

MiCRoLuBGear[®]

Lubrication device for pitch gears





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CONTENTS

1.	INTRODUCTION	1
2.	SAFETY INSTRUCTIONS	2
2.1.	Appropriate use	2
2.2.	Accident prevention regulations	2
2.3.	Liability	2
2.4.	Operation, maintenance and repair	2
3.	DESCRIPTION	3
4.	INSTALLATION	3
4.1.	Direct Installation to the Bearing.....	4
4.2.	MiCRoLuBGear fixation through an additional plate.	5
5.	OPERATING METHOD	6
5.1.	Integration in Automatic Lubrication Systems.....	6
5.2.	Number of MiCRoLuBGear units.	7
5.3.	Operation.....	8
6.	TROUBLESHOOTING	8
7.	TECHNICAL DATA	9
7.1.	Features	9
7.2.	Tightening torques.....	9
7.3.	Dimensions	9
7.4.	Order Information	10

1. Introduction

MiCRoLuBGeaR has been designed to enable the independent re-lubrication of different teeth in open gears. Furthermore, its installation allows different lubrication patterns/criteria per each tooth where it has been installed.

MiCRoLuBGeaR has been mainly designed to be used in wind turbines pitch gears. These systems commonly suffer a lack of even distribution of lubricant, since only a 90 degree cog segment is actually used. Automatic lubrication becomes more difficult since around 90% of the wind turbine production, the rotor blades remain in what is known as the zero degree position, and it is adjusted by only minimal values. Therefore, two or three teeth of the open gear drive are exposed to extremely high loads while the turbine is in production. Conventional lubrication of this cog segment can only be achieved if the rotor blades turn the complete 90° segment during a maintenance session. However, as maintenance normally cannot be carried out without taking the turbine offline, there are only two options to lubricate the gears of the rotor blade:

- Lubrication during the natural idle phases (no wind).
- Compulsory maintenance intervals, associated with additional losses of production.

The idea of adapting the lubrication task to natural idle phases is attractive to wind farm operators but not at all to designers or maintenance staff. The fact is that production phases may be extremely long during windy periods. These periods tend to be longer for offshore plants than in onshore installations. In such cases, the lubrication film could degenerate and fail before the end of the natural wind production phase, thus causing damage to the gear drive.

MiCRoLuBGeaR avoids energy generation losses and lubricates the pitch at 0 degree position. MiCRoLuBGeaR, combined with a right Automatic Lubrication System as shown Figure 1, lubricates the tooth in contact while the wind turbine operates and the pitch system is working.

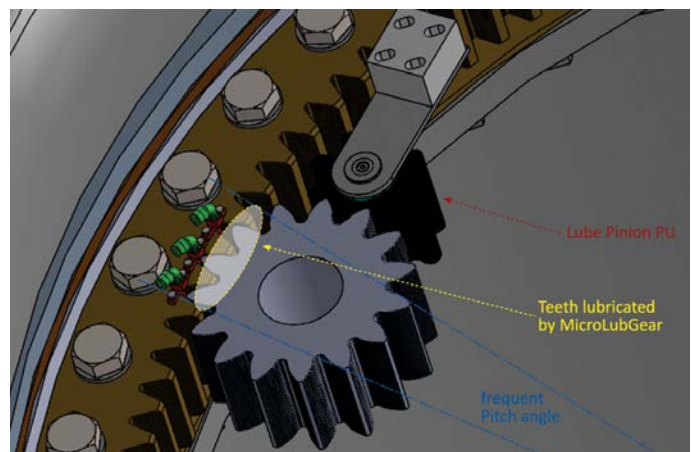


Figure 1: MiCRoLuBGeaR combined with Lube Pinion.

2. Safety instructions

2.1. Appropriate use

This manual has been designed to provide to the design engineers, installers and maintenance technicians the needed information to install MiCRoLuBGear in all Wind Turbines models. To avoid breakage or malfunctioning, the information given in this manual should be carefully read and strictly applied.

Failure to observe this information may lead to health and safety risks for persons as well as economic losses due to breakage of equipment parts.

MicroLubgear is a device designed to supply lubricant evenly over the tooth flange of open gears where it is installed. Every MiCRoLuBGear can be fed with different amounts of lubricant. It allows dividing re-lubrication according to each tooth requirements.

It is especially recommended for open gears where the operation is neither continuous nor uniform for every tooth. Furthermore, it is strongly recommended for open gears where the frequency of re-lubrication and/or the grease amount affects to the useful life of the gear.

2.2. Accident prevention regulations

Observe all regulations of the country and city in which the MiCRoLuBGear will be used.

2.3. Liability

Liability is limited to the lubricants fluency through the MiCRoLuBGear channels outlet.

2.4. Operation, maintenance and repair

- Risk of crushing on moving parts, take care into the catchment area of the tooth.
- Repairs are to be performed only by authorized persons.
- Use MiCRoLuBGear in combination with gears of the same module.
- Lubricant should be supplied via an auxiliary lubrication system.

3. Description

MiCRoLuBGear device can be adapted on every platform of WTGs – with electrical pitch system, and also for yaw gears – from serial production or even be retrofitted on operative wind farms. It can be also integrated in automatic lubrication systems based on lube pinion.

The lubricant is pumped from a centralized pump station and distributed to the lube pinion/s and/or MiCRoLuBGear/s installed on the gear. Just a minimum and metered volume of grease reaches MiCRoLuBGear's inlet – as long as pitch system operates – and throughout integrated micro-channels, the lubricant is evenly applied to the tooth flank that is going to be engaged. In this way, MiCRoLuBGear improves the efficiency of the automatic system, restores the grease film on the gear teeth and optimizes the grease consumption.

4. Installation

For each MiCRoLuBGear the following materials are required for its proper installation:

1. 1 x M6x100 hose connector. Use AISI 316Ti fittings under environmental conditions C5-M
2. 2 x Screws A2 ISO 4017 M4x20
3. 2 x Plain washers A2 ISO 8738 for a Metric 4 bolt
4. 1 x MiCRoLuBGear

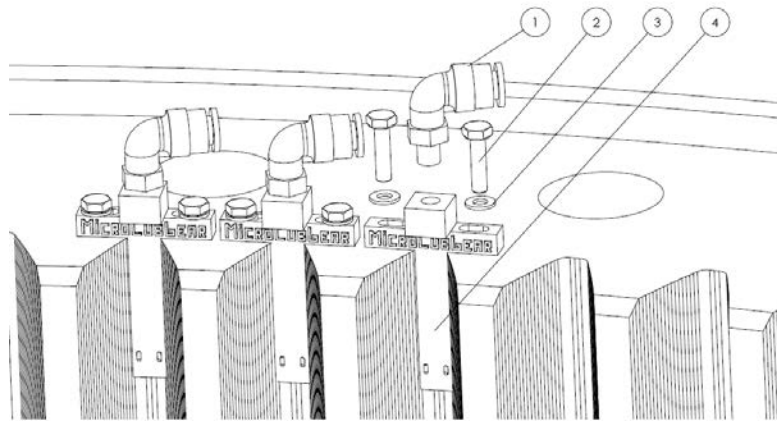


Figure 2: MiCRoLuBGear exploded drawing

Two integration procedures are possible to fix the MiCRoLuBGear part to the gear pitch (see Figure 4, where the MiCRoLuBGear is directly bolted to the Pitch bearing and Figure 5 where the MiCRoLuBGear is fixed to an additional plate). The use of one or the other procedure may depend on the bearing manufacturer recommendations, the pitch systems manufacturer recommendations and/or the wind turbine model.

4.1. Direct Installation to the Bearing

Prior to MiCRoLuBGeaR installation two threaded holes should be done on the gear. The distance between holes (A) depends on the gear module and it is summarized in Table 1. Depending on the dedendum teeth correction, the position of the holes (B) relative to the root of the tooth should be adapted to each gear geometry as shown Figure 3.

Gear module	A (mm)
M12	18 to 26
M16	30 to 38
M20	(*)
M22	(*)
M24	(*)

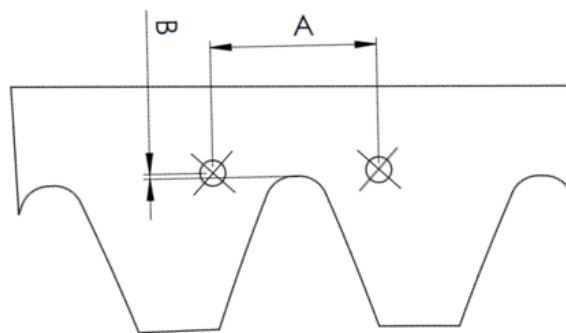


Figure 3: Bearing holes to install MiCRoLuBGeaR

Table 1: Distance between threaded holes.

(*)Available on demand.

Once the two thread holes are drilled, the MiCRoLuBGeaR part 4 should be placed in contact with the gear dedendum and parallel with the tooth root, two plain washers should be allocated in place (see part 3), after LOCTITE 222 or similar should be applied to the two M4 bolts (part 2), which will be then screw in the threads with 3 Nm torque. Finally LOCTITE 511 or similar is applied to the hose connector (part 1), which is then screw with a 3 Nm torque in place, see Figure 4.

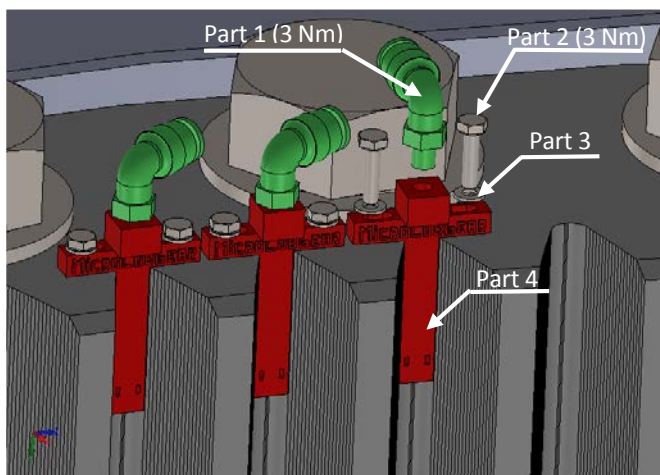


Figure 4: MiCRoLuBGeaR directly bolted to the Pitch bearing

4.2. MiCRoLuBGear fixation through an additional plate.

MiCRoLuBGear can be fixed to a plate prior to its installation to the Pitch system. The MiCRoLuBGear installation procedure to the plate, starts machining two threads in the plate, which should fulfil the same distances summarized in Table 1 depending on the Gear Module. After, the MiCRoLuBGear (Figure 4, part 4) should be allocated in place in contact with the gear dedendum and parallel with the tooth root, two plain washers should be allocated in place (see Figure 4, part 3), after adhesive should be applied to the two M4 bolts (Figure 4, part 2), which will be then screw in the threads with 3 Nm torque. Finally adhesive is applied to the hose connector, which then is screw with a 3 Nm torque in place.

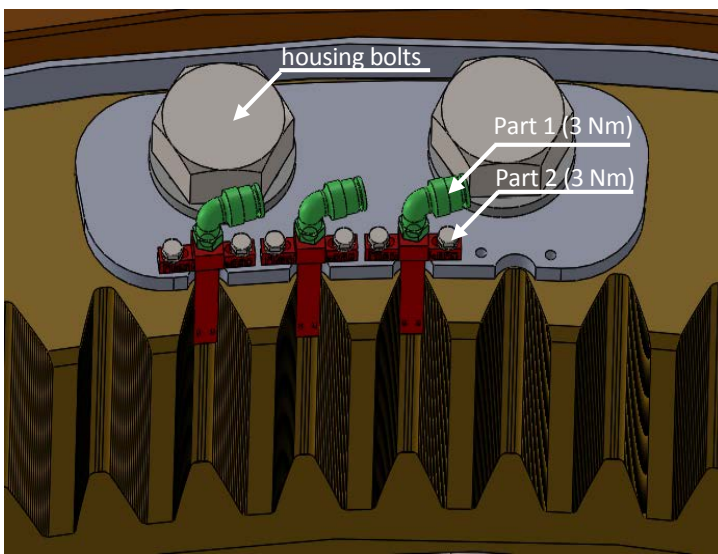


Figure 5: MiCRoLuBGear is fixed to an additional plate

Figure 6 shows details of the plate needed for this assembly. The plate length (Length $<2C$) should be smaller than two times the distance between the housing bolts (C) to prevent the contact with the adjacent bolts. Distance A is summarized in Table 1 and depends on the Gear Module. Distance B depends on the gear dedendum geometry. Specifically, at least 1mm free space should be left between the plate and the teeth dedendum to prevent the contact between the MiCRoLuBGear and the supplementary plate.

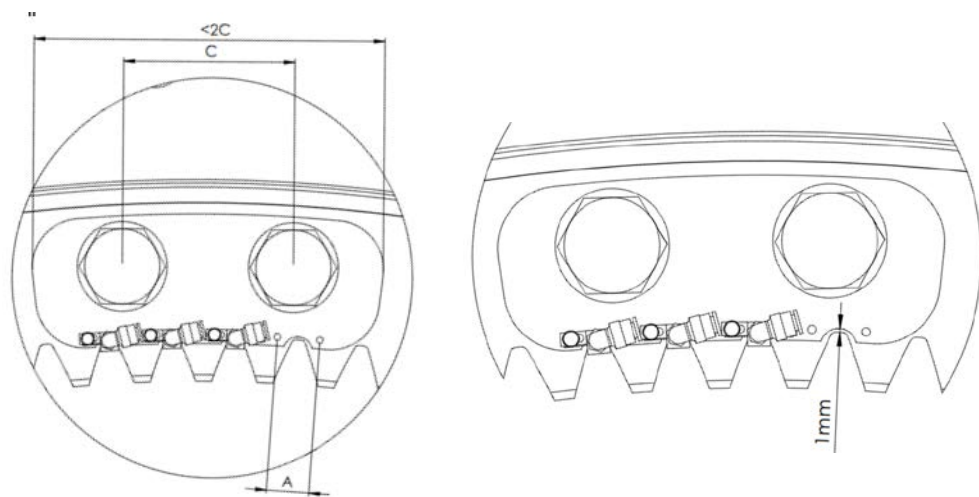


Figure 6: Details of the plate needed for the MiCRoLuBGear assembly

5. Operating Method

Each MiCRoLuBGear receives lubricant from its metric 6 inlet. The lubricant is led throughout the internal micro-channels to the outlet, so that the lubricant flows up and gets stuck to the flanges as shown in Figure 7(B). Later on, the lubricant is evenly spread while the gear gets in contact with the drive pinion.

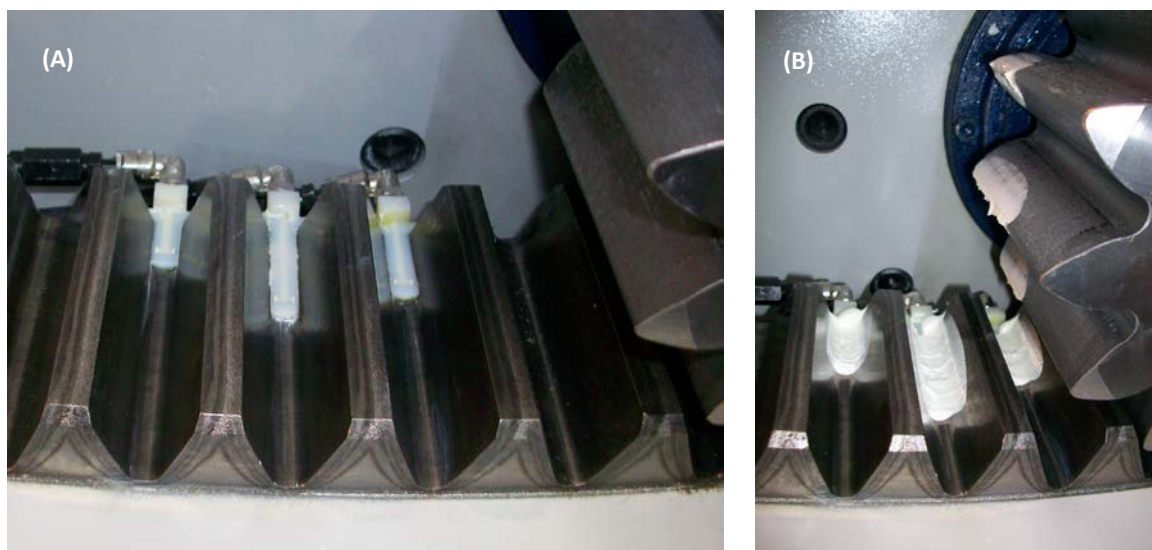


Figure 7: MiCRoLuBGear with different length integrated at the gear. (A) Without grease injection, (B) with grease injected.

5.1. Integration in Automatic Lubrication Systems.

MiCRoLuBGear allows to be fed by an external pumping device. It must be connected by means of pipes, from metering devices or even directly from an automatic pump station. There are different technical systems suitable to be combined with MiCRoLuBGear:

- Single line
- Progressive
- Multiline
- Dual line
- Single point lubricators

Depending on the number of MiCRoLuBGear to install (see section 5.2), combined to the lubrication requirements of the open gear to lubricate, it will be recommended to use any of these technical systems. Please contact to G.T.RIVI – Lincoln Spain for further assistance.

It is strongly recommended to combine MiCRoLuBGear with high quality lubrication products able to dose minimum quantities of lubricant at the proper frequency, while the gear is in operation. Figure 8 shows MiCRoLuBGear units combined with G.T.RIVI-Lincoln progressive lubrication system.

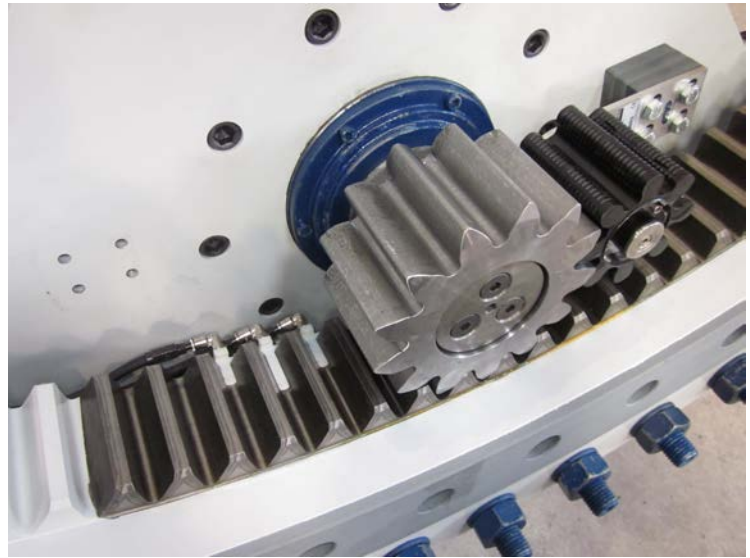


Figure 8: MiCRoLuBGear combined with lube pinion.

5.2. Number of MiCRoLuBGear units.

Normally three MiCRoLuBGear units should be installed to ensure that all the teeth in contact, when the pitch gear is in the 0 degree position, are properly lubricated. Even though, Figure 9 (a) shows a case where only 2 teeth are in contact and therefore two MiCRoLuBGear are enough to ensure the proper lubrication in this position. Figure 9 (b) shows a general case where 3 teeth are in contact. If the technician/designer does not have this information, the installation of three MiCRoLuBGears is recommended.

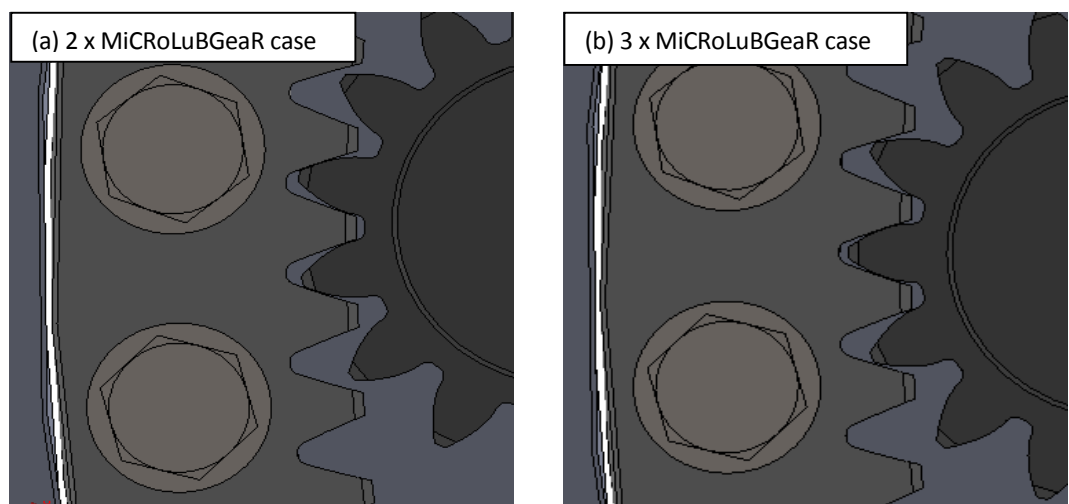


Figure 9: Teeth in contact in the Pitch Gear at 0° position: (a) Two teeth in contact (b) Three teeth in contact

5.3. Operation

Once every MiCRoLuBGeaR have been installed and connected to their respective hose connectors, the pump station should be turned on during a lubrication cycle to verify that the grease flows up and, reaches the outlets of every MiCRoLuBGeaR.

Validation has been performed with Klüber Lubricants summarized in Table 2 and its operation is guaranteed for Lubricants with equivalent physical properties.

Item.-No.:039091 <hr style="border: 1px solid #ccc;"/> Klüberplex AG 11-462 Light-coloured special lubricant for open drives	Item.-No.:017184 <hr style="border: 1px solid #ccc;"/> Klübersynth AG 14-61 Light-coloured special lubricant for open drives
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Table 2: Recommended MiCRoLuBGeaR lubricants

6. Troubleshooting

Problem	Cause		Actions
	Direct Installation	Additional plate Installation	
MiCRoLuBGeaR is not in contact with the gear dedendum	Threads to the bearing are not correctly placed.	Threads to the plate are not correctly placed.	Check B dimension in Figure 3
No grease flow at the outlets	- MiCRoLuBGeaR might be blocked internally - Automatic system is nor working properly.		- Check for an unclogged channel between inlet and outlets of MiCRoLuBGeaR - Check the lubrication system

7. Technical Data

7.1. Features

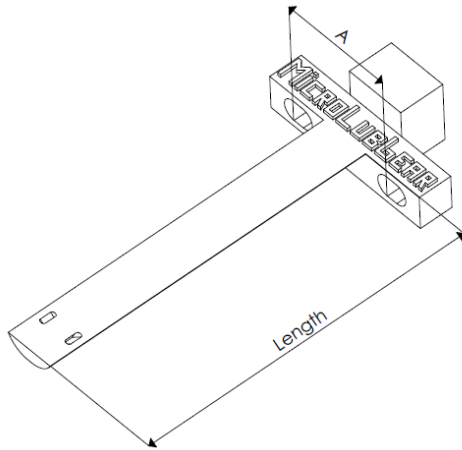
- Operation temperatures range -30°C to +40°C
- Material Polyurethane
- Inlet connection M6 x 100
- Lubricant..... Greases up NLGI 2

7.2. Tightening torques

- Fixation screw M4x20 (part 3) 3 Nm ± 10%
(glue with Loctite 222 or equiv.)

- Metric 6 hose connector..... 3 Nm ± 10%
(glue with Loctite 511)

7.3. Dimensions



Gear module	A
M12	18mm to 26mm
M16	30mm to 38mm
M20	(*)
M22	(*)
M24	(*)

(*) Available on demand.

7.4. Order Information

Type code for standard program

MLG	-		-	
		Gear Module		MiCRoLuBGeaR length

Gear Module (*)
M12
M16
M20
M22
M24

MiCRoLuBGeaR length (mm)
20
35
50
65
80

(*) Other customized systems and dedendum geometries personalized available on-demand.

MiCRoLuBGeaR is a development of:

