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**Road vehicles — Brake hose assemblies for
hydraulic braking systems used with
non-petroleum-base brake fluid**

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

International Standard ISO 3996 was prepared by Technical Committee ISO/TC 22, *Road vehicles*, Subcommittee SC 2, *Brake systems and equipment*.

This third edition cancels and replaces the second edition (ISO 3996:1986), of which it constitutes a technical revision.

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Road vehicles — Brake hose assemblies for hydraulic braking systems used with non-petroleum-base brake fluid

1 Scope

This International Standard specifies the test procedures for, and performance requirements and marking of hydraulic brake hose assemblies to be used in hydraulic braking systems of road vehicles of which the nominal inside diameter of the hose is 3,2 mm or 4,8 mm.

It applies to brake hose assemblies made of a hose fabricated from cord and synthetic elastomers and assembled with metal end fittings for use with non-petroleum-base brake fluids in accordance with ISO 4925.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 4925:1978, *Road vehicles — Non-petroleum base brake fluid*.

ISO 4926:1978, *Road vehicles — Hydraulic brake systems — Non-petroleum base reference fluids*.

ISO 7500-1:1986, *Metallic materials — Verification of static uniaxial testing machines — Part 1: Tensile testing machines*.

ISO 9227:1990, *Corrosion tests in artificial atmospheres — Salt spray tests*.

3 Definitions

For the purposes of this International Standard, the following definitions apply.

3.1 brake hose assembly: Brake hose equipped with end fittings for use in a brake system.

3.2 brake hose: Flexible conduit intended for use in a brake system to transmit and contain the fluid pressure medium used to apply force to the vehicle's brakes.

3.3 end fitting: Coupling designed for permanent attachment to the ends of a brake hose assembly by crimping or swaging.

3.4 free length: Linear length of brake hose exposed between the end fittings of a brake hose assembly while maintained straight.

3.5 leaks; burst: Loss of test fluid through the brake hose assembly other than by the designed inlet(s) and outlet(s).

3.6 cracking: Interruption of a surface due to environment and/or stress.

4 Construction

4.1 Hose

The hose shall consist of an elastomeric lining, two or more layers or plies of reinforcing cord embedded in, and/or bonded to, the elastomeric lining and outer cover. A cushion liner between the reinforcing cords is permitted. The cover shall be a black compound which will not crack when subjected to long periods

of weather ageing. The lining of this hose shall be of a compound which will effectively resist deterioration by non-petroleum-base brake fluids as designated in ISO 4925.

4.2 Hose assembly

Each hydraulic brake hose assembly shall have permanently attached end fittings.

5 Performance testing for acceptance

The test schedule shall consist of all the tests listed in table 1. The complete test schedule shall be conducted for each separate brake hose assembly design. Any changes in hose construction or materials, coupling crimp or swage design or end fittings shall be deemed to constitute a change in assembly design. Variations that do not influence the integrity of the hose coupling joint such as variation in thread size, port dimensions, hexagon size and the like shall however not be considered a design change.

When the hose assembly configurations are such that it is impractical to conduct tests such as tensile, whip and constriction, hose assemblies produced from equivalent type and fittings, production type equipment and processes shall be used as substitute brake hose assemblies.

6 Tests

6.1 Test conditions

The hose assemblies for the performance tests shall be new and unused. They shall be at least 24 h old.

For the last 4 h prior to testing, they shall be maintained at a temperature of 15 °C to 32 °C.

Prior to installation of the hose assembly for a whip test or cold bend test, all external appendages such as mounting brackets, spring guards and metal collars shall be removed, or long tubes shortened, or both.

Unless otherwise specified, the temperature of the test room shall be between 15 °C and 32 °C for all tests.

Table 1 — Hydraulic brake hose assembly performance tests and quantity of samples required

Number of samples	Qualification tests	Subclause
All	Hydrostatic pressure test	6.2
All ¹⁾	Constriction test	6.3
4	Volumetric expansion test followed by burst	6.4, 6.5
4	Brake fluid compatibility	6.6
4	Whip test	6.7
4	Tensile strength test	6.8
4	Hot impulse strength test	6.12
2	Ozone resistance test under dynamic conditions	6.11
1	Cold bend test	6.10
1	Salt spray test	6.13
Tests after water absorption		
4	Burst strength test	6.9
4	Whip test	6.9
4	Tensile test	6.9
NOTE — Total quantity of samples: 36		
1) Four brake hose assemblies may be used if assemblies have to be cut to conduct constriction tests.		

6.2 Hydrostatic pressure test

Subject the hose assembly to a hydrostatic pressure test, using inert gas, air, water or brake fluid conforming to ISO 4925 as the pressure medium. The test pressure shall be between 10,3 MPa and 14,5 MPa for inert gas and air, and between 20,7 MPa and 24,8 MPa for water and brake fluid.

WARNING — Special care shall be taken when gas or air is used, as under the pressure specified, gas and air are explosive if a failure should occur in the hose assembly.

Hold the pressure for between 10 s and 25 s.

Hose assemblies showing leaks under this test shall be rejected and destroyed.

6.3 Constriction test

6.3.1 Requirements

The constriction of the hose assemblies shall be measured with a gauge plug as shown in figure 1, in that part of the brake hose end fittings which contains the hose. The choice of gauge is left to the operator.

The constriction shall not be less than diameter A min. specified in figure 1.

6.3.2 Procedure

The hose assemblies shall be submitted to the appropriate procedure among the following.

6.3.2.1 Hold the hose assembly vertically at the fitting and insert the A diameter portion of the gauge plug into the end of the fitting for the full length of the probe. Repeat at the other end of the hose assembly.

6.3.2.2 Some hose assemblies have a fitting so designed that it is impossible to insert the gauge externally. For these hose assemblies, insert a special elongated gauge plug that meets the requirements of figure 1, with the exception of the length, which shall be such that its tip will extend past the hose opening, into the opposite end.

NOTE 1 If the gauge plug becomes misaligned at the entrance to the second fitting, it may be necessary to align the hose to allow the gauge plug to pass through.

6.3.2.3 Some hose assemblies have fittings on both ends which cannot be entered with the gauge plug. Cut these hose assemblies 50 mm \pm 2 mm from the end of the fitting and then test with the gauge plug in accordance with figure 1.

6.4 Expansion test

6.4.1 Requirements

The maximum expansion of any hose assembly tested in accordance with 6.4.4 shall not exceed the values in table 2.

6.4.2 Apparatus

The apparatus shall basically consist of the following elements (see figure 2):

- source for required fluid pressures;
- test fluid consisting of brake fluid, or water without any additives and free of air or gas bubbles;
- water pressure gauges;
- fittings in which the hose assembly may be mounted vertically for application of pressure under controlled conditions;

Table 2 — Maximum expansion

Hose nominal inside diameter	Test pressure			
	6,9 MPa		10,3 MPa	
	Regular expansion (HR) cm ³ /m	Low expansion (HL) cm ³ /m	Regular expansion (HR) cm ³ /m	Low expansion (HL) cm ³ /m
mm				
3,2	2,17	1,08	2,59	1,38
4,8	2,82	1,81	3,35	2,36

Dimensions in millimetres

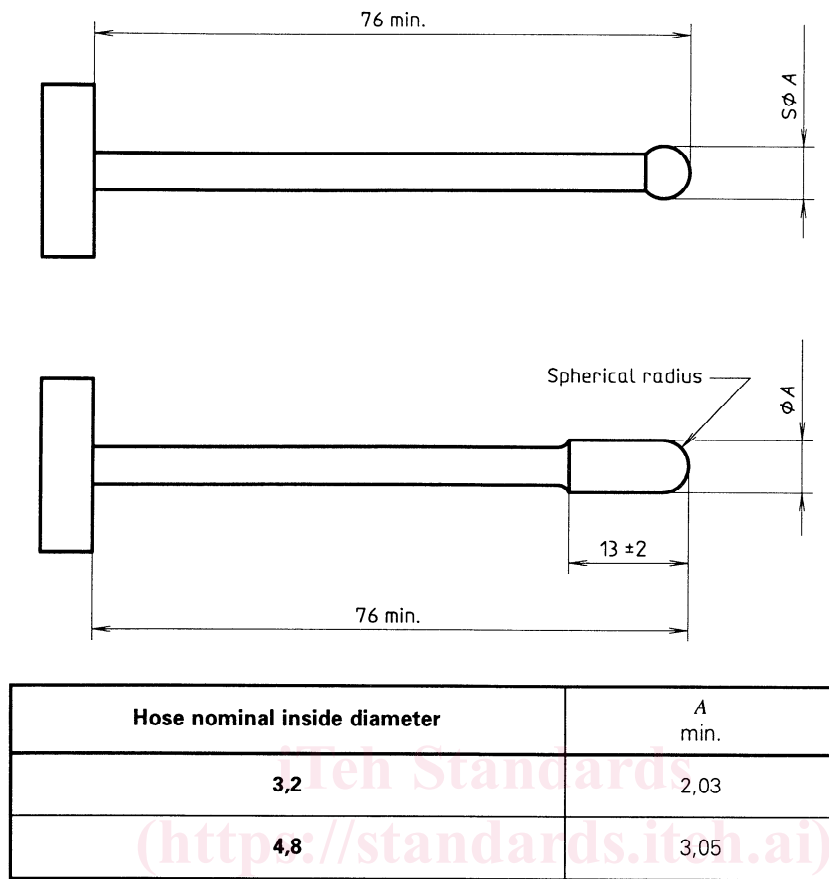


Figure 1 — Gauge plugs for testing constriction of hose bore

- e) graduated burette with $0,05 \text{ cm}^3$ increments for measuring the volume of liquid corresponding to the expansion of the hose under pressure;
- f) plumbing hardware as required.

All piping and connections shall be smooth-bore without recesses or offsets, so that all air may be freely removed from the system before running each test. Valves shall withstand the pressures involved without leakage.

6.4.3 Calibration of apparatus

The apparatus shall be tested prior to use to determine its calibration correction factors established at pressures of 6,9 MPa and 10,3 MPa using a simulated hose assembly that shall consist of at least 1,52 mm wall hydraulic steel tubing with a free length of $305 \text{ mm} \pm 6 \text{ mm}$ and an outside diameter of 6,3 mm. All fittings and adaptors used in the testing of the hose assembly shall be in this system. This may require the attachment of the tubing to the fit-

tings in the case of special end configurations. The calibration correction factors shall be subtracted from the expansion readings obtained on the test samples.

The calibration correction factor shall not exceed $0,08 \text{ cm}^3$ at 10,3 MPa.

6.4.4 Procedure

6.4.4.1 If the sample to be used in this test has been subjected to pressure above 10,3 MPa using any medium prior to this test, allow it to recover for 15 min.

6.4.4.2 Measure the free length of brake hose assembly with it vertical and a mass of $567 \text{ g} \pm 3 \text{ g}$ attached to the lower end.

6.4.4.3 Carefully thread the hose assembly into the adaptors designed to seal in the same manner as in actual use. Do not twist the hose assembly. Maintain the hose assembly vertical and straight without tension while under pressure.

C is the correction factor, in cubic centimetres;

l is the free length of sample, in metres.

6.4.4.9 Readjust the water level in the burette to zero as above and repeat the procedure given in 6.4.4.6 and 6.4.4.7, to obtain the expansion at a pressure of $10,3 \text{ MPa } \begin{smallmatrix} 0 \\ -0,14 \end{smallmatrix}$ MPa. If the pressure in the hose inadvertently rises to a value above that specified, but not above 24 MPa, completely release the pressure and allow the hose to recover for at least 15 min and then repeat the test. If the hose was subjected to a pressure above 24 MPa, then repeat the test using a new brake hose. If, at any time during the test, an air bubble flows out of the hose, repeat the test after allowing at least 5 min for the hose to recover.

6.5 Burst strength test

6.5.1 Requirements

When tested under hydraulic pressure, each sample of hose assembly shall withstand a pressure hold of 2 min at the specified pressure and shall withstand the minimum burst pressure as shown in table 3.

Table 3 — Hold pressure and minimum burst pressure

Hose nominal inside diameter mm	Pressure hold MPa	Minimum burst pressure MPa
3,2	27,6	49,0
4,8	27,6	34,5

6.5.2 Apparatus

The apparatus consists of a suitable pressure system in which the hose assembly is so connected that controlled and measured fluid pressure may be applied internally. The pressure shall be obtained by means of a hand- or power-driven pump or an accumulator system and shall be measured with a calibrated gauge.

As a safety measure, provision shall be made for filling the hose assembly with water or brake fluid and allowing all air to escape through a relief valve prior to the application of pressure.

The pressures shown in table 3 shall be applied at a rate of $(172,5 \pm 69) \text{ MPa/min}$.

Since this type of hose assembly withstands a minimum bursting pressure as shown in table 3, care shall be taken that all piping, valves and fittings are sufficiently rugged and adapted to high pressure work. The apparatus described in 6.4.2 may be used when it conforms to these requirements.

6.5.3 Procedure

Connect the sample to the pressure system and fill completely with water or brake fluid, allowing all air to escape. Removal of air bubbles may be facilitated by shaking the hose. Apply $27,6 \text{ MPa } \begin{smallmatrix} 0 \\ -0,13 \end{smallmatrix}$ MPa pressure at the rate specified in 6.5.2 and hold for $120 \text{ s } \begin{smallmatrix} 0 \\ -10 \end{smallmatrix}$ s. At the expiration of this hold period, increase the pressure at a rate of $(172,5 \pm 69) \text{ MPa/min}$ until the hose bursts. Read the maximum pressure obtained on the calibration gauge to the nearest 0,69 MPa and record it as the bursting strength of the hose assembly.

6.6 Brake fluid compatibility

6.6.1 Requirements

After having been subjected to a temperature of $120 \text{ }^\circ\text{C } \begin{smallmatrix} +5 \\ 0 \end{smallmatrix}$ $^\circ\text{C}$ for 70 h to 72 h while filled with compatible non-petroleum-base brake fluid as specified in ISO 4926, the hose assembly shall meet the constriction requirements specified in 6.3.1. It shall then withstand a pressure of 27,6 MPa for $120 \text{ s } \begin{smallmatrix} 0 \\ -10 \end{smallmatrix}$ s and shall not burst at less than 34,5 MPa. In addition, under the conditions in 6.6.3.3, the hose assembly shall burst within 3 h.

6.6.2 Preparation

6.6.2.1 Attach a hose assembly or manifold to which multiple hose assemblies may be attached, below a 0,5 l reservoir filled (see figure 3), with 100 ml of compatible non-petroleum-base brake fluid as specified in ISO 4926.

6.6.2.2 Fill the hose assembly with compatible non-petroleum-base brake fluid as specified in ISO 4926 and seal the lower end.

6.6.3 Procedure

6.6.3.1 Place the hose assembly vertically in an oven. Condition the hose assembly at $120 \text{ }^\circ\text{C } \begin{smallmatrix} +5 \\ 0 \end{smallmatrix}$ $^\circ\text{C}$ for 70 h to 72 h, then cool to room temperature for $30 \text{ min } \pm 5 \text{ min}$.