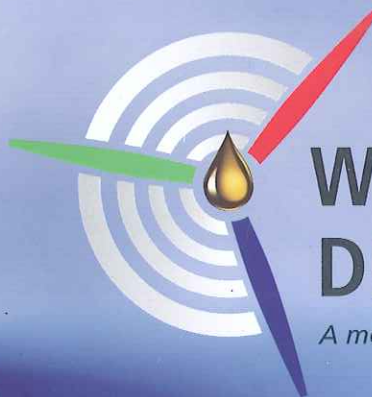


Special Lubricants for Wind Power Plants



**WINDPOWER
DIVISION**

A member of FUCHS PETROLUB AG

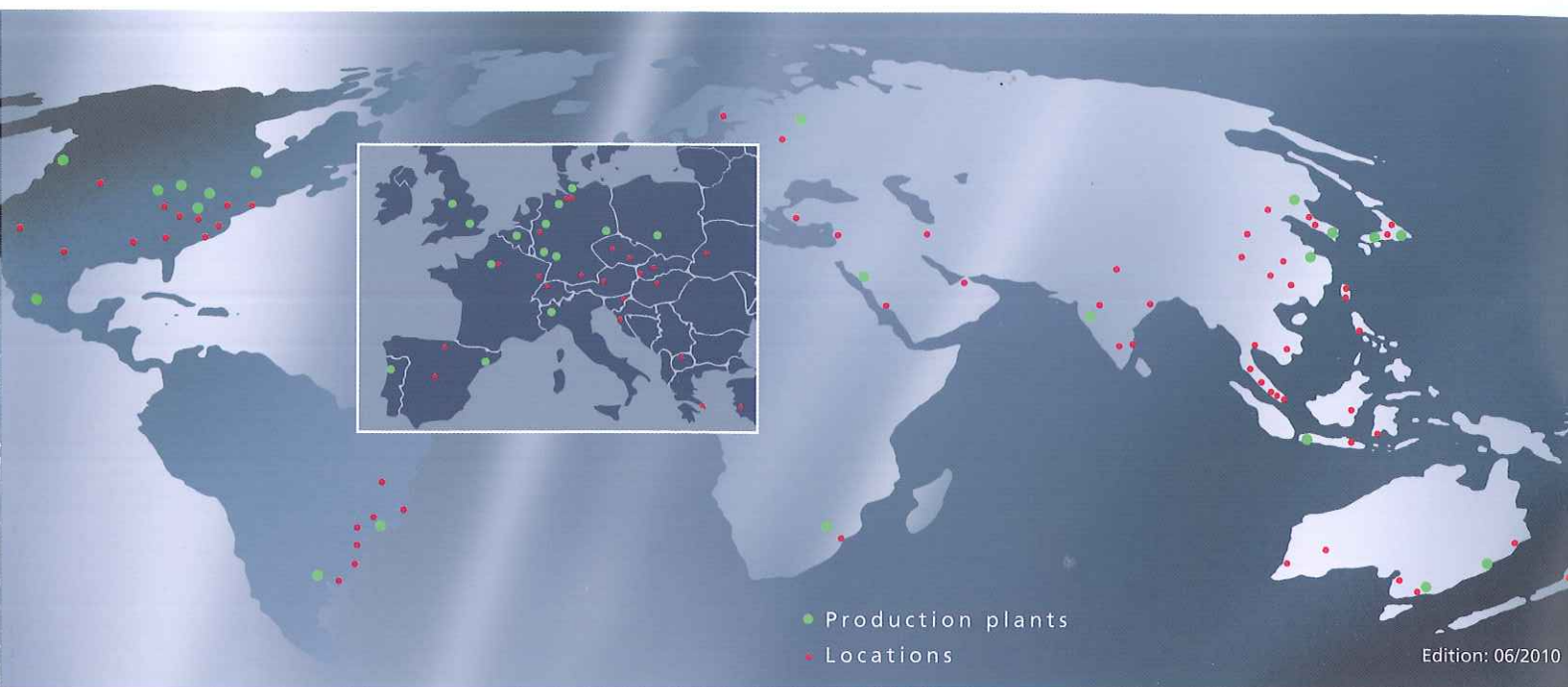
We make the wind win

**FUCHS LUBRITECH GMBH and
FUCHS EUROPE SCHMIERSTOFFE GMBH:
Now together in a powerful partnership
for all requirements of our customers.**



Special Lubricants for Wind Power Plants

Great solutions – worldwide.



The two sister companies, FUCHS EUROPE SCHMIERSTOFFE GMBH and FUCHS LUBRITECH GMBH have combined their market activities in the wind power sector under the name FUCHS WINDPOWER DIVISION.

The FUCHS WINDPOWER DIVISION offers customers in this sector a wide range of high-performance greases (FUCHS LUBRITECH) as well as hydraulic and gear oils (FUCHS EUROPE SCHMIERSTOFFE).

Together with expert advice and first-class logistics, these products are marketed through a global network of 54 FUCHS PETROLUB AG companies.

The FUCHS WINDPOWER DIVISION thus has the expertise to solve all lubrication challenges posed by the wind turbine manufacturers, the makers of the drive components as well as the wind farm operators. A wide and high-performance range of special lubricants are thus available to customers in this sector.



Two strong partners – one team.



FUCHS LUBRITECH GMBH, located in Kaiserslautern/ Germany employs more than 400 people worldwide. FUCHS LUBRITECH GMBH is a 100 % subsidiary of FUCHS PETROLUB AG, the world's largest independent manufacturer of lubricants.

LUBRITECH stands for "LUBRication" and "TECHnology". FUCHS LUBRITECH is one of the world's leading manufacturers of special lubricants and release agents. The range of products includes concrete release agents, adhesive lubricants, lubricating fluids and greases, pastes, lubricating varnishes, aerosols, glass processing media and metal forming lubricants – a total of over 1,000 special products that are precisely tailored to their respective applications. The result of this focused and innovative approach is a product range that leaves nothing to be desired and no area of application uncovered.

FUCHS LUBRITECH plant in Kaiserslautern/Germany



FUCHS EUROPE SCHMIERSTOFFE plant in Mannheim/Germany

FUCHS EUROPE SCHMIERSTOFFE GMBH is a German company whose almost 600 employees manufacture and market a wide range of lubricants and derived specialties.

The company, which was founded in 1931 as RUDOLF FUCHS, is located in Mannheim and is a 100 % subsidiary of FUCHS PETROLUB AG, the world's largest independent manufacturer of lubricants.

The company's degree of specialisation and innovation is way above the industrial average in this field.

The full product line includes almost 2,000 lubricants and derived specialties for all walks of life, industrial processes and applications.

Notice

The information contained in this brochure is based on the experience and know-how of FUCHS LUBRITECH GMBH and FUCHS EUROPE SCHMIERSTOFFE GMBH in the development and manufacturing of lubricants and represents the current state-of-the-art. The performance of our products can be influenced by a series of factors, especially the specific use, the method of application, the operational environment, component pre-treatment, possible external contamination, etc. For this reason, universally valid statements about the function of our products are not possible. The information given in this brochure represents general, non-binding guidelines. No warranty expressed or implied is given concerning the properties of the product or its suitability for any given application.

We therefore recommend that you consult a FUCHS LUBRITECH GMBH or a FUCHS EUROPE SCHMIERSTOFFE GMBH application engineer to discuss application conditions and the performance criteria of the products before the product is used. It is the

responsibility of the user to test the functional suitability of the product and to use it with the corresponding care.

Our products undergo continuous improvement. We therefore retain the right to change our product program, the products, and their manufacturing processes as well as all details of our brochure at any time and without warning. With the publication of this brochure, all previous editions cease to be valid.

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Application areas.

The FUCHS WINDPOWER DIVISION offers a broad product portfolio of special lubricants for all wind power applications. Many approvals of turbine, gearbox and bearing manufacturers as well as suppliers of filtering systems prove the high performance and quality of our products.

Lubricant application		Lubricants
1	Pitch adjustment Bearing	gleitmo 585 K STABYL EOS E 2 STABYL LT 50
	Tooth system	gleitmo 585 K STABYL EOS E 2 CEPLATTYN BL CEPLATTYN ECO 300 Plus
2	Rotor bearing	STABYL EOS E 2
3	Clutch	gleitmo 585 K STABYL EOS E 2
4	Main gearbox	GEARMASTER ECO 320 RENOLIN PG 320 RENOLIN UNISYN CLP 320 RENOLIN CLP 320
5	Generator bearings	URETHYN E/M 2 URETHYN XHD 2
6	Yaw system reduction gear	GEARMASTER ECO 220 RENOLIN PG 220 RENOLIN UNISYN CLP 220 RENOLIN CLP 220
7	Yaw system Bearing	gleitmo 585 K STABYL EOS E 2 STABYL LT 50
	Tooth system	gleitmo 585 K STABYL EOS E 2 CEPLATTYN BL CEPLATTYN ECO 300 Plus
8	Hydraulic systems	ECO HYD S series PLANTOHYD series RENOLIN HVLP series
Fasteners / assembly aids		gleitmo WSP 5040
Rapid rust removers		FERROFORM LOCC FERROFORM ECO LOCC

Further specialities for drive technology in wind power plants

RENOLIN MR 90: Special running-in, corrosion protection and test rig oil; excellent cleaning and flushing properties, high corrosion protection, very good wear protection.

RENOLIN CLP VCI gear oil: New EP-gear oil with excellent corrosion protection properties; special developed VCI-components (VCI = Volatile Corrosion Inhibitors) for safe storage and transport of machines

and components; machine elements and gears are protected against corrosion also in the vapour phase without direct contact of the oil with the metal surface.

RENOLIN HighGear Synth gear oil: Industrial gear oil newest additive technology based on polyalphaolefin (PAO); Plastic deformation (PD) technology; for pre-damaged gear sets and „critical applications“.

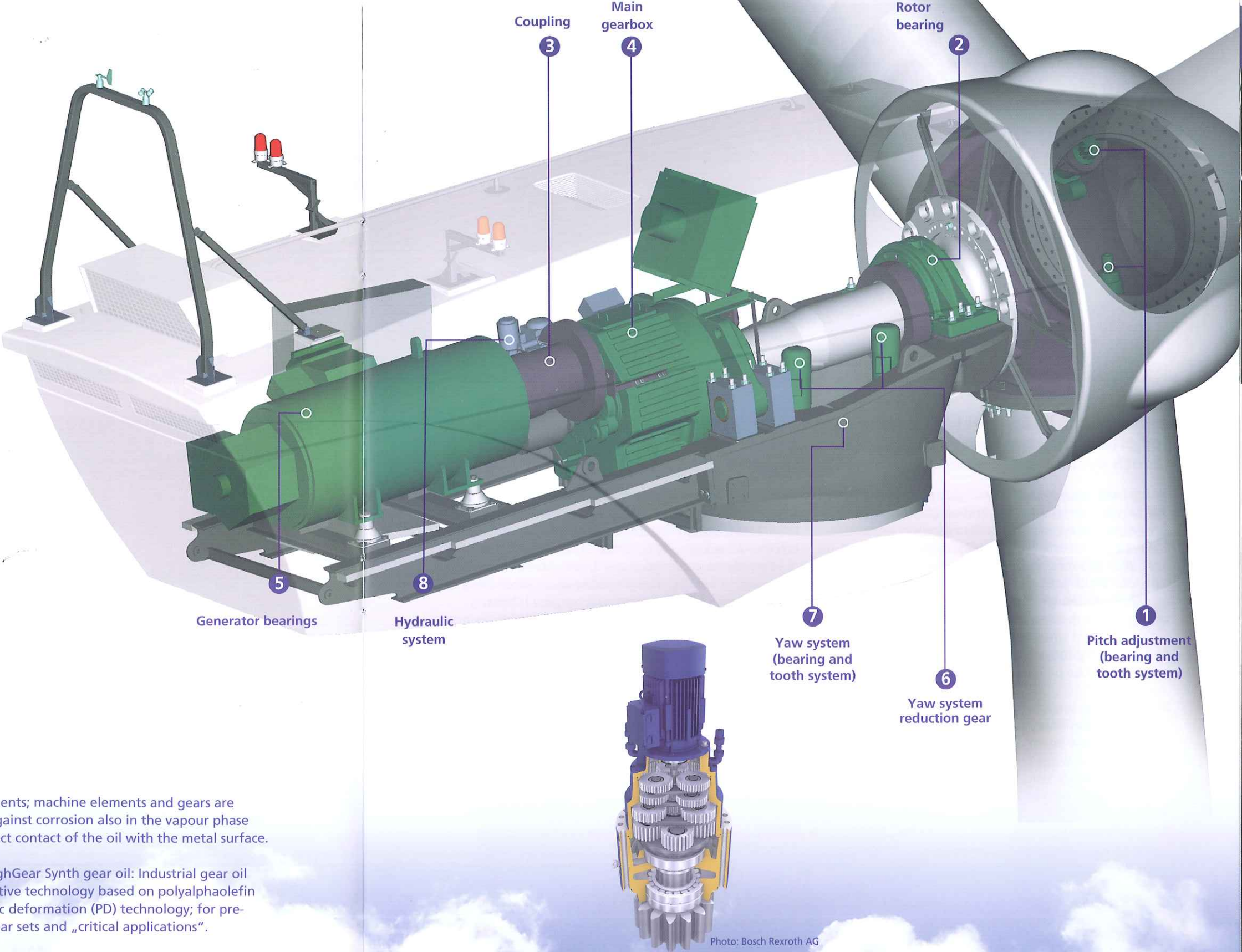


Photo: Bosch Rexroth AG

Large-size bearings in wind turbines

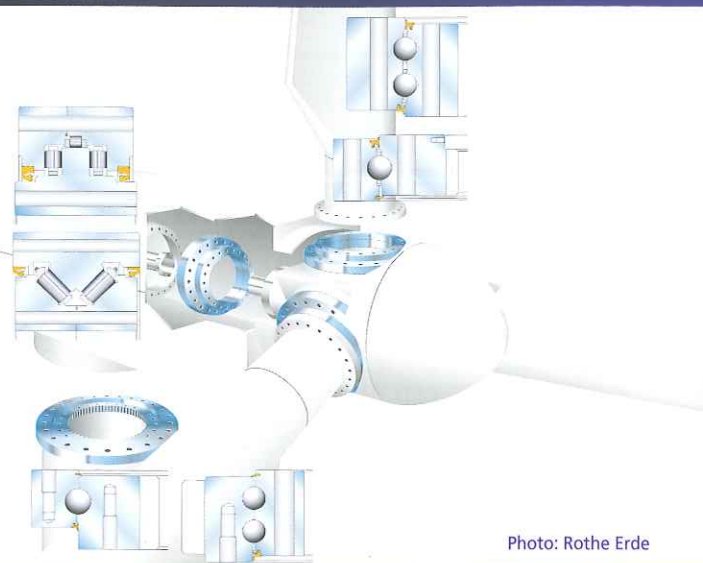


Photo: Rothe Erde

Double row large-size bearings

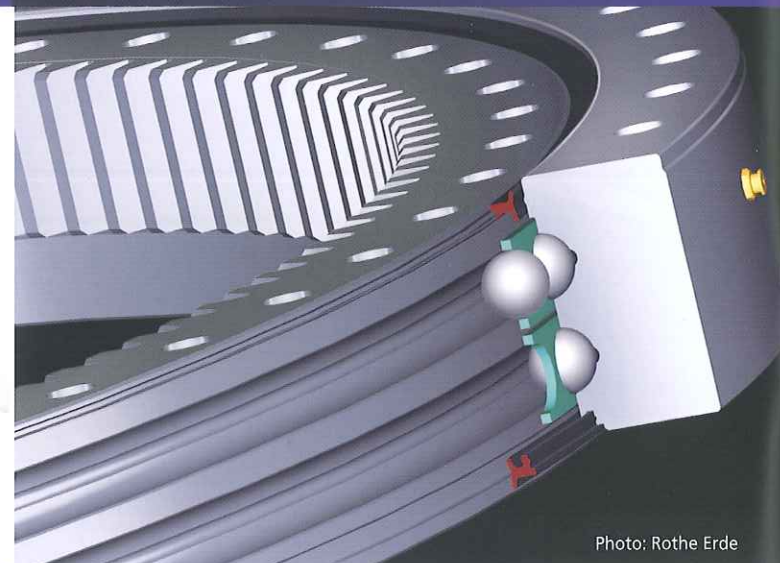
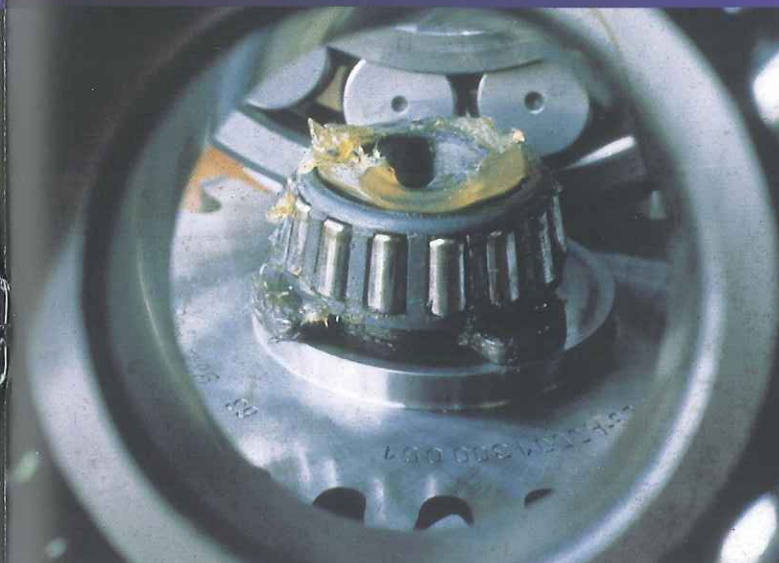


Photo: Rothe Erde

Special grease for low temperatures



High temperature grease for long-term lubrication



gleitmo 585 K: Special lubricant for pitch and yaw bearings (tooth system and bearing)

gleitmo 585 K is a fully-synthetic special lubricant containing a synergistic combination of white solid lubricants. This combination offers excellent protection against wear especially under critical operation conditions like vibrations and oscillation movements under high load which are typical for pitch and yaw bearings on wind turbines. gleitmo 585 K is well known in the wind power industry and used as OEM first fill and service lubricant since many years with best results. Also for the tooth system of the yaw- and pitch bearings. Please use a lube pinion.

- Outstanding wear protection, especially at shock loads and oscillatory movements for the use in pitch and yaw bearings
- Extremely wide temperature range, suitable for all terms of climate conditions
- Temperature range: -45 °C up to +130 °C
- Consistency: NLGI grade 2
- Identification according DIN 51502: KPFHC 2 K-40
- Outstanding protection against false brinelling and fretting corrosion
- Very high load carrying capacity at low rotational speed
- Pumpable in automatic lube systems
- Approvals: Rothe Erde (ThyssenKrupp), IMO, ZS lubrication systems
- References: Most of the wind power plant manufacturers, users of wind power plants and parts

STABYL EOS E 2: High-performance grease for wind power applications (tooth system and bearing)

STABYL EOS E 2 is a high-performance grease based on a fully-synthetic ester and a lithium soap as thickener. It fulfils the highest technical requirements for modern lubricants used in wind turbines. STABYL EOS E 2 was developed in a perennial research project in cooperation with leading bearing manufacturers and is successfully in use on wind turbines as general purpose lubricant. Also for the tooth system of the yaw- and pitch bearings. Please use a lube pinion.

- Universal application on wind power units, especially for pitch, yaw and rotor bearings
- Extreme wide temperature range, suitable for all terms of climate conditions
- Temperature range: -40 °C up to +130 °C
- Consistency: NLGI grade 2
- Identification according DIN 51502: KPE 2 K-40
- Allows considerable reduction of lubricant diversity on wind turbine units
- Very good protection against false brinelling and fretting corrosion
- High load carrying capacity at low rotational speed
- Pumpable in automatic lube systems
- Approvals: Rothe Erde (ThyssenKrupp), IMO, ZS lubrication systems
- References: Most of the wind power plant manufacturers, users of wind power plants and parts

STABYL LT 50: Low temperature grease for arctic conditions

STABYL LT 50 is a synthetic oil-based naturally coloured grease containing lithium soap as thickener. It is designed especially for the lubrication of plain and antifriction bearings. STABYL LT 50 is used as OEM first fill and service lubricant since many for pitch and yaw bearings since many years.

- Application on wind power units, especially for pitch and yaw bearings
- Extreme wide temperature range, suitable at arctic conditions
- Temperature range: -50 °C up to +130 °C
- Consistency: NLGI grade 2
- Identification according DIN 51502: KPHC 2 N-50
- High load carrying capacity at low rotational speed
- Pumpable in automatic lube systems

URETHYN XHD 2: Fully-synthetic polyurea grease for extreme application conditions

URETHYN XHD 2 is a soft lubricating grease based on a synthetic hydrocarbon base oil and a very temperature resistant polyurea thickener. A selected additive package provides excellent wear protection, even under fluctuating speeds, temperatures and loads.

- High temperature lubricant for long-life lubrication of bearings at higher temperatures and high loads and speeds e.g. in generator bearings
- Temperature range: -30 °C up to +180 °C, short-term up to +200 °C
- Consistency: NLGI grade 2
- Identification acc. to DIN 51502: KPTHC 2R-30
- Extraordinary thermal stability
- High oxidation stability
- Pumpable in automatic lube systems

Special Lubricants for Wind Power Plants

RENOLIN UNISYN CLP Series.

Gear oils with extended life time

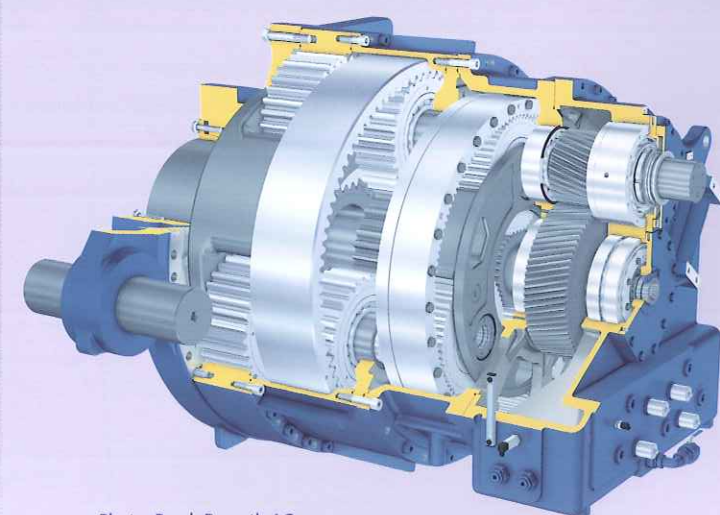
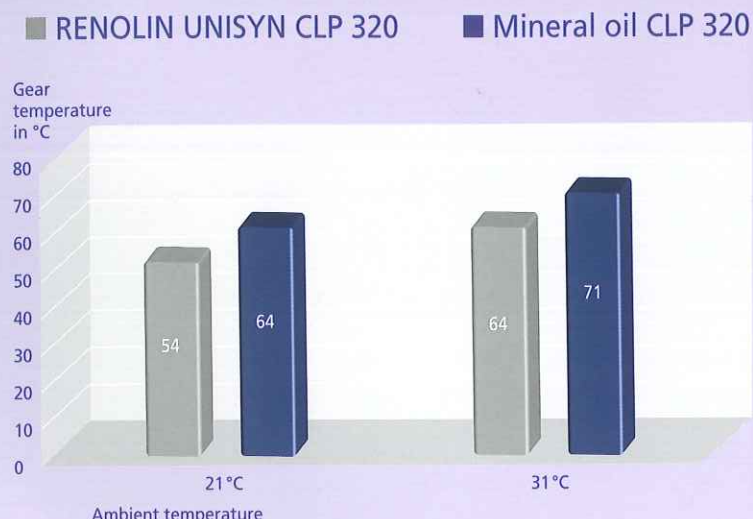


Photo: Bosch Rexroth AG

Gear oil in wind power plants



Fully-synthetic industrial gear and lubricating oil-based on polyalphaolefin (PAO)

RENOLIN UNISYN CLP 320 is based on special fully-synthetic hydrocarbons (polyalphaolefins). Synergistic acting additives guarantee excellent wear protection, excellent corrosion protection, high thermal stability, high oxidation stability and a long lifetime. In comparison to mineral oil-based products a 4–5 times higher lifetime can be achieved by using RENOLIN UNISYN CLP products. Due to our experience, our FUCHS test field results and due to field results, it is reported that RENOLIN UNISYN CLP can decrease the oil sump temperature by 5–10°C (low friction coefficient under load in comparison to mineral oil-based products). RENOLIN UNISYN CLP can be used as a high-performance EP gear oil in highly-loaded spur gears, bearings, planetary and worm gears.

RENOLIN UNISYN CLP 320 is used with great success in wind turbine applications over many years worldwide. The test results in the FAG 4-stage test (wind turbine test for industrial gear oils, Schaeffler Group) demonstrate the excellent wear protection properties of RENOLIN UNISYN CLP 320. Total Rating 1 (excellent) shows the superior wear protection properties of RENOLIN UNISYN CLP 320 at different mixed friction conditions, under different load, speed and temperature conditions. Even under EHL (Elasto-Hydrodynamic Lubrication) conditions and under the influence of contamination in form of emulsified water, the products show no wear and no sludge. Special AW/EP additives guarantee high scuffing protection. These additives avoid also micro pitting failures over a wide temperature range.

- Fully-synthetic gear oil-based on PAO
- ISO VG 68-680
- Miscible and compatible with mineral and ester oil
- **Micro pitting test FZG-GFT:**
LS >10, high protection
- **FZG GFT: C/8,3/+60°C and +90°C: load stage high**
- **FZG-scuffing test: high protection**
FZG A/8,3/90: load stage > 14
FZG A/16,6/140: load stage > 12
- **FAG wind turbine test – 4 stage test:**
rating 1,0 (excellent wear protection, no wear)
- **FE 8-roller bearing wear test, 7,5/80/80 and 7,5/100/80: no wear**

- Excellent oxidation stability
- Excellent thermal stability –
SKF WTGU test at +100°C: passed
- Excellent filterability
- Low foaming tendency
- Excellent air release properties
- Excellent material compatibility
- Approvals and references: Acciona, Bosch Rexroth, Enercon, Flender, Gamesa, Hansen, Jahnelt+Kestermann, Liebherr, Zollern and other leading manufacturers of gearboxes and wind power plants

GEARMASTER ECO Series.



Environmentally friendly gear oils

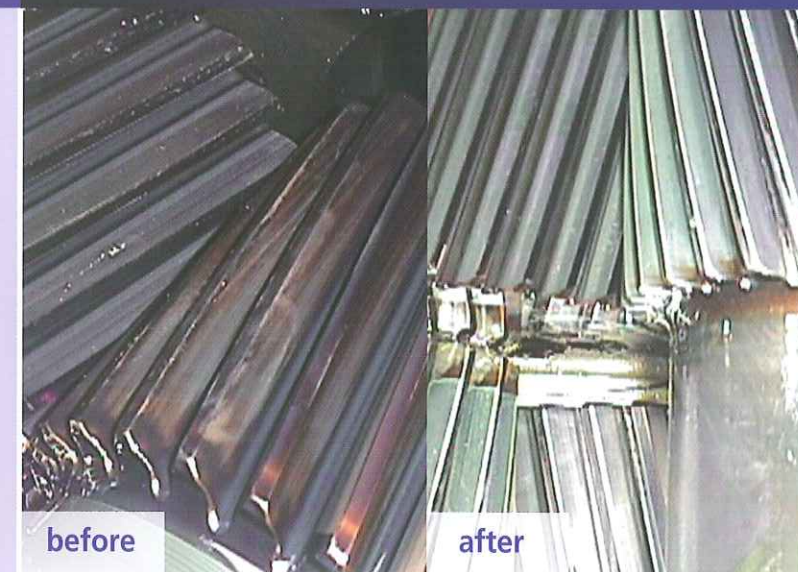


Environmentally harmless lubricating and gear oils based on synthetic ester

GEARMASTER ECO industrial EP gear oils are based on special fully-synthetic saturated ester. The products of the GEARMASTER ECO series are high-performance industrial gear oils which can be used in highly loaded spur gears, bearings, planetary and worm gears. Due to the excellent biodegradability (biodegradability > 60 % according to OECD 301 C) the GEARMASTER ECO products can also be recommended for the use in environmentally sensitive areas. GEARMASTER ECO products are based on polar saturated esters which have excellent wetting and cleaning properties („Clean Gear Technology“). They provide excellent wear protection, excellent corrosion protection, high thermal stability, high oxidation

- Fully-synthetic biodegradable gear oil-based on synthetic ester
- ISO VG 68-680
- Miscible and compatible with mineral oil and PAO
- **Micro pitting test FZG-GFT: LS > 10, high protection**
FZG GFT: C/8,3/+60°C and +90°C: load stage high
- **FZG-scuffing test: high protection**
FZG A/8,3/90: load stage 14
FZG A/16,6/140: load stage > 12
- **FAG wind turbine test – 4 stage test:**
rating 1,0 (excellent wear protection, no wear)
- **FE 8-roller bearing wear test, 7,5/80/80 and 7,5/100/80: no wear**

Gear after change over to GEARMASTER ECO



stability and a long lifetime. GEARMASTER ECO products can decrease the oil sump temperature due to their low friction coefficient in comparison to mineral oil-based products. GEARMASTER ECO 320 have been used with great success in wind turbine applications worldwide over many years as a high-performance EP gear oil. The test results in the FAG 4-stage test (wind turbine test for industrial gear oils, Schaeffler Group) demonstrate the excellent wear protection properties of GEARMASTER ECO 320. Total Rating 1 (excellent) shows the superior wear protection properties at 4 defined test conditions (different mixed friction conditions, different load, speed and temperature conditions). Special AW/EP additives guarantee high scuffing wear protection. These additives avoid also micro pitting failures over a wide application temperature range.

- Excellent oxidation stability
- Excellent thermal stability –
SKF WTGU test at +100°C: passed
- Excellent cleaning properties
- **„Clean Gear Technology“**
- Excellent filterability
- Low foam tendency, excellent air release properties
- Excellent material compatibility
- Approvals and references: Bosch Rexroth, Chongqing Chongchi, Flender, Moventas, Winergy (GE) and other leading manufacturers of gearboxes and wind power plants

Special Lubricants for Wind Power Plants

Excellent wear protection.

Reliability and durability.



Research and development for perfect solutions



Wear protection right from the start



FAG FE 8-roller bearing wear test rig



FZG gear test rig



RENOLIN UNISYN CLP 320: FAG 4-stage test



	Criterion	Test	Result
Stage 1*	wear at boundary lubrication	FEB-80h	1,0 passed
Stage 2**	fatigue beh. at mixed friction cond.	FEB-80h	1,0 passed
Stage 3***	fatigue behaviour at EHL-cond.	L11-700h	1,0 passed
Stage 4***	fatigue behaviour and residues with water added	FEB-WKA	1,0 passed
summary:		1,0	passed

Oil: Fuchs Renolin Unisyn CLP 320
tested as VP LA_4_05_005 Var. 6.1
Supplier: Fuchs Europe
Oil type: PAO

* Tested by FUCHS report PFMA-06-0110 (unknown batch number)
** Tested by Assmann report 4206b – batch V6.2
*** Step 3 and 4 tested by Schaeffler KG

	result:	1	2	3	4	5	test	result	rating	
Stage 1*	wear of rollers V50WK	< 10	< 15	< 20	< 30	< 30	yes	0	1	passed
	rippings	no	–	small	ro or wash	ro + wash	yes	no	1	
	micro pittings	no	–	–	no	strong	yes	no	1	
Stage 2**	running time (hours)	> = 800	–	–	–	< 800	yes	800	1,0	passed
	wear of rollers V50WK	< 10	< 15	< 20	< 30	< 30	yes	2	1	
Stage 3***	no fatigue damage forced by additives up to L50 (hours)	700	650	600	550	< 550	yes	stage 2 700	1,0 1	passed
Stage 4***	running time 600 hours	> = 600	–	–	–	< 600	yes	600	1	passed
	filter blocking	no	–	–	–	–	yes	no	1	
	wear of rollers V50WK	< 10	–	–	–	–	yes	0	1	
	wear of cage V50KF	< 20	–	–	–	–	yes	84	1	
	fatigue damages	no	–	–	–	–	yes	no	1	
	residues at the bearing	slight	sl/mod	moderate	mod/heavy	heavy	yes	slight	1	
	residues at the preheating system	slight	sl/mod	moderate	mod/heavy	heavy	yes	slight	1	
								stage 4	1,0	
summary									1,0	passed

Special hydraulic fluids for wind power applications

ECO HYD S PLUS:
Rapidly biodegradable hydraulic fluid based on saturated synthetic esters

Fully-synthetic, high-performance hydraulic fluid and lubricating oil-based on special saturated synthetic esters. Multigrade characteristic due to excellent viscosity temperature behaviour (natural high shear stable viscosity index, VI > 150), excellent low temperature properties, good lubrication film stability, high wear protection (FZG A/8,3/90 failure load stage > 12) rapidly biodegradable (> 60 % according to OECD 3001C). The ISO guideline 15 380 should be observed when changing systems from mineral or synthetic oil to biodegradable lubricants.

RENOLIN HVI 32 GA:
Special multigrade hydraulic fluids – mineral oil-based

RENOLIN HVI 32 GA is a specially developed multigrade hydraulic oil-based on selected base oils. Due to the base oil properties together with synergistic acting additives the product has a wide operating temperature range. RENOLIN HVI 32 GA has a high shear stable viscosity index, VI > 160. This high viscosity index (flat viscosity temperature graph) guarantees excellent cold flow properties and high lubricating film stability. The fluid guarantees high wear protection, high stability and good corrosion protection.

Multigrade hydraulic fluids from FUCHS

RENOLIN UNISYN OL series

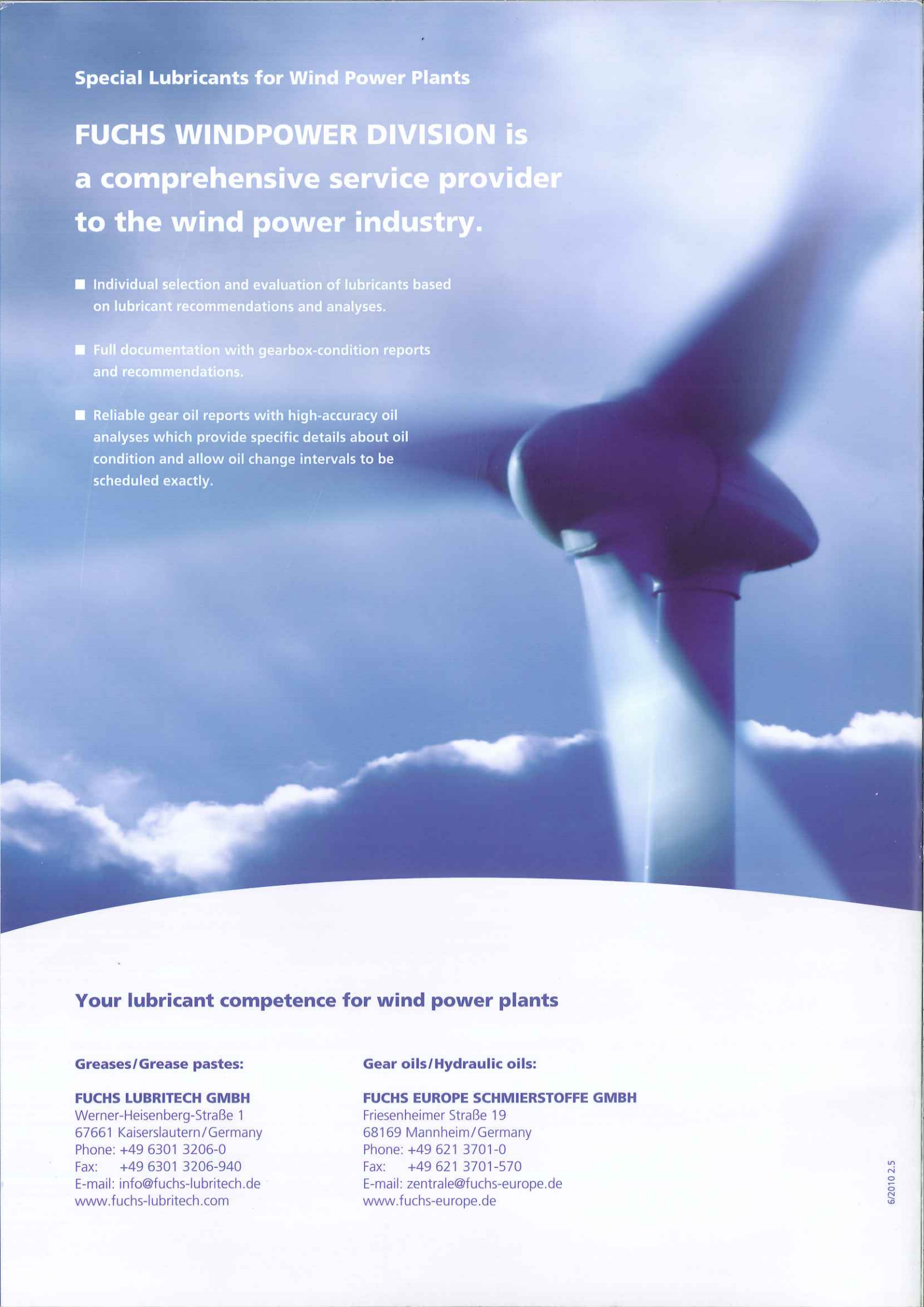
Fully-synthetic hydraulic fluid based on synthetic hydrocarbons (polyalphaolefin). Excellent low temperature properties (pour point < -50 °C).

RENOLIN EXTREME TEMP series

Semi-synthetic hydraulic fluids based on hydro-treated base oils, high share stability, excellent wear protection, long lifetime.



Foam behaviour according to ASTM D 892



Special Lubricants for Wind Power Plants

**FUCHS WINDPOWER DIVISION is
a comprehensive service provider
to the wind power industry.**

- Individual selection and evaluation of lubricants based on lubricant recommendations and analyses.
- Full documentation with gearbox-condition reports and recommendations.
- Reliable gear oil reports with high-accuracy oil analyses which provide specific details about oil condition and allow oil change intervals to be scheduled exactly.

Your lubricant competence for wind power plants

Greases/Grease pastes:

FUCHS LUBRITECH GMBH
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Fax: +49 6301 3206-940
E-mail: info@fuchs-lubritech.de
www.fuchs-lubritech.com

Gear oils/Hydraulic oils:

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