INTERNATIONAL STANDARD 4930

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION•МЕЖДУНАРОДНАЯ ОРГАНИЗАЦИЯ ПО СТАНДАРТИЗАЦИИ•ORGANISATION INTERNATIONALE DE NORMALISATION

Road vehicles — Elastomeric seals for hydraulic disc brake cylinders using a non-petroleum base hydraulic brake fluid (Service temperature 150 °C max.)

Véhicules routiers — Joints en caoutchouc pour cylindres de freins hydrauliques à disque utilisant un liquide de frein à base non pétrolière (Température maximale d'utilisation 150 °C)

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Descriptors : road vehicles, brake systems, hydraulic brakes, disc brakes, rubber products, seals (stoppers), specifications, tests, performance tests, test equipment.

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FOREWORD

ISO (the International Organization for Standardization) is a worldwide federation of national standards institutes (ISO member bodies). The work of developing International Standards is carried out through ISO technical committees. Every member body interested in a subject for which a technical committee has been set up 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.

Draft International Standards adopted by the technical committees are circulated to the member bodies for approval before their acceptance as International Standards by the ISO Council.

International Standard ISO 4930 was developed by Technical Committee ISO/TC 22, *Road vehicles*, and was circulated to the member bodies in July 1976.

It has been approved by the member bodies of the following countries :

Australia	Iran	Romania
Austria	Italy	South Africa, Rep. of
Belgium	Japan	Spain
Brazil	Korea, Rep. of	Sweden
Bulgaria	Mexico	Switzerland
Chile	Netherlands	United Kingdom
Czechoslovakia	New Zealand	U.S.A.
France	Philippines	U.S.S.R.
Hungary	Poland	Yugoslavia

The member body of the following country expressed disapproval of the document on technical grounds :

Germany

Printed in Switzerland

Road vehicles — Elastomeric seals for hydraulic disc brake cylinders using a non-petroleum base hydraulic brake fluid (Service temperature 150 °C max.)

1 SCOPE

This International Standard specifies the performance test methods and requirements for elastomeric seals used in road vehicle disc brake cylinders.

2 FIELD OF APPLICATION

This International Standard applies to solid section type seals (square, rectangular, 'O'-ring) mounted stationary in the cylinder bore or on the movable piston of disc brakes.

3 REFERENCES

ISO 48, *Vulcanized rubbers — Determination of hardness (Hardness between 30 and 85 IRHD).*

ISO 188, *Rubber, vulcanized — Accelerated ageing or heat resistance tests.*

ISO 1817, *Vulcanized rubbers — Resistance to liquids — Methods of test.*

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

ISO 4928, *Road vehicles — Elastomeric cups and seals for hydraulic brake actuating cylinders using a non-petroleum base hydraulic brake fluid (Service temperature 120 °C max.)*

ASTM E 145-68, *Specification for gravity-convection and forced-ventilation ovens.* [1)]

4 PRODUCT REQUIREMENT

Seals shall be free from blisters, pin-holes, cracks, embedded foreign material, or other physical defects, and shall conform to the dimensions specified on the drawings.

5 BRAKE TEST FLUID

The test fluid for all tests except the test prescribed in clause 15 shall be compatibility fluid as defined in ISO 4926. The fluid specified in clause 15 shall be ISO fluid for storage corrosion test as defined in ISO 4926.

6 APPARATUS

6.1 Resistance to fluid at elevated temperature, physical stability and precipitation characteristics

6.1.1 Oven, uniformly heated, dry air type conforming to the requirements for Type IIB in ASTM E 145-68.

6.1.2 Test jar, screw-top straight-sided round glass type, having a capacity of 250 ± 10 ml and inner dimensions of approximately 125 mm height and 50 mm diameter, with a tinned steel lid (no insert or organic coating).

6.2 High temperature stroking test

Apparatus as illustrated in figure 1 with **oven** in accordance with 6.1.1.

6.3 Low temperature leakage test

Apparatus as illustrated in figure 2.

7 TEST REQUIREMENTS

7.1 After the test for resistance to fluid at elevated temperature — physical stability (clause 9), the seals shall conform to the following requirements :

7.1.1 Any change in volume shall be within 0 to + 15 %.

7.1.2 Any change in hardness shall be within 0 to − 15 IRHD.

7.2 After the test for resistance to fluid at elevated temperature — precipitation characteristics (clause 10), not more than 0,05 % sediment by volume shall be formed in the test fluid used.

1) This reference will be replaced by an ISO reference when the latter becomes available.

7.3 After the test for resistance to elevated temperature in dry air (clause 11), the seals shall conform to the following requirements :

7.3.1 Any change in hardness shall be within 0 to + 15 IRHD.

7.3.2 Seal condition : test specimens shall show no evidence of blistering, cracking, or change in shape from original form.

7.4 After the ambient temperature stroking test (clause 12), seals and assembly shall conform to the following requirements :

7.4.1 No leakage beyond normal wetting of the bore(s) shall occur during the stroking test.

7.4.2 No leakage beyond normal wetting of the bore(s) shall occur during the static leak test 12.2.6.

7.5 After the high temperature stroking test (clause 13), the seals and assembly shall conform to the following requirements :

7.5.1 No leakage beyond normal wetting of the bore(s) shall occur during the stroking test.

7.5.2 No leakage beyond normal wetting of the bore(s) shall occur during the static leak test 13.2.9.

7.6 After the low temperature leakage test (clause 14), the seals and assembly shall conform to the following requirements :

7.6.1 No leakage beyond normal wetting of the bore(s) shall occur during the test period or pressure application.

7.6.2 The seal shall not crack, shall remain flexible and shall return to its approximate original shape within 1 min when tested according to the procedure prescribed in 14.3.

7.7 After the cycling humidity storage corrosion test (clause 15), the seals and assembly shall conform to the following requirements :

7.7.1 No evidence of rubber adhesion of the test seal(s) shall appear during disassembly of the test brake.

7.7.2 No surface of the sealing systems shall show evidence of corrosion or deterioration which would interfere with proper sealing action. Normal staining or discoloration of metal parts is acceptable if surface finish is unaffected.

7.8 After all tests, disassemble the cylinder and inspect the seal. Record the visual condition of the seal, bore and piston. Seals shall not show excessive deterioration such as scoring, scuffing, blistering, cracking, or change in shape from original appearance.

8 PREPARATION OF TEST SPECIMENS

All seals to be tested shall be cleaned prior to testing by rinsing in isopropyl alcohol and blown dry or wiped dry with a lint-free cloth. Seals shall not remain in alcohol for more than 30 s.

9 RESISTANCE TO FLUID AT ELEVATED TEMPERATURE – PHYSICAL STABILITY

9.1 Test specimens

From three or more seals to be tested, obtain a sample of mass 3 to 5 g.

9.2 Procedure

9.2.1 Determine and record the initial volume of the sample in accordance with ISO 1817.

9.2.2 Determine and record the initial hardness of the sample in IRHD. Measure hardness as prescribed in ISO 48 using a microtester (or according to a procedure previously agreed upon between vendor and purchaser).

9.2.3 Place the sample in the test jar (6.1.2) and completely immerse in 75 ml of brake test fluid (see clause 5). Seal the test jar to prevent vapour loss and place in the oven (6.1.1) at 120 ± 2 °C for 70 h.

9.2.4 After 70 h, remove the test jar from the oven and allow the sample to cool in the test jar at 23 ± 5 °C for 60 to 90 min. At the end of the cooling period, remove the sample from the test jar, rinse in isopropanol or ethanol and wipe dry with a clean, lint-free cloth.

Do not allow the sample to remain in the alcohol for more than 30 s.

9.2.5 Determine and record within 60 min the final volume and hardness in IRHD of each seal in accordance with 9.2.1 and 9.2.2.

9.2.6 Report the change in volume as a percentage of the original volume. It is given by the formula

$$\% \text{ change in volume} = \frac{(m_3 - m_4) - (m_1 - m_2)}{(m_1 - m_2)} \times 100$$

where

m_1 is the initial mass, in grams, in air;

m_2 is the initial apparent mass, in grams, in water;

m_3 is the mass, in grams, in air after immersion in test fluid;

m_4 is the apparent mass, in grams, in water after immersion in test fluid.

10 RESISTANCE TO FLUID AT ELEVATED TEMPERATURE – PRECIPITATION CHARACTERISTICS

10.1 Test specimens

From two or more seals to be tested obtain a sample of 4 ± 0,5 g. Since whole seals are quite large, small pieces may be cut from the seal to arrive at the required mass. Use a minimum number of pieces to obtain a mass of 4 ± 0,5 g.

10.2 Procedure

10.2.1 Place the sample in a test jar (6.1.2) and cover with 75 ml of the test fluid (see clause 5). Seal the test jar to prevent vapour loss and place in the oven (6.1.1) at 120 ± 2 °C. (Optional : a blank test may be conducted on the brake fluid prior to the test, and any sediment resulting from this blank test may be deducted from the volume of sediment obtained after the test.)

10.2.2 After 70 h remove the test jar from the oven. Allow the sample to remain in the fluid at room temperature for 24 h, after which agitate the test fluid and pour into a cone-shaped centrifuge tube.

10.2.3 Rotate the centrifuge tube for 30 min at 1 500 min^{-1}. Note the volume of sediment observed in the tube. Repeat the above rotation for an additional 30 min and record any difference in volume of sediment.

10.2.4 Record the percentage amount of sediment obtained after the second centrifuging.

11 RESISTANCE TO ELEVATED TEMPERATURE IN DRY AIR

11.1 Test specimens

Two or more seals shall be used.

11.2 Procedure

11.2.1 Measure and record the hardness of each seal in IRHD in accordance with 9.2.2.

11.2.2 Place the test seals in a circulating air oven, as prescribed in ISO 188, and maintain for 22 h at 175 ± 2 °C.

11.2.3 At the termination of the heating period remove the seals from the oven and allow to cool for 16 to 96 h at room temperature.

11.2.4 After cooling, measure and record the hardness in IRHD in accordance with 9.2.2 and note any visual change such as cracking, blistering, distortion, etc.

12 AMBIENT TEMPERATURE STROKING TEST

12.1 Test specimen

Adequate test seals for at least one complete cylinder shall be prepared.

12.2 Procedure

12.2.1 Moisten the seals and cylinder bores with brake test fluid (see clause 5). Install the test seals in the cylinder.

12.2.2 Complete test cylinder assembly, placing the piston to simulate a half-worn lining position.

12.2.3 Mount the test cylinder assembly on a production hub and disc assembly or equivalent simulating fixture.

12.2.4 Connect the test fixture to the pressure source. It may be necessary or desirable to include a fluid accumulator (see ISO 4928).

12.2.5 *Test parameters*

12.2.5.1 Temperature : 18 to 32 °C.

12.2.5.2 Pressure : Apply pressure by external means at a maximum rate-of-pressure rise of 21,0 ± 1,4 MPa/s from 0 to 7,0 ± 0,3 MPa.

12.2.5.3 Cycles required : 500 000 total.

12.2.5.4 Cycle rate : 3 600 per hour ± 10 %.

12.2.6 *Leakage test*

Observe leakage during and after the stroking test. After completion of the stroking test, run high and low pressure leak tests.

12.2.6.1 HIGH PRESSURE LEAK TEST

Apply 0,7 MPa hydraulic pressure for 5 min and observe and record leakage, if any.

12.2.6.2 LOW PRESSURE LEAK TEST

Remove the cylinder from the test stand and connect the test cylinder to a pressure source at 10 ± 1,75 kPa for 24 h. Observe leakage, if any.

NOTE — The pressure source may be a static column of fluid. A 1 200 mm column will provide 10 kPa.

12.2.7 Disassemble the cylinder and inspect the seal. Record the visual condition of the seal, bore and piston. Seals shall not show excessive deterioration such as scoring, scuffing, blistering, cracking, or change in shape from original appearance.

13 HIGH TEMPERATURE STROKING TEST

13.1 Test specimens

Adequate test seals for at least one complete cylinder shall be prepared.

13.2 Procedure

13.2.1 Moisten the seals and cylinder bores with brake test fluid (see clause 5). Install the test seals in the cylinder.

13.2.2 Complete test cylinder assembly, placing the piston to simulate a half-worn lining position.

13.2.3 Mount the test cylinder assembly on a production hub and disc assembly or equivalent simulating fixture.

13.2.4 Place the complete test fixture in an oven conforming to clause 4 of ISO 188 (see also figure 1).

13.2.5 Connect to the actuating pressure device.

The device may be composed of a pneumatically or hydraulically actuated automotive type master cylinder whose rate of operation shall be controlled at 1 000 ± 100 strokes/h.

The test fixure shall be connected to the actuating pressure device and arranged in such a manner as to yield a maximum rate-of-pressure rise of 7,0 MPa/s, and a minimum dwell period below 0,18 MPa of 0,25 s. (It may be found necessary to install a fluid accumulator, such as a standard wheel cylinder as in ISO 4928, to meet the prescribed pressure/displacement curve.)

13.2.6 *Test parameters*

13.2.6.1 Temperature : 120 ± 2 °C.

13.2.6.2 Pressure : 7,0 ± 0,3 MPa at a rate-of-pressure rise of 7,0 MPa/s max.

13.2.6.3 Elapsed time : 70 h.

13.2.6.4 Cycles required : 70 000 ± 5 000.

13.2.7 After 70 h, discontinue stroking, shut off the heat, open the oven door, release hydraulic pressures in the system and allow the oven to cool for 60 min. The circulating fan may be left on to aid in cooling.

13.2.8 After a 60 min cooling period, remove the test assembly and allow to complete cooling in the open air for 25 ± 5 h.

13.2.9 *Leakage test*

Observe leakage during and after the 70 h stroking test. After completion of the 25 h cooling period, carry out a high and low pressure leak test.

13.2.9.1 HIGH PRESSURE LEAK TEST

Apply 0,7 MPa hydraulic pressure for 5 min and observe and record leakage, if any.

13.2.9.2 LOW PRESSURE LEAK TEST

Remove the cylinder from the test stand and connect the test cylinder to a pressure source at 10 ± 3,3 kPa for 24 h. Observe leakage, if any.

NOTE — The low pressure source may be a static column of fluid. A 1 200 mm column will provide 10 kPa.

13.2.10 Disassemble the cylinder and inspect the seal. Record the visual condition of the seal, bore, and piston. Seals shall not show excessive deterioration such as scoring, scuffing, blistering, cracking, or change in shape from original appearance.

14 LOW TEMPERATURE LEAKAGE TEST

14.1 Test specimens

Adequate test seals for at least one complete cylinder shall be prepared.

14.2 Procedure

14.2.1 Moisten the seals and cylinder bores with brake test fluid (see clause 5). Install the test seals in the cylinder.

14.2.2 Complete the test cylinder assembly, placing the piston to simulate a new lining position. Arrangements must be made to change the piston position during the cold test to simulate new, half, two-thirds, and full-worn lining positions.

14.2.3 Mount the test cylinder assembly on a production hub and disc assembly or equivalent simulating fixture.

14.2.4 Place the test fixture in a cold chamber at − 40 to − 43 °C and connect to the pressure source as shown in figure 2. The pressure source shall be located to provide a static reservoir head of 300 to 600 mm.

14.2.5 Allow the cylinder to soak for 72 h with the piston in the new lining position.

14.2.6 After 72 h, stroke the actuating mechanism six times at 1 ± 0,07 MPa followed by six times at 4,2 ± 0,35 MPa. The strokes shall be held for approximately 5 s and applied approximately 60 s apart. Immediately after stroking, remove the first shims and by means of the stroking mechanism, move the pistons into the half-worn lining position using minimum line pressure to establish the new location for all pistons. Observe and record leakage, if any, 30 min after the new position is established. Allow the test cylinder to continue to soak for 24 h.

14.2.7 After 96 h total soaking time, repeat 14.2.6, except progress to two-thirds worn lining position.

14.2.8 After 120 h total soaking time, repeat 14.2.6, except progress to full-worn lining position and discontinue test 30 min after establishing final piston position.

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ERRATUM

Page 5

Clause 15.2.6; the first line is to read :

"Continue the above 24 h cycle for a total of 12 days."

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14.2.9 Disassemble the cylinder and inspect the seal. Record the visual condition of the seal, bore and piston. Seals shall not show excessive deterioration such as scoring, scuffing, blistering, cracking, or change in shape from original appearance.

14.3 Bend test procedure

14.3.1 Place one seal in a cold chamber at −40 to −43 °C.

14.3.2 After 22 h, fold the seal back upon itself between the thumb and finger and release within 2 to 5 s.

The cold seal shall be folded while in the cold chamber and shall be handled with cold gloves to prevent heating by fingers.

15 CYCLING HUMIDITY STORAGE CORROSION TEST

15.1 Test specimens

Adequate test seals for at least one complete cylinder shall be prepared.

15.2 Procedure

15.2.1 Moisten the seals and cylinder with ISO fluid for corrosion storage test (see ISO 4926). Install the test seals in the cylinder.

15.2.2 Complete the test cylinder assembly, placing the piston to simulate a half-worn lining position. The cylinder assembly need not be assembled to a hub or test fixture as long as provisions are made to hold the pistons in their correct positions and boots are properly installed.

15.2.3 Place the test cylinder in a humidity chamber capable of maintaining 95 % ± 2 % relative humidity and a temperature range of 21 to 46 °C. The cylinder should be placed with the inlet port open and facing down.

15.2.4 Maintain the cylinder at 43 to 46 °C and 95 % ± 2 % humidity for 16 h.

15.2.5 Change the temperature to 18 to 21 °C while maintaining 95 % ± 2 % relative humidity, and maintain for 8 h.

15.2.6 Continue the above 24 h cycle for 12 days. When interrupted during incidence of one or more non-working days, maintain in accordance with 15.2.5 until the temperature cycling can be resumed.

15.2.7 At the conclusion of the 12-day test remove the test cylinder for disassembly and inspection. Do not rotate the cylinder, and where possible, disassemble while holding in the test position.

15.2.8 Inspect and note all components for corrosion, pitting, adhesion and other deleterious factors resulting from corrosion and/or interaction between the materials involved.