

High-Temperature Power Steering Return Hose—Low Pressure

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 hose fabricated from textile reinforcement and synthetic rubber, assembled with clamps and/or 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 1.21 MPa (175 psi) maximum working pressure. This specification defines the minimum performance levels of a flexible connector in the hydraulic steering system to convey power steering fluid from the steering gear back to the pump/reservoir.

2. References

2.1 Applicable Publications—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 PUBLICATION—Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

SAE J962—Formed Tube Ends for Hose Connections

2.1.2 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

- a. ID—9.09 to 9.91 mm (0.358 to 0.390 in)
- b. OD—15.88 to 17.48 mm (0.625 to 0.688 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 1 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 1, 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 1 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 nine sample hose assemblies, selected at random, as listed in Table 1, are required to conduct a complete test. In the event of a failure, the test or tests that have failed shall be retested using a minimum of twice the number of samples indicated in Table 1. Failure of any of the retested samples shall be cause for rejection of the entire lot.**TABLE 1—INSPECTION TESTS**

Title and Section Number	Minimum Sample Size
1. Length Change (9.6) 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
6. Kink Resistance (9.8)	1
7. Assembly Effort (9.9)	1

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 L/m \pm 0.8 L/m (1.6 GPM \pm 0.2 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 0.40 MPa (0 to 58 psi)
 2. High Pressure—1.20 to 1.35 MPa (174 to 196 psi)
- b. Cycle Rate—30/40 cycles per min.
- c. Pressure Rise Time—0.2 s \pm 0.02 s
- d. Pressure Dwell Time—0.7 s \pm 0.05 s
- e. Oil Temperature (in hose)—150 °C \pm 3 °C (302 °F \pm 5 °F)
- f. Ambient Temperature—150 °C \pm 6 °C (302 °F \pm 10 °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 °C (180 °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 380 N (85 lb) without the fittings pulling off or rupture of the hose.

9.3 Low-Temperature Flexibility—Samples shall be subjected to a temperature of $-40\text{ °C} \pm 1\text{ °C}$ ($-40\text{ °F} \pm 2\text{ °F}$) 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.

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 6.90 MPa (1000 psi).

9.6 Length Change—Hose shall not change more than +2%, -6% when pressurized from 0 to 1.21 MPa (175 psi).

9.7 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 $24.0 \text{ h} \pm 0.5 \text{ h}$ at room temperature and then place in an exposure chamber containing air mixed with ozone in such quantities that a $50 \text{ mPa} \pm 5 \text{ mPa}$ partial pressure of ozone is present at $40 \text{ }^\circ\text{C} \pm 3 \text{ }^\circ\text{C}$ ($104 \text{ }^\circ\text{F} \pm 5 \text{ }^\circ\text{F}$) for 70 to 72 h. Ambient air temperature in the chamber during the test shall be $40 \text{ }^\circ\text{C} \pm 3 \text{ }^\circ\text{C}$ ($104 \text{ }^\circ\text{F} \pm 5 \text{ }^\circ\text{F}$).

9.8 Kink Resistance—The change in OD of the hose at the center of the loop shall not exceed 20% when the end of a 230 mm (9.0 in) length of hose is placed in a locating fixture having two holes at 18 to 19 mm (0.709 to 0.748 in) diameter, 25 mm (1 in) deep and 115 mm (4.5 in) between centerlines of the hose.

9.9 Assembly Effort—The force required to install a 76 mm (3 in) length of hose at a rate of 50 mm/min (2 in/min) over an insert shall not exceed 133 N (30 lb). The insert used shall be as defined by SAE J962.

9.10 100% Proof Pressure Test—Bulk Hose—Each bulk hose length shall be proof pressure tested using water as the pressure medium. Test pressure shall be 1.7 MPa (250 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.

9.11 Identification Marking—Hose shall be identified with the SAE number, 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—IDENTIFICATION MARKING

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

10. Notes

10.1 Marginal Indicia—The change bar (I) 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.