

Email: sales@gneemetal.com