SAE International

SURFACE VEHICLE STANDARD

SAE J1394 JUN2013

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Superseding J1394 JUN2004

Metric Nonmetallic Air Brake System Tubing[1]

RATIONALE

This technical report is being Stabilized because it covers technology, products, or processes which are mature and not likely to change in the foreseeable future, and it represents continuing commercial product. Producers and users are encouraged to reference SAE J844 for new product development and reference SAE J1394 for legacy information.

STABILIZED NOTICE

This document has been declared "Stabilized" by the SAE Air Brake Tubing and Tube Fittings Committee and will no longer be subjected to periodic reviews for currency. Users are responsible for verifying references and continued suitability of technical requirements. Newer technology may exist.

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1. ***Scope***—This SAE Standard covers the minimum requirements for metric sizes of nonmetallic tubing as manufactured for use in air brake systems. Nonreinforced products are designated type A and reinforced products type B. It is not intended to cover tubing for any portion of the system that operates below -40 °C (-40 °F), above +93 °C (+200 °F), above a maximum working gage pressure of 1.0 MPa (150 psi), or in an area subject to attack by battery acid. This tubing is intended for use in the brake system for connections that maintain a basically fixed relationship between components during vehicle operation. Coiled tube assemblies required for those installations where flexing occurs are covered by this standard and SAE J1131 to the extent of setting minimum requirements on the essentially straight tube and tube fitting connections, which are used in the construction of such assemblies.[2]

NOTE—As all elements of SAE J1394 are being merged into SAE J844, two separate documents are no longer required; therefore, SAE J1394 will be cancelled in July, 2005.

2. *References*

2.1 Applicable Publications—The following publications form a part of the specification to the extent specified herein. Unless otherwise indicated, the latest revision of SAE publications shall apply.

2.1.1 SAE PUBLICATIONS—Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

SAE J246—Spherical and Flanged Sleeve (Compression) Tube Fittings
SAE J844—Nonmetallic Air Brake System Tubing
SAE J1131—Performance Requirements for SAE J844 Nonmetallic Tubing and Fittings Assemblies Used in Automotive Air Brake Systems
SAE J1149—Metallic Air Brake System Tubing and Pipe

2.1.2 GOVERNMENT PUBLICATIONS—Available from the Superintendent of Documents, U. S. Government Printing Office, Mail Stop: SSOP, Washington, DC 20402-9320.

49 CFR 393.45—Brake Tubing and Hose, Adequacy
49 CFR 571.106—Brake Hoses

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1. The metric values contained herein are to be regarded as standard; the in-lb values in parentheses may only be approximate. See SAE J844 for nonmetallic air brake system tubing (inch-dimensioned) and SAE J1149 for metallic air brake system tubing and pipe.
2. Federal regulations covering designed requirements and accepted applications for coiled tube assemblies are set forth in 49CFR393.45.

2.1.3 ASTM PUBLICATIONS—Available from ASTM, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.

ASTM D 4329—Practice for Operating Light- and Water-Exposure Apparatus (Fluorescent UV-Condensation Type) for Exposure of Plastics
ASTM G 53—Recommended Practice for Operating Light- and Water-Exposure Apparatus (Fluorescent UV-Condensation Type) for Exposure of Nonmetallic Materials

3. Installation and Assembly Recommendations

3.1 End Fittings—End fittings are to be assembled to the tubing in accordance with the fitting manufacturer's recommendations. The fitting may be of the design shown in the proposed metric version of SAE J246, or any other design suitable for use with metric size nonmetallic air brake tubing. Performance test requirements for nonmetallic air brake assemblies are covered in SAE J1131.

3.2 Noncoiled Tubing—Noncoiled tubing should not be used in flexing applications such as frame to axle.

3.3 Support and Routing—When installed in a vehicle, this tubing shall be routed and supported so as to:

a. Eliminate chafing, abrasion, kinking, or other mechanical damage.
b. Minimize fatigue conditions.
c. Be protected against road hazards by installation in a protected location or by providing adequate shielding at vulnerable areas.
d. Not be exposed to temperatures, internal or external, over +93 °C (+200 °F) or below -40 °C (-40 °F).
e. Not be exposed to attack by battery acid.
f. Avoid excessive sag.

4. Identification—Air brake tubing shall be labeled in contrasting color with the legend repeated every 380 mm (15 in) or less along the entire length of tubing in legible block capital letters.

The following minimum information, in the order listed, is required. Additional information and/or another lay line may be added, if necessary.

a. Metric airbrake
b. SAE J1394
c. Type A or B
d. Nominal tubing OD in mm—6, 8, 10, 12, or 16
e. Tubing manufacturer's identification

5. Manufacture—The tubing shall be manufactured to comply with the requirements outlined in this document.

6. Construction—Type A tubing shall consist of a single wall extrusion of 100% virgin nylon (polyamide) containing additives that provide heat and light resistance. Type B tubing shall consist of a core extrusion of 100% virgin nylon (polyamide) containing additives that provide heat resistance. This core shall be reinforced with polyester braid or equivalent and covered with a protective jacket of 100% virgin nylon (polyamide) containing additives that provide heat and light resistance. The protective covering shall be bonded to the core through the interstices of the braid. The inner core and outer jacket shall be of contrasting colors.

7. ***Dimensions and Tolerances*—**The tubing shall conform to dimensions shown in Table 1 under all conditions of moisture. Conformance with this requirement shall be determined on samples that have been subjected to 110 °C (230 °F)[3] for 4 h[4] in a circulating air oven, and on separate samples that have been immersed in boiling water for 2 h. Dimensional tests shall be made after samples have been returned to room temperature for 0.5 to 3.0 h.

TABLE 1—DIMENSIONS AND TOLERANCES

Tubing Type	Tubing Size OD mm	Tubing Size OD in	Tubing Size ID mm	Tubing Size ID in	Minimum Wall Thickness mm	Minimum Wall Thickness in	OD Tolerances mm	OD Tolerances in	ID Tolerances mm	ID Tolerances in
A	6.0	0.236	4.0	0.157	0.9	0.035	±0.1	±0.004	±0.1	±0.004
A	8.0	0.315	6.0	0.236	0.9	0.035	±0.1	±0.004	±0.1	±0.004
B	10.0	0.393	7.0	0.275	1.35	0.053	±0.15	±0.006	±0.15	±0.006
B	12.0	0.472	9.0	0.354	1.35	0.053	±0.15	±0.006	±0.15	±0.006
B	16.0	0.629	12.0	0.472	1.8	0.071	±0.15	±0.006	±0.15	±0.006

TABLE 2—MECHANICAL PROPERTIES

Tubing Type	Nominal Tubing OD mm	Minimum Burst Pressure at 24 °C (75 °F)(1) MPa	Minimum Burst Pressure at 24 °C (75 °F)(1) psi	Test Bend Radius(2) mm	Test Bend Radius(2) in	Maximum Stiffness N	Maximum Stiffness lbf
A	6	7.6	1100	20	0.75	9	2
A	8	6.2	900	32	1.25	27	6
B	10	8.2	1200	38	1.50	36	8
B	12	6.9	1000	45	1.75	90	20
B	16	6.0	875	70	2.75	225	50

1. With moisture content of tubing 0.06% max.
2. For test purposes only.

8. ***Mechanical Properties*—**The tubing shall conform to the mechanical properties shown in Table 2, when tested according to the method outlined in this document.

9. ***Performance Requirements*—**The tubing shall satisfactorily meet the following performance tests (see Footnotes 3, 4, 5, and 6).

9.1 Leak Test[5]—The tubing manufacturer shall subject each continuous length of tubing to test at a gage pressure of 1.4 MPa + 0.35, –0 (200 psi + 50, –0) with an appropriate gas for a period of time (minimum 30 s) sufficient to determine the presence of any leaks. Defective sections shall be cut off and scrapped. The remaining tubing shall be recoupled at the points where defective sections were removed and again subjected to the 1.4 MPa + 0.35, –0 (200 psi + 50, –0) pressure test. The procedure shall be repeated until all sections of tubing designated for distribution to users have successfully withstood the test.

3. All test temperatures specified may vary by ±3 °C (±5 °F).
4. All times are minimum unless otherwise specified.
5. An inspection test conducted on each lot of tubing and where a lot is defined as "the output of one production shift of one size and color of tubing."

9.2 Moisture Absorption[6]—Expose sample of tubing for 24 h in a circulating air oven at 110 °C (230 °F). Remove from oven, weigh immediately, and expose for 100 h at 100% relative humidity and 24 °C (75 °F). Within 5 min from humidity conditioning, wipe surface moisture from both the interior and exterior surfaces of the tubing and reweigh. Moisture absorption shall not exceed 2% by weight.

9.3 Ultraviolet Resistance[6]—Place samples of tubing in the sample racks of a Q-Panel QUV test apparatus* equipped with Phillips bulbs, type UVA-340. Expose for 300 h minimum. If the test apparatus is equipped with a "Solar Eye," the bulbs need not be rotated and the irradiance should be set at 0.85, however all bulbs should be discarded after 4800 h maximum, or if they fall below the 0.85 irradiance level, which ever occurs first. If the test apparatus is not equipped with a "Solar Eye," the bulbs must be rotated every 400 h maximum, as recommended by the manufacturer and ASTM G 53, this procedure will result in discarding lamps after 1600 h of use. Control the temperate of the apparatus to 45 °C ± 3 °C. The distance from the plate upon which the specimens are mounted and the light bulbs will be 51 mm maximum. The automatic humidity cycling must be turned off. Rotate the specimens according to ASTM D 4329 except the time interval should be each 96 h maximum instead of weekly. Maintain and operate the QUV tester in accordance with the manufacturers instructions. Immediately following this exposure, subject the tubing to the impact test shown in Figure 1. Subject tubing to room temperature burst as specified in 9.10. Tubing shall withstand no less than 80% of the burst pressure shown in Table 2.

*The Q-Panel QUV Accelerated Weathering Tester is available from:
The Q-Panel Company
26200 First Street
Cleveland, OH 44145
(216) 835-8700

9.4 Cold Temperature Flexibility[6]—Expose sample of tubing for 24 h in a circulating air oven at 110 °C (230 °F). Remove from oven and within 30 min expose for 4 h at -40 °C (-40 °F). Also expose a mandrel at -40 °C (–40 °F) having a diameter equal to twelve times the nominal diameter of the tubing. (In order to obtain uniform temperatures, the tubing and mandrel may be supported by a nonmetallic surface during the entire period of test.) Immediately following this exposure, bend tubing 180 degrees over the mandrel, accomplishing the bending motion within a period of 4 to 8 s. The tubing shall show no evidence of fracture.

9.5 Heat Aging[6]—Three separate heat aging tests shall be conducted; each phase shall be run on separate tubing samples. Subject tubing to room temperature burst test as specified in 9.10. Tubing shall withstand 80% of the burst pressure shown in Table 2.

9.5.1 PHASE 1—Bend samples of tubing 180 degrees around a mandrel having a diameter equivalent to twice the bend radius specified in Table 2. While in this position, expose tubing and mandrel for 72 h in an circulating air oven at 110 °C (230 °F). Remove from oven and permit tubing to return to 24 °C (75 °F) while still on the mandrel. Within 30 min after stabilization at 24 °C (75 °F), return the tubing to a straight position in a minimum of 4 s, then rebend (against the set) 180 degrees around the mandrel, accomplishing the bending motion within a period of 4 to 8 s.

9.5.2 PHASE 2—Expose samples of tubing for 72 h in a circulating air oven at 110 °C (230 °F). Remove from oven and permit tubing to return to 24 °C (75 °F). Within 30 min after stabilization at 24 °C (75 °F), subject tubing to the impact test shown in Figure 1.

9.5.3 PHASE 3—Immerse samples of tubing in boiling water for 2 h. Remove from water and permit to return to 24 °C (75 °F). Within 30 min after stabilization at 24 °C (75 °F), subject tubing to the impact test shown in Figure 1.

6. A qualification test.

NOMINAL TUBE O.D.	HOLE DIA D MM	HOLE DIA D IN
6	6.8	0.268
8	8.8	0.346
10	10.8	0.425
12	12.8	0.504
16	16.8	0.661

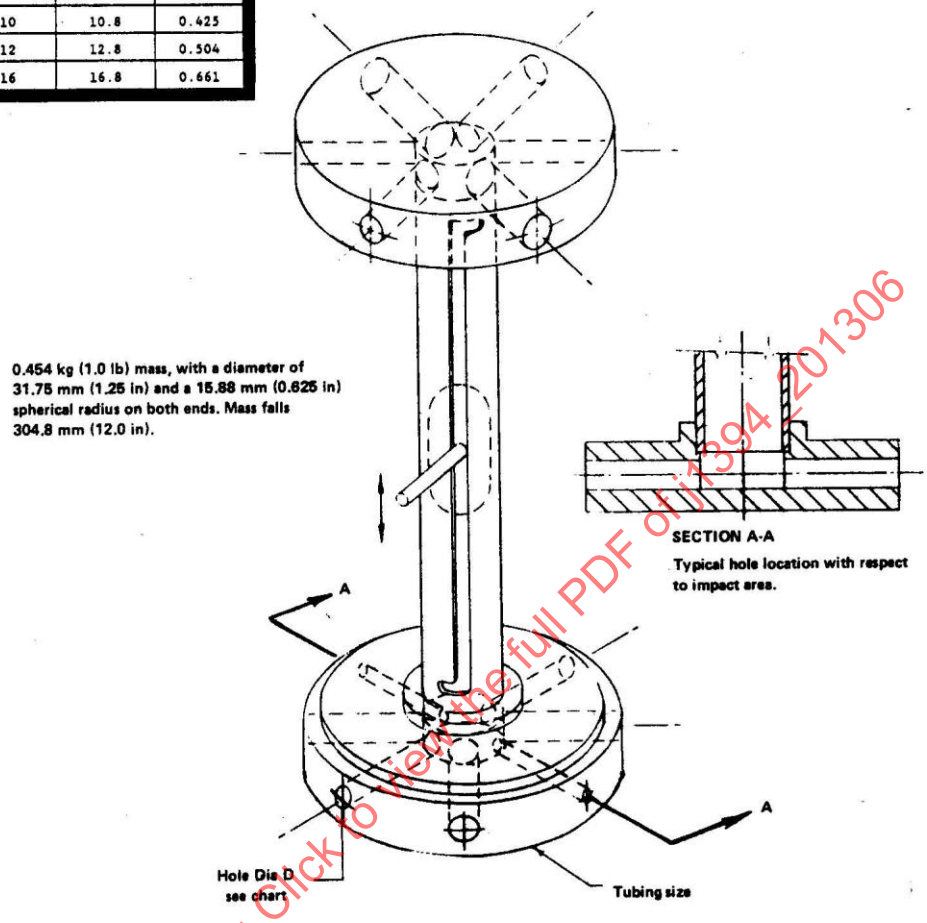

FIGURE 1—TYPICAL NYLON TUBING IMPACT APPARATUS

9.6 Resistance to Zinc Chloride[7]—Bend tubing to the bend radius shown in Table 2. While in this position, immerse in a 50% (by weight) aqueous solution of zinc chloride for 200 h at 24 °C (75 °F). Remove from solution. Tubing shall show no evidence of cracking on the outside diameter.

NOTE—Fresh, anhydrous zinc chloride should be used to make a concentration of 50% (by weight) aqueous solution (specific gravity of 1.576 or a Baume rating of 53 degrees at 16 °C [61 °F]).

9.7 Resistance to Methyl Alcohol[7]—Bend tubing to the bend radius shown in Table 2. While in this position, immerse in 95% methyl alcohol for 200 h at 24 °C (75 °F). Remove from solution. Tubing shall show no evidence of cracking.

7. A qualification test.