SINCE 1839 Schaeffer's SPECIALIZED LUBRICANTS

TECHNICAL DATA

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ISO 9001 CERTIFIED

211SW Wind Turbine Oil ISO 320

Wind Turbine Oil is a full synthetic, extreme pressure gear lubricant that is designed to provide maximum protection and optimum performance especially in the area of micropitting resistance to wind turbine and industrial gear drives and oil lubricated roller element bearings even under the most extreme operating conditions.

Wind Turbine Oil is formulated from a unique, novel class and blend of synthetic base fluids that have been carefully selected and tested to provide the following performance advantages:

- Excellent oil film thickness over a broad temperature range
- Excellent viscoelastic and elastohydrodynamic lubricant film thickness
- Exceptional oxidation and thermal stability
- Naturally high viscosity index
- Excellent low temperature fluidity
- Low coefficients of traction to reduce power losses and improve efficiency
- Excellent hydrolytic stability and demulsibility
- Very good air release properties

Blended into the synthetic base fluids is thermally stable and durable extended performance extreme pressure additive system that provides the Wind Turbine with the following performance advantages:

- Excellent protection from micropitting fatigue wear especially to heavily loaded gear drives with surface-hardened tooth metallurgies even under extreme conditions
- Excellent resistance to gear scuffing wear
- Excellent extreme pressure retention
- Excellent thermal and oxidative stability and durability
- Excellent clean gear performance under conditions of high temperature and oxidation
- Enhanced gear, bearing and seal cleanliness
- Excellent prevention against the formation of sludge, carbon and varnish deposits that can erode seals and cause premature bearing and gear wear
- Excellent resistance to rust and corrosion
- Excellent demulsibility characteristics and hydrolytic stability
- Excellent resistance to foaming
- Excellent filterability
- Outstanding filter life, even in the presence of water
- Excellent compatibility with seal and elastomeric materials
- Compatibility with internal coatings and paints

The ever increasing performance requirements made on wind turbine gears and today's highly loaded industrial gear drives has led to higher operating loads, power densities and increased torque. These performance requirements result in the gear drives being not only being subjected to higher operating temperatures, which subjects the gear lubricant to extreme thermal stress but also higher loading conditions. Therefore, it is important that the gear lubricant possess thermal stability and durability characteristics along with excellent load carrying capabilities to protect the gears and bearings from excessive wear and micropitting.

Continued on next page

Wind Turbine Oil's synthetic base fluids and thermally stable and durable, multi-functional, extreme pressure, additive package enables the Wind Turbine Oil to resist oxidation and thermal stress at operating temperatures and to provide the loaded carrying protection that is needed. This results in:

- A vast reduction in the formation of deposits.
- Better heat transfer and lower operating temperatures.
- Excellent protection to the gears and bearings even under the most extreme thermally stressed operating conditions to provide less wear to gears, bearings and seals
- High micropitting resistance offers sufficient protection to gears that are subject to high loads and would normally be susceptible to this type of damage
- Excellent wear protection to both gears and rolling element bearings o in order ensures that the service life calculated for the lubricated components is achieved.
- Excellent viscosity-temperature behavior to support the formation of a sufficient lubricating film even at elevated and high temperatures.
- Longer oil service life than petroleum base oil formulations due to the excellent ageing and oxidation resistance of the products PAO synthetic base fluids
- Increased gear efficiency
- Increase power output
- Reduced energy consumption
- Longer equipment life and reduced maintenance costs

Most types of gearing are designed to operate under hydrodynamic lubrication conditions. That is, a full fluid oil film must separate the metal surfaces of the gears and bearings during operation. However, during periods of cold start up, extremely high operating temperatures or high shock loading and vibration conditions, this full fluid film can be destroyed. Unless a boundary lubricant is present in the gear lubricant when this full fluid film is destroyed, excessive wear can take place.

Wind Turbine Oil contains a proven friction reducer and boundary lubricant called Micron Moly®. Micron Moly® is a liquid soluble type moly that plates itself to the metal surfaces of the gears and bearings. Once plated, Micron Moly® forms an indestructible long lasting solid lubricant film that is capable of withstanding pressures up to 500,000 psi. This solid lubricant film, once plated to the gears and bearings, will reduce friction, vibration and wear, thus extending equipment life.

The Micron Moly® also provides a smooth finished surface on all moving parts of the gears. This minimizes the action of cold welding and vibration, which can occur during start up after gears have been standing idle and during periods of high shock loading. This in turn lessens starting loads and peak power demand, thus resulting in a realistic power cost savings.

Wind Turbine Oil meets and exceeds the following specifications and OEM requirements: AIST 224 (previously US Steel 224); AGMA 9005 E-02; AGMA 9005-F-16; AGMA 6006-A03 DIN 51517 Part 3 (CLP); ISO 12925-1 Type CKD; DIN 51502 Type CLP; David Brown S1.53.101 Type E; IEC 61400-4; JIS K-2219; SEB 181226, Hansen Industrial BUI-Tec-2009-4-001; FLSmidth; GB 5903-2011 L-CKD; FAG Step 1-4; Siemens (Flender) AS7300 Revision 14; Winergy; GE Energy; Bosch Rexroth; Eickhoff; Nanjing; Brevini; Renk AG; Santasalo Moventas; SEW; Sumitomo Drives; Suzlon, Vestas, Jahnel Kestermann, Mitsubishi Heavy Industries.

TYPICAL PROPERTIES

ISO Grade	**320**
Specific Gravity @ 15°C (60°F)	0.86
Viscosity cSt @ 40°C ASTM D-445	319.6
Viscosity cSt @ 100°C	37
Brookfield Viscosity, cP @ -26°C ASTM D-2893	82,000
Viscosity Index ASTM D-2270	165
Flash Point °F (°C) ASTM D-92	482°(250°)

Pour Point °F (°C) ASTM D-97	-38°(-39°)
FZ Scuffing Load A/8.3/90 DIN 5182 Fail Stage	14+
FZG Micropitting Test (FVA 54/7) Fail Stage GFT Rating	 10 High
FVA Micropitting Test @ 90°C After Load Stage 9 ffg, µm After Load Stage 9 GF%	 0.2 0.8
FVA Micropitting Test @ 60°C After Load Stage 9 ffg, µm After Load Stage 9 GF%	 0.45 0.34
Fag FE 8 DIN 51819-3 *7.5 rpm, 80kN Axial Load, 80°C, 80 hours* Average Weight Loss of Rollers, mg Maximum Weight Loss of Rollers Cage Wear, mg	 2 3 151
FAG FE 8 Step Test Step 1 *7.5 rpm, 80kN Axial Load, 80°C, 80 hours* Average Weight Loss of Rollers, mg Cage Wear, mg	 2 151
FAG FE 8 Step Test Step 2 *7.5 rpm, 80kN Axial Load, 80°C, 80 hours* Average Weight Loss Rollers, mg	 4
FAG FE 8 Step Test Step 3 *7.5 rpm, 100kN Axial Load, 80°C, 80 hours*	 No fatigue damage
FAG FE 8 Step Test Step 4 *750 rpm,60kN Axial Load, 100°C, 600 hours, water added 1 drop ever 120 seconds* Weight Loss Rollers, mg Weight Loss Cage, mg	 <1 19
Oxidation Stability Test ASTM D-2893 % Viscosity Increase @ 100°C % Viscosity Increase @ 121°C	 1.3 2.71
EMCOR Rust Test ASTM D-6138 Rating	0/0
Rust Test ASTM D-665 Procedure A – Distilled Water Procedure B – Salt Water	 Pass Pass
Foam Tendency Stability Test ASTM D-892 Sequence I Sequence II Sequence III	 0/0 0/0 0/0
Air Release @ 75°C IP313	8 minutes, 48 seconds
Extended Flender Foam Test % 1 minutes after stopping test 0°C 20°C 25°C 40°C 60°C % Oil-air dispersion 5 minutes after stopping test 0°C 20°C 25°C 40°C 60°C	 14 15 12 8 4 12 11 8 4 1
Copper Strip Corrosion Test ASTM D-130	1A
Demulsibility Test ASTM D-2711 Free Water, ml % Water in oil Emulsion, ml	 83 0.65 Trace
Demulsibility (ASTM D-1401) O-W-E Time (minutes)	 40-40-0 18 minutes
Falex Wear Test ASTM D-3233 Procedure A, Failure Stage Lb.-f	4,500