SURFACE VEHICLE STANDARD

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Superseding J2494-3 FEB2019

Performance Requirements for SAE J844 Nonmetallic Air Brake Tubing and Push to Connect Fitting Assemblies Used in Vehicular Air Brake Systems

RATIONALE

The purpose of this specification revision is to modify the language/description of the oil used in the 3.7, which, as described in 3.7.1, "is intended to evaluate the effects of contaminated compressor oil as described in SAE J2024 Section 3 at high and low temperatures on fitting performance." The contaminated oil mixture is currently specified in 3.7.4, as "consisting of 11 parts SAE 15W40CD type oil and one part SOFTC-2A contaminates." Since API oil service requirements are constantly being reviewed and updated, as pointed out by others on the committee, it is inevitable that older grades, such as the SAE 15W40CD grade originally listed, will eventually become obsolete and/or unavailable. The recommended revision to the document is to change the oil description in 3.7.4 from "SAE 15W40CD" to "SAE 15W40 (current API Diesel C Service Category for four-stroke diesel engines, such as API CK4 current as of 2018)," so that most current and applicable oil grades that become standardized for service will be used for the oil mixture, keeping the test relevant for future vehicles. Note that the phrase "such as API CK4 current as of 2018" is added to further clarify what is the current (as of this revision) API service category, addressing an SAE first ballot comment.

SAE J2494-3 has been reaffirmed to comply with the SAE Five-Year Review policy.

1. SCOPE

This SAE Standard is intended to establish uniform performance criteria and methods of testing push-to-connect tube fittings, with SAE J844 air brake tubing as used in vehicular air brake systems.

The specific tests and performance criteria applicable to the tubing are set forth in SAE J844. The test values contained in this performance standard are for test purposes only. For environmental and usage limitations, refer to SAE J844.

1.1 General Requirements

a. Test temperature shall use ±3 °C as the test tolerance range.

b. Ambient temperature shall be 24 °C.

c. All test times are minimum times, unless otherwise specified.

d. Dry air shall be a minimum of -50 °C dew point.

e. Tubing shall be cut square at 90 degrees ± 7 degrees.

f. Precondition all test specimens at 700 kPa ± 70 kPa for 30 seconds without any leakage.

g. New specimens shall be used for all tests.

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https://www.sae.org/standards/content/J2494/3_202312/

2. REFERENCES

2.1 Applicable Publications

The following publications form a part of this specification to the extent specified herein. Unless otherwise indicated, the latest issue of SAE publications shall apply.

2.1.1 SAE Publications

Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or +1 724-776-4970 (outside USA), www.sae.org.

SAE J844 Nonmetallic Air Brake System Tubing

SAE J2024 Contaminants for Testing Air Brake Components and Auxiliary Pneumatic Devices - Truck and Bus

SAE J2494-1 Dimensional Specifications for Metallic Body Push-to-Connect Fittings Used on a Vehicular Air Brake System

SAE J2494-2 Dimensional Specifications for Nonmetallic Body Push-to-Connect Fittings Used on a Vehicular Air Brake System

SAE J2494-4 Cartridge Cavity

SAE HS J806 SAE Oil Filter Test Procedure

2.1.2 ASTM Publications

Available from ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959, Tel: 610-832-9585, www.astm.org.

ASTM B117 Salt Spray (Fog) Testing

ASTM D4329 Standard Practice for Fluorescent UV Exposure of Plastics

ASTM G53 Practice for Operating Light- and Water-Exposure Apparatus (Fluorescent UV-Condensation Type) for Exposure on Nonmetallic Materials

ASTM G151 Standard Practice for Exposing Nonmetallic Materials in Accelerated Test Devices that Use Laboratory Light Sources

ASTM G154 Practice for Operating Fluorescent Light Apparatus for UV Exposure of Nonmetallic Materials

2.1.3 Federal Publications

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

49 CFR 571.106 Brake Hoses (DOT FMVSS 571.106)

3. REQUIREMENTS FOR METALLIC AND NONMETALLIC FITTINGS

3.1 Tensile Tests (15 Specimens)

3.1.1 Description

Both hot and cold tensile tests shall be conducted with different unaged assemblies (fittings attached within 30 days of test date). Tests consist of subjecting the assembly to increasing tensile load in a suitable testing machine until the specified force value or elongation percentage has been obtained.

3.1.2 Apparatus

A tensile test machine with suitable indicating device shall be used for the tensile test. The fixtures for holding the test specimens shall be arranged so the tubing and fittings have a straight centerline corresponding to the direction of the machine pull. The lower part of the fixture shall be equipped with a container of sufficient dimensions to submerge the required length of tubing in water. A means of heating the water to boiling shall be provided. A cover shall not be used on the container. This allows the steam to dissipate into the environment. If a fan is used in this test, then take precautions to direct the air away from the test specimen.

3.1.3 Test Specimens

The tubing specimens (a minimum of 15) shall be obtained from current production stock and cut to a length sufficient to obtain 150 mm ± 6 mm of tubing between end fittings after assembly. Assemble fittings to the tubing using the manufacturer's recommendations.

3.1.4 Procedure (15 Specimens)

3.1.4.1 High Temperature Tensile Test (Five Specimens)

Place the test specimen in the tensile machine with the lower fitting and 102 mm (+6/-0 mm) of tubing submerged below the surface of the boiling distilled water such that the outside diameter is exposed to the water. Continue boiling for 5 minutes (+0.5/-0 minutes). Apply load at a rate of pull of 25 mm/min.

3.1.4.2 Conditioned Tensile Test (Five Specimens)

Condition test specimen at -40 °C for 30 minutes (+0.5/-0 minutes), normalize at ambient temperature then submerge in boiling water for 15 minutes. Repeat for a total of four complete cycles. Allow the test specimen to normalize at room temperature for 30 minutes. Conduct the tensile test within 30 minutes after the normalizing period while at ambient temperature of 24 °C. Apply load at a rate of 25 mm/min.

3.1.4.3 Water Absorption and Tensile Test (Five Specimens)

After immersion in distilled water at ambient temperature for 70 hours, conduct tensile test on the specimen by applying a load at the rate of 25 mm/min. The tube assembly shall withstand without separation of the tube and end fittings a tensile pull as listed in Table 1.

3.1.5 Acceptance Criteria - Requirements

Each specimen shall elongate 50% (minimum), that is 150 mm increased to 225 mm, or shall withstand the load listed in Table 1 without causing separation from the fitting.

Table 1 - Tensile requirements

Nominal Tubing OD (Inches)	Tensile Load (Newtons)
5/32	225
3/16	225
1/4	225
5/16	335
3/8	670
1/2	900
5/8	1450
3/4	1560

3.2 Air Leakage (Five Specimens)

3.2.1 Description

This test is designed to evaluate the effects of high and low system pressures on the fitting assembly at high and low temperatures.

3.2.2 Apparatus

The equipment must be capable of controlling the ambient air temperature between -40 °C and 104 °C while applying 1035 kPa or 70 kPa dry air to the test lines. A mass flow meter capable of determining air leakage shall be provided.

3.2.3 Test Specimens

Cut tubing specimens to a length sufficient to obtain 460 mm between fittings after assembly. Assemble identical fittings to the tubing using the manufacturer's recommendations.

3.2.4 Procedure

Place both ends of the test specimens in temperature cycling cabinet and connect to a pressure source capable of 70 kPa ± 7 kPa and 1035 kPa ± 70 kPa pneumatic pressure. Pressure 4 cph, alternating between 70 kPa ± 7 kPa and 1035 kPa ± 70 kPa. Subject the test specimens while under pressure to ambient temperature for 2 hours, 104 °C for 12 hours, ambient temperature for 2 hours, -40 °C for 2 hours, and ambient temperature again for 2 hours in the order listed.

See Table 2 and Figure 1.

Table 2 - Air leakage test conditions

Time (Hours)	Pressure (kPa)	Temperature (°C)
2	1035	24
14	1035	104
16	1035	24
18	1035	-40
20	1035	24

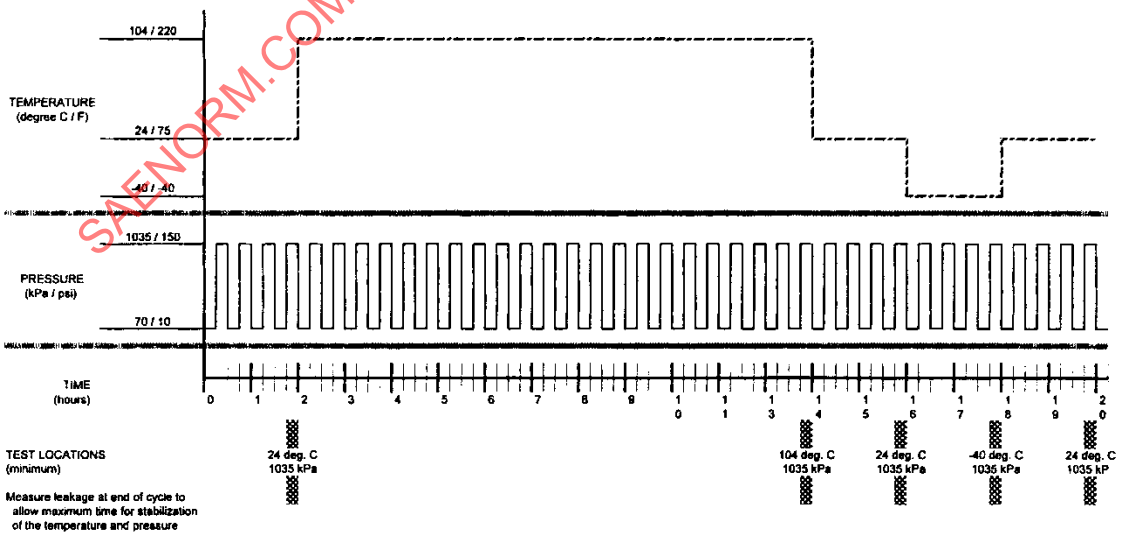

Figure 1 - Air leakage test cycle chart

3.2.5 Acceptance Criteria

After the pressure in the assembly is allowed to stabilize, the test specimens are considered a failure if the average leakage per fitting on any assembly at specified test conditions in Table 2 exceeds the amounts listed in Table 3.

Table 3 - Leakage test requirements

Test Temperature (°C)	Maximum Leakage (Standard Cubic Centimeters/Minute)
104	3
24	5
-40	7

3.3 Vibration Test (Five Specimens)

3.3.1 Description

This test is designed to evaluate the effects of vibration on a tube and fitting assembly under varying internal pressures and ambient temperatures. Leakage rate is used to gauge acceptability.

3.3.2 Apparatus

Equipment capable of vibrating one end of the test specimen at 600 Hz through 12 mm displacement in a plane perpendicular to the tube while the other end is held rigid. The distance between the static and the vibrating head is to be such that when the assembly is displaced 12 mm, no parallel pull to the longitudinal axis of the assembly will occur. The equipment must be capable of automatically adjusting the system pressure to compensate for fluctuating temperatures between -40 °C and 104 °C and associated air pressure of 830 kPa (±70 kPa) dry air during the test process. A mass flow meter capable of determining air leakage shall be provided.

3.3.3 Test Specimens

Allowing 12 mm slack, cut a minimum of five tubing specimens to a length sufficient to obtain 460 mm between fittings after assembly. Assemble identical fittings to the tubing using the manufacturer's recommendations.

3.3.4 Procedure

Allowing 12 mm slack, mount the lines straight in the vibration machine. Oscillate one end of the lines at 600 cpm (±20 cpm) through a total stroke of 12 mm for a total of 1000000 cycles (+50000/-0 cycles), while maintaining test conditions as shown in Table 4. Starting at 104 °C, vary the ambient air temperature from 104 to -40 °C at 250000 vibration cycle intervals, approximately 7 hours intervals. Using a mass flow meter, observe for fitting leakage during and after the test.

Table 4 - Vibration test requirements

Test Cycles	Test Pressure (kPa)	Test Temperature (°C)
0/250000	0	104
250001/500000	0	-40
500001/750000	830	104
750001/1000000	830	-40

3.3.5 Acceptance Criteria

The test is considered a failure if the average leakage per fitting on any assembly at test temperatures exceeds the amounts listed in Table 3.

3.4 Fitting Separation Pressure Test Requirements (Five Specimens)

3.4.1 Description

This test is intended to evaluate fitting retention at proof pressure of 2760 kPa ± 70 kPa and at minimum separation pressure.

3.4.2 Apparatus

The test apparatus consists of a suitable source of hydraulic pressure and the necessary gauges and piping.

3.4.3 Test Specimens

Cut a minimum of five tubing specimens to obtain 300 mm between fittings after assembly. Assemble fittings to the tubing using the manufacturer's recommendations.

3.4.4 Procedure

Plug one end of the test specimen and mount in the apparatus with the end unrestrained. Apply proof pressure at ambient temperature, to the test specimen and hold for 30 seconds. Increase pressure at a constant rate so as to reach the specified minimum separation pressure within a time period of 3 to 15 seconds.

3.4.5 Acceptance Criteria

Fittings shall not separate from the tubing nor shall the assembly visibly leak at less than specified minimum separation pressure of 5500 kPa ± 70 kPa.

3.5 Frozen Water Retention Test (Five Specimens)

3.5.1 Description

This test is intended to evaluate the effects of frozen water on fitting retention while assembly is pressurized to 2760 kPa ± 70 kPa.

3.5.2 Apparatus

The test apparatus consists of a suitable source of pneumatic pressure and the necessary gauges and piping.

3.5.3 Test Specimens

The tubing specimens shall be obtained from current production stock and cut to a length sufficient to obtain 150 mm ± 6 mm of tubing between end fittings after assembly. Assemble fittings to the tubing using the manufacturer's recommendations.

3.5.4 Procedure

Submerge one end of fitting assembly in water for 15 seconds, then remove the specimens from the water making sure the orientation of the fitting is such that no water is allowed to drain. Place test specimens in -10 °C air for a minimum of 1 hour or until completely frozen. Conduct pressure test on the specimens while at -10 °C by applying 2760 kPa ± 70 kPa pneumatic pressure and hold for 5 minutes.

3.5.5 Acceptance Criteria

Fittings shall not separate from the tubing at the specified minimum test pressure of 2760 kPa.

3.6 Reassembly Test (Five Specimens)

3.6.1 Description

This test is intended to evaluate the effects of repeated assembly and disassembly of a tube and fitting. Leakage rate is used to gauge acceptability.

3.6.2 Apparatus

The test apparatus consists of a suitable source of pneumatic pressure and the necessary gauges and piping. A mass flow meter capable of determining air leakage shall be provided.

3.6.3 Test Specimens

Cut a minimum of five tubing specimens to obtain 300 mm between fittings after assembly. Assemble fittings to the tubing using manufacturer's recommendations.

3.6.4 Procedure

The tube and fitting connections shall be assembled, pressurized to 830 kPa ± 70 kPa pneumatic for 5 minutes (+0.5/-0.0 minutes), depressurized, and disassembled five times. Tube end must not be trimmed between each assembly and disassembly cycle. Reassemble for sixth time and pressurize the test specimen to 830 kPa ± 70 kPa with pneumatic pressure at ambient temperature, hold for 5 minutes and check for leakage.

3.6.5 Acceptance Criteria

The test is considered a failure if the average leakage per fitting on any assembly at test temperatures exceeds the amounts listed in Table 3.

3.7 Oil Compatibility Test (Five Specimens)

3.7.1 Description

This test is intended to evaluate the effects of contaminated compressor oil as described in SAE J2024 Section 3 at high and low temperatures on fitting performance.

3.7.2 Apparatus

The test apparatus consists of a suitable source of hydraulic pressure, 1035 kPa and necessary gauges and piping in environmental test chambers at 100 °C and -40 °C.

3.7.3 Test Specimens

Cut a minimum of five tubing specimens to obtain a minimum of 300 mm between fittings after assembly. Assemble fittings to the tubing using manufacturer's recommendations.

3.7.4 Procedure

Fill test specimens with contaminated oil mixture consisting of 11 parts SAE 15W40 (current API Diesel C Service Category for four-stroke diesel engines, such as API CK4 current as of 2018) type oil and one part SOFTC-2A contaminates. Subject specimens to 100 °C, and atmospheric pressure for 72 hours (+1/-0.0 hour), then apply internal pressure of 1035 kPa ± 70 kPa for 5 minutes while maintaining a temperature of 100 °C. Reduce to atmospheric pressure and permit test specimens to return to ambient temperature then subject test specimens to -40 °C and atmospheric pressure for 24 hours (+1/-0.0 hour). Then apply internal pressure of 1035 kPa ± 70 kPa for 5 minutes (+0.5/-0.0 minutes) while maintaining a temperature of -40 °C.

3.7.5 Acceptance Criteria

Tubing shall not rupture or disconnect from the fittings.

3.8 Fitting Assembly Corrosion Resistance Test (Five Specimens)

3.8.1 Description

This test is designed to test the effects of salt spray corrosion on fitting assembly performance.

3.8.2 Apparatus

Utilize the apparatus described in ASTM B117 Salt Spray (Fog) Testing. Mix a salt solution five parts by weight of sodium chloride to 95 parts of distilled water, using sodium chloride substantially free of nickel and copper, and containing on a dry basis not more than 0.1% of sodium iodide and not more than 0.3% of total impurities. Ensure that the solution is free of suspended solids before the solution is atomized. After atomization at 35 °C, ensure that the collected solution is in the pH range of 6.5 to 7.2. Make the pH measurement at 25 °C. Maintain a compressed air supply to the nozzle or nozzles free of oil and dirt and between 70 and 170 kPa. The test specimens shall be supported or suspended 30 degrees from the vertical and parallel to the principal direction of the horizontal flow of fog through the chamber. The test specimens shall not have contact with any metallic material or any material capable of acting as a wick.

Condensation that falls from the test specimens shall not return to the solution reservoir for respraying. Condensation from any source shall not fall on the test specimen or the solution collectors. Spray from the nozzles shall not be directed onto the test specimens.

3.8.3 Test Specimens

The test specimens shall consist of two end fittings and a minimum of 200 mm of tubing between fittings.

3.8.4 Test Procedure

Subject the test specimens to the salt spray continuously for 72 hours (+1/-0.0 hour). Regulate the mixture so that each collector will collect from 1 to 2 mL of solution per hour for each 80 cm^2 of horizontal collecting area. Maintain exposure zone temperature at 35 °C. Upon completion, remove the salt deposit from the surface of the tube assembly by washing gently or dipping in clean running water not warmer than 38 °C and then drying immediately. Allow the test specimens to stabilize at ambient temperature, then pressurize to 840 kPa ± 70 kPa pneumatic pressure for 5 minutes.

3.8.5 Acceptance Criteria

After 72 hours exposure to salt spray, the fittings shall show no pit corrosion on the fitting surface. The average leakage per fitting on any assembly shall not exceed in amount listed in Table 3.

3.9 Side Load Leakage Test (Five Specimens)

3.9.1 Description

This test is designed to evaluate the leakage effects of maximum side loading on a tube and fitting assembly at ambient temperature. Leakage rate is used to gauge acceptability.

3.9.2 Apparatus

Equipment must be capable of controlling air pressure to 1035 kPa through a manifold consisting of a fixed and an adjustable block (see Figure 2). A mass flow meter capable of determining air leakage shall be provided.

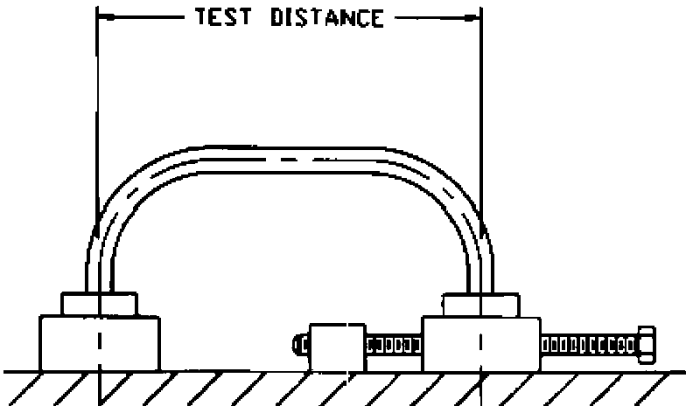

Figure 2 - Side load test fixture

3.9.3 Test Specimens

Prepare test specimens using straight tube fittings. The length of tubing shall be determined by the following formula: Test specimens length = π (minimum kink radius[1]) + 2 (fitting insertion depth).

3.9.4 Test Procedure

Mount test specimens on test manifold blocks using identical tube fittings as shown in Figure 2. Using the adjustable block, increase the distance between the centerlines of the test fittings to equal the test distance listed in Table 5. Pressurize the test specimens to 1035 kPa at ambient temperature for a period of 5 minutes. If the tubing kinks during the test, the test shall be restarted using another specimen of tubing.

Table 5 - Side load test requirements

Nominal Tubing OD (Inches)	Test Distance (mm)
5/32	30
3/16	50
1/4	65
5/16	80
3/8	95
1/2	127
5/8	160
3/4	180

3.9.5 Acceptance Criteria

After 5 minutes, the test is considered a failure if the average leakage per fitting on any assembly at test temperature exceeds the amount listed in Table 3.

4. ADDITIONAL REQUIREMENTS FOR NONMETALLIC FITTINGS ONLY

4.1 Moisture Absorption (Five Specimens)

4.1.1 Description

This test is designed to evaluate the resistance of nonmetallic fitting components to moisture absorption. Change in weight is used to gauge acceptability.

[1] As listed in SAE J844 Table 3.