Seamless Low Carbon Steel Tubing Annealed for Bending and Flaring —SAE J524 JAN80

SAE Standard
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LAND SEA AIR SPACE

PREPRINT

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SAE Standard

Report of the Tube, Pipe, Hose, and Lubrication Fittings Committee, approved January 1954, last revised by Fluid Conductors and Connectors Technical Committee January 1980.

Scope—This standard covers cold drawn and annealed seamless 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 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.

Dimensions and Tolerances—The tolerances applicable to tubing outside diameter are shown in Table 1. The wall thickness shall not vary more than ±10% for tubing having 0.50 in. (12.7 mm) or larger, nominal inside diameter nor more than ±15% for tubing having a smaller nominal inside diameter. Tubing outside diameter and wall thickness shall be as specified by 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.

The inside of tubing shall be clean and free from any contamination that cannot be removed readily 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 to 0.60
Phosphorus	0.040 max
Sulfur	0.050 max

[a] Check analysis tolerance shall be as specified in SAE J409, Table 1.

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), 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 ϕ 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.

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:

$$P = \frac{2TS}{D}$$

where: D = outside diameter of tubing, in. (mm)
P = hydrostatic pressure, psi (MPa)
S = allowable unit stress of material = 20,000 psi (140 MPa) ϕ
T = minimum wall thickness of tubing, in. (mm)

No tube shall be tested beyond a hydrostatic pressure of 5000 psi (35 MPa), unless so specified. ϕ

Nondestructive Electric Test—In lieu of the hydrostatic test, when mutually agreed upon by the purchaser and manufacturer, all tubing shall be tested by passing it through an electric eddy current tester which is capable of detecting defects that would prevent the tubing from passing the hydrostatic pressure proof test.

Corrosion Protection—The inside and outside of the finished tubing shall be protected against corrosion during shipment and normal storage. If a corrosion preventive compound is applied, it shall be such that after normal storage periods it can readily be removed by cleaning agents normally used in manufacturing.

ϕ **TABLE 1—TUBING OUTSIDE DIAMETER TOLERANCES**

Nominal Tubing OD[a,b]		OD Tolerance ±	
in	mm	in	mm
Up to 1.00	Up to 25.4	0.004	0.10
Over 1.00 to 1.50 inclusive	Over 25.4 to 38.1 inclusive	1.006	0.15
Over 1.50 to 2.00 inclusive	Over 38.1 to 50.8 inclusive	0.008	0.20
Over 2.00 to 3.50 inclusive	Over 50.8 to 88.9 inclusive	0.010	0.25

[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.