

Technical Information

**Substances Hazardous to the Aquatic Environment
ENERCON Wind Energy Converter E-82 E4**

Legal notice

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1 Introduction

This document provides information on substances hazardous to the aquatic environment that are contained in the E-82 E4 wind energy converter.

1.1 Water Hazard Classes

Substances which are hazardous to the aquatic environment are classified into the following 3 water hazard classes (WHC):

- WHC1: Slightly hazardous to the aquatic environment
- WHC2: Hazardous to the aquatic environment
- WHC3: Extremely hazardous to the aquatic environment

The classification is according to the evaluation scheme of the Administrative Regulation on the classification of Substances Hazardous to Waters (assessment) dated 17.05.1999 and amended on 27.07.2005.

1.2 Avoiding substances hazardous to the aquatic environment

The required amount of substances hazardous to the aquatic environment has already been reduced to a minimum by the design of the E-82 E4 wind energy converter.

ENERCON's direct-drive annular generator makes the use of gears for the drive train redundant. Therefore less polluting substances are used in the E-82 E4 wind energy converter than in wind turbines of comparable performance with a drive train.

Large amounts of hydraulic fluid can be saved by the use of electro-mechanical components (adjustment of the yaw and pitch gears).

Synthetic esters are used in the transformers located in the tower base. Synthetic ester is a dielectric insulating liquid and is classified as not hazardous to the aquatic environment.

1.3 Handling of substances hazardous to the aquatic environment

The yaw drive and pitch gear are supplied already filled by the manufacturer. They can be refilled as required. The hydraulic system is assembled and filled in the production plant. Oil filtering is carried out by qualified personnel at four-year intervals. Due to the closed oil filter system there is usually no contact with gear oil. An oil change may have to be carried out by qualified personnel.

The permanent lubricators used are closed cartridges, which are replaced every six months by qualified personnel. The closed system of the permanent lubricators means that there is little contact with the lubricant.

The central lubrication system for lubricating the anti-friction bearings is refilled by qualified personnel every six months. The central lubrication system is refilled via a closed refill system. The closed refilling system of the central lubricator means that there is little contact with the lubricant.

1.4 Safety measures

The technical safety equipment to prevent substances hazardous to the aquatic environment from escaping from the system is outlined for each mechanical component in ch. 4, p. 12 and ch. 5, p. 18.

All mechanical components where substances hazardous to the aquatic environment are used are checked for leaks and unusual grease leakage by qualified personnel twice a year. The mechanical components are equipped with suitable collecting equipment.

All optional components where substances hazardous to the aquatic environment are used are checked by qualified personnel. The inspection intervals for the optional components are listed in ch. 5, p. 18.

Constant remote monitoring of the system means that malfunctions and accidents that can lead to substances hazardous to the aquatic environment escaping from the system are detected early and appropriate measures can be initiated.

1.5 Measures in case of accidental release

The following procedures must be performed when water-polluting substances are accidentally released:

- Prevent from spreading over a large area (e.g. by containment or oil barriers).
- Collect using absorbent materials such as sand, diatomaceous earth, acid binding agent, universal binder or sawdust.
- Grease should be collected mechanically.

2 Overview of substances hazardous to the aquatic environment

The following table is an overview of substances hazardous to the aquatic environment in the E-82 E4 wind energy converter.

Components		Grease/Trade name	Quantity	Capacity [l]	Annual grease requirement [l]	Total capacity [l]
Yaw gear		RENOLIN UNISYN CLP 220	6	11.5 - 14 ^{1,2}	As needed	69 - 84 ^{1,2}
Yaw gear bearing lubrication		Klüberplex BEM 41-141	6	-	2.12 - 3.18 g	-
Pitch gear		RENOLIN UNISYN CLP 220	3	3.6 - 4 ^{1,2}	As needed	10.8 - 12 ^{1,2}
Pitch gear bearing lubrication		Klüberplex BEM 41-141	3	-	2.12 - 3.18 g	-
Central lubrication system	Central lubrication system total	Klüberplex BEM 41-141	1	4	-	4
	Front hub bearing		1	4.3	0.53	4.3
	Rear hub bearing		1	4.5	0.53	4.5
	Blade flange blade flange bearing		3	3.9	1.05	11.7
	Pitch gear rim		3	-	2.07	-
Permanent lubricator (6 months)	Yaw bearing	Klüberplex BEM 41-141	1	4.5 ²	1.44	4.5 ²
	Yaw gear rim	Klüberplex AG 11-461	1	0.125 ²	0.5	0.25 ²
Hydraulic system of rotor lock		RENOLIN PG 46	1	4	-	4
ENERCON hoist cable and safety cable		HHS 2000	1	-	0.1	0.1
ENERCON service hoist winch	P609	Mobil SHC 632	1	1.5 ²	-	1.5 ²
	G-trac (alternative)	RENOLIN PG 68		0.6 ²	-	0.6 ²
Chain hoist	DEMAG	Shell Donax TD 10W-30	1	0.5 ²	-	0.5 ²
	LIFTKET (alternative)	TECTROL CLP 220		0.35 ²	-	0.35 ²

Components		Grease/Trade name	Quantity	Capacity [l]	Annual grease requirement [l]	Total capacity [l]
Chain hoist chain		RENOLIN UNISYN CLP 220	1	-	0.2	0.2
Generator/Water cooling system		Glykosol N	1	400	-	400
Automatic nacelle extinguisher system ³	Extinguishing agent container	MOUSSEAI-CF	1	10 - 50 ²	-	10 - 50 ²

¹ depending on manufacturer; ² manufacturer's instructions; ³ optional components

3 Additional information for substances hazardous to the aquatic environment

3.1 Information on the physical properties and composition

Trade name	Composition	WHC	Aggregate state	Density at 20 °C [kg/dm ³]	European waste key
Klüberplex BEM 41-141	Mineral oil, synthetic hydrocarbon oil, special lithium soap	1	pasty	0.88	- ¹
Klüberplex AG 11-461	Mineral oil, ester oil, aluminium complex soap, solid lubricant	1	pasty	1.07	- ¹
RENOLIN UNISYN CLP 220	Synthetic oils with additives	1	liquid	0.85	13 02 06
RENOLIN PG 46	Synthetic oils with additives	1	liquid	1.03	13 02 06
HHS 2000	Petroleum mixture	1	aerosol	0.742	16 05 04
RENOLIN PG 68	Preparation of synthetic oils with additives	1	liquid	1.035	13 02 06
Shell Donax TD 10W-30	Mineral oil and additives	2	liquid	0.884	13 02 05
MOBIL SHC 632	Synthetic base components and additives	1	liquid	0.858	13 02 06
RENOLIN UNISYN CLP 220	Synthetic oils with additives	1	liquid	0.85	13 02 06
Glykosol N	Monoethylene glycol and water	1	liquid	1.125	- ¹
TECTROL CLP 220	-	1	liquid	0.896	13 02 05
MOUSSEAL-CF	Foam fire extinguishing agent	1	liquid	0.001	07 07 04

¹ The waste code should be indicated in agreement with the regional waste disposal organization.

3.2 Information on reportable ingredients

Trade name	Reportable ingredients	Symbols/R-phrases	CAS no.	EC no.	EINECS no.	Concentration [%]
Klüberplex BEM 41-141	No reportable substances	-	-	-	-	-
Klüberplex AG 11-461	Naphthenic acids, zinc salts	Xi; R36	12001-85-3	234-409-2	-	1 - 5
	Benzenaminium, N-Phenyl	R52/53	68411-46-1	270-128-1	-	0.25 - 2.5
	N-alkylated Benzotriazol	Xi; R38; R43; N; R51/53	94270-86-7	-	-	0.1 - 0.25
RENOLIN UNISYN CLP 220	Phosphoric acid ester, amine salt	N R51/53	92623-72-8	-	296-404-1	0.1 - 1
	Amine phosphate	Xn R22; Xi R41; Xi R43; N R51/53	-	-	931-384-6	0.1 - 1
RENOLIN PG 46	Aromatic amine, alkylated	R52/53	-	-	-	1 - 2.4
	Phenol derivative	R53	-	-	-	0.1 - 1
	Oleic acid derivative	Xn R20; Xi R38-41; N R50/53	110-25-8	-	203-749-3	0.1 - 1
	Phosphate ester derivative	X R36/38; N R51/53	-	-	-	≤ 0.1
HHS 2000	Naphtha	F; R11, Xi; R38, N; R51/53, Xn; R65, R67	64742-49-0	265-151-9	-	35 - 40
	n-Hexan	F; R11, R62, Xn; R48/20-R65, Xi; R38, R67, N; R51-R53	110-54-3	203-777-6	-	1.5 - 2
MOBIL SHC 632	Dec-1-ene	-	68037-01-04	-	-	10 - 20
	Triphenyl phosphate	-	115-86-6	204-112-2	-	0.1 - 0.25

Trade name	Reportable ingredients	Symbols/R-phrases	CAS no.	EC no.	EINECS no.	Concentration [%]
RENOLIN PG 68	Aromatic amine, alkylated	R52/53	-	-	-	1 - 2.4
	Phenol derivative	R53	-	-	-	0.1 - 1
	Oleic acid derivative	Xn R20; Xi R38-41; N R50/53	-	-	-	0.1 - 1
	Phosphate ester derivative	Xi R36/38; N R51/53	-	-	-	≤ 0.1
Shell Donax TD 10W-30	Calcium sulfonate	R53	68783-96-0	272-213-9	-	1 - 5
	Zink alkyl Dithiophosphate	Xi R38; R52/53	68649-42-3	272-028-3	-	1 - 5
RENOLIN UNISYN CLP 220	Phosphoric acid ester, amine salt	N R51/53	-	296-404-1	-	0.1 - 1
	Amine phosphate	Xn R22; Xi R41; Xi R43; N R51/53	-	931-384-6	-	0.1 - 1
Glykosol N	Monoethylene glycol	-	107-21-1	203-473-3	-	45
TECTROL CLP 220	Petroleum distillate	Xn; N; R51; R53; R65/66	-	-	-	0.1 - 1
MOUSSEAL-CF	1.2 Ethanediol	R22	107-21-1	-	-	< 30
	2-(2-Butoxyethoxy)ethanol	R 36	112-34-5	-	-	< 10

4 Overview mechanical components

4.1 Yaw drives

The 6 yaw drives consisting of an asynchronous motor and yaw drives are used for yaw control in the E-82 E4 wind energy converter.

Gears are lubricated using synthetic gear oil.

The bearing lubrication (option) of the yaw drive is achieved via a grease nipple. The grease nipples on the yaw drives are lubricated with 2-3 pumps of the grease gun. There is one grease nipple on every yaw drive.

4.1.1 Safety equipment

The yaw gears consist of a closed, fully sealed cast housing. Oil and grease collecting pans with sufficient capacity are installed below the yaw gears. In the event of an oil leak during operation or while refilling yaw gear oil, the nacelle casing can catch the oil.



Inspection/Visual inspection

Gears are inspected for leaks by trained, skilled personnel twice a year.

4.2 Pitch drives

The 3 pitch drives consisting of a direct current motor and pitch gear serve as positioning drives for adjusting the rotor blade angle of the E-82 E4 wind energy converter.

The pitch gears are designed as multi-stage planetary gears and are mounted on the rotor hub rotating around the horizontal axis during operation.

The bearing lubrication (option) of the pitch gear is achieved via a grease nipple. The grease nipples on the pitch gear are lubricated with 2-3 pumps of the grease gun. There is one grease nipple on every pitch gear.

4.2.1 Safety equipment

The pitch gears consist of a closed, fully sealed cast housing.

In the event of an oil leak during operation or while refilling pitch gear oil, the spinner casing can catch the entire amount of oil.



Inspection/Visual inspection

Gears are inspected for leaks by trained, skilled personnel twice a year.

4.3 Rotor hub central lubrication system

The purpose of the central lubrication system is to supply the lubrication points in the rotating part of the E-82 E4 wind energy converter with the required, precisely dosed quantities of lubricant from a central position. The central lubrication system consists of one unit with a capacity of 4 l. The central lubrication system is refilled every six months.

The central lubrication system supplies the following mechanical components of the system with grease:

- the front hub bearing (3 lubrication points),
- the rear hub bearing (3 lubrication points),
- Blade flange bearings (3x, 6 lubrication points per blade flange bearing)
- Pitch drive (3 lubricating pinions, one lubrication point per lubrication pinion)

4.3.1 Safety equipment

This is a closed system.

In the event of an accidental grease leak the hub adapter will be able to catch the grease.



Monitoring

The central lubrication system is equipped with a pressure sensor. A warning message is generated as soon as the pressure drops within the closed system. This warning message is analysed immediately by the remote monitoring system and a Service team is alerted.



Inspection/Visual inspection

Lubrication points are inspected for abnormal exit of grease by trained, skilled personnel twice a year.

4.4 Anti-friction bearings

The yaw bearing, the three blade flange bearings and the hub bearing have been designed as rolling bearings.

4.4.1 Yaw bearing/Yaw gear rim

The yaw bearing connects the nacelle to the tower. The cantilevered pinions of the yaw drive engage with the external teeth of the yaw bearing.

The yaw bearing is completely sealed on one side and excess used grease escapes on the opposite side. The chosen sealing concept ensures that the bearing is flushed with fresh grease from the bottom to the top and that used grease escapes from the top side of the gear ring and is additionally used to lubricate the drive gear. The yaw gear rim is also lubricated manually with grease every six months.

Lubrication of the yaw bearing and yaw gear rim is via a permanent lubricator.

The following lubricating points must be supplied with grease:

- Yaw bearing (6 greasing points)
- Yaw gear rim (2 lubricating pinions, one lubrication point per lubrication pinion)

4.4.1.1 Safety equipment

Grease pans installed below the drive gear collect excess grease.



Inspection/Visual inspection

Lubrication points are inspected for abnormal grease leakage by trained, skilled personnel twice a year. If required, used grease from the pan is also collected and disposed of in accordance with regulations.

4.4.2 Blade flange bearings/pitch drive

The blade flange bearing establishes the connection between the hub and the blade adapter to which the rotor blade is connected. The cantilevered pinions of the pitch gears engage with the external teeth of the blade flange bearing.

The lubrication of the blade flange bearings and the lubricating pinions of the pitch drive takes place via a central lubrication unit with grease that is constantly supplied. The central lubrication system is refilled every six months.

The following lubricating points must be supplied with grease:

- Blade flange bearings (3x, 6 lubrication points per bearing)
- Pitch drive (1 lubricating pinions, one lubrication point per lubrication pinion)

4.4.2.1 Safety equipment

A fully sealed grease pan collects the used grease.



Inspection/Visual inspection

Lubrication points are inspected for abnormal exit of grease by trained, skilled personnel twice a year. If required, used grease from the pan is also collected and disposed of in accordance with regulations.

4.4.3 Hub bearing

The hub rotates on the axle pin. The hub with the blade adapter supports the 3 rotor blades and the rotor of the ring generator, which is rigidly coupled to the hub. On the rotor head side, the hub is mounted with double row tapered roller bearings and with a cylindrical roller bearing on the machine housing side.

The bearings are constantly supplied with grease by a central lubrication system.

The following mechanical components must be supplied with grease:

- front hub bearing (3 lubrication points)
- rear hub bearing (3 lubrication points)

4.4.3.1 Safety equipment

Used grease escapes from a sealing gap and accumulates between the bearing seats in the rotor hub. Used grease is collected between the bearing seats during the intended service lifespan. Bearings are sealed to the outside by rotary shaft lip seals and preceding V-rings to protect against dust and splash water.



Inspection/Visual inspection

Lubrication points are inspected for abnormal exit of grease by trained, skilled personnel twice a year.

4.5 Hydraulic system of rotor lock

The rotor lock serves to immobilise the rotor for maintenance and repair work. In general, the rotor lock is actuated up to five times during a period of approx. three months (setting/releasing the rotor lock).

4.5.1 Safety equipment

This is a closed hydraulic system that is kept pressure-free. Pressure is only built up if a braking request is received.

For the event of an oil leak, an oil catch pan with sufficient capacity has been mounted under the hydraulic units.



Inspection/Visual inspection

The hydraulic system is inspected for leaks by trained personnel twice a year.

4.6 ENERCON Service Hoist

The ENERCON service hoist is a closed, cable-guided system for transporting persons and material. Basically, the ENERCON service hoist consists of a suspension, a hoist cage, cable guides, and an emergency control unit.

The hoist and safety cables are manually lubricated with grease and the winch is lubricated with gear oil.

4.6.1 Safety equipment

The winch used in the ENERCON service hoist is made up of a closed fully sealed housing. In the event of an oil leak, the ENERCON service hoist can catch the gear oil.



Inspection/Visual inspection

1x a year, trained personnel check the winch for leaks and check the lubrication on the hoist and safety cables.

4.7 Chain hoist

The chain hoist is used to carry tools and materials from the tower base to the nacelle and vice versa.

The chain on the chain hoist is manually greased.

The chain hoist is lubricated with gear oil.

4.7.1 Safety equipment

The chain hoist consists of a closed, fully sealed housing. In the event of an oil leak, the nacelle casing can catch the gear oil.



Inspection/Visual inspection

1x a year, trained personnel check the chain hoist for leaks and check the lubrication on the chain.

4.8 Liquid cooling generator

ENERCON's direct-drive annular generator makes the use of gears for the drive train redundant. The main carrier, the generator stator and the axle pin are firmly bolted together; the hub spins on the axle pin. The generator rotor is bolted to the hub such that the combination of stator and rotor acts as a generator.

The generator is equipped with a water cooling system as well as an air cooling system. The water cooling system is a closed cooling system. To cool the generator stator, a coolant pump pushes coolant into the circumferential hollow space (cooling jacket) of the generator stator. Here, the coolant heats up and then flows into the chiller from where it returns to the coolant pump once it has cooled down. A water / monoethylene glycol mix is used as coolant.

4.8.1 Safety equipment

This is a closed water cooling system.



Monitoring

The water cooling system is equipped with a pressure sensor. A warning message is generated as soon as the pressure drops within the closed system. This warning message is analysed immediately by the remote monitoring system and a Service team is alerted.

5 Overview of optional components

5.1 Automatic nacelle extinguisher system

The automatic nacelle extinguisher system protects the wind energy converter and the surrounding area. The system prevents any fire from spreading inside the nacelle. It immediately extinguishes incipient fires at the source, e.g. in electrical cabinets or boxes. This minimises any damage to the wind energy converter and the environment.

5.1.1 Safety equipment

The automatic nacelle extinguisher system is impervious to shocks, impacts, vibration, and dirt.

Once the fire has been extinguished, the extinguishing agent is mainly collected by the housing of the respective component. If the extinguishing agent leaks out of the component, the nacelle casing or the tower floor can catch it.



Inspection/Visual inspection

The functionality of the nacelle extinguisher system is inspected by qualified personnel once a year.

6 List of related documents

No.	Document	Document no.
1	Material safety data sheet Glykosol N	D0188278
2	Material safety data sheet HHS 2000	D0306781
3	Material safety data sheet Klüberplex AG 11-461	D0188406
4	Material safety data sheet Klüberplex BEM 41-141	D0167370
5	Material safety data sheet MOBIL SHC 632	D0306773
6	Material safety data sheet RENOLIN PG 46	D0167357
7	Material safety data sheet RENOLIN PG 68	D0306661
8	Material safety data sheet RENOLIN UNISYN CLP 220	D0167349
9	Material safety data sheet Shell Donax TD 10W-30	D0306770
10	Material safety data sheet TECTROL CLP 220	D0321747
11	Material safety data sheet MOUSSEAL-CF	D0341148

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