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Road vehicles — Petroleum-based brake-fluid for stored-energy hydraulic brakes

*Véhicules routiers — Liquide de frein à base pétrolière pour dispositifs de freinage à centrale
hydraulique*

Reference number
ISO 7308:1987 (E)

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.

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. They are approved in accordance with ISO procedures requiring at least 75 % approval by the member bodies voting.

International Standard ISO 7308 was prepared by Technical Committee ISO/TC 22, *Road vehicles*.

Users should note that all International Standards undergo revision from time to time and that any reference made herein to any other International Standard implies its latest edition, unless otherwise stated.

Contents

	Page
1 Scope	1
2 Field of application	1
3 References	1
4 Definition	1
5 Materials	1
6 Requirements	1
6.1 Boiling point	1
6.2 Viscosity	2
6.3 Water content	2
6.4 Fluidity and appearance at low temperatures	2
6.5 Hygroscopicity	2
6.6 Foaming	2
6.7 Compatibility	2
6.8 Effect on rubber	2
6.9 Performance under simulated service	2
6.10 Corrosion	3
6.11 Shear stability	3
6.12 Anti-wear stability	3
7 Test methods	3
7.1 Boiling point	3
7.2 Viscosity	3
7.3 Water content	3
7.4 Fluidity and appearance at low temperatures	3
7.5 Hygroscopicity	3
7.6 Foaming	4

7.7	Compatibility	4
7.8	Effect on rubber	4
7.9	Performance under simulated service	5
7.10	Corrosion	8
7.11	Shear stability	10
7.12	Anti-wear properties	10

Annexes

A	Acrylonitrile-butadiene rubber (NBR) brake cups to test brake-fluid complying with ISO 7308	11
B	Hiding power chart	15
C	Mixed formulae and basic mechanical characteristics of the rubber used for tests simulating the effect on rubber	16
D	Assembly of metal strips for corrosion test in brake-fluids used for full-power hydraulic systems with pump	17
E	Chemical composition of metal pieces for corrosion test	19
F	Specifications of balls used in tests carried out with the four-ball machine, for anti-wear properties	20

Road vehicles — Petroleum-based brake-fluid for stored-energy hydraulic brakes

1 Scope

This International Standard lays down the characteristics and test methods for petroleum-based brake-fluids used in the hydraulic brake systems of road vehicles.

2 Field of application

The brake-fluid specified in this International Standard is for use in road vehicle hydraulic brake systems equipped with synthetic rubber cups and seals (butadiene-acrylonitrile copolymer or equivalent).

It is for use in hydraulic brake systems equipped with a pump; it may also be used in other systems without a pump. This brake-fluid is not intended for use under arctic conditions.

3 References

ISO 37, *Rubber, vulcanized — Determination of tensile stress-strain properties.*

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

ISO 1817, *Rubber, vulcanized — Determination of the effect of liquids.*

ISO 2235, *Abrasive sheets — Designation, dimensions and tolerances.*

ISO 3104, *Petroleum products — Transparent and opaque liquids — Determination of kinematic viscosity and calculation of dynamic viscosity.*

ISO 3405, *Petroleum products — Determination of distillation characteristics.*

ISO 7309, *Road vehicles — Hydraulic braking systems — ISO reference petroleum base fluid.*

ASTM D 91, *Test for precipitation number of lubricating oils.*

ASTM D 892, *Test for foaming characteristics of lubricating oil.*

ASTM D 974, *Test for neutralization number by color-indicator titration.*

ASTM D 1744, *Test for water in liquid petroleum products by Karl Fischer reagent.*

ASTM D 2266, *Test for wear preventive characteristics of lubricating grease (four-ball method).*

ASTM D 2603, *Test for shear stability of lubricating oils containing polymers using an injector rig.*

ASTM D 3182, *Recommended practice for rubber — Materials, equipment and procedures for mixing standard compounds and preparing standard vulcanized sheets.*

4 Definition

For the purposes of this International Standard, the following definition applies.

stored-energy hydraulic brakes: Braking system where energy is supplied by a hydraulic fluid under pressure, stored in one or more accumulator(s), fed from one or more pressure pump(s) each fitted with a means of limiting the pressure to a maximum value. This value shall be specified by the manufacturer.

5 Materials

The quality of the materials used shall be such that the resulting product will conform to the requirements of this International Standard and ensure uniform characteristics. The fluid shall be green in colour. On visual inspection, the fluid shall be clear and free of suspended matter, dirt and sediment.

6 Requirements

6.1 Boiling point

Brake-fluid when tested by the procedure specified in 7.1 shall have a minimum boiling point of 235 °C.

When tested by the same method, the temperature corresponding to 10 % of condensate shall be at least 250 °C.

6.2 Viscosity

Brake-fluid when tested by the procedure specified in 7.2 shall have the kinematic viscosities specified in 6.2.1 and 6.2.2.

6.2.1 At -40 °C

Not more than 2 000 mm²/s (2 000 cSt).

6.2.2 At 100 °C

Not less than 6 mm²/s (6 cSt).

6.3 Water content

Brake-fluid when tested by the procedure specified in 7.3 shall have a water content of 0,005 % or less.

6.4 Fluidity and appearance at low temperatures

6.4.1 At -40 °C

When brake-fluid is tested by the procedure specified in 7.4.1, the black contrast lines on the hiding power chart shall be clearly discernible when viewed through the fluid in the sample bottle. The fluid shall show no stratification or sedimentation and, upon turning the sample bottle upside down, the air bubble shall reach the fluid surface in not more than 10 s.

6.4.2 At -50 °C

When brake-fluid is tested by the procedure specified in 7.4.2, the black contrast lines on the hiding power chart shall be clearly discernible when viewed through the fluid in the sample bottle. The fluid shall show no stratification or sedimentation and, upon turning the sample bottle upside down, the air bubble shall reach the fluid surface in not more than 35 s.

6.5 Hygroscopicity

When brake-fluid is tested by the procedure specified in 7.5, the increase in mass of the sample shall be below 0,1 %.

6.6 Foaming

When brake-fluid is tested by the procedure specified in 7.6, the foaming tendency, reported in millilitres, shall be

- at 24 °C: 100 max.
- at 93 °C: 200 max.
- at 24 °C (after test at 93 °C): 100 max.

The complete absence of foam after blowing, reported in minutes, shall be

- at 24 °C: 2 max.
- at 93 °C: 2 max.
- at 24 °C (after test at 93 °C): 2 max.

6.7 Compatibility

6.7.1 At -40 °C

When brake-fluid is tested by the procedure specified in 7.7.1, the black contrast lines on the hiding power chart shall be clearly discernible when viewed through the fluid in the centrifuge tube.

The fluid shall show no stratification or sedimentation.

6.7.2 At 60 °C

When brake-fluid is tested by the procedure specified in 7.7.2, the fluid shall show no stratification, and sedimentation shall not exceed 0,05 % (V/V) after centrifuging.

6.8 Effect on rubber

Brake-fluid, when tested by the procedure specified in 7.8, shall not show changes of characteristics greater than the values given in table 1.

Table 1 — Rubber characteristics changes

Rubber	Hardness change IRHD	Volume change %
Polychloroprene	0 to -10 max.	0 to +10
Butadiene-acrylonitrile	+3 to -5 max.	0 to +10

6.9 Performance under simulated service

Brake-fluid, when tested by the procedure specified in 7.9, shall meet the performance requirements specified in 6.9.1 and 6.9.10.

6.9.1 Metal parts shall not show corrosion as evidenced by pitting to an extent discernible to the naked eye; staining or discoloration is permitted.

6.9.2 The initial diameter of any cylinder or piston shall not change by more than 0,13 mm during test.

6.9.3 Rubber cups shall not decrease in hardness by more than 15 IHRD and shall not reach unsatisfactory operating condition as evidenced by excessive scoring, scuffing, blistering, cracking, chipping (heel abrasion), or change in shape.

6.9.4 The base diameter of the rubber cups shall not increase by more than 0,9 mm.

6.9.5 The average lip diameter interference set of all the rubber cups in the test shall not be greater than 65 %.

6.9.6 During any period of 24 000 strokes, the volume loss of fluid shall not exceed 36 ml.

6.9.7 The cylinder pistons shall not seize or function improperly throughout the test.

6.9.8 During the last 100 strokes at the end of the test, the volume loss of fluid shall not exceed 36 ml.

6.9.9 The fluid at the end of the test shall not be in an unsatisfactory operating condition as evidenced by sludge, gel or abrasive grittiness, and sedimentation shall not exceed 1,5 % (V/V) after centrifuging.

6.9.10 No more than a trace of gum shall be deposited on brake cylinder walls or other metal parts during the test. The brake cylinders shall be free of deposits which are abrasive or which cannot be removed when rubbed with a cloth wetted with white spirit.

6.10 Corrosion

Brake-fluid, when tested by the procedure specified in 7.10, shall not cause corrosion exceeding the limits shown in table 2. Apart from the area where the metal strips are in contact, they shall be neither pitted nor roughened to an extent discernible to the naked eye; staining or discoloration is permitted.

Table 2 — Corrosion test strips and mass changes

Test strips*	Test metal — ISO designation	Maximum permissible mass change mg/cm ² of surface area
Electrolytic copper	Cu-DLP	± 0,05
Brass	CuZn39Pb1	± 0,05
Bronze	CuSn8P	± 0,05
Steel	C 35	± 0,05
Steel	Type 4	± 0,05
Cast iron	Ft 20	± 0,05
Zinc alloy	ZnAl4	± 0,05
Aluminium	AlMg1SiCu	± 0,05

* See annexes D and E.

The fluid at the end of the test shall show no jelling at 23 ± 5 °C. No crystalline deposit shall form and adhere to either the glass jar walls or the surface of the metal strips. The fluid shall not contain more than 0,10 % (V/V) sediment.

The neutralization index measured by the method specified in ASTM D 974 shall not change by more than ± 1 mg of potassium hydroxide (KOH) per gram.

The rubber samples at the end of the test shall show no disintegration, as evidenced by blisters or sloughing indicated by carbon black separation on the surface of the rubber.

6.11 Shear stability

When tested by the method specified in 7.11, the decrease in viscosity of the fluid at 100 °C, measured according to the method described in 7.2, shall not exceed 0,5 mm²/s.

6.12 Anti-wear stability

When tested by the method specified in 7.12, the brake-fluid shall not produce a scar greater than 1 mm in diameter.

7 Test methods

7.1 Boiling point

Determine the boiling point of the fluid as the temperature of initial boiling according to the method in ISO 3405.

7.2 Viscosity

Determine the kinematic viscosity according to the method in ISO 3104.

7.3 Water content

The water content shall be measured in accordance with ASTM D 1744 (method of direct titration by potentiometer known as the Karl Fischer method).

7.4 Fluidity and appearance at low temperatures

7.4.1 At -40 °C

Place 100 ml of fluid in a glass sample bottle of approximately 125 ml capacity, an outside diameter of $37 \pm 0,5$ mm and an overall height of $165 \pm 2,5$ mm. Cork the bottle and place it in a cold bath maintained at -40 ± 2 °C for 144 ± 4 h.

Remove the bottle from the bath, quickly wipe it with a clean, lint-free cloth wetted with ethanol or acetone, and determine the transparency of the fluid by holding the bottle against a hiding power chart (see annex B) and observing the clarity of the contrast lines on the chart when viewed thorough the fluid. Examine the fluid for evidence of stratification and sedimentation. Turn the bottle upside down and determine the number of seconds required for the air bubble to reach the fluid surface.

7.4.2 At -50 °C

Place 100 ml of fluid in a glass sample bottle of approximately 125 ml capacity, an outside diameter of $37 \pm 0,5$ mm and an overall height of $165 \pm 2,5$ mm. Cork the bottle and place it in a cold bath maintained at -50 ± 2 °C for $6 \pm 0,2$ h.

Remove the bottle from the bath, quickly wipe it with a clean, lint-free cloth wetted with ethanol or acetone, and determine the transparency of the fluid by holding the bottle against a hiding power chart and observing the clarity of the contrast lines on the chart when viewed through the fluid. Examine the fluid for evidence of stratification or sedimentation. Turn the bottle upside down and determine the number of seconds required for the air bubble to reach the fluid surface.

7.5 Hygroscopicity

7.5.1 Apparatus

7.5.1.1 Desiccator, in borosilicate glass with a cover fitted with a ground glass tap and porcelain disc as shown in figure 1.

7.5.1.2 Crystallization dish, in borosilicate glass as shown in figure 1.

7.5.1.3 Oven that can be kept at 50 ± 1 °C.

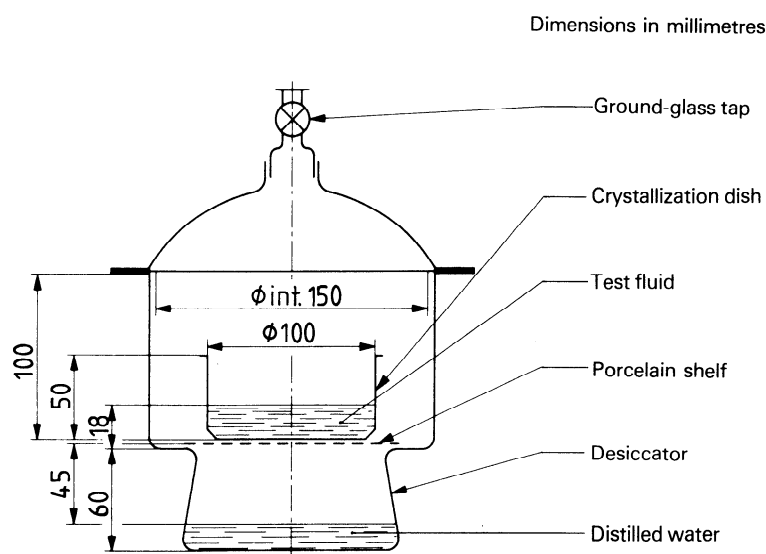


Figure 1 – Hygroscopicity apparatus

7.5.2 Method

Pour 150 ml of distilled water into the bottom of the desiccator (7.5.1.1). For each test, replace the distilled water.

Place the desiccator in the oven (7.5.1.3) at 50 ± 1 °C, for 2 h.

Weigh the crystallization dish (7.5.1.2) within 1 mg.

Pour approximately 100 g of fluid weighed to the nearest 1 mg into the crystallization dish. This operation shall be carried out rapidly and immediately before putting the crystallization dish in the desiccator.

Quickly put the crystallization dish in the desiccator and put the whole unit in the oven set at 50 ± 1 °C, for 16 h.

Remove the desiccator crystallization dish unit from the oven, leaving the crystallization dish in the desiccator and cover with a watch-glass to prevent drops of condensed water falling in.

After leaving for 4 to 8 h, remove the crystallization dish, wipe the outside with a dry cloth and reweigh immediately to within 1 mg.

Calculate the percentage increase in mass.

7.6 Foaming

The foaming test is conducted according to ASTM D 892.

7.7 Compatibility

7.7.1 At -40 °C

Mix 50 ml of the fluid to be tested with 50 ml of the ISO reference fluid (see ISO 7309) and pour this mixture into a cone-shaped centrifuge tube which is then corked. Place the

centrifuge tube in a bath maintained at -40 ± 2 °C, for 22 ± 2 h. Remove the centrifuge tube from the bath, quickly wipe it with a clean, lint-free cloth wetted with ethanol or acetone, and determine the transparency of the fluid by holding the tube against a hiding power chart and observing the clarity of the contrast lines on the chart when viewed through the fluid. Examine the fluid for stratification and sedimentation.

7.7.2 At -60 °C

Put the centrifuge tube (see 7.7.1) in an oven maintained at 60 ± 2 °C, for 22 ± 2 h. Remove the tube from the oven and immediately examine the contents for evidence of stratification. Determine the percentage sediment by volume as described in ASTM D 91.

7.8 Effect on rubber

Use standard vulcanized sheets of polychloroprene and butadiene-acrylonitrile meeting the specifications given in annexes A and C.

7.8.1 Test strip sampling

From sheets of 2 mm thickness corresponding to the elastomers given in table 1, cut out two test strips B as given in ISO 1817.

7.8.2 Apparatus and method

The apparatus and the method are those described in ISO 1817 (case of rubber after immersion).

7.8.3 Test conditions

See table 3.