

**Report about an endoscopic inspection of the gear box
of a wind turbine**

GA-Nr.: 1598.G80.05.18

Clienet:

Operator: see client

Site: Bomber/Germany

**Number and type:
of turbines** 1 x Gamesa G 80

Manufacturer: Gamesa Corporacion Tecnologica
Parque Tecnologico de Bizkaia, edificio 222
48170, Zamudio, Vizcaya, Spain

Identification-No.: Bomberg

Date of inspection: 24.05.2018

Expert: Hilmar Bavinck
Sebastian Poll

Weather conditions: 25,0 C° 2,9 m/s

Table of contents

I.	Setting of tasks	Page 2
II.	Valuation standard	Page 2
III.	Assembly drawing with key	Page 4
VI.	Gearbox data	Page 5
V.	Result of the inspection (mechanical engineering))	page 6
VI.	Concluding remark	Page 17

I. Setting of tasks

The client asked the company Bavinck Wind Technik GmbH to check the technical state of a gear box and create an expert report.

II. Valuation standard

General approved rules of the technology.

Inspection of wind power and industrial gear boxes

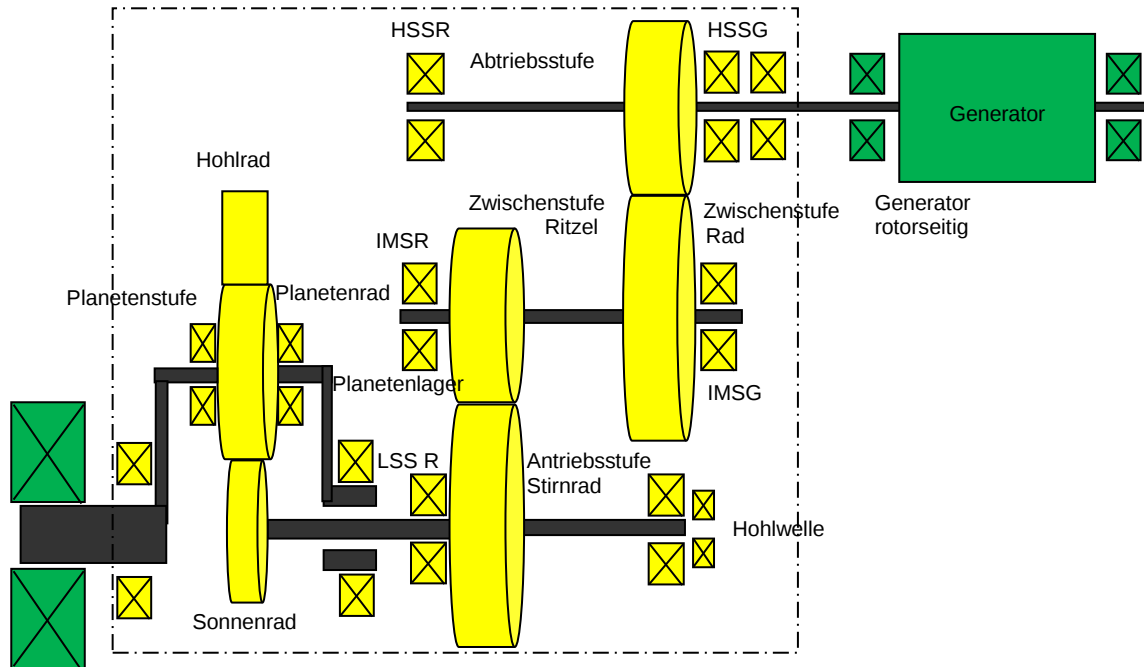
DIN EN ISO 9712	VT visual inspection stage 1 and 2 multisectorial
2012 - 12	(contains c, f, t, w and after wp)
DIN 3979	tooth damages at tooth gears;
1979-07	Indications, Features, Causes

ÖNORM ISO 15243 2005 – 07	Antifriction bearing damages – designations, characteristics and causes
FAG Publikation Nr. WL82 102/2 DA 2000	Antifriction bearing damages damage detection and inspection of used antifriction bearings
SKF Druckschrift Dd 8239 DE 2008 – 08	Antifriction bearing damages and their causes

Meaning of the abbreviations

BWE	Bundesverband Windenergie e. V.
GL	Germanische Loyd
DIBt	Deutsches Institut für Bautechnik
QM VA...	Process instruction Bavinck Wind-Technik GmbH
SKF	Svenska Kugellagerfabrik
FAG	Fischer Aktiengesellschaft

III. planetary gear with a shifted spur gear stage



Keys of the endoscope abbreviations

LSS G 11 – W1 - first spur-wheel shaft / G – generator-side / 11 – first bearing pic 1

HSS R 22 – W3 - third spur-wheel shaft / R – rotor-side / 22 – second bearing pic 2

HR 1 – HR – ring gear / 1 - pic 1 (e.g. HR1 to HR5 ring gear pic 1 to pic 5)

SR 1 – SR - sun gear / 1 - pic 1 (e.g. SR1 to SR4 sun gear pic 1 to pic 4)

P1 R1 Z 1 – P1 1. planetary stage / R1 – planet gear 1/ Z – tooth flank / 1 - pic 1

P2 R1 Z 1 – P2 2. planetary stage / R1 – planet gear 2/ Z – tooth flank / 1 - pic 1

P1 R3 Z 4 – P1 1. planetary stage / R3 – planet gear 3 / Z – tooth flank / 4 - pic 4

Ohne Beanst
Without

Slight
Complaints

Further
Complaints

Significant
Complaints

IV. Gearbox data

Documentation	
Manufacturer	Hansen
Gearbox type	EH802FN21-BN-101,02
Gearbox number	EH802F-001/AM0092
Year of construction/ Revision	2008
Gear ratio I is 1:	I = 101,02 M
Gear oil level	min.
Oil type/Designation	VG 320
Power PN in KW	3.800 KW
Weight	14.600,00 KG

V. Explanation to the defects



Picture 1

Picture 1 indicates that there is an oil loss through the labyrinth seal of the drive stage.



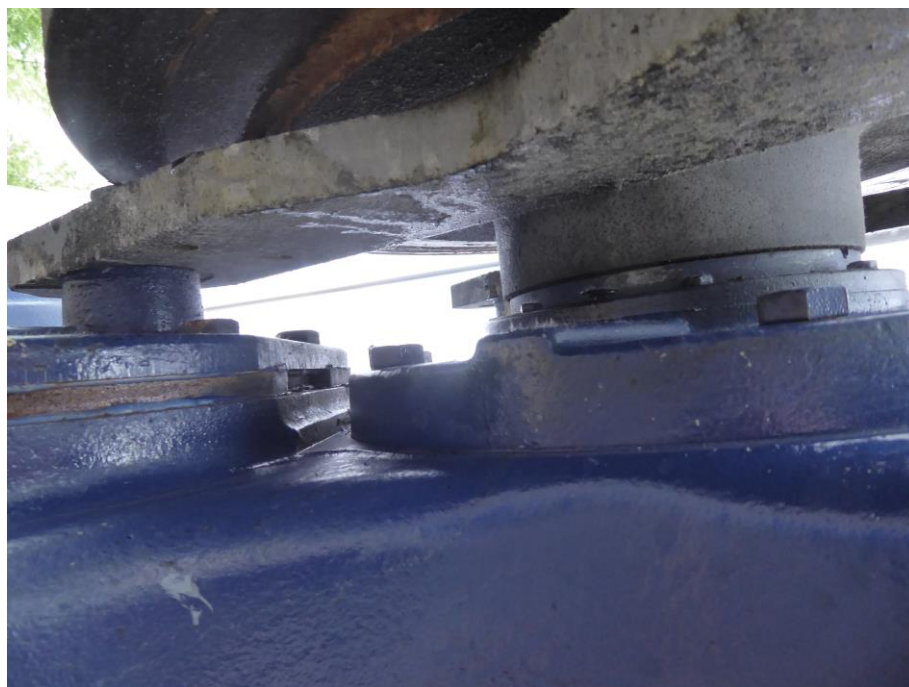
Picture 2

The gear air filter shows a little bit oil on the paper on picture 2.



Picture 3

Picture 3 shows the type plate of the gear box.



Picture 4

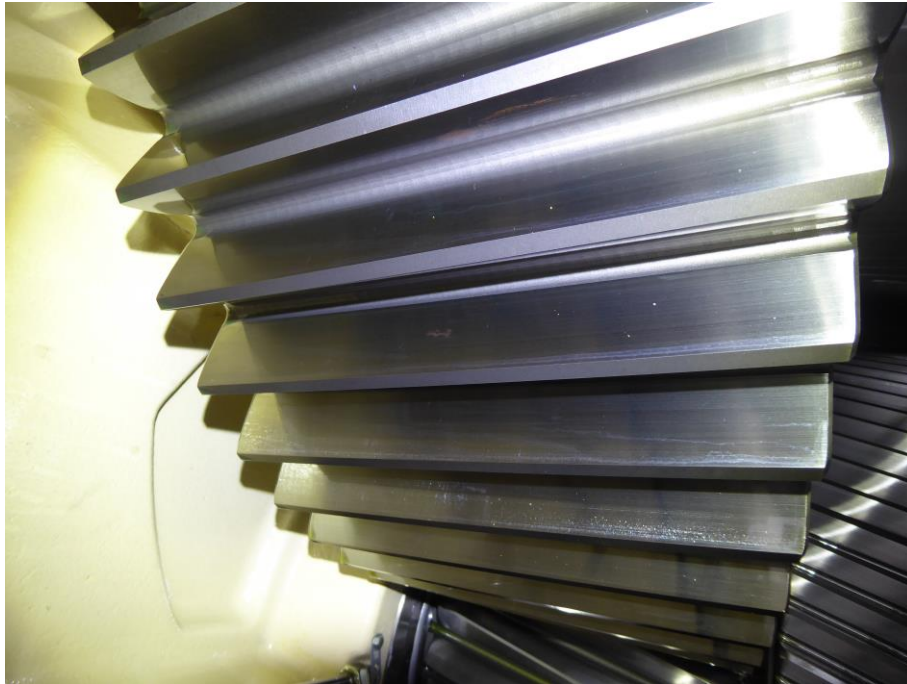
At the shaft bushing of the output stage an oil loss in the area of the labyrinth seal is visible also as picture 4 shows.



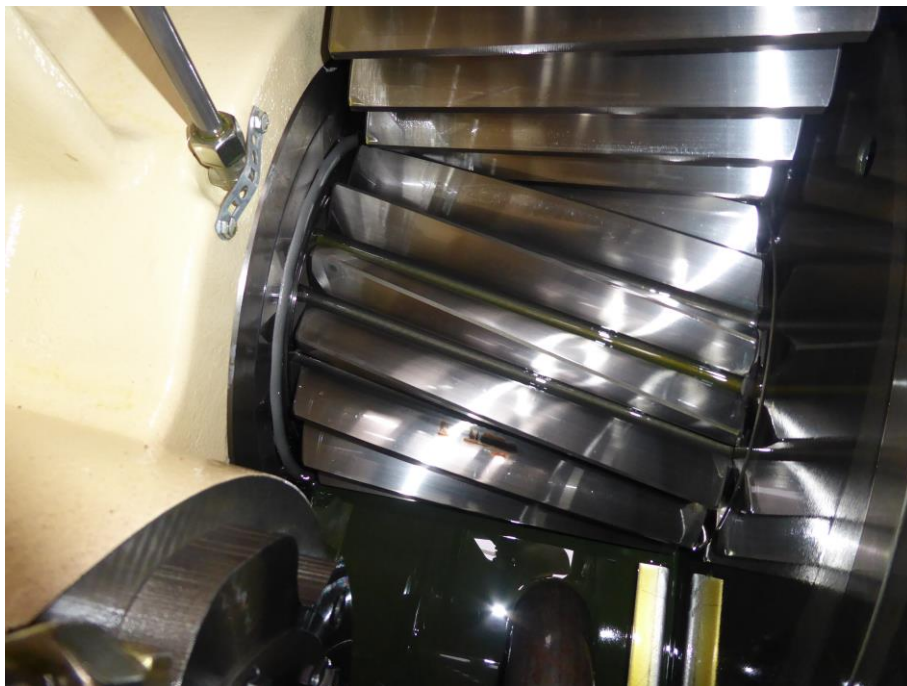
Picture 5

As recognizable on picture 5, the filter housing of the fine filtration indicates a slight leakage.

Spur gear stage

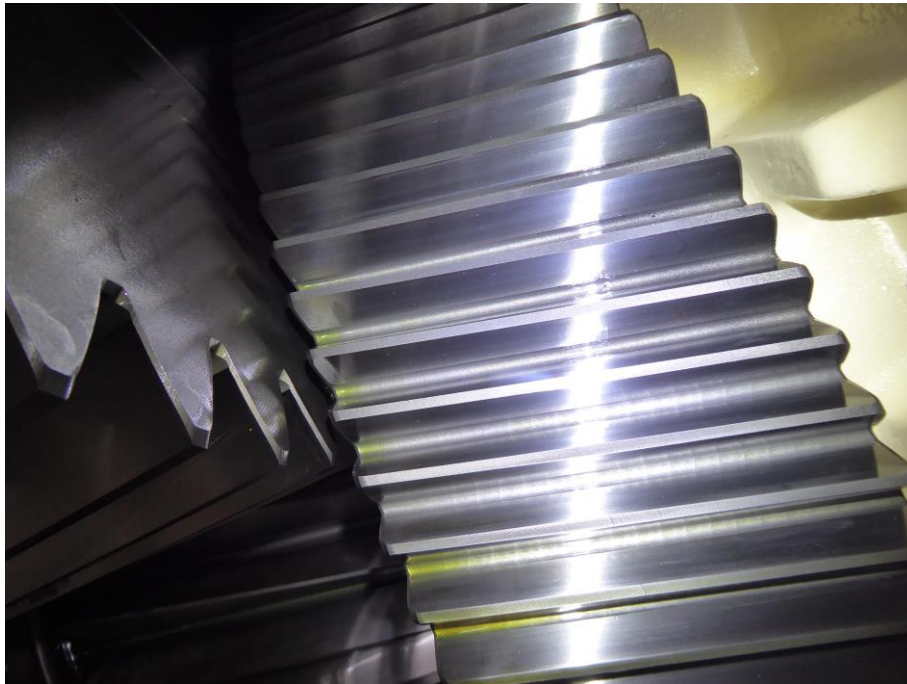


Picture 6

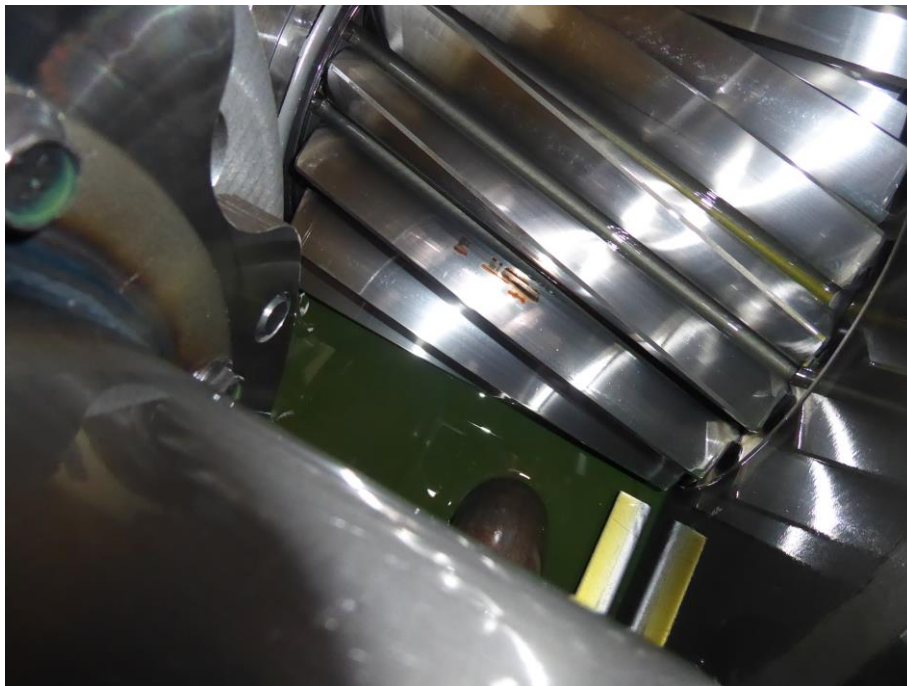


Picture 7

Pictures 6 and 7 show the input stage of the spur gear part. The load flanks of this tooth pair show a marginal frontal loading of the pinion with distinctive line forming in the tooth base of the gear. Furthermore a slight insufficient correction by grindings with a contact pattern alignment towards the generator is recognizable.



Picture 8



Picture 9

Pictures 8 and 9 show the output stage of the spur gear part. Here shows the load flanks also a marginal frontal loading of the pinion with distinctive line forming in the tooth base of the gear. In addition, an insufficient corrective grinding to a supporting image orientation towards the rotor and single arrest marks can be seen.



Picture 10



Picture 11

Picture 10 shows the rotor side bearing of the output stage and picture 11 shows the bearing of the drive stage generator sided. All visible bearings of the spur gear stage indicate just operational running marks with slight scoring in sense of rotation which present harmless overall.

Planetary stage



Picture 12



Picture 13

Pictures 12 and 13 show the tooth flanks of the first and third planetary gear of the planetary stage. A distinctive line forming in the tooth base is recognizable and the load flanks show a slight roughening of the tooth surfaces. Furthermore a contact pattern alignment towards the generator as well as some standstill marks are visible.

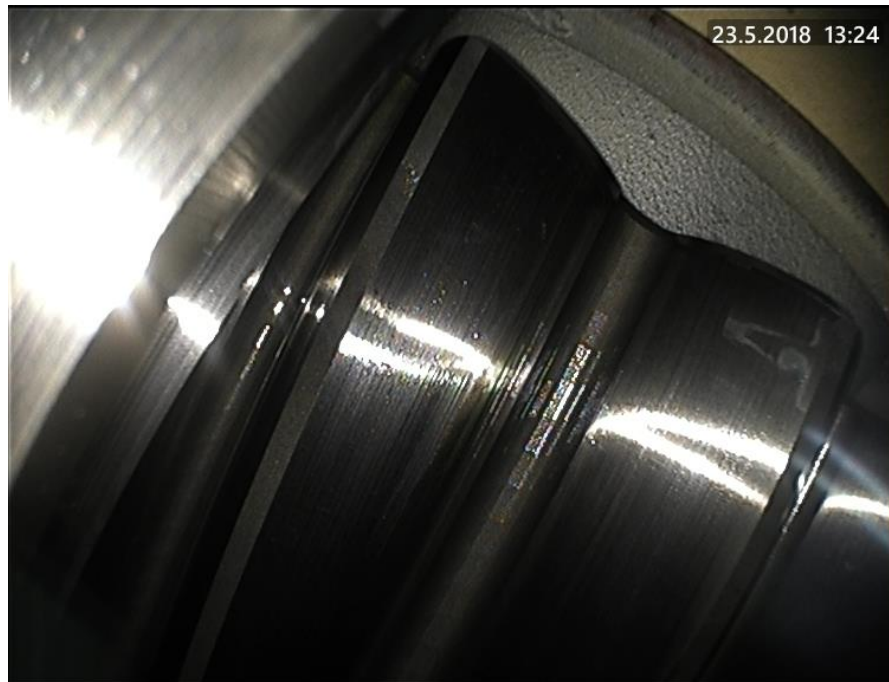


Picture 14



Picture 15

The bearings of the planetary gears indicate running marks with slight scoring in sense of rotation and some metal particle as recognizable on pictures 14 and 15, which is unusual to be regarded as easy and requires observation.

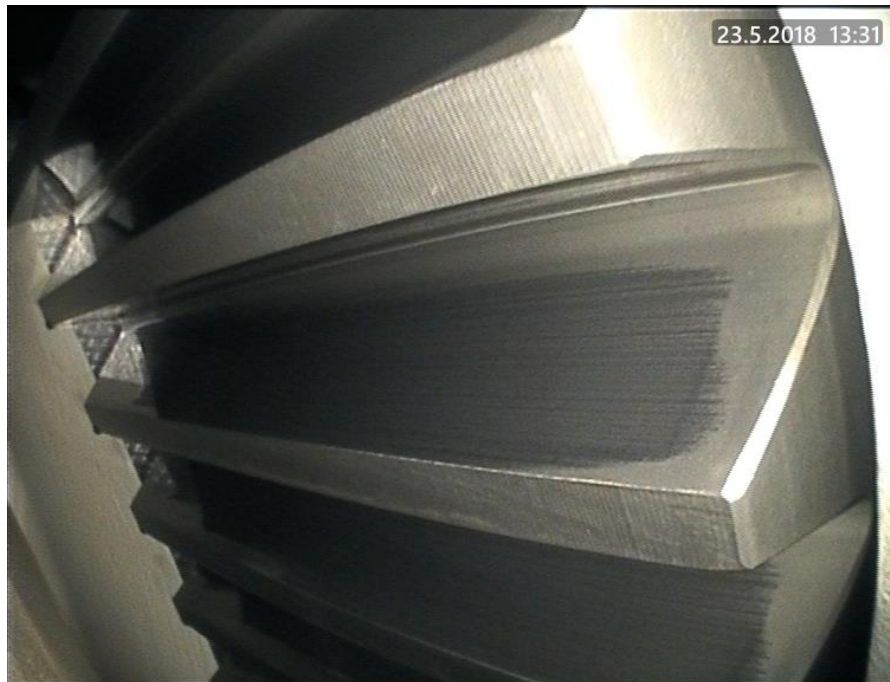


Picture 16

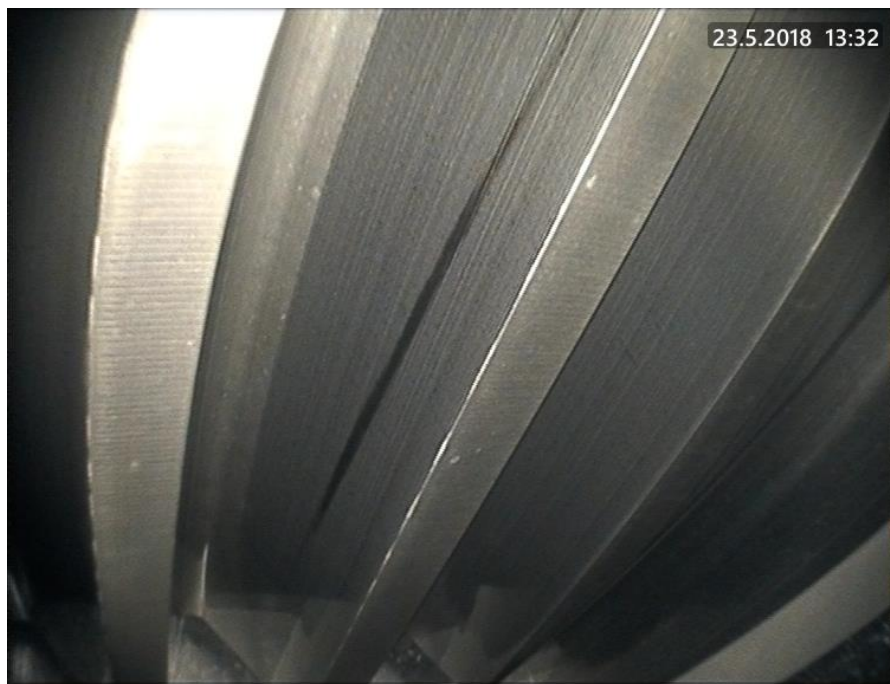


Picture 17

Pictures 16 and 17 show the sun gear of the planetary stage. In the tooth base a distinctive line forming is caused by the frontal loading of the planetary gears. Furthermore, a contact pattern alignment towards the generator and a roughening of the load flanks is recognizable.

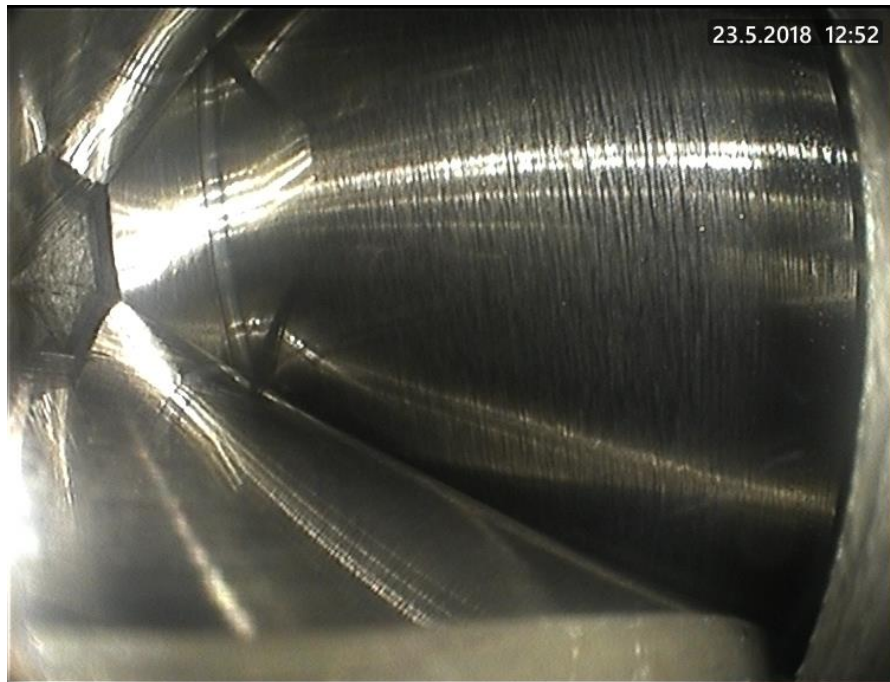


Picture 18



Picture 19

On pictures 18 and 19 the tooth flanks of the ring gear are imaged. Here is a contact pattern alignment to the rotor out and there are some pronounced standstill sichtbr sightbr, but they are not questionable.



Picture 20



Picture 21

On pictures 20 and 21 the rotor side bearing of the planetary carrier is recognizable. The bearings show, in addition to the normal running tracks, individual grooves that indicate slight roughening.

VI. Concluding remark

In this gear box are the described anomalies that are in shape from visible frontal strain, conspicuous line deformation, incipient gray tints, insufficient contour, contact pattern alignment, idle markers, etc., all of which could be classified as non-critical.

The visible initial mottling or slight roughening of several Load flanks and occasional idle marks are afterwards Operating time of the transmission and therefore requires further monitoring. It is also recommended to take an oil sample out of the gearbox (not from the oil circuit) and analyze the sample to determine how far the Slipperiness is still present or should be a higher quality oil due to climatic conditions.

On the visible bearing of the gear stage and on the bearings of planetary stages appear primarily traces of operation with occasional light, which are not critical and only need to be monitored.

All detected anomalies actually seem to be harmless and must also be monitored. In addition, the gear box should be rechecked after 24 months (under standard conditions and regular observation).

The leaks at the drive shaft and the output shaft are low and should be checked and cleaned regularly. The leakage at the filter fittings must be permanently remedied by the manufacturer as part of the maintenance. In addition, the paper filter of the gearbox renewal must be renewed.

At present, there are no concerns for the further operation of the gear box.

Schüttorf, 26.05.2018

Hilmar Bavinck

Hilmar Bavinck
-Expert-

