OPUS LUBRICANTS PRODUCT DATA

SYNOPUS INDUSTRIAL GEAR OILS

Description

The PAO series EP Synopus Industrial Gear Oils are range of products particularly suited to gear applications in which extreme conditions are expected. These products are formulated with PAO synthetic base stocks in order to provide performance greatly superior to conventional petroleum oils. Further, the PAO series are fully compatible significantly improved load carrying ability, excellent wear and rust protection, high viscosity index, high flash point, low pour point, outstanding oxidative stability and cleaner systems. The gear oils meet with all the Flanders requirements, including Wind Turbine Specifications.

Application

- Gear applications which require extreme service conditions
- Due to the low friction a lower energy consumption up to 3% can be expected
- Gear applications where extreme temperatures (both high & low) are seen
- Wide Temperature Range – 50 to 180 depending on the grade

Performance Levels

- US. Steel 224, 222, 223
- Din 51517, part 3 (clp)
- Cincinnati Machine P – 74
- David brown S1. 53.101 Type E
- SEB 181 226
- AGMA 250.04 (EP Gear Oils), AGMA 9005 EO2 – D94 (EP Gear Oils)

PLEASE NOTE THE FOLLOWING DATA ARE TYPICAL VALUES AND DO NOT CONSTITUTE A SPECIFICATION.

Benefits

- Excellent oxidation and thermal stability
- High operating temperature range
- Lower maintenance cost
- Improves cleanliness
- Extended lubricant life
- Compatibility with most used paints, gaskets, and seals
- Compatibility with petroleum-based lubricants, therefore minimal effort by changeover

Typical Data

ISO GRADES AVAILABLE	68	100	150	220	320	460	680

Attached is extensive performance testing carried out on ISO 220 and 320, however the same additive package and the treat rate is used for all the ISO grades to provide extreme performance.

Wind turbine Specifications

A summary of the performance requirements for wind turbines manufacturers is given below:

1. DIN 51517 Pt III (January 2004), which includes FZG Scuffing Load Test [A/8.3/90]
2. FAG FE8 DIN 51819-3 with weight loss limits of <30mg roller wear.
3. ASTM D2893 oxidation test
4. FZG Micro pitting according to FVA Nr. 54 At 90°C and 60°C Requirement is ≥ 10 is ISO 220VG Min. Results from independent test houses mainly either FZG Institute Munich
5. FZG Scuffing, single [A/8.3/90] & double speed [A/16/6/90] Requirement between 12 and 14 Pass

Synopus Industrial Gear Oils Meet and Exceed Wind Turbine Specifications Din 51517 Part 111

Viscosity Grade	**ISO 220**	**ISO 320**	**Limits**
Kinematic Viscosity at 40°C, ASTM D445, mm²/s	219.40	325.6	198-242
Kinematic Viscosity at 100°C, ASTM D445, mm²/s	25.73	35.49	
Viscosity Index, ASTM D2270	149	155	90min.
Density at 15°C, g/ml	0.86	0.86	Report
Flash Point (COC), ASTM D97, °C	>250	>250	200min.
Pour Point (COC), ASTM D92, °C	-38	-35	-9 max.
Water content, ISO 3733, %	0.014	0.008	<0.1
Foam Tendency/ Stability, ml (ISO 6247)	Bracknell	Bracknell	
Sequence I	20/0	20/0	100/0
Sequence II	230/0	170/0	100/0
Sequence III	0/0	0/0	100/0
Foam Tendency/ Stability, ml (ISO 6247)	ISP		
Sequence I	60/0[1]		100/0
Sequence II	60/0		100/0
Sequence III	0/0		100/0
Foam Tendency/ Stability, ml (ISO 6247) Option A	Bracknell & ISP	Bracknell	
Sequence I	0/0	0/0	100/0
Sequence II	0/0	0/0	100/0
Sequence III	0/0	0/0	100/0
Air Release at 75°C, IP313, minutes and seconds	2'24" [1]	8'48" [1]	
Demulse at 82°C, ASTM 1401, minutes	8' 20"	17'52" [1]	30 max.
Copper Corrosion, ASTM D130 (3h at 100°C)	1b	1a	2 max.
Rust Test – Procedure A, D665	Pass	Pass	Pass
Rust Test – Procedure B, D665	Pass	Pass	
S-200 oxidation, ASTM D2893, (312 h at 121°C)			
Viscosity Increase, %	2.71	1.33	6 max.
Precipitation Number, ml	0	0	
FZG Scuffing Load Test [A/8.3./90]	14 pass[1]	14 Pass	12 min.

FAG FE8 DIN 51819-3			
7.5 RPM, 80Kn axial Load, 80°C, 80 hours			
Weight loss Rollers, mg	4[2]	4[2]	<30[3]
Weight loss Cage, mg	28.5[2]	28.5[2]	
Compatibility with SRE – NBR28 (DIN 53528 – 3, 7d @ 100°C			
Relative change in Volume, %	6.5	6.5	-5/+10
Change in Shore A hardness, %	-1.4	0	-10/+10
Change of Tensile strength, % max.	-16	-15	30 max
Change of Elongation, % max.	-33	-34	30 max

Freudenberg Seals compatibility carried out on ISO 220

Test	**ISO 220**	**Limits**
Static test Din 53521, 72 NBR 902, 1000h, 100C		
Hardness Shore A	+7	+5/-5
Volume swell, %	5.7	+5/-2
E-Modul, %	+45%	-
Tensile Strength, %	-7.1%	-50 max
Elongation at Break, %	-47%	-60 max.
Static test DIN 53521, 75 FKM 170055, 1000 h, 130C		
Hardness Shore A	+1	+5/-5
Volume swell, %	5.1	+5/-2
E-Modul, %	-1.7%	-
Tensile Strength, %	-8%	-50 max.
Elongation at Break, %	+7%	-60 max.
Static test DIN 53521, 75 FKM 170055, 1000 H, 130C		
Hardness Shore A	+3	+5/-5
Volume Swell, %	3.1	+5/-2
E – Modul, %	+35%	-
Tensile Strength, %	-13%	-50 max.
Elongation at Break, %	-47%	-60 max.
Dynamic test DIN 3761, 72 NBR 902 1000 h @ 80C	Pass	Pass
Dynamic test Din 3761, 75 FKM 585 1000 h 110C	Pass	Pass
Dynamic test DIN 3761, 75 FKM 170055 1000 h @ 110C	Pass	Pass

Viscosity Grade	**ISO 220**	**ISO 320**	**Limits**
Flender Foam [Test Oil/Foam Volume at 5 mins]			
Original Oil	10%	12%	15%
Contamination with 2% running in oil	12%	13%	15%
Contamination with 4% running in oil	10%	13%	15%
Flender Foam Test – Winergy Method – Fresh Oil			
Run at 0°C	20%	14%	20%
Run at 20°C	17%	15%	17%
Run at 40°C	8%	8%	13%
Run at 60°C	6%	4%	10%
Hydac Single Pass Foam/Filtration Test	Pass	Pass	
Hydac Multi Pass Foam/Filtration Test	Pass		
Fresh oil before Filtration	12%		
Oil after 100 Filtration Cycles	9%		
Oil after 1000 Filtration Cycles	10%		
Demulsification ASTM D2711			
Volume of free water, ml, minimum	80		80 min.

Water in emulsion %	0.5		1 max.
FZG Scuffing Load test [A/8.3/90]	14Pass		>12
FZG Scuffing Load Test [A/8.3/60]	14 Pass		>12
FZG Scuffing Load Test [A/16.6/90]	14 Pass		>12
FZG Scuffing Load Test [A/16.6/60]	14 Pass		>12
4 Ball LWI, ASTM D 2783			
Load Wear Index, kgf	56.16	54.09	
Weld point, kg	250	250	

Viscosity Grade	**ISO 220**	**ISO 320**
FZG Micro pitting Test at 90°C [FVA 54/7] ISO 220 VG oil		
Test run at Afton Chemical Ltd, Bracknell		
First Stepwise Phase, LS	= 10	
Second Stepwise Phase, LS	= 10	
GF Class	High	
FZG Micro pitting Test at 90°C [FVA 54/7] ISO 320 VG oil		
Test run at Shell PAE, Hamburg		
First Stepwise Phase, LS		>10
Second Stepwise Phase, LS		>10
GF Class		High
FZG Micro pitting Test at 90°C [FVA 54/7] ISO 320 VG oil - Testing Run at Ruhr University Bochum		
First Stepwise Phase, LS		=10
Second Stepwise Phase, LS		=10
GF Class		High
FZG Micro pitting Test at 60°C [FVA 54/7] ISO 220 VG oil		
Testing Run at Ruhr University Bochum		
First Stepwise Phase, LS	>10	
Second Stepwise Phase, LS	>10	
GF Class	High	
FZG Micro pitting Test at 60°C [FVA 54/7] ISO 220 VG oil		
Testing Run at Afton Chemical Ltd, Bracknell		
First Stepwise Phase, LS	= 10	
Second Stepwise Phase, LS	=10	
GF Class	High	
FZG Micro pitting Test at 60°C [FVA 54/7] ISO 320 VG oil		
Testing Run at Afton Chemical Ltd, Bracknell		
First Stepwise Phase, LS		=10
Second Stepwise Phase, LS		>10
GF Class		High

Blend ID	**Go010701 HI 11999**	**Most Severe Limits**	**FAG Specification – for Wind Turbines**
Viscosity Grade	**ISO 220**		
FAG FE8 DIN 51819-3 - 7.5 rpm, 80kN axial load, 80°C, 80 hours			
Weight loss Rollers, mg	4	<10	
Weight loss Cage, mg	28.5	<80	
FAG FE8 Step 1 test 7.5 rpm, 100kN axial load, 80°C, 80 hours			
Weight loss Rollers, mg	Pass		≤20
Weight loss Cage, mg	Pass		≤100
FAG FE8 1745-hour test			
75 rpm, 80kN axial load, 80°C, 1745 hours			
Weight loss Rollers, mg	4	<10	
Weight loss Cage, mg	-	<100	

FAG FE8 Step 2 test			
Weight loss Rollers, mg	5		≤20
FAG FE8 Step 3 test	Pass		No fatigue damages
FAG FE8 Step 4 test, 750 rpm, 60 kN axial load, 100°C, 600 hours Water added: 1 drop/120s			
Weight loss Rollers, mg	1		≤20
Weight loss Cage, mg	19		≤100

Blend ID	**HI 11999**	**SKF Specification – for Wind Turbines**
Viscosity Grade	**ISO 220**	
Kinematic viscosity, mm2/s	216.50	Report
Pour Point, °C	-39	< -20 for synthetic oil
Oxidation stability, ASTM D2893		
Viscosity Increase at 100°C, %	1.3	6% max.
Viscosity Increase at 121°C, %	2.71	< 6%
SKF Film aging, 4 weeks at 120°C	1	2 max
Rating Evaporation loss, %	4.4	15 max.
Oil description	No lacquer	No lacquer
Foam ISO 6247	10/0[2]	75/10/10.00
	50/0	75/10/10.00
	0/0	75/10/10.00
Contamination ISO 4406	17/15/12	As required
SKF PS 1061432-4e solid impurities. %	<0.02	0.02
SKF roller test, 8 weeks at 100°C		
Roller attack	1	2 max.
Viscosity change	5.7	10% max.
Sludge formation	None	None
Incrustation	None	None
Copper corrosion		
3h at 120C	1	2 max.
24h at 120C	3	2 max.
FAG FE8 DIN 51819-3		
7.5 rpm, 80Kn axial load, 80°C, 80 hrs		
Weight loss Rollers, mg	4	< 30mg
Weight	28.5	Report
SKF Emcor test		
Corrosion Degree	0-0	1 max.
SKF filterability test	5	< 15 minutes

Blend ID	**HI 12619**	**SKF Specification – for Wind Turbines**
Viscosity Grade	**ISO 320**	
Corrosion of Roller Bearings @ 100°C		
2 weeks	1	2 max
4 weeks	1	2 max
6 weeks	1	2 max
8 weeks	1	2max
Corrosion of Roller Bearings @ 120°C		
2 weeks	1	2 max
4 weeks	1	2 max
6 weeks	4	2 max
8 weeks	4	2 max
Oil Ageing (100°C)		
Kv40 After Aging, mm^2s^{-1}	5.7	±10%
Sludge formation	None	Traces
Incrustation	None	None

Colour after 1:50 dilution with Heptane	1	6 max
Oil Ageing (120°C)		
Kv40 After Aging, mm^2s^{-1}	18.8	±10%
Sludge formation	Moderate	Traces
Incrustation	Moderate	None
Colour after 1:50 dilution with Heptane	3	6 max
Oil film stability (120°C)		
Evaporation loss after 4 weeks,	4.4	15 max
% oil film ageing	1	2 max
Corrosion of brass (copper corrosion)		
3hrs @ 100°C	1	2 max
3hrs @ 120°C	1	2 max
24hrs @ 100°C	1	2 max
24hrs @ 120°C	3	2 max
Kv40, mm^2s^{-1}	325.7	±10%
Corrosion protection (SKF EMCOR)		
Distilled water	0/0	1 max
0.5% NaCl Solution	2/2	1max
Pour Point	-39	-20 (synthetics)
Foaming Characteristics		
Sequence I	10/0	75/10
Sequence II	50/0	75/10
Sequence III	10/0	75/10
Cleanliness (ISO 4406)	17/15/12	As required
Filtration (SKF 5µ), minutes	5	15 Max

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