INTERNATIONAL STANDARD

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Second edition
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Road vehicles — Specification of non-petroleum-base brake fluids for hydraulic systems

Véhicules routiers — Spécifications pour liquides de frein à base non pétrolière pour systèmes hydrauliques

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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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. 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.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 4925 was prepared by Technical Committee ISO/TC 22, *Road vehicles*, Subcommittee SC 2, *Braking systems and equipment*.

This second edition cancels and replaces the first edition (ISO 4925:1978), which has been technically revised.

Introduction

The specifications for fluids given in this International Standard incorporate a range of performance standards in use throughout the world at the time of publication. The classes include fluids technically equivalent to those designated DOT 3, DOT 4 and DOT 5.1.

The major use of these fluids is in the hydraulic brake and clutch systems of road vehicles, but they can also be used in any suitable hydraulic system.

Road vehicles — Specification of non-petroleum-base brake fluids for hydraulic systems

1 Scope

This International Standard gives the specifications — requirements and test methods — for non-petroleum-base fluids used in road-vehicle hydraulic brake and clutch systems that are designed for use with such fluids and equipped with seals, cups or double-lipped type gland seals made of styrene-butadiene rubber (SBR) and ethylene-propylene elastomer (EPDM).

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 37:1994, *Rubber, vulcanized or thermoplastic — Determination of tensile stress-strain properties*

ISO 48:1994, *Rubber, vulcanized or thermoplastic — Determination of hardness (hardness between 10 IRHD and 100 IRHD)*

ISO 812:1991, *Rubber, vulcanized — Determination of low-temperature brittleness*

ISO 815:1991, *Rubber, vulcanized or thermoplastic — Determination of compression set at ambient, elevated or low temperatures*

ISO 3104:1994, *Petroleum products — Transparent and opaque liquids — Determination of kinematic viscosity and calculation of dynamic viscosity*

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

ASTM D 91, *Standard test method for precipitation number of lubricating oils*

ASTM E 298, *Standard test methods for assay of organic peroxides*

ASTM D 395, *Standard test methods for rubber property — Compression set*

ASTM D 412, *Standard test methods for vulcanized rubber and thermoplastic elastomers — Tension*

ASTM D 664, *Standard test method for acid number of petroleum products by potentiometric titration*

ASTM D 746, *Standard test method for brittleness temperature of plastics and elastomers by impact*

ASTM D 865, *Test method for rubber — Deterioration by heating in air (test tube enclosure)*

ASTM D 1120, *Standard test method for boiling point of engine coolants*

ASTM D 1123, *Standard test method for water in engine coolant concentrate by the Fisher reagent method*

ASTM D 1209, *Standard test method for colour of clear liquids (platinum-cobalt scale)*

ASTM D 1364, *Standard test method for water in volatile solvents (Karl Fischer reagent titration method)*

ASTM D 1415, *Standard test method for rubber property — International hardness*

ASTM D 1613, *Standard test method for acidity in volatile solvents and chemical intermediates used in paint, varnish, lacquer and related products*

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

SAE J 1703, *Motor vehicle brake fluid*

3 Materials

On visual inspection, the fluid shall be clear and free of suspended matter, dirt and sediment. The quality of the materials used shall be such that the resulting product conforms to the requirements of this International Standard and that uniformity of performance is ensured. Fluids may be dyed, provided no confusion is possible between them and other types of fluids.

4 Specifications

The product shall meet the requirements for the appropriate class in accordance with Table 1, using the test methods according to Clause 5.

NOTE It is intended that a stroking test be added to a future revision of this International Standard.

Table 1 — Brake fluid specifications — Tests and requirements

Test method (subclause)	Test description		Unit	Requirement(s)			
				Class 3	Class 4	Class 5-1	Class 6
5.1	Viscosity						
		at – 40 °C	mm^2/s	⩽ 1 500		⩽ 900	⩽ 750
		at 100 °C	mm^2/s	⩾ 1,5			
5.2	Equilibrium reflux boiling point (ERBP)		°C	⩾ 205	⩾ 230	⩾ 260	⩾ 250
5.2.6		Wet ERBP	°C	⩾ 140	⩾ 155	⩾ 180	⩾ 165
5.3	pH		—	7 to 11,5			
5.4	Fluid stability						
5.4.1		High-temperature stability	°C	± 5 °C			
5.4.2		Chemical stability	°C	± 5 °C			

Table 1 — Brake fluid specifications — Tests and requirements (*continued*)

Test method (subclause)	Test description	Unit	Requirement(s)			
			Class 3	Class 4	Class 5-1	Class 6
5.5	Corrosion					
	Metal strip characteristics after testing					
	Mass change					
	Tinned iron	mg/cm^2	– 0,2 to 0,2			
	Steel	mg/cm^2	– 0,2 to 0,2			
	Aluminium	mg/cm^2	– 0,1 to 0,1			
	Cast iron	mg/cm^2	– 0,2 to 0,2			
	Brass	mg/cm^2	– 0,4 to 0,4			
	Copper	mg/cm^2	– 0,4 to 0,4			
	Aspect	—	No pitting or roughness outside contact area			
	Staining/discoloration	—	Permitted			
	Liquid characteristics after testing					
	Aspect	—	No gel, none adhering crystals			
	pH	—	7 to 11,5			
	Sediment	% vol.	⩽ 0,1			
	Rubber cup characteristics after testing					
	Blisters or carbon black separation at surface	—	None			
	Hardness decrease	IRHD	⩽ 15			
	Base diameter increase	mm	⩽ 1,4			
	Volume increase	%	⩽ 16			
5.6	Fluidity and appearance at low temperatures					
5.6.1	at – 40 °C for 144 h					
	Aspect	—	Clear and homogeneous			
	Bubble flow time	s	⩽ 10			
	Sediments	—	Absence			
5.6.2	at – 50 °C for 6 h					
	Aspect	—	Clear and homogeneous			
	Bubble flow time	s	⩽ 35			
	Sediments	—	Absence			

Table 1 — Brake fluid specifications — Tests and requirements *(continued)*

Test method (subclause)	Test description	Unit	Requirement(s)			
			Class 3	Class 4	Class 5-1	Class 6
5.7	Water tolerance					
5.7.1	at – 40 °C for 22 h					
	Aspect	—	Clear and homogeneous			
	Bubble flow time	s	⩽ 10			
	Sediments	—	Absence			
5.7.2	at 60 °C for 22 h					
	Aspect	—	Clear and homogeneous			
	Sediments	% vol.	⩽ 0,05			
5.8	Compatibility/miscibility with ISO 4926 fluid					
5.8.1	at – 40 °C for 22 h					
	Aspect	—	Clear and homogeneous			
	Sediments	—	Absence			
5.8.2	at – 60 °C for 22 h					
	Aspect	—	Clear and homogeneous			
	Sediments	% vol.	⩽ 0,05			
5.9	Resistance to oxidation					
	Metal strip aspect	—	No pitting or roughness no more than a trace of gum			
	Staining/discoloration	—	Permitted			
	Mass change of aluminium strip	mg/cm^2	– 0,05 to + 0,05			
	Mass change of cast iron strip	mg/cm^2	– 0,3 to + 0,3			
5.10	Effect on rubber					
5.10.2.1	Styrene Butadiene Rubber (SBR)					
	at 120 °C					
	Cup diameter increase	mm	0,15 to 1,4			
	Hardness change	IRHD	– 15 to 0			
	Volume increase	%	1 to 16			
	Blisters or carbon black separation at surface	—	None			
5.10.2.2	Ethylene Propylene Diene Monomer (EPDM)					
	at 120 °C					
	Hardness change	IRHD	– 15 to 0			
	Volume change	%	0 to 10			
	Blisters or carbon black separation at surface	—	None			

NOTE It is intended that a stroking test be added to a future revision of this International Standard.

5 Test methods

5.1 Viscosity

5.1.1 General

Determine the kinematic viscosity of the fluid in accordance with ISO 3104.

Report the viscosity to the nearest 1 mm^2/s at – 40 °C and to the nearest 0,01 mm^2/s at + 100 °C. Duplicate runs that agree within 1,2 % relative are acceptable for averaging (95 % confidence level).

5.1.2 Repeatability (single analyst)

The coefficient of variation of results (each the average of duplicates) obtained by the same analyst on different days shall not be greater than 0,4 % at 47 degrees of freedom. Two such values shall be considered unacceptable (95 % confidence level) if they differ by more than 1,2 %.

5.1.3 Reproducibility (multi-laboratory)

The coefficient of variation of results (each the average of duplicates) obtained by analysts in different laboratories shall not be greater than 1,0 % at 15 degrees of freedom. Two such values shall be considered unacceptable (95 % confidence level) if they differ by more than 3,0 %.

5.2 Equilibrium reflux boiling point (ERBP)

5.2.1 General

Determine the ERBP of the fluid in accordance with ASTM D 1120[1], but with the following changes to the procedure and to the apparatus (see Figures 1 and 2).

— Thermometer: immersion shall be 76 mm and the thermometer shall be calibrated.

— Heat source: use either a suitable variac-controlled heating mantle designed to fit the flask, or an electric heater with rheostat heat control.

5.2.2 Preparation of apparatus

Thoroughly clean and dry all glassware before use. Attach the flask to the condenser. When using a heating mantle, place the mantle under the flask and support it with a suitable ring clamp and laboratory-type stand, holding the whole assembly in place by a clamp. When using a rheostat controlled heater, centre a standard porcelain or other suitable refractory having a diameter opening of 32 mm to 38 mm over the heating element of the electric heater and mount the flask on the refractory so that direct heat is applied to the flask only through the opening in the refractory. Place the whole assembly in an area free from draughts or other causes of sudden temperature changes.

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1) Boiling chips for use with ASTM D 1120 can be obtained from Electro Minerals Co. (US) Inc, PO Box 423, Niagara Falls, NY 14302, USA, or from the Society of Automotive Engineers (SAE), 400 Commonwealth Drive, Warrendale Pa 15096, USA (RM-75).

This information is given for the convenience of users of this International Standard and does not constitute an endorsement by ISO of the product named. Equivalent products may be used if they can be shown to lead to the same results.

5.2.3 Test procedure

Turn on the condenser water and apply heat to the flask at such a rate that the fluid is refluxing within (10 ± 2) min at a rate higher than one drop per second. The reflux rate shall not exceed five drops per second. Immediately adjust the heat input to obtain a specified equilibrium reflux rate of one drop per second to two drops per second over the next (5 ± 2) min period. Maintain a timed and constant equilibrium reflux rate of one drop per second to two drops per second for an additional 2 min; record the average value of four temperature readings taken at 30 s intervals at the equilibrium reflux boiling point.

Report the boiling point to the nearest degree Celsius. Duplicate results that agree within 3 °C are acceptable for averages (95 % confidence level).

5.2.4 Repeatability (single analyst)

The standard deviation of results (each the average of duplicates), obtained by the same analyst on different days shall not be greater than 1,3 °C at 34 degrees of freedom. Two such values shall be considered unacceptable (95 % confidence level) if they differ by more than 4 °C.

5.2.5 Reproducibility (multi-laboratory)

The standard deviation of results (each the average of duplicates), obtained by analysts in different laboratories, shall be not greater than 3,5 °C at 15 degrees of freedom. Two such values shall be considered unacceptable (95 % confidence level) if they differ by more than 10,5 °C.

5.2.6 Wet ERBP test

5.2.6.1 Apparatus

5.2.6.1.1 Two corrosion test jars or equivalent screw-top, straight-sided, round glass jars each having a capacity of about 475 ml and approximate inner dimensions of 100 mm height by 75 mm diameter, with matching lids having new, clean inserts providing water-proof and vapour-proof seals[2)].

5.2.6.1.2 Desiccator and cover: bowl-form glass desiccator with 250 mm inside diameter, having a matching tubulated cover fitted with a No. 8 rubber stopper (see Figure 3).

5.2.6.1.3 Desiccator plate of 230 mm diameter, perforated porcelain desiccator plate, without feet, glazed on one side (No.18 or equivalent)[3)].

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2) Suitable corrosion test jars (RM-49) and tinned steel lids (RM-63) can be obtained from the Society of Automotive Engineers (SAE), 400 Commonwealth Drive, Warrendale, Pa 15096, USA.

3) Desiccator plates (No. 08-641C) can be obtained from Fischer Scientific, Springfield, New Jersey, USA or CeramTec AG (No. 602786), Glaswerk Wertheim KG (No. 911743431) or equivalents, according to DIN/ISO 12911, diameter 235 mm.

This information is given for the convenience of users of this International Standard and does not constitute an endorsement by ISO of the product named. Equivalent products may be used if they can be shown to lead to the same results.