Designation: A254/A254M – 12 (Reapproved 2019)

Standard Specification for Copper-Brazed Steel Tubing[1]

This standard is issued under the fixed designation A254/A254M; 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.

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. The tubing is available in either of two types, single strip or double strip as shown in Fig. 1.

1.2 *Units*—This specification is expressed in both inch-pounds units and in SI units; however, unless the purchase order or contract specifies the applicable M specification designation (SI units), the inch-pound units shall apply. The values stated in either inch-pound units or SI units are to be regarded separately as standard. Within the text, the SI units are shown in brackets. The values stated in each system may not be exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems may result in non-conformance with the standard. In this specification hard or rationalized conversions apply to diameters, lengths, and tensile properties. Soft conversion applies to other SI measurements.

1.3 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

A370 Test Methods and Definitions for Mechanical Testing of Steel Products

A751 Test Methods, Practices, and Terminology for Chemical Analysis of Steel Products

E30 Test Methods for Chemical Analysis of Steel, Cast Iron, Open-Hearth Iron, and Wrought Iron (Withdrawn 1995)[3]

E59 Practice for Sampling Steel and Iron for Determination of Chemical Composition (Withdrawn 1996)[3]

2.2 *Society of Automotive Engineers Standard:*[4]

J 533 Flares for Tubing

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 or number of pieces),

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

3.1.3 Type, single strip or double strip, 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),

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 commercially accepted steelmaking 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

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[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

[3] The last approved version of this historical standard is referenced on www.astm.org.

[4] Available from SAE International (SAE), 400 Commonwealth Dr., Warrendale, PA 15096-0001, http://www.sae.org.

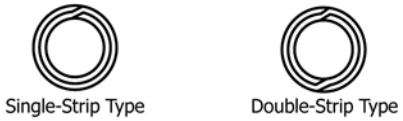

FIG. 1 Brazed Tubing, Double-Wall, 360-deg Brazed Construction

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 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 may be 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 E30 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 E59.

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 A370.

6.1.2 Specimens shall be tested at room temperature.

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

TABLE 2 Tensile Requirements

Property	Requirement
Tensile strength, min, psi [MPa]	42 000 [290]
Yield strength, min, psi [MPa]	25 000 [170]
Elongation in 2 in. [50 mm] min, %	25

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 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. [65 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.)

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 [MPa],
S = allowable fiber stress, 16 000 psi [110 MPa],
t = actual wall thickness of tubing, in. [mm], and
D = actual outside diameter of tubing, in. [mm].

6.5.2 An underwater air pressure between 225 and 250 psi [1.55 and 1.73 MPa].