

Non-Metallic, Non-Reinforced Automotive Air-Conditioning Refrigerant Line Assembly Requirements

RATIONALE

SAE J3143 has been issued to establish performance requirements for non-metallic and non-reinforced automotive air-conditioning refrigerant line assemblies.

1. SCOPE

The scope of SAE J3143 will cover non-metallic line assemblies intended for containing and circulating lubricant (PAG, POE compressor oils), liquid, and gaseous R-134a, R-152a, or R-1234yf refrigerant in automotive air-conditioning systems. SAE J3143 will also provide the necessary hose permeation values used in SAE J2727 mobile air-conditioning system refrigerant emission charts. The assembly shall be designed to minimize permeation of the refrigerant, contamination of the system, and to be functional over a temperature range of -30 to 125 °C. Specific construction details are to be agreed upon between user and supplier. Figure 1 shows a typical A/C system with TXV.

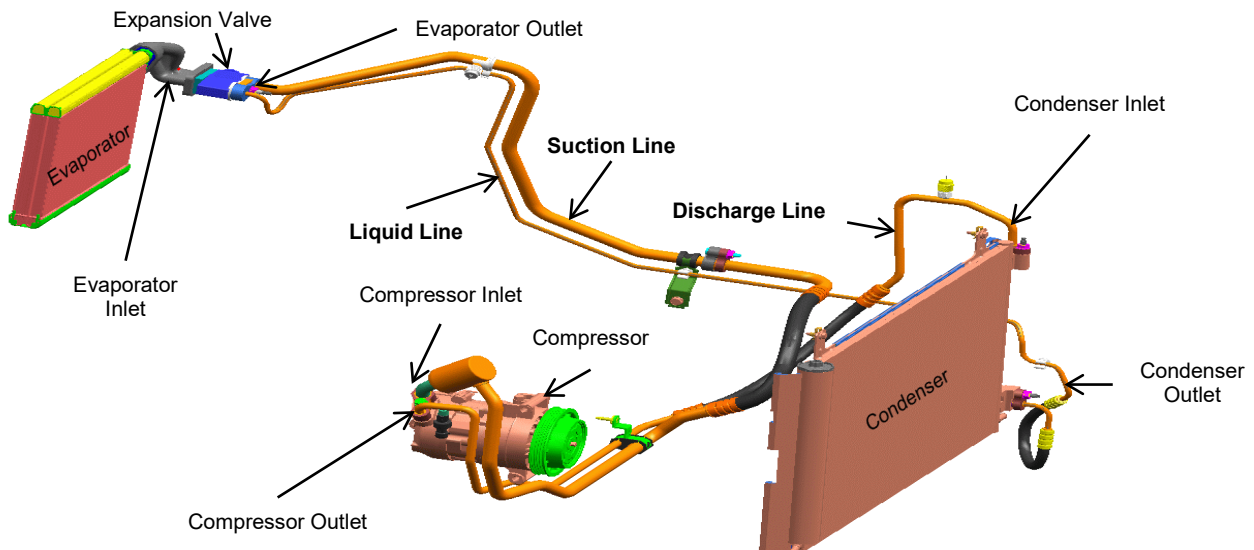


Figure 1 - Typical A/C system with TXV

SAE Technical Standards Board Rules provide that: "This report is published by SAE to advance the state of technical and engineering sciences. The use of this report is entirely voluntary, and its applicability and suitability for any particular use, including any patent infringement arising therefrom, is the sole responsibility of the user."

SAE reviews each technical report at least every five years at which time it may be revised, reaffirmed, stabilized, or cancelled. SAE invites your written comments and suggestions.

Copyright © 2019 SAE International

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system or transmitted, in any form or by any means, electronic, mechanical, photocopying, recording, or otherwise, without the prior written permission of SAE.

TO PLACE A DOCUMENT ORDER: Tel: 877-606-7323 (inside USA and Canada)
Tel: +1 724-776-4970 (outside USA)
Fax: 724-776-0790
Email: CustomerService@sae.org
http://www.sae.org

SAE WEB ADDRESS:

Full document details: SAE J3143_201907

SAE values your input. To provide feedback on this Technical Report, please visit http://standards.sae.org/J3143_201907

Documents
Document Sharing Hub

Disclaimer: The pressures and temperatures defined (see Table 1) for the various lines (liquid, discharge, and suction) are based on a typical TXV system. Care needs to be taken to understand the pressure and temperature requirements of a particular line within different types of A/C systems. For example, heat pump systems may contain a reversing valve (discharge/suction), which results in higher than normal temperature and pressures within a suction line. Requirements for this application will be different.

2. REFERENCES

2.1 Applicable Documents

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 International, 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 J343	Test and Test Procedures for SAE 100R Series Hydraulic Hose and Hose Assemblies
SAE J639	Safety Standards for Motor Vehicle Refrigerant Vapor Compression Systems
SAE J844	Nonmetallic Air Brake System Tubing
SAE J2064	Coupled Automotive Refrigerant Air-Conditioning Hose Assemblies
SAE J2260	Nonmetallic Fuel System Tubing with One or More Layers
SAE J2727	Mobile Air Conditioning System Refrigerant Emission Charts for R-134a and R-1234yf
SAE J2911	Procedure for Certification that Requirements for Mobile Air Conditioning System Components, Service Equipment, and Service Technician Training Meet SAE J Standards

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 D380	Methods of Testing Rubber Hose
-----------	--------------------------------

3. ASSEMBLY TUBING REQUIREMENTS

The tubing shall have a suitable thermoplastic inner layer and a suitable thermoplastic outer layer. The inner and outer layers shall be compatible with the refrigerant and lubricant. The outer layer shall be resistant to ambient heat and contact with typical under hood fluids (i.e., fuels, engine oil, brake fluids, grease antifreeze, screen wash, etc.). These requirements do not preclude the use of one layer of thermoplastic being suitable for both the inner and outer layers. The tubing for testing shall be in the straight condition. If the application is a preformed assembly, this may require additional testing with tubing formed with the production intent process to confirm the integrity of the assembly.

4. ASSEMBLY REQUIREMENTS

Assemblies shall be fabricated by the manufacturer or an agent of the customer for the manufacturer. If permanently attached fittings to the tubing are utilized, fabrication of the assembly requires specialized assembly equipment. Each test in Section 6 which requires attached fittings to the tubing (assembly) shall be conducted with production intent fittings and tube attachment process. In the case of field attached assemblies, it is the responsibility of the assembly manufacturer that their components and assemblies shall meet the requirements of this standard.

5. ASSEMBLY IDENTIFICATION

A tube assembly marked (printed on tube) or tagged "SAE J3143" signifies that it has been connected, tested, and has met the requirements of SAE J3143 for the marked refrigerant(s). "SAE J3143" shall be at least 2 mm minimum height and shall be durable and readable. This marking shall appear on the outside cover of the tube at intervals not greater than 380 mm. A durable tag may be attached to each assembly. The tag shall be metal or Mylar with a protective plastic cover. The tag and tube assembly marking information must be at least 2 mm minimum height, durable and readable and shall include the following information:

- SAE J3143
- Name of assembly manufacturer
- Refrigerant(s) validated

6. TESTING

After the conclusion of all tests, the refrigerant charge in each specimen shall be exhausted in a suitable reclamation container.

6.1 Sample Conditioning and Standard Tolerances

Charged samples shall be stabilized for 16 hours minimum at $23\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$, $50\% \pm 10\%$ relative humidity prior to testing.

Unless otherwise noted, a tolerance of $\pm 2\text{ }^{\circ}\text{C}$ shall be applied to all temperatures within this specification.

6.1.1 Unless otherwise specified, three samples shall be tested, plus a control sample where applicable.

6.2 Assembly Permeation Test

6.2.1 Test Specimens

The test specimens are to consist of four assemblies which have a length of $107\text{ cm} \pm 1.2\text{ cm}$. The tubing length and inner diameter shall be accurately measured for use in the final rate calculation. Three of the assemblies are to be used for determining the permeation rate at a specific temperature. The fourth assembly is to be used for a control sample.

One end of each assembly can be fitted with a capped charge fitting. The other end can be attached to a canister (optional) with or without a capped charge fitting or can be plugged with a fitting. If a canister is used, the tube assemblies are to be attached to a canister each having an internal volume of 500 to 900 cm^3 and having a minimum burst strength of 8.6 MPa.

6.2.2 Charging Procedure and Initial Weights

The assemblies are to be weighed and recorded to 0.01 g to establish an initial weight prior to charging. The test samples (control sample not charged) are to be evacuated then charged with refrigerant to $0.70\text{ g/cc} \pm 0.03\text{ g/cc}$ of the internal volume of the assembly and then re-weighed. Cooling of samples is recommended for ease of charging. The refrigerant charge remaining at the end of the test shall exceed 0.20 g/cc to ensure a saturated refrigerant condition during the entirety of the test.

6.2.3 Initial Measurement of Length and Diameter

Place reference marks 500 mm apart on the outer surface of the tubing, midway between fittings. Measure the OD at each mark and the length between the marks. The initial measurements shall be made while the assembly is under pressure (i.e., charged).

6.2.4 Temperature/Humidity Exposure

Test parts to be preconditioned as specified in 6.1 prior to test. The test conditions shall be $80\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$ and $50\% \pm 5\%$ relative humidity.

6.2.4.1 Establish Constant Loss Rate

Weigh the samples at the end of the first 24 hours temperature exposure and then continue weighing at periodic intervals (minimum period shall be 24 hours). The weighings shall be reported in net loss of grams, charged sample weight loss minus control sample weight loss. The net weight loss versus time shall continue to be recorded until steady state is reached. Steady state is reached when the last four readings are within 10% of the lowest reading or after 25 days, whichever comes first.

6.2.5 Loss Rate Determination

The permeation rate for each specimen may be determined as follows:

For samples that meet the 10% rule, use the data from the last five weighings and calculate per Equation 1. For samples that run for 25 days, the final weighing period shall be the last 5 days or 7 days of the test period. The samples during the final period shall be weighed five times at least 24 hours apart. No charge specimen may lose more than 40 g in the first 24 hour period.

$$\text{Permeation Rate For a Sample (kg/m}^2\text{/yr)} = 2.79 \times 10^6 \frac{(W-V)}{TDL} \quad (\text{Eq. 1})$$

where:

W = total weight loss of the sample during final period (g)

V = total weight loss of control sample during final period (g)

T = total duration of final weighing period (hours)

D = internal diameter of sample (mm)

L = total exposed length of sample (mm)

6.2.6 Acceptance Determination

a. Refrigerant Permeation Rate

The assembly shall not be permeable to refrigerant loss at a rate greater than 1.5 kg/m²/year.

b. Change in Length (Performed at Room Temperature)

The assembly shall not contract in length (between the marks) more than 4% or elongate more than 2% (between the marks) following testing exposure.

Measure the final length while the assembly is still pressurized (i.e., charged). The final length is the distance between reference marks while the tubing is pressurized.

Complete the determination of the change in length using Equation 2:

$$\Delta l = \frac{l_1 - l_0}{l_0} \times 100 \quad (\text{Eq. 2})$$

where:

l_0 = original distance between reference marks before assembly is pressurized

l_1 = distance between reference marks at end of test

Δl = percentage change in length, which will be positive (+) in case of an increase

c. Change in Diameter (Performed at Room Temperature)

The tubing diameter shall not increase more than 5% (at the marks) following testing exposure.

Measure the final diameters while the assembly is still pressurized (i.e., charged). The final diameter is the average of the diameters measured at the reference marks.

Complete the determination of the change in diameter using Equation 3:

$$\Delta d = \frac{d_1 - d_0}{d_0} \times 100 \quad (\text{Eq. 3})$$

where:

d_0 = average original diameter measured at reference mark s

d_1 = average final diameter measured at reference marks while under pressure

Δd = percentage change in diameter, which will be positive (+) in case of an increase

d. Burst Testing

The assembly shall then be subjected to burst testing at room temperature per 6.4.2 within 24 hours of the completion of the permeation test and the average result shall meet the post-test burst criteria per Table 1.

Furthermore, the average burst result shall not be less than 70% of the average room temperature burst result as tested on tubing assemblies per 6.4.2.

6.3 Proof Test

The assembly shall satisfactorily withstand a hydrostatic proof test using hydraulic or a suitable fluid at a constant rate of 6.9 MPa/min at peak working temperature as per Table 1 with a minimum hydrostatic pressure equal to 50% of the minimum required burst strength for a period not less than 2 minutes.

6.4 Assembly Bursting Strength

The minimum bursting strength for tube assemblies shall be as shown in Table 1 using hydraulic or a suitable fluid:

Table 1 - Assembly burst pressure requirements

Description	Peak Working Temperature (°C)	Peak Working Pressure (MPag)	Burst Requirement at Working Temperature/ Post-Test Burst (MPag)	Burst Requirement at Room Temperature (MPag)
Liquid Lines	90	3.95	7.9	10.0
Discharge Lines	125	4.14	8.3	10.4
Suction Lines	56	1.46	2.9	3.6