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INTERNATIONAL
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SURFACE VEHICLE STANDARD

Submitted for recognition as an American National Standard

SAE J343 | REV. NOV95

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Superseding J343 JUN93

(R) TEST AND TEST PROCEDURES FOR SAE 100R SERIES HYDRAULIC HOSE AND HOSE ASSEMBLIES

This document is technically equivalent to ISO 6605 except as noted in the Foreword.

Foreword—SAE J343 has been revised to be technically equivalent to ISO 6605, except that additional tests in paragraphs 4.9 to 4.14 were included.

1. *Scope*—This SAE Standard gives methods for testing and evaluating performance of the SAE 100R series of hydraulic hose and hose assemblies (hose and attached end fittings) used in hydraulic fluid power systems.

Specific tests and performance criteria for evaluating hose assemblies used in hydraulic service are in accordance with the requirements for hose in the respective specifications of SAE J517.

This document further establishes a uniform means of testing and evaluating performance of hydraulic hose assemblies.

2. *References*

2.1 Applicable Documents—The following publications form a part of this specification to the extent specified herein. The latest issue of SAE publications shall apply.

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

SAE J517—Hydraulic Hose

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

ASTM D 380—Standard Methods of Testing Rubber Hose

2.1.3 ISO PUBLICATIONS—Available from ANSI, 11 West 42nd Street, New York, NY 10036-8002.

ISO 3448—Industrial liquid lubricants—ISO viscosity classification
ISO 6605—Hydraulic fluid power—Hose assemblies—Method of test

3. *Test Procedures*—The test procedures described in the current issue of ASTM D 380 shall be followed. However, in cases of conflict between the ASTM specifications and those described as follows, the latter shall take precedence.

4. *Standard Tests*

WARNING—**Water or another liquid suitable for the hose under test shall be used as the test medium. The use of air and other gaseous materials as testing media should be avoided because of the risk to operators. In special cases where such media are required for the tests, strict safety measures are imperative. Furthermore, it is stressed that when a liquid is used as the test medium, it is essential that all air is expelled from the test piece because of the risk of injury to the operator due to the sudden expansion of trapped air released when the hose bursts.**

4.1 **Dimensional Check Test**—The hose shall be inspected for conformity to all dimensions tabulated in the applicable specification.

Determine finished outside diameters and reinforcement diameters, where required, by calculation from measurement of the respective circumference.

As an alternative, use a flexible tape graduated to read the diameter directly.

Measure the inside diameter by means of a suitable expanding ball or telescoping gage.

Measure concentricity over both the reinforcement and the finished outside diameters using either a dial indicator gage or a micrometer.

Round the foot of the measuring instrument to conform to the inside diameter of the hose.

Take readings at 90 degree intervals around the hose

NOTE—Acceptability is based on the total variation between the high and the low readings.

Take inside and outside diameter measurements at a minimum of 25 mm from the hose ends and concentricity measurements at a minimum of 13 mm from the hose ends.

4.2 **Proof Test**—Test the hose assemblies hydrostatically to the specified proof pressure for a period of not less than 30 s nor more than 60 s.

There shall be no indication of failure or leakage.

4.3 **Change in Length Test**—Conduct measurements for the determination of elongation or contraction on a previously untested, unaged hose assembly having at least 600 mm length of free hose between hose fittings.

Attach the hose assembly to the pressure source in an unrestricted straight position. If the hose is not straight due to its natural curvature, it may be fastened laterally to achieve a straight position. Pressurize to the specified operating pressure for a period of 30 s, then release the pressure.

Place accurate reference marks 500 mm apart on the outer cover of the hose, midway between fittings, after allowing the hose assembly to restabilize for a period of 30 s following pressure release.

Repressurize the hose assembly to the specified operating pressure for a period of 30 s.

Measure the final length while the hose is pressurized. The final length is the distance between reference marks while the hose is pressurized.

Complete the determination of the change in length using Equation 1:

$$\Delta\ell = \frac{\ell_1 - \ell_0}{\ell_0} \times 100 \quad \text{(Eq.1)}$$

where:

ℓ_0 is the distance between the reference marks when the hose was not pressurized following the initial pressurization;

ℓ_1 is the distance between the reference marks under pressure;

$\Delta\ell$ is the percentage change in length, which will be positive (+) in the case of an increase in length and negative (-) in the case of a decrease in length.

4.4 **Burst Test**—Subject unaged hose assemblies, on which the end fittings have been attached for not more than 30 days, to a hydrostatic pressure, increased at a constant rate so as to attain the specified minimum burst pressure within a period of not less than 15 s nor more than 60 s.

Reject hose assemblies showing leakage, hose burst or indication of failure below the specified minimum burst pressure.

NOTE—This is a destructive test. Assemblies which have been subjected to this test shall be destroyed.

4.5 **Cold Bend Test**—Subject hose assemblies to the specified temperature in a straight position for 24 h.

Then, while still at the specified temperature, the samples shall be evenly and uniformly bent once over a mandrel having a diameter equal to twice the specified minimum bend radius. Bending shall be accomplished within a period of not less than 8 s nor more than 12 s.

In the case of hose sizes up to and including 22 mm nominal inside diameter, bend them through 180 degrees over the mandrel; in the case of hose sizes larger than 22 mm nominal inside diameter, bend them through 90 degrees over the mandrel.

After bending, allow the sample to warm to room temperature, visually examine it for cover cracks and subject it to the proof test. There shall be no cover cracks or leakage. (In lieu of the bending test, hoses larger than 22 mm nominal inside diameter may be considered acceptable if samples of tube and cover pass the Low Temperature Test on Tube and Cover of ASTM D 380.)

Reject any samples with visible cracks or leakage.

NOTE—This is a destructive test. Assemblies which have been subjected to this test shall be destroyed.

4.6 **Impulse Test**—Test four unaged hose assemblies with end fittings which have been attached for not more than 30 days. Where the individual standard requires, also test aged hose assemblies.

Apply a pulsating pressure internally to the hose assemblies at a rate between 0.5 and 1.3 Hz; record the frequency used. The pressure cycle shall fall within the shaded area of Figure 1 and conform as closely as possible to the curve shown.

The nominal rate of pressure rise shall be equal to that shown in Equation 2:

$$R = f\,(10p - k) \tag{Eq.2}$$

where:

R = rate of pressure rise in MPa/s
f = frequency in Hz
p = nominal impulse test pressure in MPa
k = 5 MPa

The actual rate of pressure rise shall be determined as shown on Figure 1, and shall be within a tolerance of ±10% of the calculated nominal value.

Select a test fluid which complies with the requirements of ISO VG 46 ± 4.6 at 40 °C per ISO 3448, and circulate it at a rate sufficient to maintain a uniform fluid temperature within the hose assemblies. Other fluids may be used as agreed upon between the customer and the manufacturer.

Calculate the free (exposed) length of hose under test, shown on Figure 2, as follows:

a. Hose sizes up to and including 22 mm nominal inside diameter (see Equation 3):

$$\text{180 degrees bend free length} = \pi r + 2d \tag{Eq.3}$$

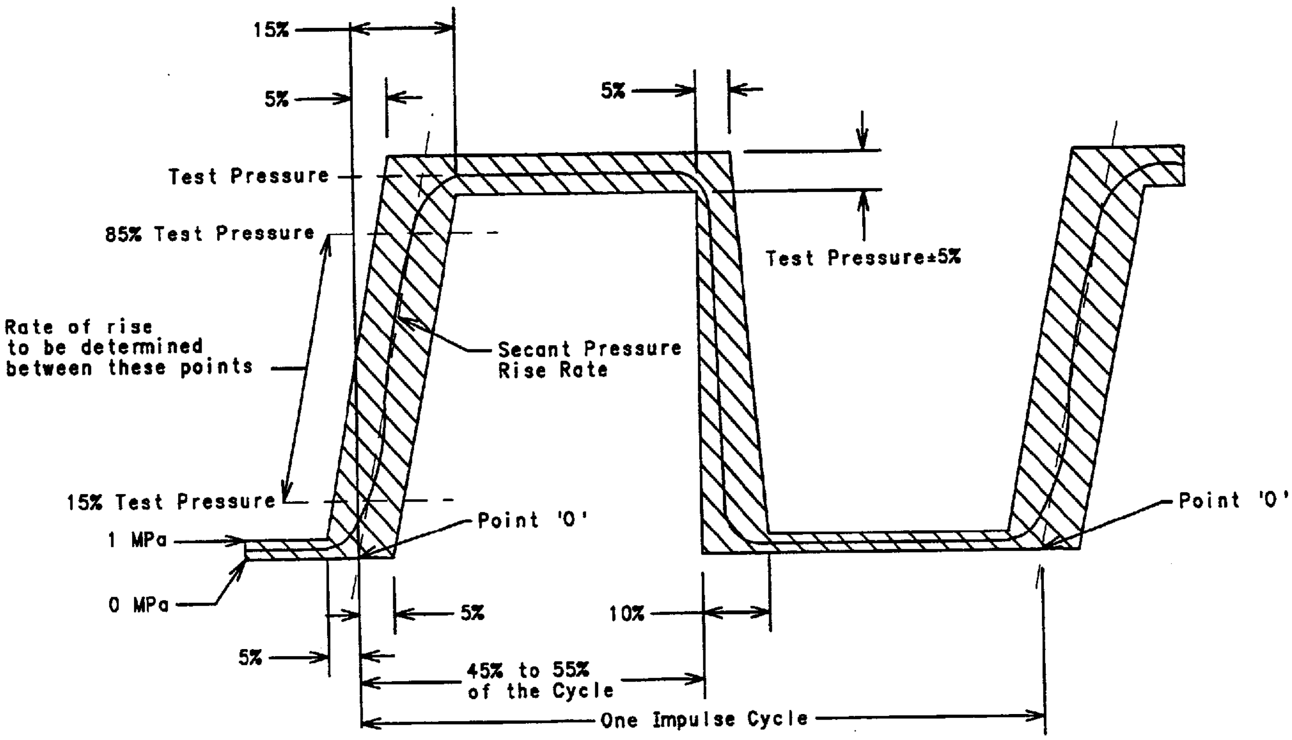
b. Hose sizes larger than 22 mm nominal inside diameter (see Equation 4):

$$\text{90 degrees bend free length} = \frac{\pi}{2} r + 2d \tag{Eq.4}$$

where:

r = minimum bend radius
d = hose outside diameter

Connect the test pieces to the apparatus. The test pieces shall be installed according to Figure 2. Test pieces of hose of nominal inside diameter up to and including 22 mm shall be bent through 180 degrees and hoses of nominal inside diameter larger than 22 mm shall be bent through 90 degrees.

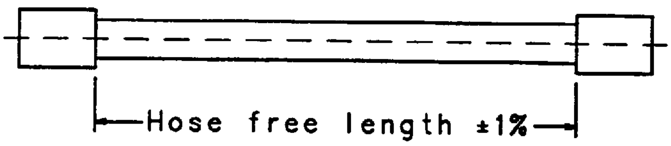


NOTES:
1. Secant pressure rise is the straight line drawn through two points on the pressure rise curve; one point at 15% of the test pressure and the other at 85% of the test pressure
2. Point '0' is the intersection of the secant pressure rise with 0 pressure.
3. Pressure rise rate is the slope of the secant pressure rise expressed in MPa/s.
4. Cycle rate shall be uniform at 0.5 to 1.3 Hz.
5. The nominal rate of pressure rise shall be equal to:

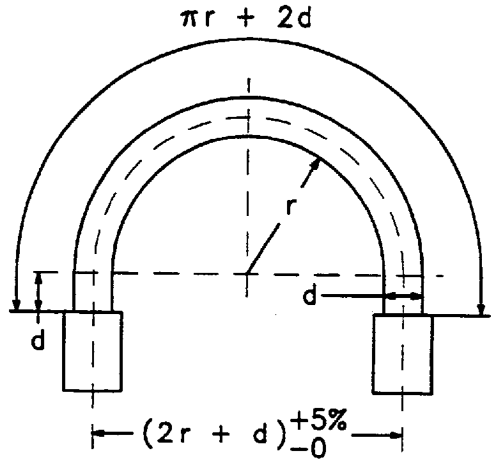
   $R = f\,(10p - k)$

   where: R = rate of pressure rise in MPa/s
   f = frequency in Hz
   p = nominal impulse test pressure in MPa
   k = 5 MPa

FIGURE 1—PRESSURE-IMPULSE CYCLE
METHOD OF DETERMINATION OF RATE OF PRESSURE RISE IN IMPULSE TEST



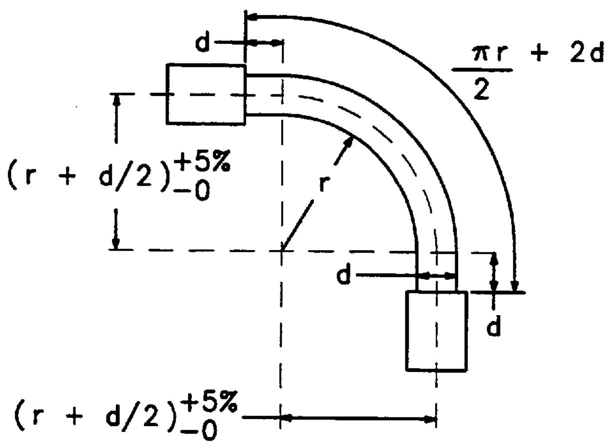
Hose sizes up to and including 22 mm nominal inside diameter



NOTES

r = Minimum bend radius
d = Hose outside diameter
Hose free length = $\pi r + 2d$

Hose sizes larger than 22 mm nominal inside diameter



NOTES

r = Minimum bend radius
d = Hose outside diameter
Hose free length = $\frac{\pi}{2} r + 2d$

FIGURE 2—TEST SPECIMEN FOR PRESSURE IMPULSE TEST

Test the hose at the impulse test pressure indicated in the individual specification. The test fluid shall be circulated through the assemblies at the specified temperature with a tolerance of ±3 °C. Cooling or heating of the test chamber shall not be permitted, except when individual standards require testing with synthetic base test fluids at a temperature higher than 150 °C. When such higher temperatures are required, the impulse test fluid need not be circulated if both the fluid and the assemblies are externally heated in the test chamber, at the specified temperature with a tolerance of ±5 °C.

Determine the duration of the impulse test in total number of cycles by the individual standard for the hose assemblies. Where aged samples are required, refer to the individual standards.

It is recommended the test fluid be changed frequently to prevent breakdown.

NOTE—This is a destructive test. Assemblies which have been subjected to this test shall be destroyed.

4.7 **Leakage Test**—Subject unaged hose assemblies, on which the end fittings have been attached for not more than 30 days, to a hydrostatic pressure of 70% of the specified minimum burst pressure for a period of between 5.0 to 5.5 min.

Reduce the fluid pressure to 0 MPa.

Re-apply the 70% of minimum burst hydrostatic pressure for another 5.0 to 5.5 min period.

Reject assemblies showing leakage or failure.

NOTE—This is a destructive test. Assemblies which have been subjected to this test shall be destroyed.

4.8 **Visual Examination of Product**—All bulk hose shall be visually inspected to see that the hose identification has been properly applied and all assemblies shall be inspected to determine that the correct fittings are properly installed.

4.9 **Oil Resistance Test**—After 70 h immersion in ASTM Emergency Standard Practice IRM903 oil at the designated temperature, the volume change of specimens taken from the hose inner tube and cover shall be within the specified limits.

4.10 **Ozone Resistance Test**—Hydraulic hose shall be tested for resistance of the cover compound to ozone in accordance with the latest issue of ASTM D 380, except that the mandrel shall be a diameter twice the minimum bend radius specified in the individual hose standard, and the cover shall be examined at the completion of the test under 7X magnification.

4.11 **Electrical Conductivity Test (for thermoplastic hose only)**—Hose assemblies having a free length of 152 mm ± 13 mm without fluid and capped to prevent entry of moisture shall be exposed to a minimum of 85% relative humidity at 24 °C ± 3 °C for a period of 168 h. Surface moisture shall be removed prior to testing.

Conditioned assemblies shall have one end fitting attached to the lead from a source of 60 Hz sinusoidal, 37.5 kV (rms) electricity. This lead shall be suspended by dry fabric strings so that the hose hangs free, at least 600 mm from any extraneous objects. The lower end of the hose shall be connected to ground through a 1000 to 1 000 000 Ω resistor, keeping the resistor near the end of the hose. A suitable AC voltmeter shall be connected across the resistor, using a fully shielded cable with the shielding well grounded. Thirty-seven and one-half kV shall be applied to the specimen for 5 min and a current reading taken. This current shall not exceed the value specified.

4.12 Electrical Conductivity Test (PTFE hose only)—Test specimen shall be a 330 mm ± 10 mm cut length of hose with fitting attached to one end and the reinforcing braid flared away from the PTFE tube on the opposite end to prevent contact with the free end of the tube. The inner surface of the tube shall be cleaned, first with naphtha dry cleaning fluid or Stoddard solvent, and then with isopropyl alcohol to remove surface contamination, followed by thorough drying at room temperature.

Relative humidity shall be kept below 70% and room temperature between 16 °C and 32 °C.

The specimen shall be mounted in a vertical position as shown in Figure 3. The adapter at the base is simply a convenient means of assuring proper electrical contact if a swivel female fitting is chosen, and may be omitted if a male fitting is used. In either case, the electrode must be insulated from ground.

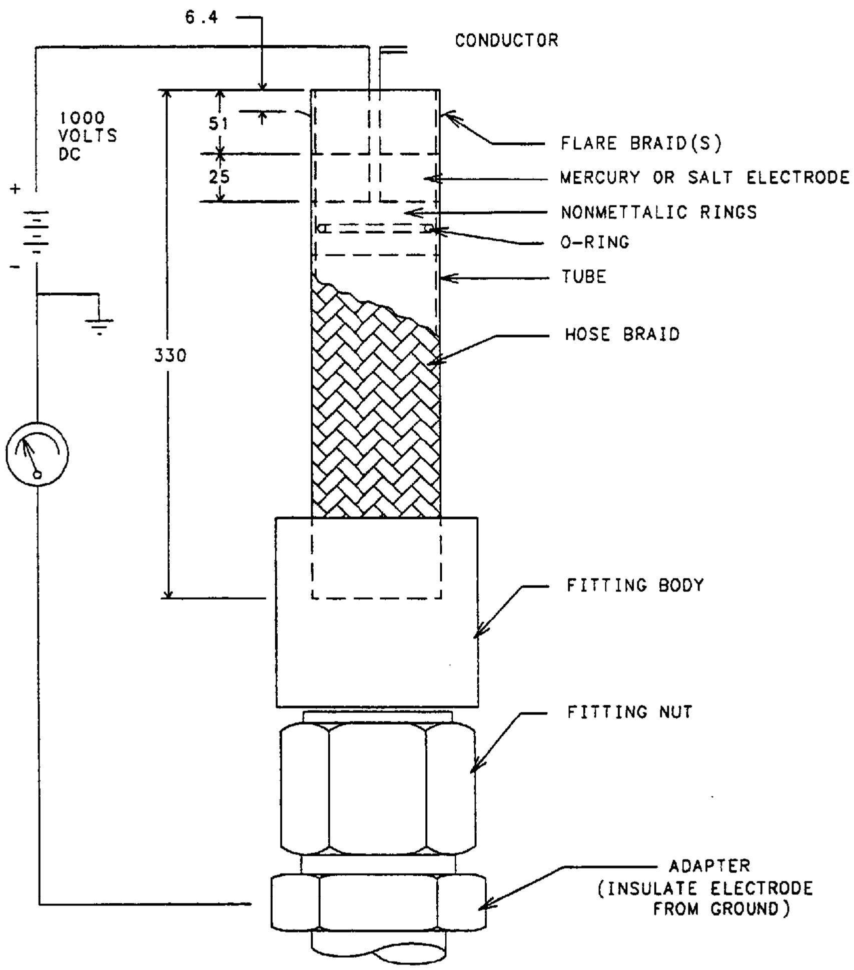


FIGURE 3—CONDUCTIVITY TEST DIAGRAM

A mercury or salt water solution electrode shall be provided at the upper end as shown, by inserting a nonmetallic plug with an O-ring seal to a distance of 75 mm from the end of the tubing, thus providing an average test length of 255 mm. Mercury or salt water solution shall then be added to a level 25 mm above the plug. Any suitable conductor to this electrode may be used, including a threaded end attached to the plug if so desired. Concentration of salt water, if used, shall be 450 g NaCl per liter of H_2O.

1000 V DC shall be applied between the upper electrode and the lower electrode (adapter or male fitting hex). The current shall be measured with an instrument with a sensitivity of at least 1 μA (1×10^{-6} A).

4.13 Resistance to Vacuum Test—The hose shall not blister nor show any other indication of failure when subjected to the specified vacuum for a period of 5 min. Where practicable, one end of the hose shall be equipped with a transparent cap and electric light to permit visual examination for failure. Where the length or size of the hose precludes visual examination, failure shall be determined by inability to pass through the hose a ball or cylinder 6.5 mm less in diameter than the bore of hoses of 12.5 mm nominal inside diameter and larger. For hoses under 12.5 mm nominal inside diameter, a ball or cylinder 3.0 mm smaller in diameter than the bore shall be used.

4.14 Volumetric Expansion Test—Volumetric expansion tests shall be run in accordance with the current issue of ASTM D 380.

5. Notes

5.1 Marginal Indicia—The (R) is for the convenience of the user in locating areas where technical revisions have been made to the previous issue of the report. If the symbol is next to the report title, it indicates a complete revision of the report.

PREPARED BY THE SAE FLUID CONDUCTORS AND CONNECTORS
TECHNICAL COMMITTEE SC2—HYDRAULIC HOSE AND HOSE FITTINGS

J343 NOV95

Rationale—Presently SAE Standard J343, ISO 1402, ISO 6605, and ISO 6803 contain tests for hydraulic hoses and hose assemblies. At a recent ISO/TC45/TC131 joint working group meeting the three ISO Standards were reviewed for content and mutual standardization. It has been suggested that SAE Standard J343 be rewritten to be technically equivalent to ISO/DIS 6605, where applicable.

Relationship of SAE Standard to ISO Standard—This document is technically equivalent to ISO/DIS 6605 except that additional tests in paragraphs 4.9 to 4.14 were included.

Application—This SAE Standard is intended to establish uniform methods for the testing and performance evaluation of the SAE 100R series of hydraulic hose and hose assemblies. The specific tests and performance criteria applicable to each variety of hose and/or assemblies made therefrom are set forth in the respective specifications of SAE J517.

Reference Section

SAE J517—Hydraulic Hose

ASTM D 380—Standard Methods of Testing Rubber Hose

ASTM D 518—Test Method for Rubber Deterioration—Surface Cracking

ASTM D 622—Methods of Testing Rubber Hose for Automotive Air and Vacuum Brake System

ASTM D 1149—Test Method for Rubber Deterioration—Surface Ozone Cracking in a Chamber (Flat Specimens)

ISO 3448—Industrial liquid lubricants—ISO viscosity classification

ISO 6605—Hydraulic fluid power—Hose assemblies—Method of test

Developed by the SAE Fluid Conductors and Connectors Technical Committee SC2—Hydraulic Hose and Hose Fittings

Sponsored by the SAE Fluid Conductors and Connectors Technical Committee