Welded and Cold Drawn Low Carbon Steel Tubing Annealed for Bending and Flaring —SAE J525 JAN80

SAE Standard
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Society of Automotive Engineers, Inc.
400 COMMONWEALTH DRIVE, WARRENDALE, PA. 15096

LAND SEA AIR SPACE

PREPRINT

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Report of the Tube, Pipe, Hose, and Lubrication Fittings Committee, approved April 1958, last revised by the Fluid Conductors and Connectors Technical Committee January 1980.

Scope—This standard covers cold worked and annealed electric resistance welded single wall low carbon steel pressure tubing intended for use as hydraulic lines and in other applications requiring tubing of a quality suitable for flaring and bending.

Manufacture—The tubing shall be made from a single strip of steel shaped into a tubular form, the edges of which are joined and sealed by electric resistance welding. After forming and welding, the tubing shall be normalized and subjected to a cold working operation that shall result in a 15% minimum reduction in cross sectional area, of which at least 8% shall consist of a reduction in wall thickness. Subsequent to cold working, the tubing shall be annealed in such a manner as to produce a finished product which will meet all requirements of this standard. Tubing that has been pickled to remove scale shall be suitably treated to eliminate any embrittlement induced by the pickling process.

Dimensions and Tolerances—The tolerances applicable to tubing outside diameter, inside diameter, and wall thickness are shown in Table 1. Tubing shall be subject to any two of the tolerances specified, as designated by the purchaser.

Quality—Lengths of finished tubing shall be reasonably straight and have smooth ends free from burrs. Tubing shall be free from scale and injurious defects and have a workmanlike finish. Surface imperfections such as handling marks, die marks, or shallow pits shall not be considered injurious defects provided the imperfections are within the tolerances specified for diameter and wall thickness. The removal of such surface imperfections is not required. There shall be no dimensional indications of the presence of the weld.

The inside of tubing shall be clean and free from any contamination that cannot be readily removed by cleaning agents normally used in manufacturing.

Material—Tubing shall be made from low carbon steel conforming to the following chemical composition.

Element	ϕ Cast or Heat Analysis[a] % by Weight
Carbon	0.18 max
Manganese	0.30–0.60
Phosphorus	0.040 max
Sulfur	0.050 max

[a] Check analysis tolerance shall be as specified in SAE J409, Table 3.

Mechanical Properties—The finished tubing shall have mechanical properties as tabulated below:

Yield Strength, min	ϕ 25,000 psi (170 MPa)
Ultimate Strength, min	45,000 psi (310 MPa)
ϕ Elongation in 2 in (50 mm), min	35%[a]
Hardness (Rockwell B scale), max	65[b]

[a] For tubing having nominal outside diameter of 0.375 in (9.5 mm) or less, and/or wall thicknesses of 0.035 in (0.9 mm) or less, a minimum elongation of 25% is permissible.

[b] The hardness test shall not be required on tubing with a nominal wall thickness of less than 0.065 in (1.65 mm). Such tubing shall meet all other mechanical properties and performance requirements.

Performance Requirements—The finished tubing shall satisfactorily meet the following performance tests. Test specimens shall be taken from tubing which has not been subjected to cold working after the anneal of the finished sized tubing.

Flattening Test—A section approximately 3 in. (75 mm) in length, cut from the finished tubing, shall not crack or show any flaws when flattened between parallel plates to a distance equal to three times the wall thickness of the section under test. Superficial ruptures resulting from minor surface imperfections shall not be considered cause for rejection.

Reverse Flattening Test—A test specimen shall be taken from every shipment or every 1500 ft (460 m), whichever is smaller, of finished tubing and split longitudinally 90 deg on each side of the weld. The section containing the weld shall be opened and flattened with the weld at the point of maximum bend. There shall be no evidence of cracks or lack of penetration or overlaps resulting from flash removal in the weld.

Refer to ASTM A 370, Methods and Definitions for Mechanical Testing of Steel Products, paragraph T5(B), reverse flattening test.

Expansion Test—A test specimen shall be taken from every shipment or every 1500 ft (460 m), whichever is smaller, of finished tubing and subjected to expansion over a hardened tapered plug having a slope of 0.1:1.0 until the outside diameter has been expanded 25% without evidence of cracking or flaws. ϕ

Pressure Proof Test—Unless otherwise specified, tubing supplied under this standard shall have been tested hydrostatically, with no evidence of failure, at a pressure which will subject the material to a yield stress of 20,000 psi (140 MPa). Test pressures shall be as determined by Barlow's ϕ formula for thin hollow cylinders under tension:

ϕ **TABLE 1—TUBING OUTSIDE DIAMETER AND WALL THICKNESS TOLERANCE**

Nominal Tubing OD[a,b]		Tolerance ±				
		OD		ID		Wall
in	mm	in	mm	in	mm	Thickness (%)
Up to 0.38	Up to 9.5	0.002	0.05	0.002	0.05	15
Over 0.38 to 0.63 inclusive	Over 9.5 to 15.9 inclusive	0.0025	0.06	0.0025	0.06	10
Over 0.63 to 2.00 inclusive	Over 15.9 to 50.8 inclusive	0.003	0.08	0.003	0.08	10
Over 2.00 to 2.50 inclusive	Over 50.8 to 63.5 inclusive	0.004	0.10	0.004	0.10	10
Over 2.50 to 3.00 inclusive	Over 63.5 to 76.2 inclusive	0.005	0.13	0.005	0.13	10
Over 3.00 to 4.00 inclusive	Over 76.2 to 101.6 inclusive	0.006	0.15	0.006	0.15	10

[a] The actual outside diameter shall be the average of the maximum and minimum outside diameters as determined at any one cross section through the tubing.

[b] Refer to SAE J514 for nominal tubing outside diameters to be used in conjunction with standard hydraulic tube fittings.

The ϕ symbol is for the convenience of the user in locating areas where technical revisions have been made to the previous issue of the report. If the symbol is next to the report title, it indicates a complete revision of the report.