

Submitted for recognition as an American National Standard

(R) SEAMLESS LOW-CARBON STEEL TUBING ANNEALED FOR BENDING AND FLARING

1. **Scope**—This SAE 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.
2. **References**
 - 2.1 **Applicable Publications**—The following publications form a part of this specification to the extent specified herein. Unless otherwise specified, the latest issue of SAE publications shall apply.
 - 2.1.1 SAE PUBLICATIONS—Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

SAE J409—Product Analysis—Permissible Variations from Specified Chemical Analysis of a Heat or Cast of Steel

SAE J514—Hydraulic Tube Fittings

SAE J1677—Tests and Procedures for SAE Low-Carbon Steel and Copper Nickel Tubing
 - 2.2 **Related Publication**—The following publication is provided for information purposes only and is not a required part of this document.
 - 2.2.1 SAE PUBLICATION—Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

SAE J533—Flares for Tubing
 3. **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 document.
 4. **Dimensions and Tolerances**—The tolerances applicable to tubing outside diameter are shown in Table 1. The wall thickness shall not vary more than $\pm 10\%$ for tubing having 12.7 mm or larger, nominal inside diameter nor more than $\pm 15\%$ for tubing having a smaller nominal inside diameter. Tubing outside diameter and wall thickness shall be as specified by purchaser.

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TABLE 1—TUBING OUTSIDE DIAMETER TOLERANCES

Nominal Tubing OD ⁽¹⁾⁽²⁾ mm	OD Tolerance ± mm
Up to 25.4	0.10
Over 25.4 to 38.1 inclusive	0.15
Over 38.1 to 50.8 inclusive	0.20
Over 50.8 to 88.9 inclusive	0.25

1. 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.
2. Refer to SAE J514 for nominal tubing outside diameters to be used in conjunction with standard hydraulic tube fittings.

5. **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.
6. **Material**—Tubing shall be made from low-carbon steel conforming to the following chemical composition as shown in Table 2.

TABLE 2—CHEMICAL REQUIREMENTS

Element	Cast or Heat Analysis ⁽¹⁾ % by Weight
Carbon	0.18 max
Manganese	0.30 to 0.60
Phosphorus	0.040 max
Sulfur	0.050 max

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

7. **Mechanical Properties**—The finished tubing shall have mechanical properties as tabulated in Table 3:

TABLE 3—MECHANICAL PROPERTIES

Properties	Values
Yield Strength, min	170 MPa
Ultimate Strength, min	310 MPa
Elongation in 50 mm, min	35% ⁽¹⁾
Hardness (Rockwell B), max	65 ⁽²⁾

1. For tubing having nominal outside diameter of 9.5 mm or less, and/or wall thicknesses of 0.9 mm or less, a minimum elongation of 25% is permissible.
2. The hardness test shall not be required on tubing with a nominal wall thickness of less than 1.65 mm. Such tubing shall meet all other mechanical properties and performance requirements.

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8. **Performance Requirements**—The finished tubing shall satisfactorily meet the following performance tests. All tests are to be conducted in accordance with the procedures in SAE J1677. (The section listed in the parentheses is for the SAE J1677 document.)

8.1 **Flattening Test (5.1)**

8.2 **Flaring Test**—As Required (Double Flare 5.5.1)
(Single Flare 5.5.3)

8.3 **Expansion Test (5.4)**

8.4 **Pressure Proof Test (5.8)**—Where allowable unit stress of material(s) = 140 MPa.

8.5 **Nondestructive Electronic Test (5.9)**

9. **Test Certificates**—A certificate of compliance to the performance requirements shall be furnished to the purchaser by the producer if requested in the purchase agreement.

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

11. **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.

Extended corrosion resistance coatings, such as tern coating, galvanizing, epoxy paint, etc., are available and can be supplied at the request of the user.

12. **Notes**

12.1 **Marginal Indicia**—The change bar (I) 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