International Standard 6118

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

Road vehicles — Elastomeric cups and seals for hydraulic brake actuating cylinders using a non-petroleum base hydraulic brake fluid (service temperature 70 °C max.)

Véhicules routiers — Coupelles et joints en élastomère pour cylindres de freins hydrauliques utilisant un liquide de frein à base non pétrolière (température maximale d'utilisation 70 °C)

First edition — 1980-10-15

UDC 629.113-592.2 : 678.06 **Ref. No. ISO 6118-1980 (E)**

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

Price based on 12 pages

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 6118 was developed by Technical Committee ISO/TC 22, *Road vehicles*, and was circulated to the member bodies in March 1979.

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

Australia	Japan	Spain
Austria	Korea, Dem. P. Rep. of	Sweden
Belgium	Korea, Rep. of	Switzerland
Chile	Mexico	United Kingdom
Czechoslovakia	Netherlands	USA
France	Poland	USSR
Germany, F. R.	Romania	
Italy	South Africa, Rep. of	

No member body expressed disapproval of the document.

Printed in Switzerland

Road vehicles — Elastomeric cups and seals for hydraulic brake actuating cylinders using a non-petroleum base hydraulic brake fluid (service temperature 70 °C max.)

1 Scope

This International Standard specifies performance tests of hydraulic brake cups and seals for road vehicles; it does not include requirements relating to chemical composition, tensile strength and elongation of the elastomer compound; disc brake seals are not covered by this International Standard.

2 Field of application

This International Standard applies to moulded brake seals (cups or double-lipped type gland seals), 60 mm in diameter and smaller, compounded from elastomer, for use in hydraulic actuating cylinders employing road vehicle non-petroleum base hydraulic brake fluid conforming to the requirements of ISO 4925. The elastomer used in these seals shall be suitable for operation in a temperature range of −40 to + 70 °C.

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 1250, *Mineral solvents for paints — White spirits and related hydrocarbon solvents.*

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

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

4 Definitions

For the purpose of this International Standard the following definitions apply :

4.1 sloughing : The release of carbon black on the surface of the elastomer.

4.2 scoring : The formation of grooves in the elastomer parallel to the direction of travel of the piston or seal.

4.3 scuffing : Visible erosion of the outer surface of the elastomer.

5 General requirements

5.1 Workmanship and finish

Seals shall be free from blisters, pin-holes, cracks, protuberances, embedded foreign material or other physical defects which can be detected by thorough inspection, and shall conform to the dimensions specified on the drawings.

5.2 Marking

The identification mark of the manufacturer and other details as specified on drawings shall be moulded into each seal. Each seal in conformity with this International Standard may also have the following mark : "ISO 6118".

5.3 Packaging

Seals shall be packaged to meet requirements specified by the purchaser.

5.4 Sampling

The minimum lot on which complete specification tests shall be conducted for quality control testing, or the frequency of any specific type test used to control production, shall be agreed upon by the manufacturer and the purchaser.

6 Test requirements

6.1 Resistance to fluid at elevated temperature

After being subjected to the test for resistance to compatibility fluid at elevated temperature as prescribed in 7.1, the seals shall conform to the requirements specified in table 1.

Table 1 — Requirements for fluid resistance at elevated temperatures (70 °C)

Characteristic	Permitted change
Volume	+ 1 to + 16 %
Outside diameter, lip	0 to + 5,75 %
Outside diameter, base	0 to + 5,75 %
Hardness	− 10 to 0 IRHD

The seals shall show no excessive disintegration as evidenced by blisters or sloughing.

6.2 Precipitation

Not more than 0,3 % sediment by volume shall be formed in the centrifuge tube after the seals have been tested as specified in 7.2.

6.3 Wheel cylinder seals heat pressure stroking

Wheel cylinder seals when tested by the procedure specified in 7.3 shall meet the following performance requirements :

6.3.1 Lip diameter change

The minimum lip diameter of wheel cylinder seals after the stroking test shall be greater than the wheel cylinder bore by the minimum dimensions specified in table 2.

Table 2 — Lip diameter change, wheel cylinder seals

Diameter mm	Excess over bore mm min.
Up to 25	0,50
Over 25 up to 38	0,65
Over 38 up to 60	0,75

6.3.2 Leakage

Constant dampness past the seals or fluid discoloration of the filter paper on two or more inspections shall be cause for rejection.

6.3.3 Corrosion

Pistons and cylinder bore shall not show corrosion as evidenced by pitting to an extent discernible to the naked eye, but staining or discoloration shall be permitted.

6.3.4 Change in hardness

Rubber seals shall not decrease in hardness by more than 10 IRHD when tested in accordance with the procedure as specified in 7.7.

6.3.5 Condition of test seals

Wheel cylinder seals shall not show excessive deterioration such as scoring, scuffing, blistering, cracking, chipping (heel abrasion) or change in shape from original appearance.

6.4 Master cylinder seals heat pressure stroking

Master cylinder seals when tested by the procedure specified in 7.4 shall meet the following performance requirements :

6.4.1 Lip diameter change

The minimum lip diameter of master cylinder seals after the stroking test shall be greater than the master cylinder bore by the minimum dimensions specified in table 3.

Table 3 — Lip diameter change, master cylinder seals

Diameter mm	Excess over bore mm min.
Up to 25	0,40
Over 25 up to 38	0,50
Over 38 up to 60	0,65

6.4.2 Leakage

Constant dampness past the secondary seal or fluid discoloration of the filter paper on two or more inspections shall be cause for rejection.

6.4.3 Corrosion

The piston and cylinder bore shall not show corrosion as evidenced by pitting to an extent discernible to the naked eye; but staining or discoloration shall be permitted.

6.4.4 Change in hardness

The hardness of the primary and secondary master cylinder seals shall not decrease by more than 10 IRHD when tested according to the procedure specified in 7.7.

6.4.5 Condition of test seals

The primary and secondary seals shall not show excessive deterioration such as scoring, scuffing, blistering, cracking, chipping (heel abrasion) or change in shape from original appearance.

6.5 Low-temperature performance

6.5.1 Leakage

No leakage of fluid shall occur when seals are tested according to the procedure specified in 7.5.1.

6.5.2 Bend test

The seal shall not crack and shall return to its approximate original shape within 1 min when tested according to the procedure specified in 7.5.2.

6.6 Oven ageing

Seals when tested according to the procedure specified in 7.6 shall meet the following requirements :

6.6.1 Change in hardness

The change in hardness shall be within the limits of ± 5 IRHD.

6.6.2 Condition of test seals

The seals shall show no evidence of deterioration, or change in shape from original appearance.

6.7 Corrosion

6.7.1 Seals when tested by the procedure specified in 7.8 shall not cause corrosion exceeding the limits shown in table 4. The metal strips outside of the area where the strips are in contact shall be neither pitted nor roughened to an extent discernible to the naked eye, but staining or discoloration is permitted.

6.7.2 The fluid-water mixture at the end of the test shall show no jelling at 23 ± 5 °C. No crystalline type deposits shall form and adhere to either the glass jar walls or the surface of metal strips. The fluid-water mixture shall contain no more than 0,2 % sediment by volume.

Table 4 — Permissible change in mass of corrosion test strips

Test strips* (see ISO 4925, annex B)	Permissible change in mass max., mg/cm^2 of surface
Tinned iron	0,2
Steel	0,2
Aluminium	0,1
Cast iron	0,2
Brass	0,4
Copper	0,4

* Test strips may be obtained from Society of Automotive Engineers, Inc., 400 Commonwealth Drive, Warrendale, Pa. 15096 USA.

6.8 Storage corrosion test

After 12 cycles in the humidity cabinet when operated according to the procedure specified in 7.9, there shall be no evidence of corrosion adhering to or penetrating the wall of the cylinder bore which was in contact with the test seal.

Slight discoloration (staining) or any corrosion or spots away from the contact surface of the test seals shall not be cause for rejection.

7 Test procedures

7.1 Resistance to fluid at elevated temperature — Dimensional test

7.1.1 Apparatus and material

7.1.1.1 Micrometer, shadowgraph, or other suitable apparatus to measure accurately to 0,02 mm.

7.1.1.2 Glass containers, of capacity approximately 250 ± 25 ml and diameter 50 mm, which can be tightly sealed.[1)]

7.1.1.3 Chemical balance, capable of weighing to 1 mg.

7.1.1.4 Oven, uniformly heated, dry air type, conforming to the requirements of ISO 188.

7.1.1.5 Two glass-stoppered weighing bottles, of adequate mouth size to hold the seals under test.

1) Suitable glass containers and tinned steel lids can be obtained from Society of Automotive Engineers, Inc., 400 Commonwealth Drive, Warrendale, Pa. 15096 USA.

7.1.1.6 Alcohol, as referred to for washing purposes in this and following procedures, shall be 95 % (*V*/*V*) reagent grade isopropyl or ethyl alochol.

7.1.2 Test specimens

Two seals shall be used for testing at 70 °C.

7.1.3 Procedure

Rinse the seals in alcohol (see 7.1.1.6) and wipe dry with a clean, lint-free cloth to remove dirt and packing debris. Do not leave the seals in the alcohol for more than 30 s.

Measure the lip and base diameters to the nearest 0,02 mm, taking the average of two readings at right angles to one another. Take care when measuring the diameters before and after ageing that the measurements are made in the same manner and at the same locations.

Determine and record the initial hardness of the test seals. (See 7.7 and figure 5.)

Determine the volume of each seal in the following manner : Weigh the seals in air (m_1) to the nearest 0,001 g and then weigh the seals immersed in distilled water at room temperature (m_2). Quickly dip each specimen in alcohol and then blot dry with filter paper free of lint and foreign material.

Immerse two seals completely in 75 ± 1 ml of compatibility reference fluid as defined in ISO 4926, in a suitable glass container (see 7.1.1.2) and seal the container to prevent vapour loss. Place the container in the oven (7.1.1.3) set at 70 ± 2 °C for a period of 120 ± 2 h. At the end of the heating period, remove the container from the oven and allow the seals to cool in the container at 23 ± 5 °C for 60 to 90 min. At the end of the cooling period, remove the seals from the container and rinse in the alcohol and wipe dry with a clean, lint-free cloth. Do not allow the seals to remain in the alcohol for more than 30 s.

After removal from the alcohol and drying, place each seal in a separate, tared, stoppered weighing bottle and weigh (m_3). Remove each seal from its weighing bottle and weigh immersed in distilled water (m_4) to determine water displacement after hot fluid immersion. Make all weighings to the nearest 0,001 g.

Determine the final volume, dimensions and hardness of each seal within 60 min of rinsing in alcohol.

7.1.4 Expression of results

7.1.4.1 Volume change shall be reported as a percentage of the original volume. The change in volume is given by the formula :

$$\frac{(m_3 - m_4) - (m_1 - m_2)}{(m_1 - m_2)} \times 100$$

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.

7.1.4.2 Dimensional changes

The original measurements of the lip and base diameters shall be subtracted from measurements taken after the test and the differences reported in millimetres and as percentages of the original diameters.

7.1.4.3. Hardness

Change in hardness shall be determined and recorded.

7.1.4.4 Disintegration

The seals shall be examined for disintegration as evidenced by blisters or sloughing.

7.2 Precipitation test

7.2.1 Apparatus

7.2.1.1 Glass containers, of capacity approximately 250 ml and diameter 50 mm which can be tightly sealed.[1)]

7.2.1.2 Cone-shaped centrifuge tube, of capacity 100 ml.

7.2.1.3 Oven, uniformly heated, dry air type conforming to the requirements of ISO 188.

7.2.2 Test specimens

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

7.2.3 Procedure

To determine the precipitation compatibility characteristics of the test seals, place the sample (see 7.2.2) in one of the specified glass containers (see 7.2.1.1) containing 75 ml of compatibility fluid of ISO 4926. Seal the container to prevent vapour loss and place in an oven at 70 ± 2 °C for 120 ± 2 h.

1) Suitable glass containers and tinned steel lids can be obtained from Society of Automotive Engineers, Inc., 400 Commonwealth Drive, Warrendale, Pa. 15096 USA.

(Optional test — A blank test may be run on the brake fluid prior to the test and any sediment from the blank test may be subtracted from the sediment amount obtained from the test.)

At the end of the heating period, remove the container from the oven and allow to cool at room temperature for 24 h, after which remove the seals.

Agitate thoroughly the contents of the jar and transfer the fluid and suspended particles to a cone-shaped centrifuge tube of 100 ml capacity and determine the sediment as described below[1]:

a) Measure a 10 ml sample of the fluid and suspended particles to be tested in each of two clean, dry centrifuge tubes at room temperature. Fill each tube to the 100 ml mark with the naphtha (see caution below) and close tightly with a softened cork (not a rubber stopper). Then invert each tube at least 20 times, allowing the liquid to drain thoroughly from the tapered tip of the tube each time. Place the tubes in a water bath at 32 to 35 °C for 5 min. Momentarily remove the corks to relieve any pressure, and invert each tube again at least 20 times, exactly as before. The success of this method depends to a large degree upon having a thoroughly homogeneous mixture which will drain quickly and completely from the tapered tip when the tube is inverted.

Caution — Naphtha is a flammable liquid. Handle in a well-ventilated area, away from open flames or other sources of ignition. The use of protective gloves and suitable eye protection is recommended.

b) Balance the two centrifuge tubes or pairs of tubes with their respective trunnion cups and place them on opposite sides of the centrifuge head. The whirl them for 10 min at a rate sufficient to produce a relative centrifugal force (rcf) between 600 and 700 at the tips of the whirling tubes. Repeat this operation until the volume of sediment in each tube remains constant for three consecutive readings. In general, not more than four whirlings will be required.

c) Calculation and report

Read the volume of the solid sediment at the bottom of each centrifuge tube, estimating to 0,1 ml or closer if possible. If the two readings differ by not more than 0,1 ml, report the mean of the two as the "Precipitation number". If the two readings differ by more than 0,1 ml, make two more determinations and report the average of the four determinations.

7.3 Wheel cylinder seals heat pressure stroking

7.3.1 Apparatus

7.3.1.1 Oven, uniformly heated, dry air type conforming to the requirements of ISO 188.

7.3.1.2 Actuating stroking fixture, for wheel cylinder seals, designed to provide a 3,8 ± 1,7 mm movement of each piston. During the total movement of the piston the pressure shall increase to 3,5 ± 0,3 MPa. The rate of operation shall be held to a uniform reciprocating motion of 1 000 ± 100 strokes/h. Figure 2 illustrates a recommended pressure (MPa) versus wheel cylinder piston movement curve for wheel cylinders having diameters of 12,7 to 60 mm.

NOTE — A new wheel cylinder assembly must be used for each test.

7.3.2 Test specimens

Two wheel cylinder seals shall be used as test specimens.

7.3.3 Procedure

Rinse the seals in alcohol (see 7.1.1.6) and wipe dry with a clean, lint-free cloth to remove dirt and packing debris. Do not allow the seals to remain in the alcohol for more than 30 s.

Determine the lip diameter to the nearest 0,02 mm, taking the average of two readings at right angles to one another. In the case of double-lip seals, take these measurements after the seal has been assembled on the piston. Determine and record the initial hardness of the test seals in IRHD in accordance with 7.7.

Install the internal parts, which may include among other things seals, piston springs, expanders, etc., in a wheel cylinder of known diameter using compatibility fluid of ISO 4926 as a lubricant. (Boots shall not be used.) Mount the wheel cylinder assembly on the stroking fixture. Fill the system with compatibility fluid conforming to ISO 4926. Bleed all air from the system. Place a sheet of filter paper under each end of the wheel cylinder to catch and determine leakage.

Place the stroking fixture assembly (see 7.3.1.1) and actuate for 120 ± 2 h at 70 ± 2 °C. Shut off the actuating means and the oven heater at the termination of the stroking period with the master cylinder piston in the "off" position to relieve retained pressure in the system.

After a cooling period of 1 h with the oven door open and a ventilating fan on, disconnect the fluid line at the wheel cylinder inlet. Remove the entire stroking test fixture containing the test wheel cylinder from the oven and allow to cool for 22 ± 2 h at room temperature. Immediately after completion of the cooling period, make a careful inspection to check for fluid leaks past the seals and record the results.

Drain the fluid from the system, and remove the seals from the wheel cylinder. Measure double-lip seals before removal from the pistons. Rinse the seals in alcohol and dry with compressed air. Do not allow the seals to remain in the alcohol for more than 30 s.

1) This procedure is taken from ASTM D 91, *Standard test method for precipitation number of lubricating oils*, to which reference should be made for description of apparatus or terms used.

Inspect seals for scoring, scuffing, blistering, cracking, chipping (heel abrasion), and change in shape from original appearance. Inspect cylinder parts, recording any pitting on piston and cylinder walls. Determine and record the change in hardness in IRHD in accordance with 7.7.

Measure the lip diameter of each seal within 30 to 60 min after removal from the wheel cylinder and report the difference between the actual cylinder bore and the lip diameter after the test (see table 2 for allowable lip diameter change).

7.4 Master cylinder seals heat pressure stroking

7.4.1 Apparatus

7.4.1.1 Oven, uniformly heated, dry air type conforming to the requirements of ISO 188.

NOTE — When strip heaters are used, they shall be placed not less than 150 mm from the cylinder on test, but shall be shielded to prevent direct radiation to any cylinder.

7.4.1.2 Actuating stroking machine, for master cylinder seals, consisting of a suitable means for actuating the master cylinder containing the test specimens at the rate of 0,28 ± 0,03 stroke/s (1 000 ± 100 strokes/h). The total piston movement shall be sufficient to cover approximately 90 % of the total available stroke.

All master cylinders having a total stroke of 63 mm or more shall be heat pressure stroke tested at 90 % of the 63 mm stroke, or 57 mm. The rate of stroking shall be 0,22 ± 0,02 stroke/s (800 ± 80 strokes/h). Full pressure 3,5 ± 0,3 MPa shall be attained.

Figure 1 illustrates a recommended master cylinder seal stroking apparatus. Figure 3 illustrates a recommended pressure (MPa) versus master cylinder piston movement curve obtained with three wheel cylinders of approximately 22 mm diameter mounted in the three stroking fixtures shown in figure 1 actuated by a 25 mm diameter master cylinder. The total stroke of such a master cylinder shall be 25 ± 0,4 mm. The initial movement of approximately 14 to 15 mm shall be at a rate providing a gradual buildup of pressure, not exceeding 1 MPa. This shall permit the primary seal to pass over the compensating port at a low pressure. The balance of the stroke shall provide a gradual buildup of pressure to 3,5 ± 0,3 MPa during the last 1,6 to 3,2 mm of the stroke.

The master cylinder shall be located in the oven (see 7.4.1.1) and the fluid temperature in the master cylinder reservoir shall be maintained at 70 ± 2 °C.

NOTE — A new master cylinder shall be used for each test. It is recommended that at least 0,05 to 0,13 mm clearance be allowed between the master cylinder piston and the master cylinder bore when conducting a master cylinder stroking test.

7.4.2 Test specimens

One primary and one secondary seals shall be used for test specimens.

7.4.3 Procedure

Rinse the seals in alcohol (see 7.1.1.6) and wipe dry with a clean, lint-free cloth to remove dirt and packing debris. Do not allow the seals to remain in the alcohol for more than 30 s.

Determine and record the initial hardness of the test seals in IRHD in accordance with 7.7. Measure the lip diameter of the primary and secondary seals and record to the nearest 0,02 mm, taking the average of two readings at right angles to one another. Measure the lip diameter of the secondary seal after the seal has been assembled on the piston.

Dip the seals and master cylinder internal parts in compatibility fluid of ISO 4926 and coat the cylinder walls with the same fluid before assembly. Fill the system with compatibility fluid conforming to ISO 4926. Bleed all air from the system.

Operate the master cylinder assembly after installation in the oven (see 7.4.1.1) for 120 ± 2 h at the rate of 1 000 ± 100 strokes/h at a temperature of 70 ± 2 °C as described in 7.4.1. After allowing excess fluid to evaporate, place a sheet of filter paper under the secondary seal of the master cylinder to catch and determine leakage past the secondary seal. Shut off the heat and actuating means at the termination of the stroking period with the master cylinder in the "off" position to relieve retained pressure in the master cylinder.

After a cooling period of 1 h with the oven door open and the ventilating fan on, disconnect the fluid line at the master cylinder outlet. Remove the master cylinder from the oven and allow to cool for 22 ± 2 h. Immediately after completion of the cooling period, make a careful inspection to check fluid leakage past the master cylinder secondary seal.

Drain the fluid from the master cylinder. Remove the primary seal from the cylinder, rinse with alcohol (see 7.1.1.6) and dry with compressed air. Rinse the secondary seal on the piston in alcohol (see 7.1.1.6) dry with compressed air and measure the lip diameter within 30 to 60 min after removal from the cylinder and before removal from the piston. Do not allow seals to remain in the alcohol for more than 30 s.

Inspect seals for deterioration such as scoring, scuffing, blistering, cracking, chipping (heel abrasion) and change in shape from original appearance. Inspect cylinder parts, recording any pitting on piston or cylinder walls. Measure the lip diameter of the primary seal within 30 to 60 min after removal from the cylinder and determine the difference between the actual cylinder bore and the lip diameter after the test and record the difference for both primary and secondary seals.

Determine and record the change in hardness in IRHD in accordance with 7.7.

7.5 Low-temperature performance

7.5.1 Leakage

7.5.1.1 Apparatus

7.5.1.1.1 Cold chamber, large enough to permit arrangement of the test apparatus within and to permit the operator to check and operate the apparatus without removal from the chamber.

7.5.1.1.2 Master cylinder and wheel cylinder, so connected that their operation closely approximates the brake system in actual service. The apparatus shown in figure 4 has been found to be satisfactory. The cylinder bore containing the test seals shall meet the dimensional limitations and bore finish requirements specified by the manufacturer.

7.5.1.1.3 Retractor spring, such as to require a line pressure of not more than 0,35 MPa to make a complete stroke at room temperature.

7.5.1.2 Test specimens

Two wheel cylinder seals and one primary and one secondary master cylinder seal shall be used for test seals.

7.5.1.3 Procedure

Rince the test seals in alcohol (see 7.1.1.6) and wipe dry with clean, lint-free cloth. Do not allow the seals to remain in the alcohol for more than 30 s. Assemble the test seals in the test cylinder. During the assembly of the cylinder, coat the cylinder walls with compatibility fluid of ISO 4926. Dip the seals and internal parts of the cylinders in the same compatibility fluid.

Install the wheel and master cylinder assembly containing the test seals on the test apparatus in the cold chamber. Fill the system with test fluid and bleed all air from the system. Do not use boots. Place a sheet of filter paper under the wheel and master cylinders to catch and determine leakage.

Enclose the complete actuating system in the cold chamber and subject to a temperature of −43 to −40 °C for 120 ± 2 h. Maintain the piston and seals in a static position during the first 72 ± 2 h of the test and thereafter actuate the cylinders for 6 strokes at 0,7 MPa and 6 strokes at 3,5 MPa each 24 h (after 72, 96, 120 ± 2 h). The strokes shall be approximately 1 min apart, and the piston shall return to the stop after each stroke. No leakage shall occur during the 120 h test period.

7.5.2 Bend test

7.5.2.1 Test specimen

One seal shall be used.

7.5.2.2 Procedure

Bend the test seal, after it has been maintained for 120 ± 2 h at −43 to −40 °C, between the thumb and finger through an angle of approximately 90° and release immediately. (Bend the cold seal while in the cold chamber and handle it with gloved hands to prevent warming from body heat.) Within 1 min, examine the test seal for cracking and change in shape from the original form.

7.6 Oven ageing

7.6.1 Apparatus

Oven, uniformly heated, dry air type conforming to the requirements of ISO 188.

7.6.2 Test specimens

Two seals shall be used.

7.6.3 Procedure

Rinse two test seals in alcohol (see 7.1.1.6) and wipe dry with a clean, lint-free cloth to remove dirt and packing debris. Do not allow the seals to remain in the alcohol for more than 30 s.

Determine and record the hardness of the seals in IRHD in accordance with 7.7.

Place the two test seals in the oven (see 7.6.1), and subject to hot air heating at 70 ± 2 °C for 120 ± 2 h. 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.

Inspect the seals for blistering, or change in shape from original form. Determine and record the hardness after ageing.

7.7 Hardness determination

7.7.1 Apparatus

7.7.1.1 See ISO 48.

7.7.1.2 Use a rubber anvil or cylinder having a hardness within 5 IRHD of the hardness of the seals being tested. See figure 5 for two possible types of anvil. Others may be needed for other shapes of seals. The anvil thickness must be sufficient to meet the requirements of the ISO 48 test.

7.7.2 Procedure

The hardness of the seal shall be determined in accordance with ISO 48, using an anvil such as illustrated in figure 5. The hardness tester shall be applied to the seal in such a way as to ensure full contact between the seal and the face of the supporting anvil. The same operator shall make all hardness determinations for any one test.

7.8 Corrosion test

7.8.1 Apparatus

7.8.1.1 Oven, as in 7.3.1.1.

7.8.1.2 Centrifuge, as prescribed in 7.2.3.

7.8.1.3 Chemical balance, capable of weighing to 0,1 mg.