INTERNATIONAL STANDARD

ISO 12922

First edition
1999-10-15

Lubricants, industrial oils and related products (class L) — Family H (Hydraulic systems) — Specifications for categories HFAE, HFAS, HFB, HFC, HFDR and HFDU

Lubrifiants, huiles industrielles et produits connexes (classe L) — Famille H (Systèmes hydrauliques) — Spécifications applicables aux catégories HFAE, HFAS, HFB, HFC, HFDR et HFDU

Reference number
ISO 12922:1999(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. 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 3.

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 12922 was prepared by Technical Committee ISO/TC 28, *Petroleum products and lubricants,* Subcommittee SC 4, *Classifications and specifications,* Working Group WG 3, *Classification and specifications of hydraulic fluids,* which is a joint working group with TC 131, *Fluid power systems.*

Annex A forms a normative part of this International Standard. Annex B is for information only.

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Printed in Switzerland

Lubricants, industrial oils and related products (class L) — Family H (Hydraulic systems) — Specifications for categories HFAE, HFAS, HFB, HFC, HFDR and HFDU

WARNING — The handling and use of products as specified in this International Standard may be hazardous if suitable precautions are not observed. This International Standard does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of this International Standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

1 Scope

This International Standard specifies the requirements of fire-resistant hydraulic fluids for hydrostatic and hydrodynamic hydraulic systems in general industrial applications. It is not intended for use in aerospace or power generation applications, where different requirements apply. It provides guidance for suppliers and end users of fire-resistant hydraulic fluids and also direction for equipment manufacturers of hydraulic systems.

This International Standard is written in a general form so that its application can accommodate various climatic conditions throughout the world. It also stipulates the requirements of fire-resistant hydraulic fluids at the time of delivery.

ISO 6743-4 establishes the classification of fluids used in hydraulic applications. Of the categories covered by ISO 6743-4, only the following are detailed in this specification: HFAE, HFAS, HFB, HFC, HFDR and HFDU.

NOTE For the purposes of this International Standard, the expressions "% *(m/m)*" and "% *(V/V)*" are used to represent respectively the mass fraction and the volume fraction of a material.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this International Standard. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

ISO 760:1978, *Determination of water — Karl Fischer method (General method).*

ISO 3170:1988, *Petroleum liquids — Manual sampling.*

ISO 3448:1992, *Industrial liquid lubricants — ISO viscosity classification.*

ISO 3675:1998, *Crude petroleum and liquid petroleum products — Laboratory determination of density — Hydrometer method.*

ISO 3733:1999, *Petroleum products and bituminous materials — Determination of water — Distillation method.*

ISO 4259:1992, *Petroleum products — Determination and application of precision data in relation to methods of test.*

ISO 4404:1998, *Petroleum and related products — Determination of the corrosion resistance of water-containing fire-resistant fluids for hydraulic systems.*

ISO 4406:1987, *Hydraulic fluid power — Fluids — Method for coding level of contamination by solid particles.*

ISO 5884:1987, *Aerospace — Fluid systems and components — Methods for system sampling and measuring the solid particle contamination of hydraulic fluids.*

ISO 6072:1986, *Hydraulic fluid power — Compatibility between elastomeric materials and fluids.*

ISO 6247:1998, *Petroleum products — Determination of foaming characteristics of lubricating oils.*

ISO 6618:1997, *Petroleum products and lubricants — Determination of acid or base number — Colour-indicator titration method.*

ISO 6619:1988 [1)], *Petroleum products and lubricants — Neutralization number — Potentiometric titration method.*

ISO 6743-4:1999, *Lubricants, industrial oils and related products (class L) — Classification — Part 4: Family H (Hydraulic systems).*

ISO 7745:1989, *Hydraulic fluid power — Fire-resistant (FR) fluids — Guidelines for use.*

ISO 9120:1997, *Petroleum and related products — Determination of air-release properties of steam turbine and other oils — Impinger method.*

ISO 12185:1996, *Crude petroleum and petroleum products — Determination of density — Oscillating U-Tube method.*

ISO 14935:1998, *Petroleum and related products — Determination of wick flame persistence of fire-resistant fluids.*

ISO 15029-1:—[2)], *Petroleum and related products — Determination of spray ignition characteristics of fire - resistant fluids — Part 1: Spray flame persistence — Hollow cone nozzle method.*

DIN 51348:1990 [3)], *Testing of fire resistant governor fluids; Determination of hydrolytic stability.*

DIN 51354-2:1990, *Testing of lubricants; FZG gear testing; Method A/8,3/90 for lubricant oils.*

DIN 51373:1984 [3)], *Testing of fire resistant governor fluids; Determination of oxidation stability including evaluation of the catalyst plates.*

DIN 51777-2:1974, *Testing of mineral oil hydrocarbons and solvents; Determination of water content according to Karl Fischer; Indirect method.*

NT FIRE 031, *Fluid spray: combustion efficiency; ISSN 0283-7188.*

7th edition of Luxembourg report: Doc N° 4746/10/91 EN, April 1994 [4) 5)].

CETOP RP 65H:1993 [6)] , *Manifold ignition test.*

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1) To be revised. The title will be changed to: *Petroleum products and lubricants — Determination of acid number — Potentiometric titration method*)

2) To be published (see B.1 in annex B)

3) See B.3 in annex B

4) Available from: C.C.E - Direction Générale emplois, relations industrielles et affaires sociales. Organe permanent pour la sécurité et la salubrité dans les mines et les autres industries extratives, BP 1907, L-29920, Luxembourg

5) Abbreviated, in Tables 1 and 2 ; as "VII LUX" folowed by the number of the relevant subclause (see annex A)

CETOP RP 67H:1974 [6], *Anti-wear vane pump test for hydraulic fluids.*

3 Sampling

Sampling of hydraulic fluids for the purpose of this International Standard shall be carried out in accordance with the appropriate procedure described in ISO 3170. A representative sample shall be evaluated.

NOTE Any drum, barrel, tanker, compartment or any type of container delivered to the end user may be sampled and analysed at the request of the purchaser.

4 Requirements for fire-resistant hydraulic fluids

For the purposes of this International Standard, fluids shall be classified according to ISO 6743-4 and the guidelines for use shall be referred to ISO 7745.

Fluids, when tested according to the specified methods, shall be in agreement with the limiting values indicated in Tables 1 and 2, where applicable.

The majority of test methods specified in Tables 1 and 2 contain a statement of precision (repeatability and reproducibility). Attention is drawn to ISO 4259 which covers the use of precision data in the interpretation of test results. This procedure shall be used in cases of dispute.

Detailed requirements for each category mentioned in this International Standard are provided in Table 1 for HFAE and HFAS categories and in Table 2 for HFB, HFC and HFD types.

The composition of each category is indicated at the top of each table in accordance with ISO 6743-4.

This International Standard does not purport to address all of the safety problems associated with the use of fire-resistant fluids. It is the responsibility of users to establish appropriate safety and health practices and to determine the applicability of regulatory limitations prior to use. The fluid shall not present any significant hazard to health when correctly used in hydraulic equipment, observing the handing recommendations of the supplier.

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[6] Available from: Central secretariat of CETOP, BFPA, Cheriton house, Cromwell Business Park, Banbury Road, Chipping Norton, OXON OX7 5SR, UK. Tel: (0) 1608 647900 - Fax: (0) 1608 647919.

Table 1 — Requirements for categories HFAE and HFAS fluids

Composition	Type HFAE: These are oil-in-water emulsions, typically with more than 80 % water content (+ 5 °C to + 50 °C, ISO 7745) Type HFAS: These are chemical solutions in water, typically more than 80 % water content (+ 5 °C to +50 °C, ISO 7745)			
Characteristic or test	**Unit**	**Specification**		**Standard or test method**
		Finished emulsion Category HFAE[a]	**Finished solution Category HFAS[a]**	
Appearance		c	b	
Water content, minimum	% *(V/V)*	80	80	ISO 3733
Foam at: + 25 °C maximum [d]	ml/ml	300/10	300/10	ISO 6247
+ 50 °C maximum	ml/ml	300/10	300/10	
+ 25 °C maximum	ml/ml	300/10	300/10	
pH at 20 °C		6,7 to 11,0	6,7 to 11,0	VII LUX 5.4
Emulsion stability (50 °C/600 h), maximum:	Rating	2A-2R	c	VII LUX 5.2.1
— free oil	% *(V/V)*	Trace	c	
— cream, maximum	% *(V/V)*	0,5	c	
Corrosion protection	Rating	e	e	ISO 4404
Elastomer compatibility NBR1, EPDM1 and FPM1 elastomer, 60 °C/168 h		e	e	ISO 6072
— relative volume change, maximum	%	7	7	
— relative hardness change: minimum	IRHD	–7	–7	
maximum	IRHD	+2	+2	
— change in tensile strength	%	e	e	
— elongation at break	%	e	e	

a These products are normally supplied as concentrates, and should be used with the correct water quantity as specified by the supplier (viscosity of concentrate to be 350 mm^2/s maximum at 20 °C).

b The appearance of the delivered fluid shall be clear and bright and free of any visible particulate matter, under normal visible light at ambient temperature, using a clear glass container of approximately 10 cm diameter.

c The requirement is not relevant to this fluid type.

d For fluids with a viscosity greater than 10 mm^2/s at 20 °C.

e Report only on request.

Table 2 — Requirements for categories HFB, HFC and HFD fluids

Composition	Type HFB: These are water-in-oil emulsions (+5 °C to + 50 °C, ISO 7745) Type HFC: These are water polymer solutions, typically with more than 35 % water content (– 20 °C to +50 °C, ISO 7745) Type HFDR: These are synthetic fluids free of water consisting of phosphate esters (– 20 °C to + 70 °C/150 °C[a], ISO 7745) Type HFDU: These are synthetic fluids free of water but of other compositions than HFDR (– 20 °C to + 70 °C/150 °C[a], ISO 7745)				
Characteristic or test	**Unit**	**Specifications**			**Standard or test method**
		Finished emulsion Category HFB [b]	**Finished solution Category HFC** [b]	**Category HFD** [b] (R-U classes)	
Viscosity grade, ISO VG		**46 - 68 - 100**	**22 - 32 - 46 - 68**	**15 - 22 - 32 - 46 - 68 - 100**	**ISO 3448** [l]
Appearance		c	j	j	
Water content	% *(m/m)*	c	⩾ 35	⩽ 0,1	ISO 760 or DIN 51777-2[i]
	% *(V/V)*	⩾ 40	c	c	ISO 3733
Foam at: 25 °C maximum	ml/ml	c	300/10	300/10	ISO 6247
50 °C maximum	ml/ml	c	300/10	c	
100 °C maximum	ml/ml	c	c	300/10	
25 °C maximum	ml/ml	c	300/10	300/10	
Air release at 25 °C	min	d	c	c	
Air release at 50 °C maximum	min	c	20; 20; 25; 25	8; 10; 12; 15; 25; 30	ISO 9120
pH at 20 °C		c	6,7; 11,0	c	VII LUX 5.4
Emulsion stability, 1 000 h at 20 °C, maximum:					VII LUX 5.2.2
— change in water content at 425 ml	%	5	c	c	
— change in water content at 125 ml	%	5	c	c	
— surface oil	ml	10	c	c	
— accumulated free water	ml	2	c	c	
Emulsion stability, 48 h at 70 °C, maximum					VII LUX 5.2.3
— surface oil	ml	3	c	c	
— accumulated free water	ml	1	c	c	
Emulsion stability, 336 h at – 10 °C/168 h at +20 °C, maximum					VII LUX 5.2.4
— surface oil	ml	2	c	c	
— accumulated free water	ml	1	c	c	
— max change in water content at 5 ml	%	15	c	c	
— mean change in water content at 5 ml	%	10	c	c	
Acid number	mg KOH/g	d	c	d	ISO 6618, ISO 6619[f]
Corrosion protection	Rating	Pass	Pass	c	ISO 4404
		c	c	Pass	VII LUX 5.9.1
Shear stability, 100 bar/250 cycles [e]					VII LUX 5.8
— viscosity change at 20 °C, maximum	%	± 15	d	± 10	
— viscosity change at 40 °C, maximum	%	± 15	d	± 5	
— viscosity change at 100 °C, maximum	%	c	c	± 7	
— pH change, maximum		c	± 1,0	c	
— water content change, maximum	%	5	8	c	
— acid number change, maximum	mg KOH/g	± 0,50	c	± 0,50	
Density at 15 °C	kg/m³	d	d	d	ISO 3675 or ISO 12185
Elastomer compatibility: 68 °C/168 h					ISO 6072
— NBR 1[g] elastomers					
• relative volume change, maximum	%	7	7	c	
• relative hardness change mini/maxi	IRHD	–7/+2	–7/+2	c	
• change in tensile strength	%	d	d	c	
• elongation at break	%	d	d	c	

Table 2 *(continued)*

Elastomer compatibility: 100 °C/168 h					ISO 6072
— FPM 1[g], EPDM 1[g], NBR 1[g] elastomers					
• relative volume change, maximum	%	c	c	7	
• relative hardness change, mini/maxi	IRHD	c	c	–7/+2	
• change in tensile strength	%	c	c	d	
• elongation at break	%	c	c	d	
Spray ignition characteristics	Rating	m	m	m	ISO 15029-1, VII LUX 3.1.3, NT FIRE 031
Wick flame persistence	Rating	Pass	Pass	Pass	ISO 14935
Manifold ignition test	Rating	Pass	Pass	Pass	CETOP RP 65 H
Oxidation stability					DIN 51373
— Acid number increase, maximum	mg KOH/g	c	c	1,5	
— Mass losses, maximum	mg	c	c	1 (iron), 2 (copper)	
Ageing properties					VII LUX 5.3.1
— pH value increase		c	4	c	
— Insolubles	%	c	< 4	c	
Cleanliness		c	c	<18/16 [k]	ISO 4406
Hydrolytic stability					
— Acid number increase, maximum	mg KOH/g	c	c	d	DIN 51348
Vane pump	mg	c	h	h	CETOP RP67H
4-Ball machine	mm	h	h	h	VII LUX 7.14.2
FZG gear test	Fail stage	h	h	h	DIN 51354-2

[a] The higher temperature indicates the approximate upper temperature limit for short-term operation. This will depend on whether the application is hydrostatic or hydrodynamic and, for HFDU fluids, on the chemical composition of the fluid. Where doubt exists, clarification should be sought from the equipment manufacturer and/or fluid supplier.

[b] These fluids are normally supplied as the finished product.

[c] The test method or requirement is either not applicable or is not relevant to this fluid type.

[d] It may be interesting to know the value corresponding to this characteristic and this should be provided by the supplier. Otherwise no limit value is required.

[e] For fluids with a viscosity greater than 10 mm^2/s at 20 °C.

[f] For dyed fluids, ISO 6619 should be used

[g] EPDM 1 and FPM1 are elastomers normally suitable for HFDR fluids, with the exception of the combination of FPM 1 and alkyl phosphate esters. However, the degree of compatibility is highly dependent on the composition of the base polymer. NBR 1 elastomers are not suitable for use with HFDR fluids.

[h] Test methods and rating scales or limits are to be negotiated between the supplier and the user.

[i] DIN 51777-2 is applied to instances where interference by certain chemicals is to be avoided.

[j] The appearance of the delivered fluid shall be clear and bright and free of any visible particulate matter, under normal visible light at ambient temperature, using a clear glass container of approximately 10 cm diameter.

[k] Apply the sampling technique prescribed in ISO 5884.

[l] These viscosity grades are determined by measuring the viscosity as described in ISO 3104:1994, *Petroleum products — Transparent and opaque liquids — Determination of kinematic viscosity and calculation of dynamic viscosity* and ISO 3105:1994, *Glass capillary kinematic viscometers — Specifications and operating instructions.*

[m] The methods to be published in the three parts of ISO 15029 (see B.1 in annex B) measure different fluid characteristics under conditions which are not necessarily comparable. However, performance under one test condition only would normally be required. The method and the limits are therefore to be agreed between the end user and the fluid supplier, in accordance with national or other requirements. Where data are reported, reference should be made to the method used.

Annex A
(normative)

Content details of the 7th edition of Luxembourg report (1994)

Subclause 3.1.2: The «United Kingdom» spray test

Subclause 3.1.3: Stabilised flame heat release spray test

Subclause 5.2.1: Method of test for emulsion stability of type HFAE fluids (excluding type HFAS fluids)

Subclause 5.2.2: Method of test for emulsion stability of type HFB fluids at ambient temperature

Subclause 5.2.3: Method of test for emulsion stability of type HFB fluids at medium temperature

Subclause 5.2.4: Method of test for emulsion stability of type HFB. LT fluids at low temperature

Subclause 5.3.1: Determination of ageing properties of HFC fluids

Subclause 5.4: Method of test for pH of HFA and HFC fluids

Subclause 5.8: Method of test for shear strength of hydraulic fluids

Subclause 5.9.1: Method of determination of the corrosion inhibiting properties of HFA, HFC and HFD fluids

Subclause 7.14.2: Sliding contact by 4-ball machine