مؤسسة المواصفات والمقاييس الأردنية

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معالـي .....
عطوفة .....
سعادة .....

تحية طيبة وبعد،

أرجو معاليكم/عطوفتكم/سعادتكم التكرم بالعلم بأن أسلوب العمل الفني المتبع في وضع المواصفات القياسية والقواعد الفنية الأردنية يقتضي تعميم مشروع التصويت على الجهات ذات العلاقة، وذلك لإبداء الرأي والتصويت عليه تمهيداً لعرضه على مجلس الإدارة لاعتماده كمواصفة قياسية أو قاعدة فنية أردنية.

لذا أرجو أن أرفق لكم طياً نسخة عن مشروع التصويت للمواصفة القياسية الأردنية ٢٠٢٥/٢٤٢٤ الخاص بزيوت التزييت ـ الزيوت الهيدروليكية ـ المواصفات الخاصة بالفئات HFAE, HFAS, HFB, HFC, HFDR, HFDU، الذي أعدته اللجنة الفنية الدائمة لزيوت التزييت (٤).

يرجى التكرم بعرض هذا المشروع على المختصين لديكم وموافاتنا بردكم عليه خلال شهرين من تاريخه، وذلك باستخدام بطاقة التصويت المرفقة، علماً بأن عدم الرد خلال المدة يعتبر موافقة من قبلكم على المشروع المذكور.

وتفضلوا بقبول فائق الاحترام

المديـــر العـــام
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المرفقات:
- مشروع التصويت
- بطاقة التصويت

نسخة/ مدير مديرية التقييس
نسخة/ رئيس قسم فحص ومتابعة المواصفات
نسخة/ رئيس قسم الصناعات الكيميائية
نسخة/ م. رحاب المراحلة
ربا-٢٠٢٥/١٢/٧

مؤسسة المواصفات والمقاييس الأردنية

بطاقة تصويت

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الرقم	نوع الملاحظة			الملاحظة *	التعديل المقترح	رأي اللجنة الفنية
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النتيجة النهائية للتصويت:

☐ موافقة (لا توجد ملاحظات).

☐ موافقة مع الملاحظات المرفقة ، والتي يمكن الأخذ بها أو تجاوزها حسب الاقتضاء.

☐ عدم موافقة للأسباب الفنية المرفقة، والتي عند زوالها ينقلب التصويت إلى موافقة.

* يرجى تزويدنا بالمراجع التي اعتمد عليها في حالة وجود ملاحظات.

الجهة القائمة بالتصويت:	التاريخ:
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ع ت ٢٠٢٥/٢٤٢٤

الإصدار الأول

مشروع تصويت

(إعداد)

زيوت التزييت ـ الزيوت الهيدروليكية ـ المواصفات الخاصة بالفئات HFAE, HFAS, HFB, HFC, HFDR, HFDU

Lubricating oils — Hydraulic oils — Specifications for categories HFAE, HFAS, HFB, HFC, HFDR, HFDU

مؤسسة المواصفات والمقاييس

المملكة الأردنية الهاشمية

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Jordanian Standard 2424, JS 2421, JS 2422 and JS 2423 issued in 2025 cancels and es the Jordanian Standard 476 issued in 2003.

Foreword

Jordan Standards and Metrology Organization is the national standardization body in Jordan. The work of preparing Jordanian Standards is normally carried out by technical committees composed of the interested parties, which are involved in the scope of the standard. All the interested parties have the right to comment on the draft Jordanian Standard during the inquiry stage, taking into consideration the importance of harmonizing Jordanian Standards with the international, regional or national standards (as much as possible) for the purpose of eliminating technical barriers to trade and facilitating the international trade.

Jordanian Standards are drafted in accordance with the rules given in the Jordanian Directive 1-2:2005, part 2: Rules for the structure and drafting of Jordanian Standards related to standardization department*.

The permanent technical committee Lubricating oils 4 has studied the Jordanian Standard 476:2003 related to **"Mineral oils – Hydraulic oils"**, and the prepared project 2424:2025 related to " **Lubricating oils – Hydraulic oils – Specifications for categories HFAE, HFAS, HFB, HFC, HFDR, HFDU** and has recommended to withdrawn the above Jordanian Standard 476:2003 and to approve the amended project as a Jordanian technical regulation 2424:2025, according to article (12) of Standards and Metrology Law No. (22) for the year 2000 and it's amendments.

•- Introduction

Hydraulic fluids constitute the largest segment of the industrial lubricant market. Although mineral oil-based fluids are by far the most widely used type of hydraulic fluid, there are some applications where the use of these fluids could constitute a fire hazard. In order to reduce the risk to operatives in such circumstances, fire-resistant or less flammable fluids that increase operator safety have been developed. However, the following points should be noted.

- Even fire-resistant fluids can ignite at very high temperatures and the flammability behavior of the fluids specified in this Jordanian Standard covers a very wide range. It is therefore necessary to know the level of hazard in order to select the appropriate fluid.
- The properties of these fluids can be significantly different to those of conventional mineral oil-based products. For example, some fire-resistant fluids contain water. It might therefore be necessary to design the system for their use. It should also not be assumed that synthetic, non-aqueous fluids can replace mineral oil products without system modifications. Some fluids, for example, are incompatible with the elastomers used with mineral oils.

To enable the satisfactory operation of fire-resistant hydraulic fluids, it is recommended that this Jordanian Standard is read in conjunction with ISO 7745.

Lubricating oils – Hydraulic oils – Specifications for categories HFAE, HFAS, HFB, HFC, HFDR, HFDU

1- Scope

1-1 This Jordanian Standard specifies the requirements of unused fire-resistant and less flammable hydraulic fluids for hydrostatic and hydrodynamic 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 these less hazardous fluids and to the manufacturers of hydraulic equipment in which they are used.

1-2 Of the categories covered by JS 2421, which classifies the different types of fluids used in hydraulic applications, only the following are detailed in this Jordanian Standard: IIFAE, HFAS, HFB, HFC, HFDR and HFDU.

1-3 Types HFAE, HFAS, HFB, HFC and HFDR are "fire-resistant" fluids as defined by ISO 5598. Most HFDU fluids, while displaying an improvement in combustion behavior over mineral oil, fall outside this definition and are more appropriately considered as "less flammable" fluids.

1-4 The handling and use of products as specified in this Jordanian Standard can be hazardous if suitable precautions are not observed. This Jordanian Standard does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of this Jordanian Standard to establish appropriate safety and health practices and to determine the applicability of regulatory limitations prior to use.

2- Normative references

The following referenced Jordanian Standards are indispensable for the application of this Jordanian Standard. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced Jordanian Standard (including any amendments) applies. Indexes for published standard can be found in JSMO's library.

ISO 4263-2, Petroleum and related products – Determination of the ageing behaviour of inhibited oils and fluids – TOST test, Part 2: Procedure for category HFC hydraulic fluids.

ISO 4263-3, Petroleum and related products – Determination of the ageing behaviour of inhibited oils and fluids using the TOST test, Part 3: Anhydrous procedure for synthetic hydraulic fluids.

ISO 4404-1, Petroleum and related products – Determination of the corrosion resistance of fire resistant hydraulic fluids, Part 1: Water-containing fluids.

ISO 4404-2, Petroleum and related products – Determination of the corrosion resistance of fire resistant hydraulic fluids, Part 2: Non-aqueous fluids.

- ISO 5598, Fluid power systems and components – Vocabulary.
- ISO 6072, Rubber – Compatibility between hydraulic fluids and standard elastomeric materials.
- ISO 6618, Petroleum products and lubricants – Determination of acid or base number – Colour indicator titration method.
- ISO 6619, Petroleum products and lubricants – Neutralization number – Potentiometric titration method.
- ISO 14635-1, Gears – FZG test procedures, Part 1: FZG test method A/8,3/90 for relative scuffing load carrying capacity of oils.
- ISO 14935, Petroleum and related products – Determination of wick flame persistence of fire-resistant fluids.
- ISO 15029-1, Petroleum and related products – Determination of spray ignition characteristics of fire-resistant fluids, Part 1: Spray flame persistence – Hollow-cone nozzle method.
- ISO 15029-2, Petroleum and related products – Determination of spray ignition characteristics of fire-resistant fluids, Part 2: Spray test – Stabilised flame heat release method.

- ISO 20623, Petroleum and related products — Determination of the extreme-pressure and anti-wear properties of lubricants — Four-ball method (European conditions).
- ISO 20763, Petroleum and related products — Determination of anti-wear properties of hydraulic fluids — Vane pump method.
- ISO 20764, Petroleum and related products — Preparation of a test portion of high-boiling liquids for the determination of water content — Nitrogen purge method.
- ISO 20783-1, Petroleum and related products — Determination of emulsion stability of fire-resistant fluids, Part 1: Fluids in category HFAE.
- ISO 20783-2, Petroleum and related products — Determination of emulsion stability of fire-resistant fluids, Part 2: Fluids in category HFB.
- ISO 20823, Petroleum and related products — Determination of the flammability characteristics of fluids in contact with hot surfaces — Manifold ignition test.
- ISO 20843, Petroleum and related products — Determination of pH of fire-resistant fluids within categories HFAE, HFAS and HFC.
- ISO 20844, Petroleum and related products — Determination of the shear stability of polymer-containing oils using a diesel injector nozzle.
- EN 14832, Petroleum and related products — Determination of the oxidation stability and corrosivity of fire-resistant phosphate ester fluids.
- EN 14833, Petroleum and related products — Determination of the hydrolytic stability of fire-resistant phosphate ester fluids.
- ASTM D130, Standard test method for corrosiveness to copper from petroleum products by copper strip test.
- ASTM D445, Standard test method for kinematic viscosity of transparent and opaque liquids (and calculation of dynamic viscosity).
- ASTM D471, Standard test method for rubber property-effect of liquids.
- ASTM D664, Standard test method for acid number of petroleum products by Potentiometric Titration.
- ASTM D665, Standard test method for rust-preventing characteristics of inhibited mineral oil in the presence of water.
- ASTM D892, Standard test method for foaming characteristics of lubricating oils.
- ASTM D943, Standard test method for oxidation characteristics of inhibited mineral oils.
- ASTM D974, Standard test method for acid and base number by color-indicator titration.
- ASTM D2619, Standard test method for Hydrolytic Stability of Hydraulic Fluids (Beverage Bottle Method).
- ASTM D3427, Standard test method for air release properties of hydrocarbon-based oils.
- ASTM D4052, Standard test method for density, relative density, and API gravity of liquids by digital density meter.
- ASTM D4057, Standard practice for manual sampling of petroleum and petroleum products.
- ASTM D5182, Standard test method for evaluating the scuffing load capacity of oils (FZG visual method).
- ASTM D6304, Standard test method for determination of water in petroleum products, lubricating oils, and additives by coulometric Karl Fischer titration.
- JS 2421, Lubricating oils — Hydraulic oils — Classification.
- JS ISO 3448, Industrial liquid lubricants — ISO viscosity classification.

3- Terms and definitions

For the purposes of this Jordanian Standard, the terms and definitions given in ISO 5598 apply.
ISO and IEC maintain terminology databases for use in standardization at the following addresses:
- ISO Online browsing platform: available at https://www.iso.org/obp.
- IEC Electropedia: available at https://www.electropedia.org/.

4- Sampling

Sampling of hydraulic oils for the purpose of this Jordanian Standard, unless otherwise specified, shall be carried out in accordance with the pertinent procedure described in ASTM D4057. The sample shall be evaluated on a representative portion. 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.

5- Requirements for fire-resistant hydraulic fluids and less flammable hydraulic fluids

For the purposes of this Jordanian Standard, fluids shall be classified according to JS 2421. Guidelines for their selection and use can be found in ISO 7745 and CEN/TR 14489[1]. The latter also includes information on health and safety requirements.
Where applicable and when tested in accordance with the specified methods, fluids shall meet the limit values indicated in Table 1 (HFAE and HFAS fluids), Table 2 (HFB and HFC fluids) and Table 3 (HFDR and HFDU fluids). It should be noted that a significant variation exists in the level of fire-resistance displayed by the different fluid types.
The majority of test methods specified within Tables 1 to 3 contain a statement of precision (repeatability and reproducibility). ISO 4259-2, which covers the use of precision data in the interpretation of test results, shall be used in cases of dispute.
Note: For the purposes of this Jordanian Standard, the terms "% (m/m)" and "% (V/V)" are used to represent, the mass fraction and the volume fraction of a material, respectively.

6- Packaging

Hydraulic oils shall be packed in suitable containers that neither affect nor are affected by the oils.

7- Labeling

Each container shall bear the following information, clearly and indelibly marked, in Arabic and/or English.
7-1 Product name.
7-2 Classification of the hydraulic oil.
7-3 ISO-viscosity grade.
7-4 The word "Recycled" for oils refined after use.
7-5 Country of origin or the country of packaging.
7-6 The name and address of the manufacturer, the packer, and the trademark, if applicable.
7-7 Net volume in liters.
7-8 The date of production and /or batch number.
7-9 Warning statements and/or warning symbols for the transfer, handling and/or use of these products such as: ignition.

Table 1 – Specifications for types HFAE and HFAS hydraulic fluids

Property	Limit	Test method	Unit	Requirement	
				Category HFAE [a),h),c),d)]	Category HFAS [a),b),c),d)]
Composition	-	-	-	Oil-in-water emulsions typically containing ≥ 95 % water (V/V), (+ 5 °C to + 50 °C, ISO 7745)	Chemical solutions in water typically containing ≥ 95 % water (V/V), (+ 5 °C to + 50 °C, ISO 7745)
Kinematic viscosity at 40 °C	max	ASTM D445 [e)]	mm^2/s	5	5
Appearance	-	Visual		f)	g)
Water content	-	ASTM D6304	% (V/V)	h)	h)
Foaming tendency/stability at:					
+ 25 °C	max	ASTM D892	ml/ml	300/10	300/10
+ 50 °C	max		ml/ml	300/10	300/10
+ 25 °C	max		ml/ml	300/10	300/10
pH at 20 °C	-	ISO 20843	-	6,7 to 10,0	6,7 to 10,0
Emulsion stability (50 °C/600 h):		ISO 20783-1	rating	2A to 2R	i)
- free oil	max		% (V/V)	Trace	i)
- cream	max		% (V/V)	0,5	i)
Corrosion protection:					
- visual rating of metals	max	ISO 4404-1	rating	3	3
- visual rating of the fluid			rating	h)	h)
mass changes of metal strips					
- steel, copper and brass	max		mg	− 11 to + 5	− 11 to + 5
- aluminium				− 5 to + 5	− 5 to + 5
- zinc				− 22 to + 5	− 22 to + 5
Elastomer compatibility: 60 °C/168 h [j)]					
NBR 1, HNBR 1 and FKM 2 elastomers:					
- relative volume change	min	ASTM D471 ISO 6072	%	0	0
	max		%	+ 7	+ 7
- relative hardness change	min		IRHD [k)]	− 7	− 7
	max		IRHD [k)]	+ 2	+ 2
- change in tensile strength	-		%	L)	L)
- elongation at break	-		%	L)	L)

Table 1 – Specifications for types HFAE and HFAS hydraulic fluids (continued)

Property	Limit	Test method	Unit	Requirement	
				Category HFAE [a),b),c),d)]	Category HFAS [a),b),c),d)]

[a)] These products are normally supplied as concentrates and are diluted with water by the end user. To ensure the rapid and complete mixing of the finished fluid, the viscosity of the concentrate at 20 °C should be 350 mm^2/s maximum.

[b)] The limits given in this table can be applied at the dilution recommended by the supplier when using water selected from one of the following sources:

- test waters listed in ISO 4404-1 and in ISO 20783-1.
- distilled or de-ionized water.
- mains water supplied by the user.

Tests should be carried out before commercial use and the results, if reported, shall indicate the type of (test) water and the dilution level used.

[c)] The viscosity of these fluids is very low and they may be used only in equipment especially designed for such products.

[d)] As a result of their very high water content, these fluids are expected to possess excellent fire-resistance.

[e)] Test Method ASTM D7042 may be used with bias correction for formulated oils. D445 is the referee method.

[f)] Report the appearance. With HFAE fluids this can vary from transparent to opaque depending upon the formulation and the composition of the diluent.

[g)] HFAS fluids are transparent. When examined in daylight at ambient temperature using a clear glass container of approximately 10 cm in diameter, they should be clear and bright, and free from any visible particulate matter.

[h)] Limits are to be negotiated between the supplier and the user.

[i)] The requirement is not relevant to this fluid type.

[j)] ISO 6072 also specifies a long term (1 000 h) test but no limits are available. Guidance on acceptable test data under these conditions was last available in ISO 6072:2002, Annex C. NBR 1, HNBR 1 and FKM 2 are standard reference elastomers, the compositions of which are given in ISO 6072. They are the elastomer types most widely used, but not exclusively so, with the above fluids. The data provide a useful guide to the compatibility with HFAE and HFAS fluids, but can give results that are different from commercially available rubbers of the same nominal type. If case of doubt about the compatibility, contact the elastomer manufacturer.

[k)] International rubber hardness degree.

[l)] Report only on request.

Table 2 – Specifications for types HFB and HFC hydraulic fluids

Property	Limit	Test method	Unit	Requirement	
				Category HFB a)	Category HFC a)
Composition	-	-	-	Water-in-oil emulsions, typically containing ≥ 40 % water (% m/m) (+ 5 °C to + 50 °C, ISO 7745)	Water polymer solutions, typically containing ≥ 35 % water (% m/m) (− 20 °C to + 50 °C, ISO 7745)
ISO-viscosity grade	-	JS ISO 3448	-	46, 68, 100	22, 32, 46, 68
Appearance	-	Visual	-	b)	c)
Water content	-	ASTM D6304	% (V/V)	d)	d)
Density at 15 °C	-	ASTM D4052	kg/m^3	f)	f)
pH at 20 °C	-	ISO 20843	-	b)	6,7 to 10,0
Kinematic viscosity at 40 °C	max	ASTM D445 e)	mm2/s	f)	f)
Foaming tendency/stability at:					
+ 25 °C	max	ASTM D892	ml/ml	b)	300/10
+ 50 °C	max		ml/ml	b)	300/10
+ 25 °C	max		ml/ml	b)	300/10
Air release, 50 °C	max	ASTM D3427	mins	b)	20, 20, 25, 25
Emulsion stability:					
a) 1 000 h at 20 °C:					
- surface oil	max	ISO 20783-2	ml	10	b)
- accumulated free water	max		ml	2	b)
- change in water content at 425 ml	max		%	5	b)
- change in water content at 125 ml	max		%	5	b)
b) 48 h at 70 °C:					
- surface oil	max	ISO 20783-2	ml	3	b)
- accumulated free water	max		ml	1	b)
c) 336 h at -10 °C/168 h at +20 °C:					
- surface oil	max	ISO 20783-2	ml	2	b)
- accumulated free water	max		ml	1	b)
- change in water content at 5 ml	max		%	15	b)
- mean change in water content at 5 ml	max		%	10	b)

Table 2 – Specifications for types HFB and HFC hydraulic fluids (continued)

Property	Limit	Test method	Unit	Requirement	
				Category HFB [a]	Category HFC [a]
Shear stability: 17,5 MPa (175 bar)/250 cycles [g]:					
- viscosity change at 20 °C	max		%	± 15	[f]
- viscosity change at 40 °C	max	ISO 20844	%	± 15	[f]
- viscosity change at 100 °C	max		%	[b]	[b]
- pH change	max			[b]	⊥ 1,0
- water content change	max		%	5	8
- acid number change	max	ISO 6618 [h] ISO 6619 [h]	mg KOH/g	⊥ 0,50	[b]
Elastomer compatibility: 60 °C/168 h [i] NBR 1 and HNBR 1 elastomers:					
- relative volume change	min	ISO 6072	%	0	0
	max		%	+ 7	+ 7
- relative hardness change	min		IRHD [j]	− 7	− 7
	max		IRHD [j]	+ 2	÷ 2
- change in tensile strength	-		%	[k]	[k]
- elongation at break	-		%	[k]	[k]
Fire-resistance Spray ignition characteristics [l]:					
- time to extinguishment of flame	max	ISO 15029-1	s	30	30
- ignitability factor	min	ISO 15029-2	RI [m]	[f]	[f]
Wick flame persistence:					
- mean flame persistence	max	ISO 14935	s	60	60
Manifold ignition test:					
- ignition temperature	min	ISO 20823	°C	650	600
- flame propagation	min		rating	[f]	[f]
Ageing properties [n]:					
- pH value after test	min	ISO 4263-2	-	[b]	4
- insolubles	max		%	[b]	4

Table 2 – Specifications for types HFB and HFC hydraulic fluids (continued)

Property	Limit	Test method	Unit	Requirement	
				Category HFB [a]	Category HFC [a]
Lubrication performance					
Vane pump:		ISO 20763			
- total of ring and vane wear	max		mg	[b]	[d], [o]
4-ball machine:		ISO 20623			
- wear scar diameter	max		mm	[d]	[d]
FZG gear test:		ISO 14635-1			
- failure load stage	min		load stage	[b]	[d]

[a] These fluids are supplied as the finished product.

[b] The requirement is not relevant to this fluid type.

[c] When examined in daylight at ambient temperature using a clear glass container of approximately 10 cm in diameter, the appearance of the delivered fluid shall be clear and bright, and free of any visible particulate matter.

[d] Limits are to be agreed between the supplier and the user.

[e] ASTM D7042 may be used with bias correction for formulated oils. ASTM D445 is the referee method.

[f] Value or rating to be reported by the supplier. No limit is specified.

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

[h] The method should be agreed between the fluid suppler and the user. For dyed fluids, ISO 6619 should be used.

[i] ISO 6072 also specifies a long term (1 000 h) test but no limits are available. Guidance on acceptable test data under these conditions was last available in ISO 6072:2002, Annex C. NBR 1 and HNBR 1 are standard reference elastomers, the compositions of which are given in ISO 6072. They are the elastomer types most widely used, but not exclusively so, with the above fluids. The data provide a useful guide to the compatibility of this seal type with HFB and HFC fluids, but can give results that are different from commercially available elastomers of the same nominal type. If case of doubt about the compatibility, contact the elastomer manufacturer.

[j] International rubber hardness degree.

[k] Report only on request.

[l] The methods in the ISO 15029 series measure different fluid characteristics under conditions that are not necessarily comparable. Limits on ISO 15029-2:2018 have not yet been established.

[m] Ignitability factor.

[n] The test duration is 200 h.

[o] In view of the non-availability of test cartridges from the original supplier, other sources have been investigated. As yet, no precision data are available on the alternative cartridges when testing the above fluid types and no limits can, therefore, be specified. For guidance, the limits for IIFC fluids specified in ISO 20763:2004, clause 13-2, were a ring and vane mass loss of < 50 mg and < 180 mg, respectively.

Table 3 – Specifications for types HFDR and HFDU hydraulic fluids

Property	Limit	Test method	Unit	Requirement	
				Category HFDR [a]	Category HFDU [a]
Composition	-	-	-	Synthetic fluids free of water consisting of phosphate esters (– 20 °C to + 70 °C/ 150 °C [b], ISO 7745)	Synthetic fluids free of water and of other compositions (– 20 °C to + 70 °C/ 150 °C [b], ISO 7745)
ISO-viscosity grade	-	JS ISO 3448	-	15, 22, 32, 46, 68, 100	15, 22, 32, 46, 68, 100
Appearance	-	Visual	-	c)	c)
Acid number	-	ASTM D974/D664 [o]	mg KOH/g	d), e)	d), e)
Water content	-	ASTM D6304 ISO 20764 [f]	% (V/V)	0,1	0,1
Density at 15 °C	-	ASTM D4052	kg/m^3	d)	d)
Kinematic viscosity at 40 °C	max	ASTM D445 [p]	mm^2/s	d)	d)
Foaming tendency/stability at:		ASTM D892			
+ 25 °C	max		ml/ml	300/10	300/10
+ 93 °C	max		ml/ml	300/10	300/10
+ 25 °C	max		ml/ml	300/10	300/10
Air release, 50 °C	max	ASTM D3427	min	8, 10, 12, 15, 25, 30	8, 10, 12, 15, 25, 30
Corrosion protection:		ISO 4404-2			
- visual assessment of the metals	max		rating	3	3
- visual assessment of the fluid	-		rating	g)	g)
- mass changes of strips	max		mg		
– steel, copper and brass				– 11 to + 5	– 11 to + 5
- aluminium				– 5 to + 5	– 5 to + 5
- zinc				22 to – 5	– 22 to + 5
Rust prevention characteristics	–	ASTM D665	rating	d)	d)
Copper corrosion	–	ASTM D130	rating	d)	d)

Table 3 – Specifications for types HFDR and HFDU hydraulic fluids (continued)

Property	Limit	Test method	Unit	Requirement	
				Category HFB [a]	Category HFC [a]
Shear stability: 17,5 MPa (175 bar)/250 cycles:		ISO 20844			
- viscosity change at 20 °C	max		%	± 10	± 10
- viscosity change at 40 °C	max		%	± 5	± 5
- viscosity change at 100 °C	max	ISO 6618 [i]	%	± 7	± 7
- acid number change	max	ISO 6619 [i]	mg KOH/g	± 0,50	± 0,50
Elastomer compatibility: 100 °C/168 h [h]					
- FKM 2, EPDM 1 types (HFDR fluids)					
- FKM 2, NBR 1, NBR 2 types (HFDU fluids)					
- relative volume change	min	ISO 6072	%	0	0
	max		%	− 7	+ 7
- relative hardness change	min		IRHD [i]	− 7	− 7
	max		IRHD [i]	+ 2	+ 2
- change in tensile strength	-		%	[j]	[j]
- elongation at break	-		%	[j]	[j]
Fire-resistance					
Spray ignition characteristics [k]:					
- time to extinguishment of flame	max	ISO 15029-1	s	30	30
- ignitability factor	min	ISO 15029-2	RI [l]	[d]	[d]
Wick flame persistence:					
- mean flame persistence	max	ISO 14935	s	60	[d]
Manifold ignition test:					
- ignition temperature	min	ISO 20823	°C	700	400
- flame propagation	min		rating	[d]	[d]
Oxidation stability:					
- acid number increase	max	EN 14832	mg KOH/g	1,5	[m]
- mass losses	min		mg		[m]
- iron				1	
- copper				2	
Oxidation life	min	ISO 4263-3	h	[m]	250
Hydrolytic stability:					
- acid number increase	max	EN 14833	mg KOH/g	[d]	[d]

Table 3 – Specifications for types HFDR and HFDU hydraulic fluids (continued)

Property	Limit	Test method	Unit	Requirement	
				Category HFB [a]	Category HFC [a]
Lubrication performance					
Vane pump:		ISO 20763			
- total of ring and vane wear	max		mg	[b]	[d], [n]
4-ball machine:		ISO 20623			
- wear scar diameter	max		mm	[g]	[g]
FZG gear test:		ISO 14635-1			
- failure load stage	min		load stage	[g]	[g]

[a] These fluids are supplied as the finished product.

[b] The higher temperature indicates the approximate upper limit for a 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.

[c] When examined in daylight at ambient temperature using a clear glass container of approximately 10 cm in diameter, the appearance of the delivered fluid shall be clear and bright, and free of any visible particulate matter.

[d] Value or rating to be reported by the supplier. No limit is specified.

[e] The method is to be agreed between the supplier and the user. For dyed fluids, ISO 6619 should be used.

[f] ISO 20764 is applied in instances where interference by certain chemicals is to be avoided.

[g] Limits are to be negotiated between the supplier and the user.

[h] ISO 6072 also specifies a long term (1 000 h) test but no limits are available. Guidance on acceptable test data under these conditions was last available in ISO 6072:2002, Annex C. EPDM 1, FKM 2, NBR 1 and NBR 2 are standard reference elastomers, the compositions of which are given in ISO 6072. They are the elastomer types most widely used, but not exclusively so, with the above fluids. The data pro- vide a useful guide to the compatibility with HFDR and HFDU fluids, but can give results that are different from commercially available elastomers of the same nominal type. EPDM 1 and FKM 2 are normally suitable for use with HFDR fluids, with the exception of the combi- nation of FKM 2 and alkyl phosphate esters. The NBR 1 and NBR 2 reference elastomers are not suitable for use with HFDR fluids and NBR 1 might not be suitable for use with all HFDU fluids. If case of doubt about the compatibility, contact the elastomer manufacturer.

[i] International rubber hardness degree.

[j] Report only on request.

[k] The methods in the ISO 15029 series measure different fluid characteristics under conditions that are not necessarily comparable. Limits on ISO 15029-2:2018 have not yet been established.

[l] Ignitability factor.

[m] The requirement is not relevant to this fluid type.

[n] In view of the non-availability of test cartridges from the original supplier, other sources have been investigated. As yet, no precision data are available on the alternative cartridges when testing the above fluid types and no limits can, therefore, be specified. For guidance, the limits for both HFDR and HFDU fluids specified in ISO 20763:2004, clause 13-2, were a vane and ring mass loss of < 30 mg and < 120 mg, respectively.

[o] ASTM D7042 may be used with bias correction for formulated oils. ASTM D445 is the referee method.

[p] ASTM D664 is the referee method.

Annex A
(Informative)
Bibliography

[1] ISO 4259-2, Petroleum and related products – Precision of measurement methods and results – Part 2: Interpretation and application of precision data in relation to methods of test.
[2] ISO 7745, Hydraulic fluid power – Fire-resistant (FR) fluids – Requirements and guidelines for use.
[3] CEN/TR 14489:2005, Fire-resistant hydraulic fluids – Classification and specification – Guidelines on selection for the protection of safety, health and the environment.

References

- ISO 12922:2020, Lubricants, industrial oils and related products (class L), Family H (Hydraulic systems) – Specifications for hydraulic fluids in HFAE, HFAS, HFB, HFC, HFDR and HFDU.
- JS 119:2022, Label Industrial products label.

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