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SAE J528 MAY86

Seamless Copper Tube

SAE Standard
Reaffirmed May 1986

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an American National Standard

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SEAMLESS COPPER TUBE

1. **SCOPE:** This standard covers minimum requirements for soft (061) annealed seamless copper tube intended for automotive and general purposes. (Comparable specifications are ASTM B 75 and ANSI H23.3. Other copper tube is covered in SAE J463.)
2. **MANUFACTURE:** The tube shall be cold drawn to size and after forming shall be annealed in such a manner as to produce a finished product which will meet all requirements of this standard.
3. **DIMENSIONS AND TOLERANCES:** Tube furnished to this standard shall conform to the dimensional tolerances shown in Table 1 for the size of tube specified by the purchaser. (Standard nominal sizes are listed.)

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TABLE 1--TUBING DIMENSIONS AND TOLERANCES

Nominal Tubing OD		Outside Diameter ^a				Wall Thickness ^b			
		Basic		Tolerance		Basic		Tolerance	
in	mm	in	mm	+in	+mm	in	mm	+in	+mm
1/8	3.18	0.125	3.18	0.0020	0.05	0.030	0.76	0.0030	0.08
3/16	4.76	0.188	4.78	0.0020	0.05	0.030	0.76	0.0025	0.063
1/4	6.35	0.250	6.35	0.0020	0.05	0.030	0.76	0.0025	0.063
5/16	7.95	0.312	7.92	0.0020	0.05	0.032	0.81	0.0025	0.063
3/8	9.53	0.375	9.52	0.0020	0.05	0.032	0.81	0.0025	0.063
1/2	12.70	0.500	12.70	0.0020	0.05	0.032	0.81	0.0025	0.063
5/8	15.88	0.625	15.88	0.0020	0.05	0.035	0.89	0.0025	0.063
3/4	19.05	0.750	19.05	0.0025	0.063	0.035	0.89	0.0025	0.063

^aThe actual outside diameter shall be the average of the maximum and minimum outside diameters as described at any one cross section through the tubing.

^bThe tolerances listed represent the maximum permissible deviation at any point.

- 4. QUALITY:** The finished tube shall be clean, smooth, and round, free from internal and external mechanical imperfections, and shall have a bright appearance.
- 5. MATERIAL:** Unless otherwise specified by purchaser, tube shall be made from any one of the materials listed in Table 2. (UNS C12200 is most commonly used.) Average grain size of the tube shall be 0.040 mm, minimum.

TABLE 2--CHEMICAL COMPOSITION, WEIGHT %

SAE Alloy No. ^a	UNS No. ^b	Similar ASTM Copper No. ^c	Copper, min	Phosphorus	Arsenic
CA102	C10200	102 (was OF)	99.95	--	--
CA120	C12000	120 (was DLP)	99.90	0.004-0.012	--
CA122	C12200	122 (was DHP)	99.90	0.015-0.040	--
--	--	142 (was DPA)	99.40	0.015-0.040	0.15-0.50

^aSAE J463.

^bUnified Numbering System.

^cASTM B 75 and ANSI H23.3.

6. MECHANICAL PROPERTIES: Tube shall conform to the following:

Ultimate Strength (Tensile), min	30,000 psi (205 MPa)
Yield Strength (Tensile), min ^a	9,000 psi (62.0 MPa)

^aAt 0.5% extension under load.

7. EXPANSION TEST: Samples of tube (selected from sections which have not been subjected to cold working after anneal of the finished sized tube) shall be cut square and deburred. These shall be expanded on a hardened and ground tapered steel pin having an included angle of 60 deg until the outside diameter is increased 40%. Care should be taken to keep the axes of the pin and the tube in line during the expansion operation. The test may be made in a die to restrict the expansion to 40%. The expanded tube shall show no cracking or rupture visible to the unaided eye.
8. HYDROSTATIC TEST: Unless otherwise specified, tube shall show no evidence of weakness or defects when subjected to an internal hydrostatic pressure sufficient to subject the material to a fiber stress of 6000 psi (40 MPa) determined by the following formula for thin, hollow cylinders under tension. The tube need not be tested at a hydrostatic pressure of over 1000 psi (7 MPa) unless so specified.

$$P = \frac{2St}{D - 0.8t}$$

where: P = hydrostatic pressure, psi (MPa)
 t = minimum thickness of tube wall, in (mm)
 D = basic outside diameter of tube, in (mm)
 S = allowable stress of the material = 6000 psi (40 MPa)

9. EMBRITTLMENT TEST: The tube is expected to pass the following test although the actual performance of the test is not required under this specification unless specifically stipulated by the purchaser:
- (a) Heat the cleaned or degreased specimens for 20 min minimum at a temperature of 850 + 25°C (1562 + 45°F) in a furnace in which the atmosphere is at least 10% of hydrogen by volume. Then quench the specimens immediately and rapidly in water or in the same atmosphere with minimum contact with air.
- (b) Polish and etch if desired, cross-sectional test specimens taken transverse to, and bounded by, an original surface of the material. Examine the prepared surface microscopically under illumination at a magnification of 75-200 diameters inclusive. Specimens shall show no passing or open grain structure characteristic of embrittlement.

RATIONALE:

Not applicable.

RELATIONSHIP OF SAE STANDARD TO ISO STANDARD:

Not applicable.

REFERENCE SECTION:

ASTM B75

ANSI H23.3

SAE J463, Wrought Copper and Copper Alloys

APPLICATION:

This standard covers minimum requirements for soft (061) annealed seamless copper tube intended for automotive and general purposes.

COMMITTEE COMPOSITION:

DEVELOPED BY THE AUTOMOTIVE AND HYDRAULIC TUBING SUBCOMMITTEE:

Subcommittee currently being reorganized.

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