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INTERNATIONAL
400 Commonwealth Drive, Warrendale, PA 15096-0001

SURFACE VEHICLE STANDARD

SAE J528 | REV. JUN91

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Superseding J528 MAY86

An American National Standard

(R) SEAMLESS COPPER TUBE

1. ***Scope—***This SAE Standard covers minimum requirements for soft (061) annealed seamless copper tube intended for automotive and general purposes. (Comparable specification is ASTM B 75. Other copper tube is covered in SAE J463.)

2. ***References***

2.1 **Applicable Publications—**The following publications form a part of this specification to the extent specified herein. The latest issue of SAE publications shall apply.

2.1.1 SAE PUBLICATION—Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

SAE J463—Wrought Copper and Copper Alloys

2.1.2 ASTM PUBLICATION—Available from ASTM, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.

ASTM B 75—Specification for Seamless Copper Tube

3. ***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 document.

4. ***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.)

5. ***Quality—***The finished tube shall be clean, smooth, and round, free from internal and external mechanical imperfections, and shall have a bright appearance.

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TABLE 1—TUBING DIMENSIONS AND TOLERANCES

Nominal Tubing OD		Outside Diameter[1] Basic		Outside Diameter[2] Tolerance		Wall Thickness Basic		Wall Thickness[2] Tolerance	
mm	in	mm	in	± mm	± in	mm	in	± mm	± in
3.18	1/8	3.18	0.125	0.05	0.0020	0.76	0.030	0.08	0.0030
4.76	3/16	4.78	0.188	0.05	0.0020	0.76	0.030	0.063	0.0025
6.35	1/4	6.35	0.250	0.05	0.0020	0.76	0.030	0.063	0.0025
7.94	5/16	7.92	0.312	0.05	0.0020	0.81	0.032	0.063	0.0025
9.53	3/8	9.53	0.375	0.05	0.0020	0.81	0.032	0.063	0.0025
12.70	1/2	12.70	0.500	0.05	0.0020	0.81	0.032	0.063	0.0025
15.88	5/8	15.88	0.625	0.05	0.0020	0.89	0.035	0.063	0.0025
19.05	3/4	19.05	0.750	0.063	0.0025	0.89	0.035	0.063	0.0025

1. The actual outside diameter shall be the average of the maximum and minimum outside diameters as described at any one cross section through the tubing.
2. The tolerances listed represent the maximum permissible deviation at any point.

6. ***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.[1]	UNS No.[2]	Similar ASTM Copper No. [3]	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

1. SAE J463.
2. Unified Numbering System.
3. ASTM B 75.

7. ***Mechanical Properties*—**Tube shall conform to Table 3:

TABLE 3—MECHANICAL PROPERTIES

Ultimate Strength (Tensile), min	205 MPa (30 000 psi)
Yield Strength (Tensile), min [1]	62.0 MPa (9 000 psi)

1. At 0.5% extension under load.

8. ***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 degrees 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.

9. ***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 hoop (circumferential) fiber stress of 40 MPa (6000 psi) determined by the following formula for thin, hollow cylinders under pressure. The tube need not be tested at a hydrostatic pressure of over 7 MPa (1000 psi) unless so specified.

$$P = \frac{2St}{D - 0.8t} \qquad \text{(Eq. 1)}$$

where:

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

10. ***Embrittlement 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 °C ± 25 (1562 °F ± 45) 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 to 200 diameters inclusive. Specimens shall show no passing or open grain structure characteristic of embrittlement.

11. ***Notes***

11.1 **Marginal Indicia—**The change bar (l) located in the left margin is for the convenience of the user in locating areas where technical revisions have been made to the previous issue of the report. An (R) symbol to the left of the document title indicates a complete revision of the report.

PREPARED BY THE SAE FLUID CONDUCTORS AND CONNECTORS TECHNICAL COMMITTEE SC1—AUTOMOTIVE AND HYDRAULIC TUBE AND FITTINGS