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Summary Report for **BULK INDEPENDENCE [9374002]** dated **07-Oct-2023**

Machine Name	Oil Grade In Use	Oil Rating	Action	Rating
MAIN ENGINE SULZER 6RT-flex50 SYSTEM (BEFORE PURIFIER)	NAVIGO 6 CO	The oil is fit for further use provided the landed used oil sample is representative for the application.	No action required.	
MAIN ENGINE SULZER 6RT-flex50 SYSTEM (AFTER PURIFIER)	NAVIGO 6 CO	The oil is fit for further use provided the landed used oil sample is representative for the application.	No action required.	
M/E L.O. SETTLING TANK NOT APPLICABLE N.A. -	NAVIGO 6 CO	The oil is fit for further use provided the landed used oil sample is representative for the application.	No action required.	

Critical Immediate Action Required Warning Can Continue Normal Normal

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BULK INDEPENDENCE [9374002]

MAIN ENGINE DU-3708 [SYSTEM (BEFORE PURIFIER)]

Manufacturer	: SULZER	**Model**	: 6RT-flex50
Port Landed	: Netherlands	**Volume[ltr]**	:
Fuel Grade / S%	:	**Dispatched**	: 02-Oct-23
Recommended	: NAVIGO 6 CO	**Received**	: 05-Oct-23

New Oil	Alert Value.	Sample Details	1 (Current)	2	3
		Rating	**Normal**	Critical	Caution
		Sample No	**23098207**	23085384	23064027
		Bottle No	**50333164**	50252623	70004909
		Sampled Date	**26-Sep-23**	21-Aug-23	07-Jun-23
		Oil Grade In Use	**NAVIGO 6 CO**	NAVIGO 6 CO	NAVIGO 6 CO
		Unit Service Hrs	**75148**	Not Stated	74181
		Oil Service Hrs	**Not Stated**	Not Stated	Not Stated
		Daily Makeup[ltr]	**Not Stated**	Not Stated	Not Stated
New Oil	**Alert Value.**	**Analysis**			
		Appearance	**Clear**	Dark	Dark
100	<85 or>150	KV@40°C[mm²/s]	**112.5**	122.5	124.1
11.5		KV@100°C[mm²/s]	**12.35**	12.42	12.78
6	>15	BN[mgKOH/g]	**8.8**	12.3	12.9
	<180	Flash Point[°C]	**>200**	>200	>200
	>1	Soot/Insoluble[%wt]	**0.10**	0.20	0.20
	>0.3	Water[%wt]	**0.12**	0.50	0.06
		PQ Index/2ml	**<10**	<10	<10
		Wear Elemental [ppm]			
	>100	Aluminium (Al)	**1**	3	2
	>50	Chromium (Cr)	**<1**	<1	<1
	>100	Copper (Cu)	**3**	4	5
	>200	Iron (Fe)	**5**	14	16
	>100	Lead (Pb)	**<1**	<1	<1
	>100	Tin (Sn)	**<1**	1	<1
		Contaminant Elemental [ppm]			
		Boron (B)	**3**	10	7
	>250	Sodium (Na)	**5**	8	8
	>100	Silicon (Si)	**6**	5	6
		Molybdenum (Mo)	**<1**	1	<1
		Nickel (Ni)	**1**	3	4
		Silver (Ag)	**<1**	<1	<1
		Vanadium (V)	**1**	3	4
		Additive Elements [ppm]			
		Calcium (Ca)	**3415**	4944	5313

Oil Rating:
The oil is fit for further use provided the landed used oil sample is representative for the application.

Unit Rating:
Wear rate is normal; no abnormalities are evident.

Action:
No action required.

Alert Value :* Indicate Oil supplier/operator critical limits.
Support : technical @lukoil.com

Dated: 07-Oct-2023

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BULK INDEPENDENCE [9374002]

MAIN ENGINE DU-3708 [SYSTEM (AFTER PURIFIER)]

Manufacturer	: SULZER	**Model**	: 6RT-flex50
Port Landed	: Netherlands	**Volume[ltr]**	:
Fuel Grade / S%	:	**Dispatched**	: 02-Oct-23
Recommended	: NAVIGO 6 CO	**Received**	: 05-Oct-23

New Oil	Alert Value.	Sample Details	1 (Current)	2	3
		Rating	**Normal**	Critical	Caution
		Sample No	**23098208**	23085385	23064028
		Bottle No	**50333165**	50252622	70004908
		Sampled Date	**26-Sep-23**	21-Aug-23	07-Jun-23
		Oil Grade In Use	**NAVIGO 6 CO**	NAVIGO 6 CO	NAVIGO 6 CO
		Unit Service Hrs	**75148**	Not Stated	74181
		Oil Service Hrs	**Not Stated**	Not Stated	Not Stated
		Daily Makeup[ltr]	**Not Stated**	Not Stated	Not Stated
New Oil	**Alert Value.**	**Analysis**			
		Appearance	**Clear**	Dark	Clear
100	<85 or>150	KV@40°C[mm²/s]	**109.6**	121.7	121.5
11.5		KV@100°C[mm²/s]	**11.84**	12.38	12.73
6	>15	BN[mgKOH/g]	**8.6**	12.2	12.7
	<180	Flash Point[°C]	**>200**	>200	>200
	>1	Soot/Insoluble[%wt]	**0.10**	0.20	0.20
	>0.3	Water[%wt]	**0.07**	0.48	0.05
		PQ Index/2ml	**<10**	<10	<10
		Wear Elemental [ppm]			
	>100	Aluminium (Al)	**1**	3	2
	>50	Chromium (Cr)	**<1**	<1	<1
	>100	Copper (Cu)	**1**	4	3
	>200	Iron (Fe)	**4**	13	15
	>100	Lead (Pb)	**<1**	<1	1
	>100	Tin (Sn)	**<1**	<1	1
		Contaminant Elemental [ppm]			
		Boron (B)	**3**	6	7
	>250	Sodium (Na)	**4**	8	5
	>100	Silicon (Si)	**5**	5	3
		Molybdenum (Mo)	**<1**	<1	<1
		Nickel (Ni)	**1**	3	3
		Silver (Ag)	**<1**	<1	<1
		Vanadium (V)	**1**	3	3
		Additive Elements [ppm]			
		Calcium (Ca)	**3392**	4718	5211

Oil Rating:
The oil is fit for further use provided the landed used oil sample is representative for the application.

Unit Rating:
Wear rate is normal; no abnormalities are evident.

Action:
No action required.

Alert Value :* Indicate Oil supplier/operator critical limits.
Support : technical @lukoil.com

Dated: 07-Oct-2023

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BULK INDEPENDENCE [9374002]

M/E L.O. SETTLING TANK [-]

Manufacturer	: NOT APPLICABLE	**Model**	: N.A.
Port Landed	: Netherlands	**Volume[ltr]**	:
Fuel Grade / S%	:	**Dispatched**	: 02-Oct-23
Recommended	: NAVIGO 6 CO	**Received**	: 05-Oct-23

New Oil	Alert Value.	Sample Details	1 (Current)	2	3
		Rating	**Normal**		
		Sample No	**23098209**		
		Bottle No	**50333166**		
		Sampled Date	**26-Sep-23**		
		Oil Grade In Use	**NAVIGO 6 CO**		
		Unit Service Hrs	**75148**		
		Oil Service Hrs	**Not Stated**		
		Daily Makeup[ltr]	**Not Stated**		
New Oil	**Alert Value.**	**Analysis**			
		Appearance	**Dark**		
100		KV@40°C[mm²/s]	**118.9**		
11.5	<9.3 or>15.5*	KV@100°C[mm²/s]	**12.61**		
6	<2 or>30*	BN[mgKOH/g]	**8.9**		
	<170*	Flash Point[°C]	**>200**		
	>1.2*	Soot/Insoluble[%wt]	**0.20**		
	>0.5*	Water[%wt]	**0.07**		
		PQ Index/2ml	**<10**		
		Wear Elemental [ppm]			
	>100*	Aluminium (Al)	**2**		
	>50*	Chromium (Cr)	**<1**		
	>100*	Copper (Cu)	**4**		
	>200*	Iron (Fe)	**14**		
	>100*	Lead (Pb)	**<1**		
	>100*	Tin (Sn)	**<1**		
		Contaminant Elemental [ppm]			
		Boron (B)	**6**		
	>250*	Sodium (Na)	**22**		
	>100*	Silicon (Si)	**7**		
		Molybdenum (Mo)	**<1**		
		Nickel (Ni)	**3**		
		Silver (Ag)	**<1**		
		Vanadium (V)	**3**		
		Additive Elements [ppm]			
		Calcium (Ca)	**3524**		

Oil Rating:
The oil is fit for further use provided the landed used oil sample is representative for the application.

Unit Rating:
Wear rate is normal; no abnormalities are evident.

Action:
No action required.

Alert Value :* Indicate Oil supplier/operator critical limits.
Support : technical @lukoil.com

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Standard Test Methods Employed:	
Analysis	**Test Method**
Viscosity (KV@40°C and 100°C)	(ASTM D445-21)
Flash Point (@200°C)	(ASTM D3828-16a Method A)
Flash Point (°C)	(ASTM D3828-16a Method B;ASTM D92-18)
Soot/Insoluble	(ASTM D7899-19; ASTM D893-14 (2018); ASTM E2412-10 (2018))
Base Number	(ASTM D2896-15 Procedure B)
Acid Number	(ASTM D664-18e2 Method A)
Water	(ASTM E2412-10 (2018); ASTM D6304-20; ASTM D95-13 (2018))
Oxidation	ASTM D7414/E2412 (FTIR @5.85µm)
PQ Index	(Manufacturer Method)
ISO Cleanliness Code	(ISO 11500:2008 & ISO 4401:2021)
Elemental Analysis(Wear,Contaminants and Additive Elements)	(ASTM D5185-18)

Lubricant Analysis Glossary
The service utilizes the latest analytical techniques and computer programming to offer an advanced lubricant analysis package that provides a valuable lubricant monitoring tool for the ship operator.
Lubricant properties reported on lubricant analysis reports
(tests conducted depend on machinery type and oil grade)
Acid Number
Tests the acidity of the oil. Certain oils have an inherent acidity level related to their additive chemistry. Increasing acidity may be indicative of the presence of organic acids derived from oil oxidation.
Asphaltenes
Give an indication of heavy fuel derived components from raw fuel ingress and/or products of combustion from blowby.
Base Number
Previously known as Total Base Number (TBN) is a measure of the reserve alkalinity of an engine oil and its ability to neutralise harmful acids.
Fe
Iron - (Fe) Indicate level of iron (ferro-magnetic and non-magnetic) in the oil sample, up to a particle size of 7 microns. Typical sources of iron are cylinder liners, crankshafts, piston rings, gears. Can indicate the level of corrosive wear in cylinder scrapedown samples.
Feed Rate [g/kW/h]
Feed rate setting, which is e.g. the “Basic Feed Rate” for MAN engines, the “Base Feed Rate” for Wartsila engines and the “MCR Feed Rate” for MHI engines at the time of sampling reported on submission form by crew.
Flash Point
Primarily a test for fuel dilution in engine oils. A decrease in flash point is generally an indication of fuel ingress which has contaminated the lubricant.
Insolubles
A test for the total solids contamination in a lubricant such as combustion soot, dirt, oxidation products and metal wear debris.
ISO 4406 Cleanliness Code
The code for expressing the particulate contamination level per milliliter of fluid sample with 4, 6 and 14 micron size. Dirt ingress, filter failure and generated wear etc. results higher particulate contamination in the fluid which can cause damage to the sensitive control valves of high pressure hydraulic systems by plugging small orifices.
Oxidation
A chemical process in which a carbon atom gains bonds to oxygen in organic components like petroleum fluids. Oil oxidation leads into the degradation of the oil properties. Oxidation test result has been expressed in this report as Abs/0.1mm, it can be converted to Abs/cm by multiplying with 100.
PQ (Particle Quantification) Index
Not an oil property but an index that provides a quantitative assessment for trending purposes. It detects the amount of ferro-magnetic wear debris in the oil sample. Can indicate the level of abrasive / adhesive wear in cylinder scrapedown samples
Viscosity
A measure of the resistance of a liquid to flow. Commonly referred to as the 'thickness of an oil'.
Water
The percentage (by volume) of the total amount of water contamination.

Elemental analysis with some typical sources
(Elements reported depend on machinery type and oil grade and are reported in PPM, Parts Per Million)
Aluminium – Pistons, specific piston rings, bearing, housing, fuel derivative
Antimony - Bearings
Calcium - Lubricant derivative
Chromium - Piston rings
Copper - Bearings, gears, oil coolers, pipework, pistonrod glands
Iron - Cylinder liners, crankshafts, piston rings, gears
Lead - Bearings
Magnesium - Casings, housings, lubricant derivative
Manganese - Cylinder liners
Molybdenum - Piston rings
Nickel - Bearings, valves, gears, fuel derivative
Potassium - Salt Water
Phosphorus - Lubricant derivative
Silicon - Dust, dirt, fuel derivative, lubricant derivative
Silver - Bearings
Sodium - Salt water, coolant derivative, fuel derivative
Tin - Bearings
Vanadium - Fuel derivative
Zinc - Lubricant derivative

Alert Value
Where OEM values are known, those are the Alert Values indicated on reports, otherwise Alert Values considered suitable by Lukoil are indicated by an asterisk ‘*’