

هيئة التقييس لدول مجلس التعاون دول الخليج العربية

GCC Standardization Organization (GSO)

مشروع مواصفة اولي
تحديث المواصفة القياسية

GSO 07/SC1/ DS -GSO ١١٨٠ : 2024

إعداد اللجنة الفرعية الخليجية رقم 01 TC07/SC

Prepared by GSO Technical Sub-Committee No.TC07/SC 01

سائل نقل الحركة الآلية (الأوتوماتيكي) Automatic transmission fluid (ATF)

ICS: 75.100

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هذه الوثيقة مشروع لمواصفة قياسية خليجية، تم توزيعها لإبداء الرأي والملاحظات بشأنها، لذلك فهي عرضة للتغيير والتبديل ولا يجوز الاعتماد عليها كمواصفة قياسية خليجية إلا بعد اعتمادها من الهيئة.

تقديم

هيئة التقييس لدول مجلس التعاون لدول الخليج العربية هيئة إقليمية تضم في عضويتها أجهزة التقييس الوطنية في الدول الأعضاء، ومن مهام الهيئة إعداد المواصفات القياسية واللوائح الفنية الخليجية بواسطة لجان فنية متخصصة.

قرر/قررت مجلس الإدارة لهيئة التقييس لدول مجلس التعاون لدول الخليج العربية في اجتماعه رقم الذي عقد بتاريخ...../...../..... هـ ، الموافق/...../.....م اعتماد تحديث المواصفة القياسية الخليجية رقم "GSO 1180: 2024" سائل نقل الحركة الاليه (الاوتوماتيكية) " التي تم دراستها وإعدادها ضمن برنامج عمل اللجنة الفرعية الخليجية رقم TC07/SC1 " اللجنة الفرعية الخليجية لمواصفات المنتجات البترولية " المدرجة في خطة المملكة العربية السعودية . على أن تلغي المواصفة القياسية الخليجية رقم (GSO 1180 : 2022) وتحل محلها.

1. SCOPE

This draft SASO standard specifies the minimum requirements, sampling and test method for Automatic Transmission Fluids (ATF) based on road vehicles such as passenger cars and light duty trucks. It also specifies the classification as recommended by manufacturers and meeting the modern vehicles use.

2. NORMATIVE REFERENCES

SASO 20 "Methods of Sampling lubricating Oils".

SASO ASTM D 92, Standard test method for flash and fire points by Cleveland open cup.

ASTM D 97, Standard test method for pour point of petroleum products.

SASO ASTM D 130, Standard test method for corrosiveness to copper from petroleum products by copper strip test.

SASO ASTM D 445, Standard test method for kinematic viscosity of transparent and opaque liquids.

SASO ASTM D 664, Standard test method for acid number of petroleum products by Potentiometric titration.

SASO ASTM D665, Standard Test Method for Rust-Preventing Characteristics of Inhibited Mineral Oil in the Presence of Water.

SASO ASTM D 892, Standard test method for foaming characteristics of lubricating oils.

ASTM D 1500, Standard test method for ASTM Color of petroleum products (ASTM color scale).

ASTM D 2270, Standard practice for calculating viscosity index from kinematic viscosity at 40 °C and 100 °C.

ASTM D2624, Standard Test Methods for Electrical Conductivity of Aviation and Distillate Fuels.

ASTM D2893, Standard Test Methods for Oxidation Characteristics of Extreme-Pressure Lubrication Oils.

SASO ASTM D 2983, Standard Test Method for Low-Temperature Viscosity of Automatic Transmission Fluids, Hydraulic Fluids, and Lubricants using a Rotational Viscometer.

ASTM D3427, Standard Test Method for Air Release Properties of Hydrocarbon Based Oils.

SASO ASTM D 4052, Standard test method for density and relative density of liquids by digital density meter.

ASTM D 4927, Standard test method for elemental analysis of lubricant and additive components- barium, calcium, phosphorous, sulfur and zinc by wavelength-dispersive x-ray fluorescence spectroscopy.

ASTM D4951, Standard Test Method for Determination of Additive Elements in Lubricating Oils by Inductively Coupled Plasma Atomic Emission Spectrometry.

ASTM D5293, Standard Test Method for Apparent Viscosity of Engine Oils and Base Stocks Between –10 °C and –35 °C Using Cold-Cranking Simulator.

ASTM D5800, Standard Test Method for Evaporation Loss of Lubricating Oils by the Noack Method.

ASTM D 6046, Standard Classification of Hydraulic Fluids for Environmental Impact.

SASO ISO 6072, Rubber — Compatibility between hydraulic fluids and standard elastomeric materials

ASTM D6304, Standard Test Method for Determination of Water in Petroleum Products, Lubricating Oils, and Additives by Coulometric Karl Fischer Titration.

ASTM D6922, Standard Test Method for Determination of Homogeneity and Miscibility in Automotive Engine Oils.

SASO ISO 4263-1 Petroleum And Related Products – Determination Of The Aging Behavior Of Inhibited Oils And Fluids – TOST Test – Part 1 : Procedure For Mineral Oils.

SASO ISO 4406 Hydraulic fluid power - Fluids -Method for coding the level of contamination by solid particles.

3. TERMS AND DEFINITIONS

For the purpose of a draft SASO standard the following term and definition shall apply:

Automatic Transmission Fluids (ATF): It is a type of hydraulic fluid and represents a special kind of oil used in automotive with automatic transmissions, composed of base oils and additives.

4. CLASSIFICATION

Automatic Transmission Fluids (ATF) oils are classified based on the requirement indicated in Table (1), Table (2), Table (3), Table (4) and Table (5) as follows:

4.1 ATF – HV: A high Viscosity Automatic Transmission Fluid compatible with transmissions requiring Ford MERCON®, GM DEXRON®III fluids or equivalent.

4.2 ATF – LV: A Low Viscosity Automatic Transmission Fluid compatible with transmissions requiring Ford MERCON® LV/SP, GM DEXRON®VI/HP fluids or equivalent.

4.3 ATF – ULV: A Ultra-Low Viscosity Automatic Transmission Fluid use in 9 and 10-speed automatic transmissions, compatible with transmissions requiring Ford MERCON®ULV, GM DEXRON®ULV fluids or equivalent.

4.4 ATF – CVT: A Continuously Variable Automatic Transmission fluids.

4.5 ATF – DCT: A Dual Clutch Automatic Transmission fluids.

5. REQUIREMENTS

5.1 Color

The ATF shall be colored (is typically dyed red or other suitable color) to distinguish it from motor oil and other fluids in the vehicle.

5.2 Performance level

The performance level as per manufacturers recommendation shall meets minimum ATF – HV (Dexron III, Mercon or equivalent), ATF – LV (Dexron VI, Mercon LV or equivalent), ATF – ULV (Mercon ULV, Dexron ULV or equivalent), CVT and DCT fluids.

5.3 ATF Test Methods & Requirements

The ATF based on Road vehicles shall meet requirements as specified in Tables 1, 2, 3, 4 and 5.

6. SAMPLING

Samples shall be drawn according to SASO 20.

7. TESTING METHODS

The following tests shall be carried out according to the performance and application requirement and the representative sample taken in accordance with item (6).

Note (1): The tests shall be carried out according to the Saudi Standards given in item (2) or equivalents and according to international test methods standards (ISO or ASTM or IP).

7.1 PHYSICAL AND CHEMICAL TESTS:

Physical and chemical tests shall be conducted.

7.1.1 Visual inspection.

7.1.2 Determination of color.

7.1.3 Determination of miscibility and Homogeneity.

7.1.4 Determination of flash point.

7.1.5 Determination of fire point.

7.1.6 Determination of pour point.

7.1.7 Determination of Brookfield viscosity.

7.1.8 Determination of rust protection.

7.1.9 Determination of foam characteristics.

7.1.10 Determination of corrosion.

7.1.11 Determination of copper Strip corrosion.

7.1.12 Cold Crank Simulation Test.

7.1.13 Determination of kinematic viscosity.

- 7.1.14 Determination of viscosity index.
- 7.1.15 Determination of major elements.
- 7.1.16 Determination of elastomer effect.
- 7.1.17 Determination of water content.
- 7.1.18 Determination of density.
- 7.1.19 Determination Elastohydrodynamic Film Thickness.
- 7.1.20 Determination of Viscosity at high temperature and high shear.
- 7.1.21 Determination of Thermal Conductivity for fresh and used fluid after Oxidation Test.
- 7.1.22 Determination of Electrical Conductivity for fresh and used fluid after Oxidation Test.

8 PACKING

Automatic transmission fluids shall be packed in tightly closed and sealed containers preventing possibilities of oil leakage or oil contamination with any impurities; such containers neither shall affect nor be affected by the oil.

9 LABELLING

The following information shall be legibly and indelibly marked in both Arabic and English languages on each container of Automatic transmission fluids.

- 9.1 The commercial name of automatic transmission fluids (Dexron, Mercon or equivalent).
- 9.2 Net volume, in liters.
- 9.3 Producer's name or his registered trademark.
- 9.4 Name of the country of origin.
- 9.5 The classification according to viscosity and performance.
- 9.6 Date of production, Barcode and the batch number.
- 9.7 Precaution: "Avoid Environmental Pollution.

Table (1) – ATF HV (DEXRON III, MERCON OR EQUIVALENT)

Test Methods & Requirements

Test	Units	Method	Requirements
Color	-	ASTM D1500	Report
Appearance at 25 °C	-	Visual	Clear and Bright
Miscibility and Homogeneity	-	ASTM D6922	No separation or color change during or at completion of test using Reference Fluid
Density at 15 °C	kg/m ³	ASTM D4052	Report
Kinematic viscosity at 40 °C	mm ² /s (cSt)	ASTM D445	30 (min)
Kinematic viscosity at 100 °C	mm ² /s (cSt)	ASTM D445	6 (min) 5 cSt @ 100°C (min) for base oil blend
Kinematic viscosity at 150 °C	mm ² /s (cSt)	ASTM D445	Report
Viscosity index	-	ASTM D2270	150 (min)
Fluid Film Thickness	-	EHD (at 60, 80, 100 and 120 °C)	Report
Cleanliness level	-	ISO 4406	Report At supplier manufacturing site prior to unloading into shipping containers
Flash point	° C	ASTM D92	175 (min)
Fire point	° C	ASTM D92	180 (min)
Pour point	° C	ASTM D97	-40 (max)
Foam tendency/foam stability (a)		ASTM D892	No foam at 95 °C 5mm (max) height at 135 °C 15s (max) break time at 135 °C

(b)	ml		10/0
Sequence I	ml		20/0
Sequence II	ml		10/0
Sequence III			
Air release	min	ASTM D3427	5 (max)
At 50 ° C			
Total Acid Number	mg KOH/g	ASTM D664	Report
Brookfield Viscosity	mPa.s	ASTM D2983	At -10 °C : Report At -20°C : 1500 (max) At -30°C : 5000 (max) At -40°C : 20000 (max)
Viscosity after mod. NOACK at -40° C	mPa.s	ASTM D2983	2000 mPa.s (max) change
Evaporation Loss	%	ASTM D5800 Modified NOACK (150°C, 2 hours)	15% (max) change
Cold Crank Simulation	mPa.s	ASTM D5293 At -30°C	3200 (max)
Elemental analysis	ppm	ASTM D5185	Report: Al, Ba, B, Ca, Cr, Cu, Fe, Pb, Mg, Mn, Mo, Ni, P, K, Si, Ag, Na, S, Sn, Ti, V and Zn
		ASTM D4951	Report, ppm: Zinc
		ASTM D4951	Report, ppm: Phosphorus
		ASTM D4927	Report, ppm: Sulfur
Copper corrosion, 100° C, 3h	class	ASTM D130 At 100	1b (max)
Water Content	%	ASTM D6304	0,05% weight maximum

Rust prevention , 24 h (Procedure A)	-	ASTM D665	No rust and corrosion on any Surface
Elastomer compatibility(*) NBR 1, 100 ° C, 168h - Relative increase in volume - Change in shore a hardness (*)Elastomer other than NBR may be agreed between the supplier and the end users. The limits are assigned by manufactories for elastomer type chosen.	% -	ISO 6072	0 to 12 -7 to 0
Oxidation stability - Increase in acid number after 1000h - Insoluble sludge	mg KOH/g mg	ISO 4263-1	2.0 (max) Report
Oxidation Tests (300 h, 155 ° C) Lead Coupon Weight Loss, 100 h.	%	ASTM D2893	0.5 (max)
Vane Pump Wear Test	mg	ASTM D2882 a) At 80 ± 3°C b) 6.9 Mpa	10 (max)
Thermal Conductivity for fresh and used fluid after Oxidation Test	W/(m·K)	ASTM D7896 At 40°C, 70°C, 100°C	Report
Electrical Conductivity for fresh and used fluid after Oxidation Test	pS/m	ASTM D2624 At 23±2°C, 40°C, 100°C, 120°C, 150°C.	Report

FZG Gear wear test, Load Stage Pass	Load Stage Pass	ASTM D5182	
1450 RPM, 15 min at 100°C start temperature			8
1450 RPM, 15 min at 150°C start temperature			8

Table (2) – ATF LV (MERCON LV, DEXRON VI OR EQUIVALENT)

Test Methods & Requirements

Test	Units	Method	Requirements
Color	-	ASTM D1500	Report
Appearance at 25 °C	-	Visual	Clear and Bright
Miscibility and Homogeneity	-	ASTM D6922	No separation or color change during or at completion of test using Reference Fluid
Density at 15 °C	kg/m ³	ASTM D4052	Report
Kinematic viscosity at 40 °C	mm ² /s (cSt)	ASTM D445	32 (max)
Kinematic viscosity at 100 °C	mm ² /s (cSt)	ASTM D445	6,4 (max) 4.6 cSt @ 100°C (min) for base oil blend
Kinematic viscosity at 150 °C	mm ² /s (cSt)	ASTM D445	Report
Viscosity index	-	ASTM D2270	145 (min)
Fluid Film Thickness	-	EHD (at 60, 80, 100 and 120 °C)	Report
Cleanliness level	-	ISO 4406	Report At supplier manufacturing site prior to unloading into shipping containers
Flash point	° C	ASTM D92	180 (min)

Fire point	° C	ASTM D92	190 (min)
Pour point	° C	ASTM D97	-40 (max)
Foam tendency/foam stability		ASTM D892	
(a)			No foam at 95 °C 5mm (max) height at 135 °C 15s (max) break time at 135 °C
(b)			
Sequence I	ml		0.0/0
Sequence II	mL		0.0/0
Sequence III	ml		0.0/0
Air release	min	ASTM D3427	5 (max)
At 50 ° C			
Total Acid Number	mg KOH/g	ASTM D664	Report
Brookfield Viscosity	mPa.s	ASTM D2983	At -10 °C : Report At -20°C : 1500 (max) At -30°C : 5000 (max) At -40°C : 15000 (max)
Viscosity after mod. NOACK at -40° C	mPa.s	ASTM D2983	2000 mPa.s (max) change
Evaporation Loss	%	ASTM D5800 Modified NOACK (150°C, 2 hours)	15% (max) change
Cold Crank Simulation	mPa.s	ASTM D5293 At -30°C	3200 (max)

Elemental analysis	ppm	ASTM D5185	Report: Al, Ba, B, Ca, Cr, Cu, Fe, Pb, Mg, Mn, Mo, Ni, P, K, Si, Ag, Na, S, Sn, Ti, V and Zn
		ASTM D6443	Report, ppm: Cl
		ASTM D4629	Report, ppm: N
		ASTM D4927	Report, ppm: S
Copper corrosion, 100° C, 3h	class	ASTM D130	1b (max)
		At 100	
Water Content	%	ASTM D6304	0.05% weight maximum
Rust prevention , 24 h (Procedure A)	-	ASTM D665	No rust and corrosion on any Surface
Elastomer compatibility(*) NBR 1, 100 ° C, 168h - Relative increase in volume - Change in shore a hardness (*)Elastomer other than NBR may be agreed between the supplier and the end users. The limits are assigned by manufactories for elastomer type chosen.	% -	ISO 6072	0 to 12 -7 to 0
Oxidation stability - Increase in acid number after 1000h - Insoluble sludge	mg KOH/g mg	ISO 4263-1	2.0 (max) Report
Oxidation Tests (300 h, 155 ° C) Lead Coupon Weight Loss, 100 h.	%	ASTM D2893	0.5 (max)
Vane Pump Wear Test	mg	ASTM D2882 a) At 80 ± 3°C b) 6.9 Mpa	10 (max)

Thermal Conductivity for fresh and used fluid after Oxidation Test	W/(m·K)	ASTM D7896 At 40°C, 70°C, 100°C	Report
Electrical Conductivity Test	pS/m	ASTM D2624 At 23±2°C, 40°C, 100°C, 120°C, 150°C.	Report
FZG Gear wear test, Load Stage Pass 1450 RPM, 15 min at 100°C start temperature 1450 RPM, 15 min at 150°C start temperature	Load Stage Pass	ASTM D5182	8 8

Table (3) – ATF ULV (MERCON ULV, DEXRON ULV, OR EQUIVALENT)

Test Methods & Requirements

Test	Units	Method	Requirements
Color	-	ASTM D1500	Report
Appearance at 25 °C	-	Visual	Clear and Bright
Miscibility and Homogeneity	-	ASTM D6922	No separation or color change during or at completion of test using Reference Fluid
Density at 15 °C	kg/m ³	ASTM D4052	Report
Kinematic viscosity at 40 °C	mm ² /s (cSt)	ASTM D445	22 (max)
Kinematic viscosity at 100 °C	mm ² /s (cSt)	ASTM D445	4,4 (min) to 4,6 (max) 3,2 cSt @ 100°C (min) for base oil blend
Kinematic viscosity at 150 °C	mm ² /s (cSt)	ASTM D445	Report
Viscosity index	-	ASTM D2270	135 (min)
Fluid Film Thickness	-	EHD (at 60, 80, 100 and 120 °C)	Report
Cleanliness level	-	ISO 4406	Report At supplier manufacturing site prior to unloading into shipping containers
Flash point	° C	ASTM D92	180 (min)
Fire point	° C	ASTM D92	200 (min)
Pour point	° C	ASTM D97	-50 (max)
Foam tendency/foam stability (a)		ASTM D892	No foam at 95 °C 5mm (max) height at 135 °C 15s (max) break time at 135 °C

(b)	ml		50/0
Sequence I	ml		50/0
Sequence II	ml		50/0
Sequence III			
Air release	min	ASTM D3427	5 (max)
At 50 ° C			
Total Acid Number	mg KOH/g	ASTM D664	Report
Brookfield Viscosity	mPa.s	ASTM D2983	At -10 °C : Report At -20°C : 1500 (max) At -30°C : 5000 (max) At -40°C : 10000 (max)
Viscosity after mod. NOACK at -40° C	mPa.s	ASTM D2983	2000 mPa.s (max) change
Evaporation Loss	%	ASTM D5800 Modified NOACK (150°C, 2 hours)	10% (max) change
Cold Crank Simulation	mPa.s	ASTM D5293 At -30°C	3200 (max)
Elemental analysis	ppm	ASTM D5185	Report: Al, Ba, B, Ca, Cr, Cu, Fe, Pb, Mg, Mn, Mo, Ni, P, K, Si, Ag, Na, S, Sn, Ti, V and Zn
		ASTM D6443	Report, ppm: Cl
		ASTM D4629	Report, ppm: N
		ASTM D4927	Report, ppm: S
Copper corrosion, 100° C, 3h	class	ASTM D130 At 100	1b (max)
Water Content	%	ASTM D6304	0.05% weight maximum
Rust prevention , 24 h (Procedure A)	-	ASTM D665	No rust and corrosion on any Surface

Elastomer compatibility(*) NBR 1, 100 ° C, 168h - Relative increase in volume - Change in shore a hardness (*)Elastomer other than NBR may be agreed between the supplier and the end users. The limits are assigned by manufactories for elastomer type chosen.	% -	ISO 6072	0 to 12 -7 to 0
Oxidation stability - Increase in acid number after 1000h - Insoluble sludge	mg KOH/g mg	ISO 4263-1	2.0 (max) Report
Oxidation Tests (300 h, 155 ° C) Lead Coupon Weight Loss, 100 h.	%	ASTM D2893	0.5 (max)
Vane Pump Wear Test	mg	ASTM D2882 a) At 80 ± 3°C b) 6.9 Mpa	10 (max)
Thermal Conductivity for fresh and used fluid after Oxidation Test	W/(m·K)	ASTM D7896 At 40°C, 70°C, 100°C	Report
Electrical Conductivity Test	pS/m	ASTM D2624 At 23±2°C, 40°C, 100°C, 120°C, 150°C.	Report
FZG Gear wear test, Load Stage Pass	Load Stage Pass	ASTM D5182	

1450 RPM, 15 min at 100°C start temperature			11
1450 RPM, 15 min at 150°C start temperature			11

Table (4) - Continuously Variable Transmission (CVT), Test Methods & Requirements

Test	Units	Method	Requirements
Color	-	ASTM D1500	Report
Appearance at 25 °C	-	Visual	Clear and Bright
Miscibility and Homogeneity	-	ASTM D6922	No separation or color change during or at completion of test using Reference Fluid
Density at 15 °C	kg/m ³	ASTM D4052	Report
Kinematic viscosity at 40 °C	mm ² /s (cSt)	ASTM D445	30 (min)
Kinematic viscosity at 100 °C	mm ² /s (cSt)	ASTM D445	6 (min)
Kinematic viscosity at 150 °C	mm ² /s (cSt)	ASTM D445	Report
Viscosity index	-	ASTM D2270	150 (min)
Fluid Film Thickness	-	EHD (at 60, 80, 100 and 120 °C)	Report
Cleanliness level	-	ISO 4406	Report

			At supplier manufacturing site prior to unloading into shipping containers
Flash point	° C	ASTM D92	175 (min)
Fire point	° C	ASTM D92	180 (min)
Pour point	° C	ASTM D97	-٤٥ (max)
Foam tendency/foam stability		ASTM D892	
Sequence I	ml		50/0
Sequence II	mL		50/0
Sequence III	ml		50/0
Air release	min	ASTM D3427	5 (max)
At 50 ° C			
Total Acid Number	mg KOH/g	ASTM D664	Report
Brookfield Viscosity	mPa.s	ASTM D2983	At -40°C : 15000 (max)
Viscosity after mod. NOACK at -40° C	mPa.s	ASTM D2983	2000 mPa.s (max) change
Evaporation Loss	%	ASTM D5800 Modified NOACK (150°C, 2 hours)	10% (max) change
Cold Crank Simulation	mPa.s	ASTM D5293 At -30°C	3200 (max)
Elemental analysis	ppm	ASTM D5185	Report: Al, Ba, B, Ca, Cr, Cu, Fe, Pb, Mg, Mn, Mo, Ni, P, K, Si, Ag, Na, S, Sn, Ti, V and Zn
		ASTM D4951	Report, ppm: Zinc
		ASTM D4951	Report, ppm: Phosphorus
		ASTM D4927	Report, ppm: Sulfur
Copper corrosion, 100° C, 3h	class	ASTM D130 At 100	1b (max)
Water Content	%	ASTM D6304	0.05% weight maximum
Rust prevention , 24 h (Procedure A)	-	ASTM D665	No rust and corrosion on any Surface

Elastomer compatibility(*) NBR 1, 100 ° C, 168h - Relative increase in volume - Change in shore a hardness (*)Elastomer other than NBR may be agreed between the supplier and the end users. The limits are assigned by manufactories for elastomer type chosen.	% -	ISO 6072	0 to 12 -7 to 0
Oxidation stability - Increase in acid number after 1000h - Insoluble sludge	mg KOH/g mg	ISO 4263-1	2.0 max Report
Oxidation Tests (300 h, 155 ° C) Lead Coupon Weight Loss, 100 h.	%	ASTM D2893	0.5 (max)
Vane Pump Wear Test	mg	ASTM D2882 a) At 80 ± 3°C b) 6.9 Mpa	10 (max)
Thermal Conductivity for fresh and used fluid after Oxidation Test	W/(m·K)	ASTM D7896 At 40°C, 70°C, 100°C	Report
Electrical Conductivity Test	pS/m	ASTM D2624 At 23±2°C, 40°C, 100°C, 120°C, 150°C.	Report
FZG Gear wear test, Load Stage Pass	Load Stage Pass	ASTM D5182	

1450 RPM, 15 min at 100°C start temperature			8
1450 RPM, 15 min at 150°C start temperature			8

Table (5) - Dual Clutch Transmission (DCT), Test Methods & Requirements

Test	Units	Method	Requirements
Color	-	ASTM D1500	Report
Appearance at 25 °C	-	Visual	Clear and Bright
Miscibility and Homogeneity	-	ASTM D6922	No separation or color change during or at completion of test using Reference Fluid
Density at 15 °C	kg/m ³	ASTM D4052	Report
Kinematic viscosity at 40 °C	mm ² /s (cSt)	ASTM D445	35 (max)
Kinematic viscosity at 100 °C	mm ² /s (cSt)	ASTM D445	7.5 (max) 3,6 cSt @ 100°C (min) for base oil blend
Kinematic viscosity at 150 °C	mm ² /s (cSt)	ASTM D445	Report
Viscosity index	-	ASTM D2270	145 (min)
Fluid Film Thickness	-	EHD (at 60, 80, 100 and 120 °C)	Report
Cleanliness level	-	ISO 4406	Report

			At supplier manufacturing site prior to unloading into shipping containers
Flash point	° C	ASTM D92	200 (min)
Fire point	° C	ASTM D92	210 (min)
Pour point	° C	ASTM D97	-5 (max)
Foam tendency/foam stability		ASTM D892	
Sequence I	ml		10/0
Sequence II	mL		30/0
Sequence III	ml		10/0
Air release	min	ASTM D3427	5 (max)
At 50 ° C			
Total Acid Number	mg KOH/g	ASTM D664	Report
Brookfield Viscosity	mPa.s	ASTM D2983	At -40°C : 7000 (max)
Viscosity after mod. NOACK at -40° C	mPa.s	ASTM D2983	2000 mPa.s (max) change
Evaporation Loss	%	ASTM D5800 Modified NOACK (150°C, 2 hours)	10% (max) change
Cold Crank Simulation	mPa.s	ASTM D5293 At -30°C	3200 (max)
Elemental analysis	ppm	ASTM D5185	Report: Al, Ba, B, Ca, Cr, Cu, Fe, Pb, Mg, Mn, Mo, Ni, P, K, Si, Ag, Na, S, Sn, Ti, V and Zn
		ASTM D4951	Report, ppm: Zinc
		ASTM D4951	Report, ppm: Phosphorus
		ASTM D4927	Report, ppm: Sulfur
MOISTURE	ppm	ASTM 6304 Procedure C	500 (max)
Copper corrosion, 100° C, 3h	class	ASTM D130 At 100	1b (max)
Water Content	%	ASTM D6304	0.05% weight maximum
Rust prevention , 24 h (Procedure A)	-	ASTM D665	No rust and corrosion on any Surface

Elastomer compatibility(*) NBR 1, 100 ° C, 168h - Relative increase in volume - Change in shore a hardness (*)Elastomer other than NBR may be agreed between the supplier and the end users. The limits are assigned by manufactories for elastomer type chosen.	% -	ISO 6072	0 to 12 -7 to 0
Oxidation stability - Increase in acid number after 1000h - Insoluble sludge	mg KOH/g mg	ISO 4263-1	2.0 max Report
Oxidation Tests (300 h, 155 ° C) Lead Coupon Weight Loss, 100 h.	%	ASTM D2893	0.5 (max)
Vane Pump Wear Test	mg	ASTM D2882 a) At 80 ± 3°C b) 6.9 Mpa	10 (max)
Thermal Conductivity for fresh and used fluid after Oxidation Test	W/(m·K)	ASTM D7896 At 40°C, 70°C, 100°C	Report
Electrical Conductivity Test	pS/m	ASTM D2624 At 23±2°C, 40°C, 100°C, 120°C, 150°C.	Report
FZG Gear wear test, Load Stage Pass 1450 RPM, 15 min at 100°C start temperature	Load Stage Pass	ASTM D5182	8

1450 RPM, 15 min at 150°C start temperature			8
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