



# TECHNICAL DATA

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## 503SW Wind Turbine Oil ISO 220, 320, 460 and 680

Wind Turbine Oil is a para-synthetic extreme pressure gear lubricant that is designed for use in the lubrication of heavily loaded gears and rolling element bearings in gear drives of wind turbines.

Wind Turbine Oil is blended from a combination of the highest quality solvent refined severely hydrotreated paraffin base stocks and hydrogenated polyalphaolefin (PAO) base fluids. This combination provides the Wind Turbine Oil with the following performance advantages:

1. Very good oil film thickness over a broad temperature range.
2. Increased viscoelastic and elastohydrodynamic lubricant film thickness.
3. Enhanced oxidation and thermal stability.
4. Superior oxidation and thermal stability.
5. Low coefficients of traction.
6. Very good air release properties.
7. A high natural viscosity index
8. Good low temperature flow ability.
9. Compatibility with elastomeric materials and seals commonly used in wind turbine applications.

Blended into these para-synthetic base fluids is a non-aggressive, non-corrosive thermally stable and thermally durable multi-functional extreme pressure additive system that provides the Wind Turbine Oil with the following performance properties:

1. Enhanced thermal and oxidative stability and durability to handle high operating temperatures.
2. Excellent extreme pressure properties to protect the gears and bearings from excessive wear and fatigue.
3. Protection against micropitting and scuffing gear teeth even under extreme operating conditions.
4. Prevention of the formation of carbon deposits that can erode seals and cause premature bearing and gear wear.
5. Excellent seal compatibility.
6. Enhanced protection of yellow metals from corrosion.
7. Non-corrosive to yellow metals and other non-ferrous components

TD-203SW (Rev 01/2010)

8. Excellent protection of components from rust and corrosion in dry and moist operating conditions.
9. Excellent demulsibility characteristics and hydrolytic stability.
10. Enhanced gear, bearing and seal cleanliness.
11. Excellent resistance to foaming.
12. Excellent filterability.

The ever increasing performance requirements made on wind turbine gears have led to the equipment operating at higher loads, power densities and increased torque. These performance requirements have resulted in the gear drives of wind turbines being subjected to higher operating temperatures. These higher operating temperatures have resulted in the gear lubricant being subjected to extreme thermal stress.

Therefore, it is important that a gear lubricant possess thermal stability and durability characteristics. Gear lubricants that do not possess these properties rapidly oxidize and decompose when subjected to high temperatures, resulting in the formation of sludge, varnish and carbon deposits on the gears, bearings and seals, abraded seals, premature seal hardening and brittleness, and a loss of the gear lubricant's extreme pressure additive chemistries ability to protect against excessive wear, spalling and overall distress to the gears and bearings.

Wind Turbine Oil's para-synthetic base fluids and the thermally stable and the thermally durable multi-functional extreme pressure additive package enable the Wind Turbine Oil to resist oxidation and thermal stress at operating temperatures 150°F to 175°F higher than conventional gear lubricants. This results in:

1. A vast reduction in the formation of deposits.
2. Better heat transfer
3. Excellent protection to the gears and bearings even under the most extreme thermally stressed operating conditions.
4. Less wear to gears, bearings and seals
5. Increased oil seal life
6. Lower operating temperatures
7. Improved gear efficiency
8. Increased power output
9. Less energy consumption
10. Longer lubricant life
11. Less equipment downtime
12. Longer equipment life
13. Reduced maintenance costs

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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 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: US Steel 224, AGMA 9005 E-02, AGMA 250.04, AGMA 251.02, DIN 51517 Part 3 (CLP), ISO 12925-1 Type CKD.

Wind Turbine Oil is recommended for use in wind turbine gear drives manufactured by:

- Bosch Rexroth
- Eickhoff
- Fag
- Flender
- GE Energy Wind Turbine Drive Systems
- Hansen Transmissions
- Jahnel Kestermann
- Mitsubishi Heavy Industries
- SKF
- Sulzon
- Vestas
- Winergy

Typical Properties on next page

### Typical Properties

<b>ISO Grade</b>	<b>220</b>	<b>320</b>	<b>460</b>	<b>680</b>
AGMA Grade	----	6EP	7EP	8EP
Specific Gravity @15°C (60°F)	.8867	.8724	.8708	.8722
Viscosity cSt @ 40°C (ASTM D-445)	201-225	290-325	435-500	616-745
Viscosity @ 100°C (ASTM D-445)	18.50-22.50	25.00-32.00	35.00-42.00	34.50-51.50
Viscosity Index (ASTM D-2270)	112	125	127	110
Flash Point °F/°C (ASTM D-92)	470°/243°	490°/254°	500°/260°	510°/266°
Fire Point °F/°C (ASTM D-92)	510°/266°	540°/282°	550°/288°	560°/293°
Pour Point °F/°C (ASTM D-97)	-15°/-26° to -20°/-36°	-15°/-26 to -20°/-29°	-10°/-23° to -15°/-26°	-10°/-23° to -15°/-26
Rust Test (ASTM D-665)				
Procedure A (Distilled Water)	Pass	Pass	Pass	Pass
Procedure B (Salt Water)	Pass	Pass	Pass	Pass
Copper Strip Corrosion Test (ASTM D-130)	1a	1a	1a	1a
Four Ball EP Test (ASTM D-2783)				
Weld Point, kgs.	400	400	400	400
Load Wear Index	65.2	67.91	69.50	67.91
Four Ball Wear Test (ASTM D-4172)				
Scar Diameter, mm	0.3	0.28	0.28	0.28
Timken EP Test (ASTM D-2782)				
Ok Load, lbs	70	70	70	70
Failure Load, lbs	75	75	75	75
Falex EP Continuous Load (ASTM D-3233)				
Procedure A				
Failure Load, lbs	2500	2500	2500	2500
FZG A/8.3/90 (ASTM D-5182)				
Failure Load	13 <sup>th</sup> Stage	13 <sup>th</sup>	13 <sup>th</sup>	13 <sup>th</sup>
FZG Micropitting Test @ 60°C FVA 54/7 Pass Stage	>10	>10	>10	>10
FZG Micropitting Test @ 90°C FVA 54/7 Pass Stage	>10	>10	>10	>10

Typical properties continued on next page

**Typical Properties Continued**

ISO Grade	220	320	460	680
FAG FE8 Test (Stages 1,2,3,4) DIN 51818-3	Pass	Pass	Pass	Pass
Oxidation Test (ASTM D-2893)				
% Viscosity increase after 312 hours @ 203°F/95°C	3	3	3	3
L-60-1 Thermal Oxidation Test (ASTM D-5704)				
% Viscosity Increase	22	22	22	22
Demulsibility Test (ASTM D-2711)				
Free Water, ml	83	83	83	83
% Water in oil	0.65	0.65	0.65	0.65
Emulsion, ml	Trace	Trace	Trace	Trace
Foam Tendency Test (ASTM D-892)				
Sequence I	0/0	0/0	0/0	0/0
Sequence II	0/0	0/0	0/0	0/0
Sequence III	0/0	0/0	0/0	0/0

Packaging: 503SW Wind Turbine Oil is available in 420lb drums, 120lb kegs and 40lb pails.