Designation: A 254 – 97 (Reapproved 2002)

Standard Specification for Copper-Brazed Steel Tubing[1]

This standard is issued under the fixed designation A 254; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

This standard has been approved for use by agencies of the Department of Defense.

1. Scope

1.1 This specification covers double-wall, copper-brazed steel tubing suitable for general engineering uses, particularly in the automotive, refrigeration, and stove industries for fuel lines, brake lines, oil lines, heating and cooling units, and the like.

1.2 The values stated in inch-pound units are to be regarded as the standard.

2. Referenced Documents

2.1 *ASTM Standards:*

A 370 Test Methods and Definitions for Mechanical Testing of Steel Products[2]

E 30 Test Methods for Chemical Analysis of Steel, Cast Iron, Open-Hearth Iron, and Wrought Iron[3]

E 59 Practice for Sampling Steel and Iron for Determination of Chemical Composition[4]

2.2 *Society of Automotive Engineers Standard:*

J 533 Flares for Tubing[5]

3. Ordering Information

3.1 Orders for material under this specification should include the following, as required to describe the desired material adequately:

3.1.1 Quantity (feet, metres),

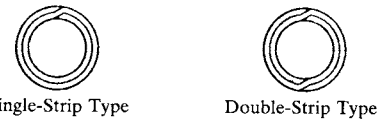
3.1.2 Name of material (copper-brazed steel tubing),

3.1.3 Type, where necessary (see Fig. 1) (normally the type is not specified),

3.1.4 Size (outside diameter and wall thickness; normally inside diameter should not be specified),

3.1.5 Length (specific or random),

3.1.6 Inside surface cleanliness where required (see Section 8),



Single-Strip Type Double-Strip Type

FIG. 1 Brazed Tubing, Double-Wall, 360-deg Brazed Construction

3.1.7 External coating, where required (see Section 7 and Supplementary Requirement S2), and

3.1.8 Special or supplementary requirements or exceptions to specification.

4. Manufacture

4.1 The steel may be made by any process.

4.2 If a specific type of melting is required by the purchaser, it shall be as stated on the purchase order.

4.3 The primary melting may incorporate separate degassing or refining and may be followed by secondary melting, such as electroslag remelting or vacuum-arc remelting. If secondary melting is employed, the heat shall be defined as all of the ingots remelted from a single primary heat.

4.4 Steel may be cast in ingots or may be strand cast. When steel of different grades is sequentially strand cast, identification of the resultant transition material is required. The producer shall remove the transition material by an established procedure that positively separates the grades.

4.5 The tubing shall be made by rolling steel strip into the form of tubing and subsequently copper brazing in a reducing atmosphere.

4.6 Tubing shall be constructed as shown in Fig. 1.

4.7 Tubing shall be suitably tested after brazing by the manufacturer to ensure freedom from leaks and detrimental flaws.

5. Chemical Composition

5.1 The steel shall conform to the requirements as to chemical composition prescribed in Table 1.

5.2 *Heat Analysis*—An analysis of each heat of steel shall be made by the steel manufacturer to determine the percentages of the elements specified. If secondary melting processes are employed, the heat analysis shall be obtained from one remelted ingot or the product of one remelted ingot of each primary melt. The chemical composition thus determined, or

[1] This specification is under the jurisdiction of ASTM Committee A01 on Steel, Stainless Steel, and Related Alloys and is the direct responsibility of Subcommittee A01.09 on Carbon Steel Tubular Products.

Current edition approved Mar. 10, 1997. Published November 1997. Originally published as A 254 – 44. Last previous edition A 254 – 94.

[2] *Annual Book of ASTM Standards*, Vol 01.03.

[3] Discontinued 1995; see *1994 Annual Book of ASTM Standards*, Vol 03.05.

[4] Discontinued 1996; see *1995 Annual Book of ASTM Standards*, Vol 03.05. Replaced by E 1806 (Vol 03.06).

[5] Available from Society of Automotive Engineers, Inc. 400 Commonwealth Dr., Warrendale, PA 15096-0001.

TABLE 1 Chemical Requirements

Element	Composition, %
Carbon	0.05 to 0.15
Manganese	0.27 to 0.63
Phosphorus, max	0.035
Sulfur, max	0.035

that determined from a product analysis made by the tubular product manufacturer shall conform to the requirements specified.

5.3 *Product Analysis*—Tubing of this quality is commonly produced in rimmed or capped steel which is characterized by a lack of uniformity in its chemical composition. For this reason, rejection for product analysis is not appropriate unless misapplication is clearly indicated.

5.4 *Methods of Analysis*—Methods described in Test Methods E 30 shall be used for referee purposes. Due allowance shall be made for the presence of copper brazing metal.

5.5 *Samples for Product Analysis*—Except for spectrographic analysis, samples shall be taken in accordance with Practice E 59.

6. Mechanical Requirements

6.1 *Tension Test*—Tensile properties of tubing as manufactured (prior to cold working) shall conform to the requirements specified in Table 2.

6.1.1 The specimens and tension tests required shall be made in accordance with Test Methods and Definitions A 370.

6.1.2 Specimens shall be tested at room temperature.

6.1.3 Test specimens shall be taken from the ends of finished tubes prior to upsetting, swaging, expanding, or other forming operations, or being cut to length. They shall be smooth on the ends and free from burrs and flaws.

6.1.4 If any test specimen shows flaws or defective machining, it may be discarded and another specimen substituted.

6.1.5 The yield strength shall be determined as that corresponding to a permanent offset of 0.2 % of the gage length of the specimen, or a total extension of 0.5 % of the gage length under load.

6.1.6 If the percentage of elongation of any test specimen is less than that specified and any part of the fracture is more than ¾ in. (19.0 mm) from the center of the gage length, as indicated by scribe marks on the specimen before testing, a retest shall be allowed.

6.2 *Flattening Test*—A section of tubing, not less than 2½ in. (64 mm) in length, shall stand being flattened between parallel plates until the inside walls are in contact without cracking or otherwise showing flaws.

6.3 *Expansion Test*—A section of tubing approximately 4 in. (100 mm) in length shall stand being expanded over a tapered mandrel having a slope of 1 in 10 until the outside diameter at the expanded end is increased 20 % without cracking or otherwise showing flaws. (Prior to the expansion test, tubing shall be cut off square, edge crowned, and deburred. It shall be held firmly and squarely in the die, and punch must be guided on the axis of the tubing.)

TABLE 2 Tensile Requirements

Property	Requirement
Tensile strength, min, psi (MPa)	42 000 (290)
Yield strength, min, psi (MPa)	25 000 (172)
Elongation in 2 in. (50.8 mm) min, %	25

6.4 *Bend Test*—The finished tubing shall stand bending on a centerline radius equal to three times the tubing outside diameter without kinking, cracking, or developing other flaws where proper bending fixtures are used.

6.5 *Pressure Proof Tests*—Each tube shall be capable of withstanding, without bursting or leaking, either of the following proof tests:

6.5.1 An internal hydrostatic pressure sufficient to subject the material to a minimum fiber stress of 16 000 psi (110 MPa). Hydrostatic pressure shall be determined by the following formula:

$$P = 2St/D$$

where:

P = hydrostatic pressure, psi (or MPa),
S = allowable fiber stress, 16 000 psi (110 MPa),
t = actual wall thickness of tubing, in. (or mm), and
D = actual outside diameter of tubing, in. (or mm).

6.5.2 An underwater air pressure between 225 and 250 psi (1.55 and 1.73 MPa).

7. Coating

7.1 Tubing may be furnished with a copper coating on the inside and outside surfaces, at the option of the manufacturer.

8. Inside Surface Cleanliness

8.1 When inside surface cleanliness is specified by the purchaser, tubing for certain uses, such as refrigeration condensers, shall conform to the following requirement for internal cleanliness:

8.1.1 When a length of tubing is washed internally with redistilled chloroform or redistilled 1,1,1-trichloroethane, the residue remaining upon evaporation of the solvent shall not exceed 1.25×10^{-4} g/in.^{2}(0.194 g/m^2) of internal surface. To perform the test, pour 100 mL of solvent through the tubing and collect. The total length of tubing tested should not be less than 40 ft (12 m), although this total length may be obtained by washing several separate lengths and pouring the same solvent through each in succession. Evaporate the solvent in a steam or hot water bath, and dry at 110°C (230°F) until the vapors are completely removed.

8.2 To maintain this level of cleanliness in shipping, handling, and storage, the purchaser may request that the manufacturer seal the tube ends with caps or closures.

9. Dimensional Tolerances

9.1 The tubing shall conform to the permissible variations in Table 3, Table 4, and Table 5.

10. Workmanship, Finish, and Appearance

10.1 Finished tubing shall be clean, smooth and round, both inside and outside, and shall be free of rust, scale, and defects that impair processing and serviceability. Finished tubes shall be reasonably straight.