SAE The Engineering Society For Advancing Mobility Land Sea Air and Space®
INTERNATIONAL
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SURFACE VEHICLE STANDARD

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An American National Standard

(R) TESTS AND PROCEDURES FOR HIGH TEMPERATURE TRANSMISSION OIL HOSE, ENGINE LUBRICATING OIL HOSE, AND HOSE ASSEMBLIES

1. ***Scope—***This SAE Standard is intended to establish uniform methods for testing and evaluation of hose and hose assemblies for use in high temperature transmission oil systems and high temperature lubricating oil systems using petroleum base oils within a temperature range of –40 ° to 150 °C (–40 ° to 302 °F) and a maximum working pressure of 1.5 MPa (217 psi). Hose construction, dimensions, identification, and hose fitting configurations shall be agreed upon by the supplier and user.

2. ***References***

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

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

ASTM D 380—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)

3. ***Performance Tests***

3.1 **Preconditioning—**The test hose or hose assemblies shall be conditioned at room temperature a minimum of 24 h prior to testing.

3.2 **Qualification Tests—**For qualification to this document, hose and hose assemblies made therefrom shall conform to the following tests and requirements:

3.2.1 PROOF TEST—Hose and hose assemblies shall be hydrostatically tested to 3 MPa (435 psi) for a period of not less than 30 s nor more than 60 s. There shall be no indication of failure or leakage.

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3.2.2 LEAKAGE TEST—Two previously untested unaged hose assemblies having 300 mm ± 3 (12 in ± 1/8) length of free hose between fittings, on which the hose fittings have been attached for not over 30 days, shall be subjected to a hydrostatic pressure of 4.2 MPa (609 psi) for a period of 5 to 5.5 min and then reduced to zero after which 4.2 MPa (609 psi) shall be reapplied for another 5 to 5.5 min. There shall be no leakage or other evidence of failure. This shall be considered a destructive test and the samples shall be destroyed.

3.2.3 CHANGE IN LENGTH TEST—Measurements for the determination of elongation or contraction shall be conducted on two previously untested, unaged hose assemblies having at least 300 mm (12 in) length of free hose between hose fittings. The hose assemblies shall be attached to the pressure source and pressurized to 1.5 MPa (217 psi) for a period of 30 s, after which time the pressure shall be released. After allowing the hose to restabilize for a period of 30 s following pressure release, reference marks 254 mm (10 in) apart shall be accurately placed upon the hose outer cover, midway between the hose fittings. This length shall be the "original length".

The hose assemblies shall then be repressurized to 1.5 MPa (217 psi) for a period of 30 s, after which time, while the hose is pressurized, the distance between the reference marks shall be measured. This length shall be the "final length". Change in length shall be computed using the following equation:

$$\text{Percent change} = \frac{(\text{Final Length} - \text{Original Length}) \times 100}{\text{Original Length}} \qquad \text{(Eq. 1)}$$

(Minus percent) Change = Contraction
(Plus percent) Change = Elongation

The percent change shall be within the agreed limits.

3.2.4 BURST TEST—Two unaged hose assemblies having at least 300 mm (12 in) length of free hose between fittings, on which the hose fittings have been attached for not over 30 days, shall be subjected to a hydrostatic pressure increasing at a constant rate so as to attain 6 MPa (870 psi) within a period of not less than 15 s nor more than 30 s. There shall be no leakage, hose burst, or other indication of failure below 6 MPa (870 psi). This shall be considered a destructive test and the sample shall be destroyed.

3.2.5 TENSILE TEST—Two hose assemblies having at least 300 mm (12 in) length of free hose between fittings shall be tested. The rate of separation of the head of the testing machine shall be 0.42 mm/s ± 0.04 (1 in/min ± 0.1). The minimum force required to separate the hose from a hose fitting shall be 1 kN (225 lbs). This shall be considered a destructive test and the samples shall be destroyed.

3.2.6 COLD FLEXIBILITY TEST—Two hose assemblies shall be subjected to –40 °C ± 2 (–40 °F ± 3.6) for 24 h in a straight position. After this time and while still at the specified temperature, each hose assembly shall be evenly and uniformly bent over a mandrel equal to 8 times the nominal hose outside diameter (or twice the minimum bend radius, if specified). Bending shall be accomplished within a period of not less than 8 s and no more than 12 s. Hoses of less than 25 mm (1 in) nominal inside diameter shall be bent 180 degrees over the mandrel and hoses of 25 mm (1 in) nominal inside diameter and larger shall be bent 90 degrees over the mandrel.

After flexing, each sample shall be allowed to warm to room temperature, then visually examined for cover cracks and subjected to the Proof Test (3.2.1). There shall be no leakage, or cracks on the cover. In lieu of the flexing test, hoses of 25 mm (1 in) nominal inside diameter and larger shall be considered acceptable if samples of tube and cover pass the Low Temperature Test on Tube and Cover, Section 25 of ASTM D 380 of latest revision.

3.2.7 TEMPERATURE CYCLING TEST—Four hose assemblies having not less than 300 mm (12 in) nor more than 1000 mm (39 in) length of free hose between hose fittings shall be tested. Two shall be filled with transmission Type F fluid and two with oil conforming to MIL-L-2104, and lightly capped. The hose assemblies shall be placed in a circulating air oven at 150 °C ± 2 (302 °F ± 3.6) for 2 h, removed from the air oven, and allowed to stabilize to room temperature for 1 h minimum; then placed in a cold box at –40 °C ± 2 (–40 °F ± 3.6) for 2 h, removed from the cold box, and allowed to stabilize to room temperature for 1 h minimum. Ten such cycles shall be conducted, after which the hose assemblies shall be stabilized to room temperature for 1 h minimum and subjected to the Proof Test (3.2.1). There shall be no leakage or failure. This shall be considered a destructive test and the samples shall be destroyed.

3.2.8 OZONE TEST—Two samples of the cover compound shall be tested in accordance with the latest issue of ASTM D 622, procedure 9, and ASTM D 1149. Where space limitations prohibit use of a hose, specimen cover stock tested in accordance with ASTM D 518, procedure B, may be substituted. After 70 h exposure in an atmosphere comprised of air and ozone with an ozone partial pressure of 50 mPa (50 parts ozone per 100 million parts of air at standard atmospheric conditions) at ambient temperature of 40 °C (104 °F), specimens shall show no evidence of cracks or deterioration when viewed with 7 power magnification while still in a stressed condition. This shall be considered a destructive test and the samples shall be destroyed.

3.2.9 HIGH TEMPERATURE CIRCULATION TEST—A minimum of two hose assemblies having at least 355 mm (14 in) 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 (200 °F ± 20) and the oil temperature 150 °C ± 2 (302 °F ± 3.6) between inlet and outlet. Oil conforming to MIL-L-2104 shall be circulated through the hose assemblies at a pressure between 0.35 and 0.69 MPa (50 to 100 psi). Entrained air in the oil must be kept to a minimum and caution must 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 test fluid shall be changed every 375 h ± 25. Tests are to be run continuously except for oil change and addition or removal of samples. All shutdown time is to be recorded. After 750 h ± 5, the test assemblies shall be removed, the oil drained, and allowed to cool for a minimum of 4 h. The samples shall then be bent around a mandrel having a diameter of 12 times the inside diameter of the hose. The time required to bend the hose around the mandrel shall be between 8 and 12 s. Rubber covered hose shall be examined visually for cover cracks. No cracks are permitted. The assemblies shall then be subjected to Proof Test (3.2.1), with the hoses in the straight position. There shall be no failure or leakage through the hose or at hose fitting juncture. All tests are to be completed within 24 h of removal of samples from the circulating oil test unit. This shall be considered a destructive test and the samples shall be destroyed.

4. Inspection Test—Inspection tests and lot sizes for inspection shall be negotiated between user and seller.

5. Notes

5.1 Marginal Indicia—The change bar (l) located in the left margin is for the convenience of the user in locating areas where technical revisions have been made to the previous issue of the report. An (R) symbol to the left of the document title indicates a complete revision of the report.

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