SURFACE VEHICLE RECOMMENDED PRACTICE

J1405™ MAY2023

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Superseding J1405 JAN2017

Optional Test Procedures for Hydraulic Hose Assemblies

RATIONALE

Certain users of SAE standards are requesting that another Optional Test Method V be added to SAE J1405. The primary user base is requesting this modification to SAE J1405 as a function of the U.S. Govt. Paperwork Reduction Act (c. 1995), stating that use of industry standards is preferred over development of other U.S. standards. This was voted upon in the September 2021 meeting with approval to proceed by the committee.

1. SCOPE

The procedures contained in this SAE Recommended Practice have been developed to establish uniform methods for impulse and high temperature circulation testing of hydraulic hose assemblies under special conditions not specified in SAE J343 for SAE J517 hoses. Basic test procedures shall be in accordance with SAE J343 except as modified in this document.

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 J517 Hydraulic Hose

SAE J1176 External Leakage Classifications for Hydraulic Systems

TO PLACE A DOCUMENT ORDER: **Tel: 877-606-7323 (inside USA and Canada)**
Tel: +1 724-776-4970 (outside USA)
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For more information on this standard, visit
https://www.sae.org/standards/content/J1405_202305/

3. OPTION I - COMPARATIVE FLEX IMPULSE PROCEDURE

3.1 Purpose

To generate comparative impulse test data, with and without flexing. This test procedure minimizes impulse test variables to provide comparative data between flexing and nonflexing to determine the effect on the ultimate life of hose. This test is not a requirement for SAE J517.

3.2 Test Procedure

For optimum validity of comparison, test specimens shall be cut from a continuous length of hose with alternate samples along the length designated for flexing and nonflexing impulse test.

Those specimens designated for nonflexing shall be tested in accordance with SAE J343. Those specimens designated for flexing are to be made up with free hose length in accordance with the following equation:

$$\text{Free hose length} = 4.142\ (\text{minimum bend radius}) + 3.57\ (\text{hose OD}) \quad \text{(Eq. 1)}$$

Performance of the flex-impulse test requires a supplementary rig capable of moving one test manifold in a continuous circular pattern as shown in Figure 1. This manifold is geared so that the center lines of the hose fittings at hose attachment stay parallel at all times. A variable drive is provided, and the number of revolutions per minute are to be controlled to 36% ± 2% of the impulse cycles per minute. This maintains a proportionality between the number of cycles of flexing and impulse and assures that the test specimen is in a different configuration of each succeeding impulse.

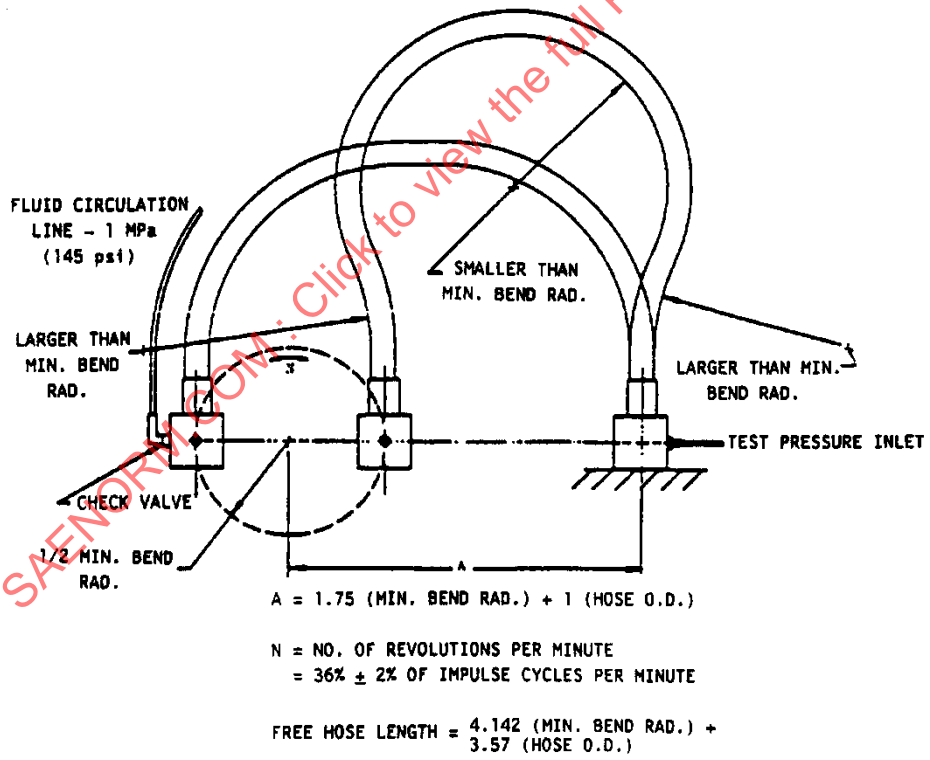

Figure 1 - Flex impulse test hose geometry

The vertical centerline of a stationary manifold is positioned a distance "A" from the center of revolution of the revolving manifold. This distance was determined empirically such that the test specimen is subjected to back bending motion near each fitting with the radius of bend at that point being greater than the applicable SAE minimum bend radius. However, when the revolving manifold reaches the position nearest the stationary manifold, the bend radius[1] inside the loop is smaller than the applicable SAE minimum bend radius[1]. Distance "A" is calculated with the following equation:

1.75 (minimum bend radius) + 1 (hose OD) (Eq. 2)

Specimens for flex-impulse testing should be mounted with straight end fittings on the rig as described above using care to avoid imparting twist to the hose. (Angular fittings may be used, provided they are installed in such a position to assure the hose travel and geometry of Figure 1.) A like number of samples, preferably not less than three, should be tested simultaneously and should be run to failure.

To accelerate completion of the test for comparative purposes, a pressure based on actual burst values of the hose is recommended, with flexing and nonflexing specimens to be tested at the same pressure. Suggested procedure is to first determine the average burst strength for the test length of hose and from this calculate the impulse test pressure as 35% of average burst. If this test procedure does not produce failures within the desired range, a higher or lower percentage may be used.

4. OPTION II - FLEX IMPULSE TEST

4.1 Purpose

To establish requirements for impulse testing with the addition of flexing. This is a specialized test which is not a requirement of SAE J517, nor is it specified in SAE J343. It is intended to provide a standard method to flex-impulse hose assemblies when flexing is deemed necessary.

4.2 Test Procedure

Four unaged hose assemblies for flexing are to be made up with free hose length in accordance with the following equation:

Free hose length = 4.142 (minimum bend radius) + 3.57 (hose OD) (Eq. 3)

Performance of the flex-impulse test requires a supplementary rig capable of moving one test manifold in a continuous circular pattern as shown in Figure 1. This manifold is geared so that the center lines of the hose fittings at hose attachment stay parallel at all times. A variable drive is provided, and the number of revolutions per minute are to be controlled to 36% ± 2% of the impulse cycles per minute. This maintains a proportionality between the number of cycles of flexing and impulse and assures that the test specimen is in a different configuration on each succeeding impulse.

The vertical centerline of a stationary manifold is positioned a distance "A" from the center of revolution of the revolving manifold. This distance was determined empirically such that the test specimen is subjected to back bending motion near each fitting with the radius of bend at that point being greater than the applicable SAE minimum bend radius. However, when the revolving manifold reaches the position nearest the stationary manifold, the bend radius inside the loop is smaller than the applicable SAE minimum bend radius.[1] Distance "A" is calculated with the following equation:

1.75 (minimum bend radius) + 1 (hose OD) (Eq. 4)

Specimens for flex-impulse testing should be mounted with straight end fittings on the rig as described above using care to avoid imparting twist to the hose. (Angular fittings may be used provided they are installed in such a position to assure the hose travel and geometry of Figure 1.)

[1] Violation of the minimum bend radius for this test does not imply that such violation is recommended in applications.

4.3 Test Requirements

The hose assemblies shall be tested at the impulse pressures, temperatures and minimum bend radii, for the minimum number of impulse cycles, as specified in SAE J517 for 100R series hoses. Other test parameters, as agreed upon by the supplier and user, may be used.

5. OPTION III - COOL DOWN LEAKAGE TEST

5.1 Purpose

To establish requirements for performing a cold start leakage test to be used in conjunction with both flexing or nonflexing impulse tests.

5.2 Test Procedure

The impulse test unit shall be shut down at 40% ± 10% and 90% ± 10% of the required number of impulse cycles and allowed to cool until the test oil and hose assemblies reach a temperature of 30 °C ± 3 °C (85 °F ± 5 °F). Accelerated cool down procedures, i.e., fans, heat exchangers, etc., may be used to speed the cooling process. Check test assemblies to assure they are clean and dry. With oil heater turned off, resume the test, and observe and note leakage for 1000 impulse cycles. The acceptable rate of leakage shall be as agreed upon by the supplier and user. (Refer to SAE J1176 for leakage classes.)

After completing the 1000 impulse cycles, turn on oil heater and continue the impulse test.

If leakage is noted during the cool down cycle, notation shall also be made as to whether or not a seal-off was affected as the temperature came back up. Results are applicable only to the specific hose construction and size, hose fitting design and size, and fitting assembly technique.

6. OPTION IV - HIGH TEMPERATURE CIRCULATION TEST

6.1 Purpose

To establish a procedure for testing and evaluation of hose assemblies for use in high temperature systems, using petroleum- or synthetic-based hydraulic fluids, with a maximum temperature rating of 150 °C (302 °F). Hose performance, dimensions, identification, and fitting configurations shall be agreed upon by the supplier and user.

6.2 Test Procedure

A minimum of two hose assemblies having at least 355 mm (14 inch) length of free hose between hose fittings shall be mounted on a circulating oil test unit in a straight configuration. The ambient temperature shall be 93 °C ± 11 °C (200 °F ± 20 °F) and the oil temperature 150 °C ± 2 °C (302 °F ± 3.6 °F) between inlet and outlet. Oil conforming to MIL-L-2104 or equivalent synthetic oil SAE 10W-30 shall be circulated through the hose assemblies at a pressure between 0.35 MPa and 0.7 MPa (50 to 100 psi). Entrained air in the oil shall be kept to a minimum. Caution shall be exercised so that the hose assemblies do not come into contact with the heating elements and are located to permit good air circulation. The petroleum-based test fluid shall be changed every 375 hours ± 25 hours; for synthetic fluids, use the fluid manufacturer's recommendation. Tests are to be run continuously except for oil changes and addition or removal of samples. All shutdown time is to be recorded. After 750 hours ± 5 hours, the test assemblies shall be removed and the oil drained and allowed to cool for a minimum of 4 hours. The samples shall then be bent around a mandrel equal to the minimum bend radius of the hose within a time of 8 to 12 seconds and examined visually for cover cracks. No cracks are permitted. The assemblies shall then be subjected to proof test based upon either the hose maximum working pressure or an application pressure agreed to between user and manufacturer. Refer to SAE J343 for proof test procedures. There shall be no indication of failure or leakage through the hose or at hose fitting juncture. All tests are to be completed within 24 hours of removal of the samples from the circulating oil test unit. This shall be considered a destructive test and the samples shall be destroyed.