

High-Temperature Power Steering Pressure Hose

Foreword—This SAE Standard represents the minimum quality recognized by original equipment manufacturers and hose suppliers as essential for satisfactory and safe operation by the hose itself and other coating parts of the power steering system. The original equipment manufacturer may, at his option, add or alter tests through OEM specifications.

1. Scope—This SAE Standard covers two types of hose fabricated from textile reinforcement and synthetic rubber, assembled with end fittings for use in high-temperature automotive power steering applications as flexible connections within the temperature range of -40 to $+150$ °C (-40 to $+302$ °F) maximum and 10.3 MPa (1500 psi) maximum working pressure. These hoses are intended for use in applications where reduction in amplitude of pump pressure pulsation is required. Class A hose has a nominal OD of 19.84 mm (0.781 in). Class B hose is a lightweight hose with a nominal OD of 17.91 mm (0.705 in). This specification defines the minimum performance levels of a flexible connector in the hydraulic steering system to convey power steering fluid from the steering pump to the steering gear.

2. References

2.1 Applicable Publications—The following publications form a part of this specification to the extent specified herein.

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

ASTM D 380—Standard Test Methods for Rubber Hose

ASTM D 413—Test Method for Rubber Property—Adhesion to Flexible Substrate

3. Hose Construction—The construction of this hose embodies a smooth bore inner tube of suitable synthetic rubber material, reinforced with textile reinforcement and covered with a synthetic rubber outer cover. The tube shall be resistant to transmission and power steering fluids. The cover shall be abrasion, heat and weather resistant.

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4. **Dimensions**—See Table 1.

TABLE 1—DIMENSIONS

	Class A Standard	Class B Light Weight
ID	9.4/10.3 mm (0.370/0.405 in)	9.4/10.3 mm (0.370/0.405 in)
OD	19.05/20.62 mm (0.750/0.812 in)	17.27/18.54 mm (0.680/0.730 in)

Concentricity based upon full indicator reading between the inside bore and the outer surface of the hose shall not exceed 0.76 mm (0.030 in).

5. **Test Procedure**—Procedures described in ASTM D 380 shall be followed wherever applicable.

6. **Qualification Tests**—To qualify hose under this specification, all of the requirements shown under Section 9 must be met. The sample sizes listed in Table 2 represent minimums for validation of a production process. The manufacturer of the power steering hose assembly is responsible for conducting appropriate design verification exercises and for controlling the production processes such that any hose assembly provided for sale or use on a vehicle will be capable of meeting the performance requirements listed in Section 9 when subjected to the tests listed in Table 2, performed per the procedures and conditions described in Section 9.

7. **Inspection Tests**—Production shipments or lots of qualified hose shall be tested in accordance with Table 2 and shall conform to the applicable test requirements, but the user may test hose or hose assemblies from any or all such production shipments or lots to all the test requirements. A minimum of seven sample hose assemblies, selected at random, as listed in Table 2, are required to conduct a complete test. In the event of a failure, the test or tests that failed shall be retested using a minimum of twice the number of samples indicated in Table 2. Failure of any of the retested samples shall be cause for rejection of the entire lot.

TABLE 2—INSPECTION TESTS

Title and Section Number	Minimum Sample Size
1. Volumetric Expansion (9.7) followed by Bursting Strength (9.5)	1
2. Tensile (9.2)	1
3. Adhesion (9.4)	1
4. Low-Temperature Flexibility (9.3)	1
5. Impulse (9.1)	3

8. **Frequency of Testing for Inspection**—All inspection tests except Impulse shall be performed on either a bulk hose lot or a coupled hose lot basis, or test may be split between a bulk hose lot and a coupled hose lot.

A coupled hose lot shall not exceed 10 000 hose assemblies and a bulk hose lot shall not exceed 6096 m (20 000 ft) of bulk hose.

9. Test Requirements

9.1 Impulse Test

9.1.1 TEST CONDITIONS—New hose assemblies shall be used for each test. The hose assemblies shall be clean and dry and allowed to stabilize at room temperature for a minimum of 24 h prior to testing.

Test equipment is to be capable of maintaining the following parameters:

- a. Continuous flow of test fluid through the hoses at a rate of $6.1 \text{ L/m} \pm 0.8 \text{ L/m}$ ($1.6 \text{ GPM} \pm 0.2 \text{ GPM}$) per hose except at high pressure.
- b. A system oil capacity sufficient to provide 4.7 to 9.4 L (1.25 to 2.50 gal) of oil per test hose.

Using new power steering fluid, the test hose assemblies shall be subjected to the following test conditions:

- a. Cycle Pressure
 1. Low pressure—0 to 0.70 MPa (0 to 100 psi)
 2. High pressure—10.3 to 10.7 MPa (1500 to 1550 psi)
- b. Cycle Rate—30/40 cycles per min.
- c. Pressure Rise Time— $0.2 \text{ s} \pm 0.02 \text{ s}$.
- d. Pressure Dwell Time— $0.7 \text{ s} \pm 0.05 \text{ s}$.
- e. Oil Temperature (in hose)— $150 \text{ }^\circ\text{C} \pm 3 \text{ }^\circ\text{C}$ ($302 \text{ }^\circ\text{F} \pm 5 \text{ }^\circ\text{F}$)
- f. Ambient Temperature— $150 \text{ }^\circ\text{C} \pm 6 \text{ }^\circ\text{C}$ ($302 \text{ }^\circ\text{F} \pm 10 \text{ }^\circ\text{F}$)
- g. Test Cycle (repeated for the duration of the test)
 1. Hot Cycle—25 000 cycles
 2. Cool Down—Shut off machine and cool to a reservoir temperature of $82 \text{ }^\circ\text{C}$ ($180 \text{ }^\circ\text{F}$). After the initial cool down at 25 000 cycles, the cool down is to be repeated at 50 000 cycle intervals.

The hose assemblies should be inspected for leakage within the first 5 min of a machine start-up following a cool down.
- h. Test Fluid—As specified by the original equipment manufacturers. Recommended fluids are:
 1. Exxon, Houston, TX—FN-1973CJ
 2. Texaco—Code 1831-PSF
- i. Test Duration
 1. Performance Validation—200 000 cycles (min)
 2. Lot Approval—100 000 cycles (min)
- j. Failure—Any fluid observed dripping from the hose during the test constitutes a failure.

9.2 **Tensile Test**—Hose assemblies shall withstand a minimum tensile load of 4480 N (1000 lb) without the fittings pulling off or rupture of the hose.

9.3 **Low-Temperature Flexibility**—Samples shall be subjected to a temperature of $-40 \text{ }^\circ\text{C} \pm 1 \text{ }^\circ\text{C}$ ($-40 \text{ }^\circ\text{F} \pm 2 \text{ }^\circ\text{F}$) for a period of 24 h, after which the hose shall be flexed in the cold chamber through 180 degrees from the centerline around a mandrel whose diameter is eight times the nominal hose OD. Flexing shall be accomplished within 3 to 5 s. Hose shall not fracture or show any cracks, checks, or breaks in the tube or cover.

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9.4 Adhesion Test—When tested in accordance with ASTM D 413, using the machine method, ring specimen, a pull of not less than 44.8 N (10 lb) shall be required to separate a 25 mm (1 in) wide ring section of the bond between any adjacent layers of the hose.

In case of repeated tearing of the rubber stock, instead of separating from the braid, no fewer than three tests will be run starting at locations approximately 120 degrees apart to assure uniform adhesion. A new test specimen will be used for each test. Take as a result of the test the average load at which tearing occurs and note as a tear adhesion. A stock tear value below the minimum is acceptable.

9.5 Bursting Strength—Samples shall meet a minimum bursting requirement of 41.4 MPa (6000 psi).

9.6 Ozone Resistance—The outer cover of the hose shall show no cracking when examining the cover of the hose under 7X magnification, ignoring the areas immediately adjacent to or within the area covered by the binding. Bend the hose around a cylinder, the diameter of which shall be eight times the nominal outside diameter of the hose and bind the ends. The cylinder and binding shall be made of metal or materials which prevent the consumption of ozone. If the hose collapses when bent around the cylinder, provide for internal support of the hose. Condition the hose, on the cylinder for 24.0 h \pm 0.5 h at room temperature and then place in an exposure chamber containing air mixed with ozone in such quantities that a 50 mPa \pm 5 mPa partial pressure of ozone is present at 40 °C \pm 3 °C (104 °F \pm 5 °F) for 70 to 72 h. Ambient air temperature in the chamber during test shall be 40 °C \pm 3 °C (104 °F \pm 5 °F).

9.7 Volumetric Expansion—Samples shall be installed on the test fixture in a manner which allows the hose to be straight but not under tension when test pressure is applied. Samples shall be preconditioned at 9.0 MPa \pm 0.14 MPa (1300 psi \pm 20 psi) for 30 s \pm 5 s and allowed to recover at 0 MPa (0 psi) for 2 min \pm 5 s prior to the test. Test pressure shall then be applied and held for 2 min \pm 5 s. At the end of this period, the inlet valve shall be closed and the test fluid allowed to rise in the burette for a period of 1 min \pm 5 s. The outlet valve shall then be closed and the reading taken. The average of three volumetric expansion readings per sample shall not exceed the values listed as follows:

- a. Volumetric Expansion cc/m at 0 to 9.0 MPa (1300 psi)
 - 1. Maximum—46 cc/m (14 cc/ft)
 - 2. Minimum—10 cc/m (3 cc/ft)

9.8 100% Proof Pressure Test—Bulk Hose—Each bulk hose length shall be proof pressure tested using water as the pressure medium. Test pressure shall be 20.7 MPa (3000 psi) minimum and held for not less than 30 s nor more than 60 s.

NOTE—Bulk Hose is defined as straight random length hose intended for further processing into cut lengths.

9.9 Identification Marking—Hose shall be identified with the SAE number, class, size of inside diameter in fractions, a six-digit date code as shown in Figure 1 and hose manufacturer's and/or coupling manufacturer's code marking. This marking shall appear on the outer cover of the hose at intervals of not greater than 254 mm (10 in).

Example date June 7, 1992

6-digit date 060792 = 06 (month) 07 (day) 92 (year)

FIGURE 1—EXAMPLE OF IDENTIFICATION MARKING

Additional identification may be added as agreed upon by user and supplier.