

# ANNEXE B

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## **Documents techniques fournis par Enercon**

B-1 Information Water pollutants in turbines

B-2 Fiches techniques des éoliennes



## Safety systems in E-70 E4 turbines to prevent water pollutants from leaking

### Contents:

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### General:

Only a minimum amount of water pollutants is required in the gearless E-70 E4 turbines in contrast to conventional systems. In order to avoid that water pollutants leak from turbine parts during failures, the safety systems described below are used in the E-70 E4 wind energy converters:

**1. Gear:** The E-70 E4 turbine has no main gear as its rotor is directly connected to an annular generator which does not require any increase in speed. For this reason the quantity of 200 l gear oil used in conventional systems is not necessary for our turbines.

**2. Yaw gear:** The E-70 E4 turbine has six yaw gears to align the nacelle with the wind direction. Each gear contains approximately 7l of oil. Electric motors are situated on the gears. The gears are installed inside the main carrier which collects the entire amount of oil. In addition oil pans are fitted underneath the yaw drives.

**3. Pitch control:** Three pitch gears pitch the E-70 E4 rotor blades with one pitch motor each. The pitch gears only contain 4l of gear oil. A GRP casing covers the entire nacelle and the rotor head and collects possibly leaking oil.

**4. Braking system:** The E-70 E4 braking system contains approximately 2.7l of hydraulic oil. The hydraulic unit is installed in a stainless steel collection pan which can collect the entire amount of hydraulic oil.

**5. Roller bearing lubrication:** The tooth flanks and bearings in the E-70 E4 turbines are greased with special lubricants. The lubricated parts are either encapsulated so that grease cannot leak or excess lubricant is collected in special bags fitted to the GRP casing.

### **6. Lubricant supply for bearings:**

Permanent lubricators supply the roller bearings and pivot bearings of the E-70 E4 turbine with lubricant. These closed cartridges contain 125 ml of lubricant each and are replaced during maintenance operations.

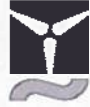
The E-70 E4 turbine can be optionally equipped with a central lubrication system for the spinner area. This system is electronically controlled, comprises a leak monitoring feature and is filled up during maintenance.

**7. Transformer oil:** The transformer is located either in the tower base or in a station outside the tower. The oil trough on the station floor is designed to collect the entire amount of transformer oil (depending on type 870l - 1500l). If the transformer is installed inside the tower, there is a steel trough which collects the transformer oil. The oil troughs in the stations and the tower bases are oil-tight according to § 19 WHG (German Water Resources Act).

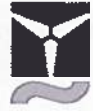
In case you have further questions, do not hesitate to contact us.  
pp S.O. Teichgräber



<b>1</b>	<b>Yaw gear</b>
Unit / component description	Yaw gear to align nacelle with wind direction (top of tower); fixed position in main carrier
Quantity	6 gears
Oil amount (each unit)	7 l
Oil type	Gear oil, liquid
Product name	MOBILGEAR SHC 460, alternative: RENOLIN Unisyn CLP 220
Description	Synthetic hydrocarbons and additives
Water hazard class (German regulation)	1
Technical equipment / safety system	Closed cast metal housing; completely sealed; vertical position in main carrier; main carrier or GRP troughs collect possibly leaking oil
Monitoring	Check for leaks during service inspections (twice a year)
Handling water pollutants	Not in turbine as delivered completely assembled
<b>2</b>	<b>Pitch gear</b>
Unit / component description	Pitch gear to control blade angle, installation on rotor hub, turns with hub
Quantity	3
Oil amount (each unit)	4l (depending on type)
Oil type	Gear oil, liquid
Product name	MOBILGEAR SHC 460, alternative: RENOLIN Unisyn CLP 220
Description	Synthetic hydrocarbons and additives
Water hazard class (German regulation)	1
Technical equipment / safety system	Closed cast metal housing; completely sealed; GRP casing of rotor collects possibly leaking oil
Handling water pollutants	Not in turbine as delivered completely assembled
Monitoring	Check for leaks during service inspections (twice a year)
<b>3</b>	<b>Hydraulic brake</b>
Unit / component description	Hydraulic unit to activate disc brake; parking brake for service work; braking during operation via pitch control
Quantity	1
Oil amount	2.7l
Oil type	Hydraulic oil, liquid
Product name	RENOLIN PG 46
Description	VDMA 24568 / HEPG 46 DIN 51524-3 / HLP 46
Water hazard class (German regulation)	1 (self-classification according to VCI [German chemical industry association] concept)
Technical equipment / safety system	Closed-loop braking system; closed unit in fixed horizontal position; installed in 9.8l stainless steel collection pan
Handling water pollutants	Not in turbine as delivered completely assembled
Monitoring	Check for leaks during service inspections (twice a year)
<b>4</b>	<b>Gear wheel lubrication</b>
Unit / component description	Gear wheels to drive yaw control and pitch control (pinion and gear rim)
Quantity	9 pinions in total



Lubrication type	Grease lubrication
Lubricant type	Open gear lubricant (paste)
Product name	MOBILTAC 81
Description	Hydrocarbons and additives
Water hazard class (German regulation)	2 (self-classification)
Technical equipment / safety system	Toothing in sealed housing
Handling water pollutants	Not in turbine as delivered completely assembled
Monitoring	Check for unusual leaks during service inspections (twice a year)
<b>5</b>	<b>Yaw bearing lubrication</b>
Unit / component description	Nacelle bearing on tower, cartridges for permanent lubrication; type: Perma
Quantity	1 pivot bearing
Lubrication type	Grease lubrication
Lubricant type	Roller bearing grease
Product name	Mobilith SHC 460
Description	Synthetic hydrocarbons and additives
Water hazard class (German regulation)	2 (self-classification)
Technical equipment / safety system	Closed four-point bearing
Handling water pollutants	Not in turbine as delivered completely assembled
Monitoring	Check for unusual leaks during service inspections (twice a year)
<b>6</b>	<b>Permanent lubricator</b>
Unit / component description	Cartridges for permanent lubrication Type: PERMA, automatic lubricator
Quantity	24 greasing points in spinner area
Lubricant amount	125 ml
Lubricant type	Roller bearing grease
Product name	MOBILITH SHC 460 (see above)
Description	Synthetic hydrocarbons and additives
Water hazard class (German regulation)	2 (self-classification)
Technical equipment / safety system	Closed cartridges
Handling water pollutants	Cartridges are ready for use on delivery and are replaced; ENERCON disposes of used cartridges
Monitoring	Check for unusual leaks during service inspections (twice a year)



<b>7</b>	<b>Alternative for pos. 6 (permanent lubricator)</b>		
Unit / component description	Central lubrication system for spinner area		
Quantity	1 system with 24 greasing points		
Lubricant amount	Max. 4 kg		
Lubricant type	Roller bearing grease		
Product name	MOBILITH SHC 460 (see above)		
Description	Synthetic hydrocarbons and additives		
Water hazard class (German regulation)	2 (self-classification)		
Technical equipment / safety system	Closed system		
Handling water pollutants	Ready for use on delivery; filled up during maintenance (max. 4 kg/a)		
Monitoring	Leak monitoring via remote monitoring system; additional inspection during maintenance		
<b>8</b>	<b>Transformer station / transformer unit</b>		
Unit / component description	Transformer station according to separate description		
Quantity	1 transformer for each turbine		
Oil amount	Depending on type between 870 l and 1500 l		
Oil type	Transformer oil according to IEC-296 or IEC 836 depending on type		
Product name	DOW-Corning 561	Rhodorsil-Öl 604 V 50	NYNAS-NYTRO 10GBN
Description	Mixture of highly refined mineral oils		
Water hazard class (German regulation)	1	1	1
Technical equipment / safety system	Transformer in transformer station: oil trough on station floor collects oil; specialist company installs station in accordance with § 19 WHG (German Water Resources Act), station can be installed in water protection zones as well Transformer in tower base: Transformer is installed above galvanised steel trough which can collect entire oil amount;		
Handling water pollutants	Not in turbine as transformer delivered completely filled up		
Monitoring	Check for leaks during service inspections (twice a year)		
A separate transformer station description is available.			

## WIND ENERGY CONVERTER CHARACTERISTICS

### E-82 E2 2MW

<b>Rotor</b>	
Type	E82 E2
Rotor diameter	82 m
Swept area	5281 m <sup>2</sup>
Power regulation	Pitch
RPM	6 – 18 min <sup>-1</sup>
Cut in wind	2,5 m/s
Cut out wind	28 – 34 m/s
Survival wind speed	59,5 m/s

<b>Gear Box</b>	
Not applicable	No gearbox

<b>Blades</b>	
Manufacturer	ENERCON
Blade length	38,8 m
Material	GRP (Epoxy)
Lightning protection	included

<b>Generator</b>	
Manufacturer	ENERCON
Nominal Power	2000 kW
Type (model)	Synchronous, direct-drive ringgenerator
Protection classification	IP 23
Insulation class	F

<b>Yaw System</b>	
Type	6 electrical motors
Yaw control	Active (based on wind vane signal)
Yaw rate	0,5°/sec

<b>Controller</b>	
Manufacturer	ENERCON
Type	microprocessor
Grid connection	Via ENERCON inverter
Remote communication	ENERCON Remote Monitoring System
UPS	included

<b>Braking System</b>	
Aerodynamic brake	<ul style="list-style-type: none"> <li>- three independent blade pitch systems with emergency supply</li> <li>- rotor brake</li> <li>- rotor lock, locking at 30°</li> </ul>

<b>Tower</b>					
Hub heights	78 m	85 m	98 m	108 m	138 m
Tower	Steel (4 + FS)	Steel + Prefab concrete (2 + 15)	Steel + Prefab concrete (2 + 18)	Steel + Prefab concrete (2 + 21)	Steel + Prefab concrete (2 + 21)
Design Wind Class	II	II	II	II	II

<b>Weights</b>	
Nacelle, excl. Rotor and hub	Approx. 18 to
Rotor Incl. Hub/Main pin	Approx. 55 to
Generator	Approx. 62 to
<b>Total Weight</b>	<b>Approx. 135 to</b>



## WIND ENERGY CONVERTER CHARACTERISTICS

### E-82 E2 2.3MW

<b>Rotor</b>	
Type	E82 E2
Rotor diameter	82 m
Swept area	5281 m <sup>2</sup>
Power regulation	Pitch
RPM	6 – 18 min <sup>-1</sup>
Cut in wind	2,5 m/s
Cut out wind	28 – 34 m/s
Survival wind speed	59,5 m/s

<b>Gear Box</b>	
Not applicable	No gearbox

<b>Blades</b>	
Manufacturer	ENERCON
Blade length	38,8 m
Material	GRP (Epoxy)
Lightning protection	included

<b>Generator</b>	
Manufacturer	ENERCON
Nominal Power	2300 kW
Type (model)	Synchronous, direct-drive ringgenerator
Protection classification	IP 23
Insulation class	F

<b>Yaw System</b>	
Type	6 electrical motors
Yaw control	Active (based on wind vane signal)
Yaw rate	0,5°/sec

<b>Controller</b>	
Manufacturer	ENERCON
Type	microprocessor
Grid connection	Via ENERCON inverter
Remote communication	ENERCON Remote Monitoring System
UPS	included

<b>Braking System</b>	
Aerodynamic brake	<ul style="list-style-type: none"> <li>- three independent blade pitch systems with emergency supply</li> <li>- rotor brake</li> <li>- rotor lock, locking at 30°</li> </ul>

<b>Tower</b>					
Hub heights	78 m	85 m	98 m	108 m	138 m
Tower	Steel (4 + FS)	Steel + Prefab concrete (2 + 15)	Steel + Prefab concrete (2 + 18)	Steel + Prefab concrete (2 + 21)	Steel + Prefab concrete (2 + 21)
Design Wind Class	II	II	II	II	II

<b>Weights</b>	
Nacelle, excl. Rotor and hub	Approx. 18 to
Rotor incl. Hub/Main pin	Approx. 55 to
Generator	Approx. 62 to
<b>Total Weight</b>	<b>Approx. 135 to</b>

## WIND ENERGY CONVERTER CHARACTERISTICS

### E-70 E4 2,3 MW

<b>Rotor</b>	
Type	E-70 E4
Rotor diameter	71 m
Swept area	3959 m <sup>2</sup>
Power regulation	Pitch
RPM	Variable, 6-21,5 rpm
Cut in wind	2,3 m/s
Cut out wind	28-34 m/s (ENERCON Storm control)
Nominal output at	15 m/s
Survival wind speed	70 m/s (according to IEC)

<b>Gear Box</b>	
Not applicable	No gearbox

<b>Blades</b>	
Manufacturer	ENERCON
Blade length	32,8 m
Material	GRP (Epoxy)
Lightning protection	Included

<b>Generator</b>	
Manufacturer	ENERCON
Nominal Power	2300 kW
Type (model)	Synchronous, direct-drive ringgenerator
Protection classification	IP 23
Insulation class	F

<b>Yaw System</b>	
Type	6 electrical motors
Yaw control	Active (based on wind vane signal)
Yaw rate	0,5°/sec

<b>Controller</b>	
Manufacturer	ENERCON
Type	microprocessor
Grid connection	Via ENERCON inverter
Remote communication	ENERCON Remote Monitoring System
UPS	included

<b>Braking System</b>	
Aerodynamic brake	<ul style="list-style-type: none"> <li>- three independent blade pitch systems with emergency supply</li> <li>- rotor brake</li> <li>- rotor lock, locking at 30°</li> </ul>

<b>Tower</b>						
<b>Hub heights</b>	57 m	64 m	85 m	85 m	98 m	113 m
<b>Tower</b>	Steel 3 sections + basket	Steel 3 sections + basket	Steel / concrete 2 sections steel + 15 concrete	Steel 4 sections + basket	Steel / concrete 2 sections steel acier + 18 concrete	Steel / concrete 2 sections steel+ 22 concrete
<b>Design Wind Class (IEC)</b>	<b>S</b> $V_{av} = 9,8 \text{ m/s}$ $V_{ext} = 59,5 \text{ m/s}$	<b>I + II</b>	<b>S</b> $V_{av} = 9,5 \text{ m/s}$ $V_{ext} = 65 \text{ m/s}$	<b>II</b>	<b>II</b>	<b>II</b>

<b>Weights</b>	
Nacelle, excl. Rotor and hub	Approx. 12 to
Rotor incl. Hub/Main pin	Approx. 40 to
Generator	Approx. 52 to
<b>Total Weight</b>	<b>Approx. 104 to</b>