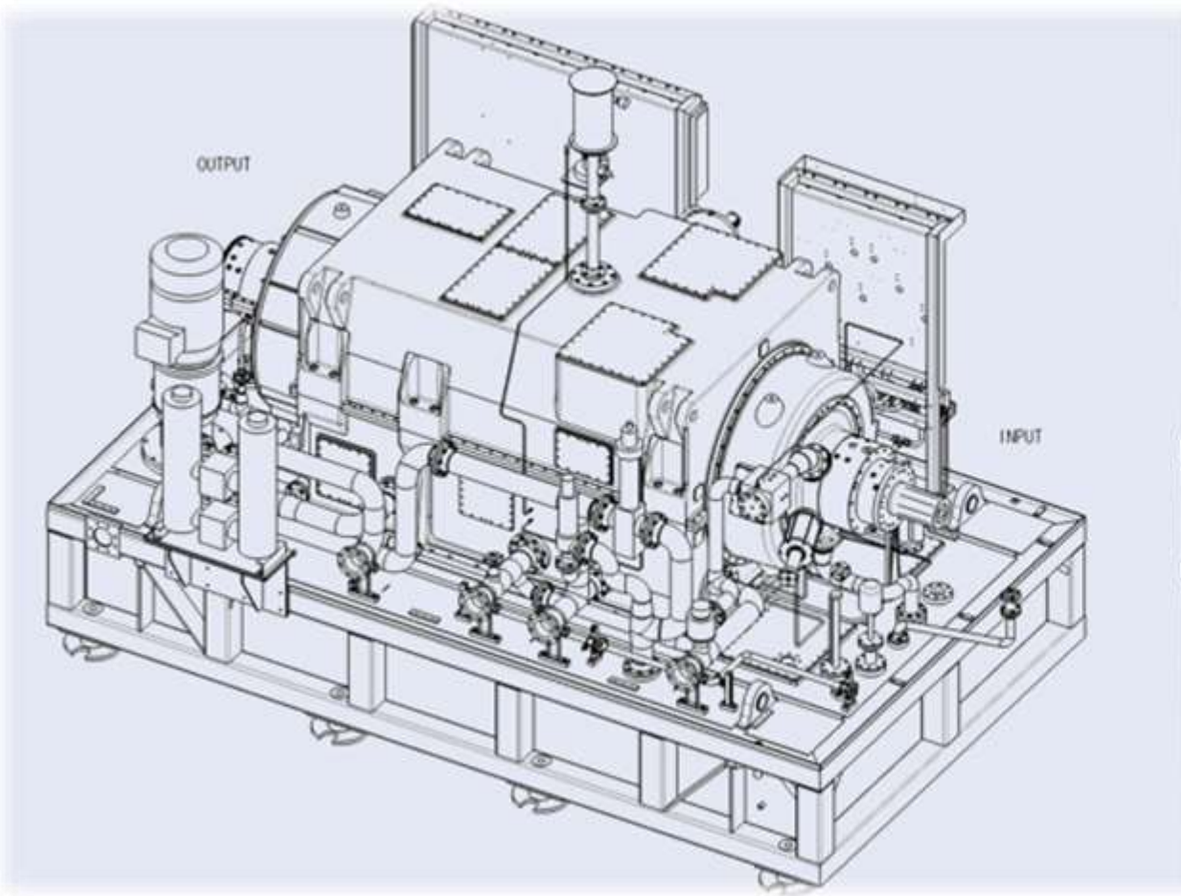
VOITH Gear Box SG ESP Bearing Damage

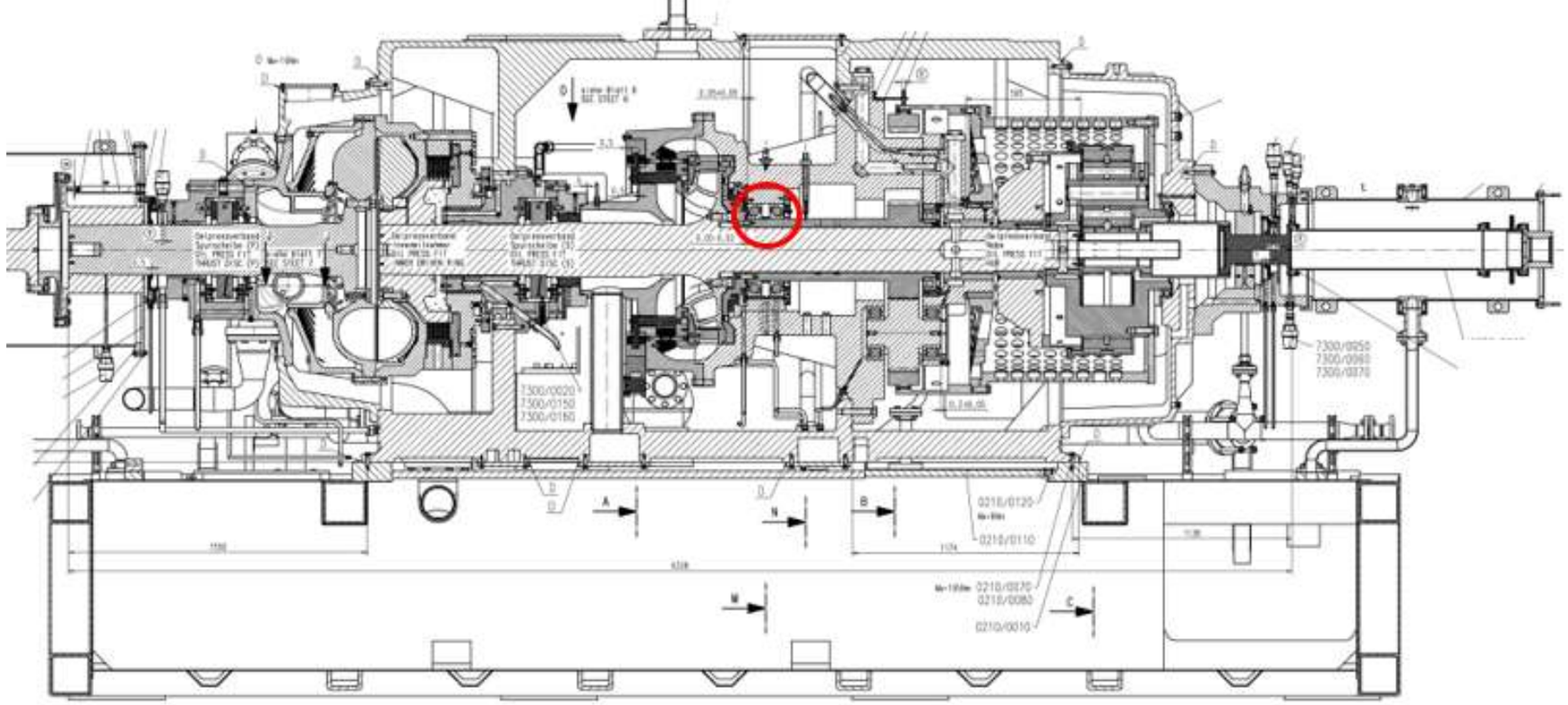
(Unplan SD 12 Days)

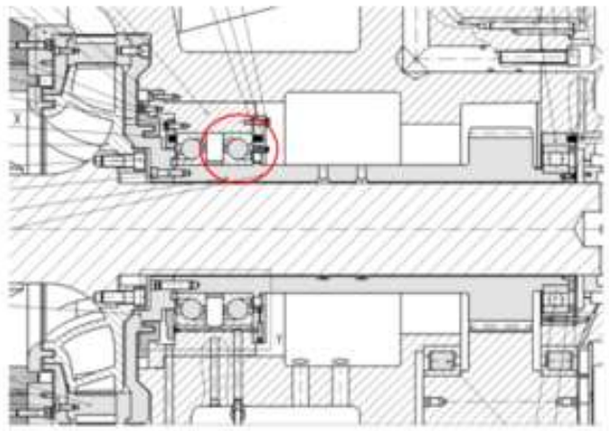


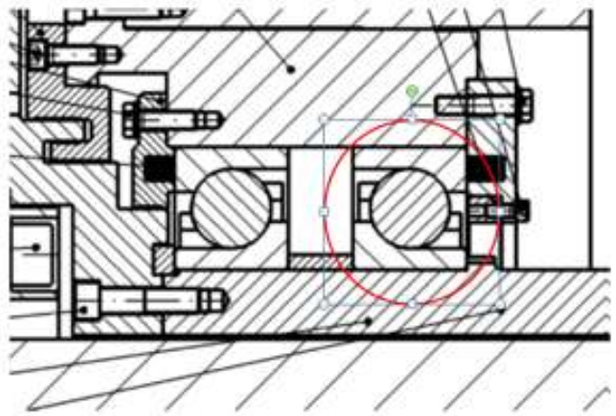
By Kitipon Nusong

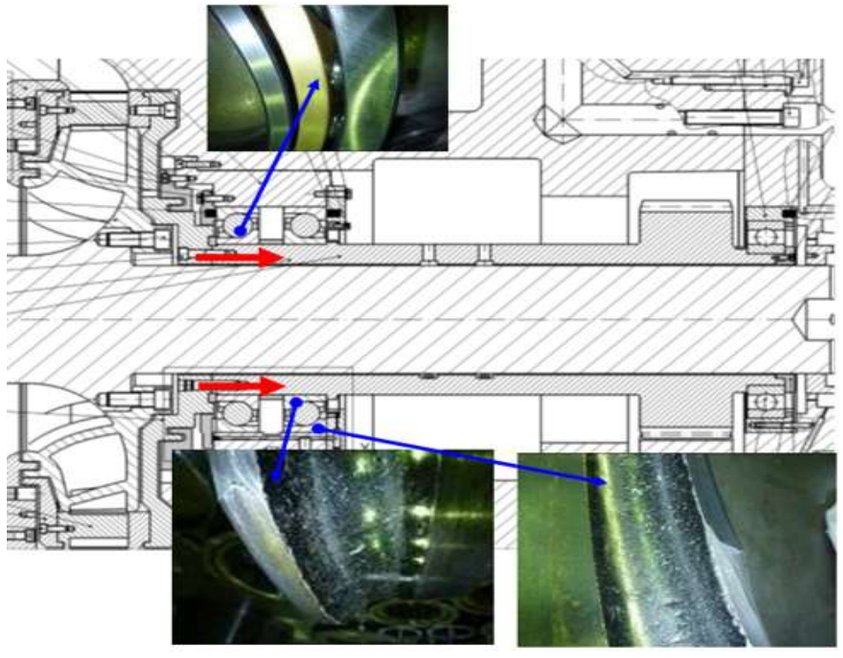
1st Problem

On November 2010 gear box has been stopped after approximate 6000 running hour due to high vibration on coupler sleeve. From investigation by bore scope, we found angular ball bearing damage. Furthermore metal and brass particle has been found in oil tank





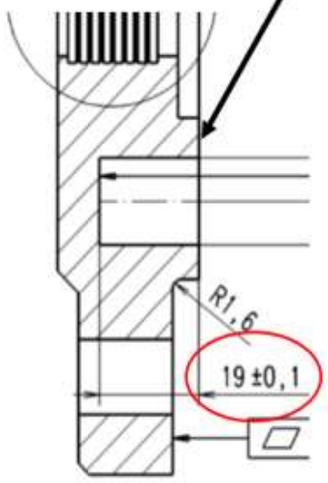




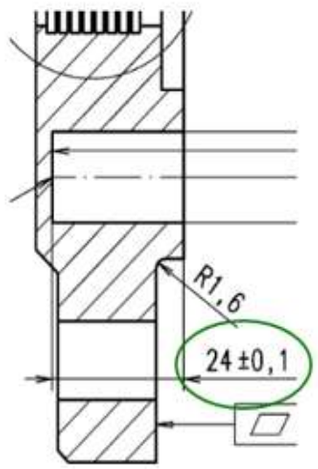
Abnormal raceway is clear indication of too high axial thrust

RCA

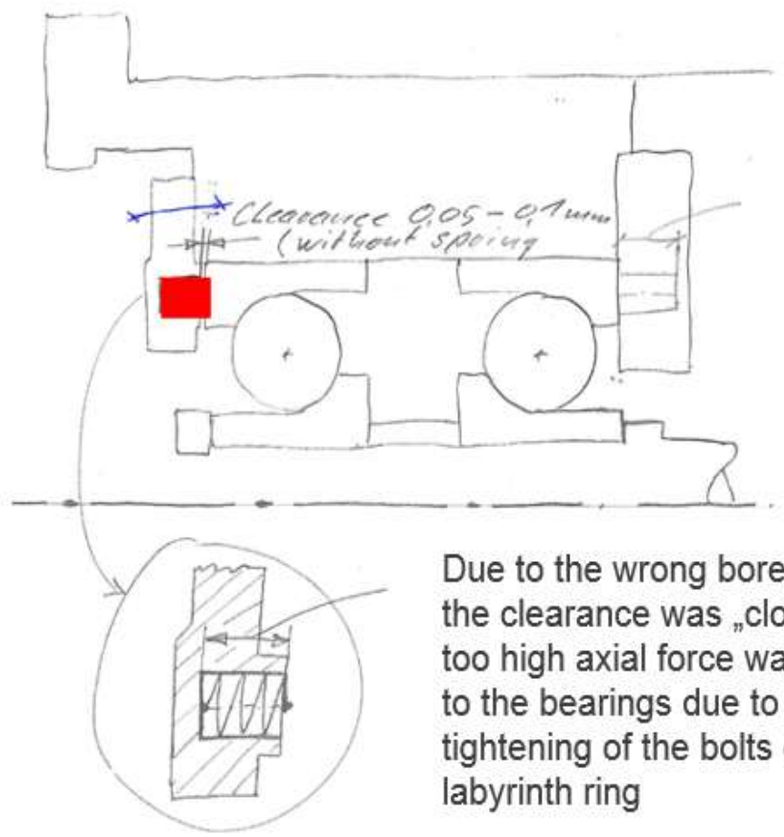
This surface is machined to adjust the axial bearing clearance. Therefore the bore hole depth can become smaller than 19 mm



Wrong bore hole depth



Correct bore hole depth



Due to the wrong bore hole depth the clearance was „closed“ and too high axial force was applied to the bearings due to the tightening of the bolts of the labyrinth ring

2nd Problem

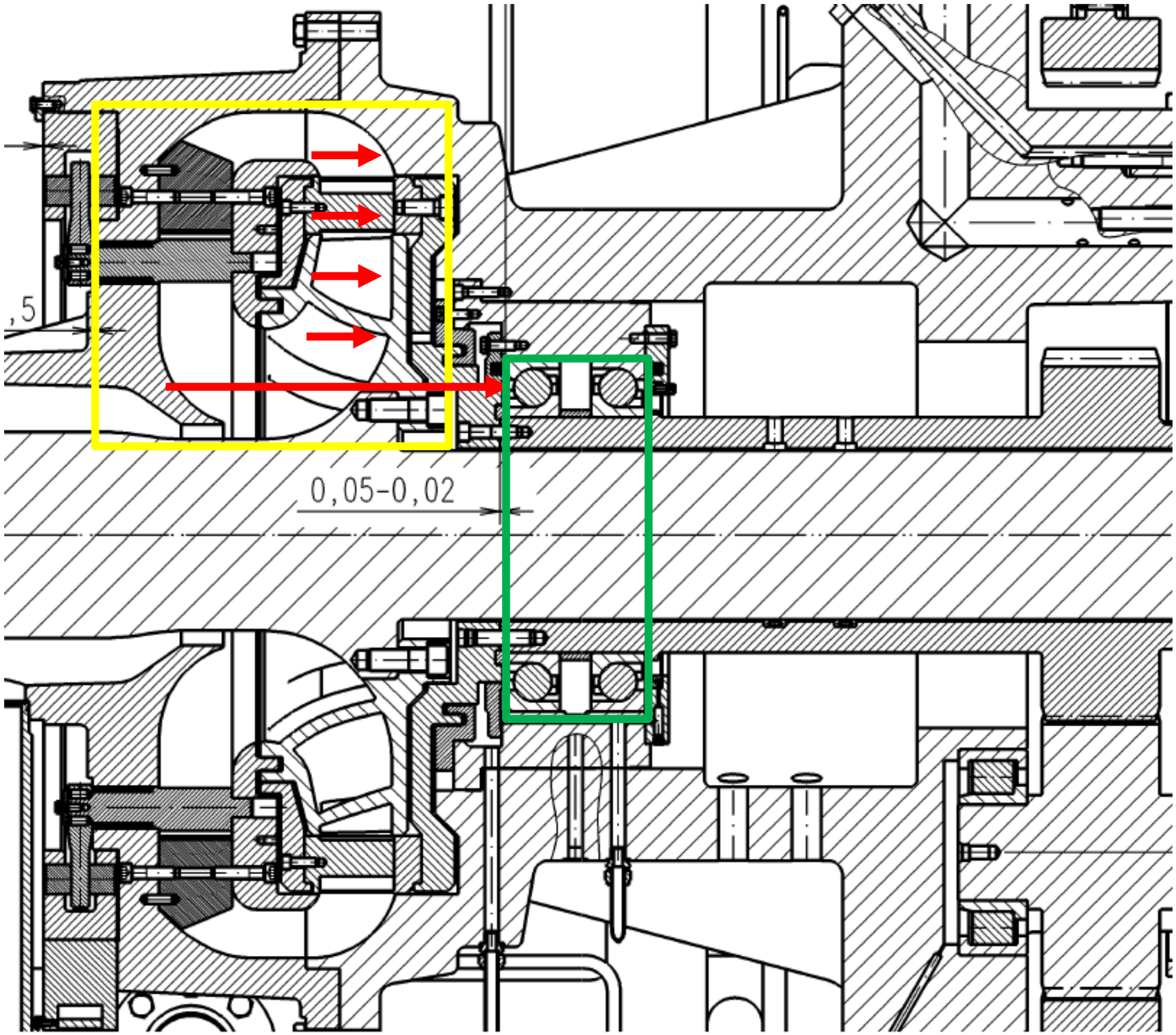
On 2012 gear box was shutdown due to high differential pressure on filter. New filter was replaced then it's clogged again after only 4 hour. We found angular ball bearing damage as same as the first time.

figure 24: bearing B13.2 - outer ring - circumferential damage

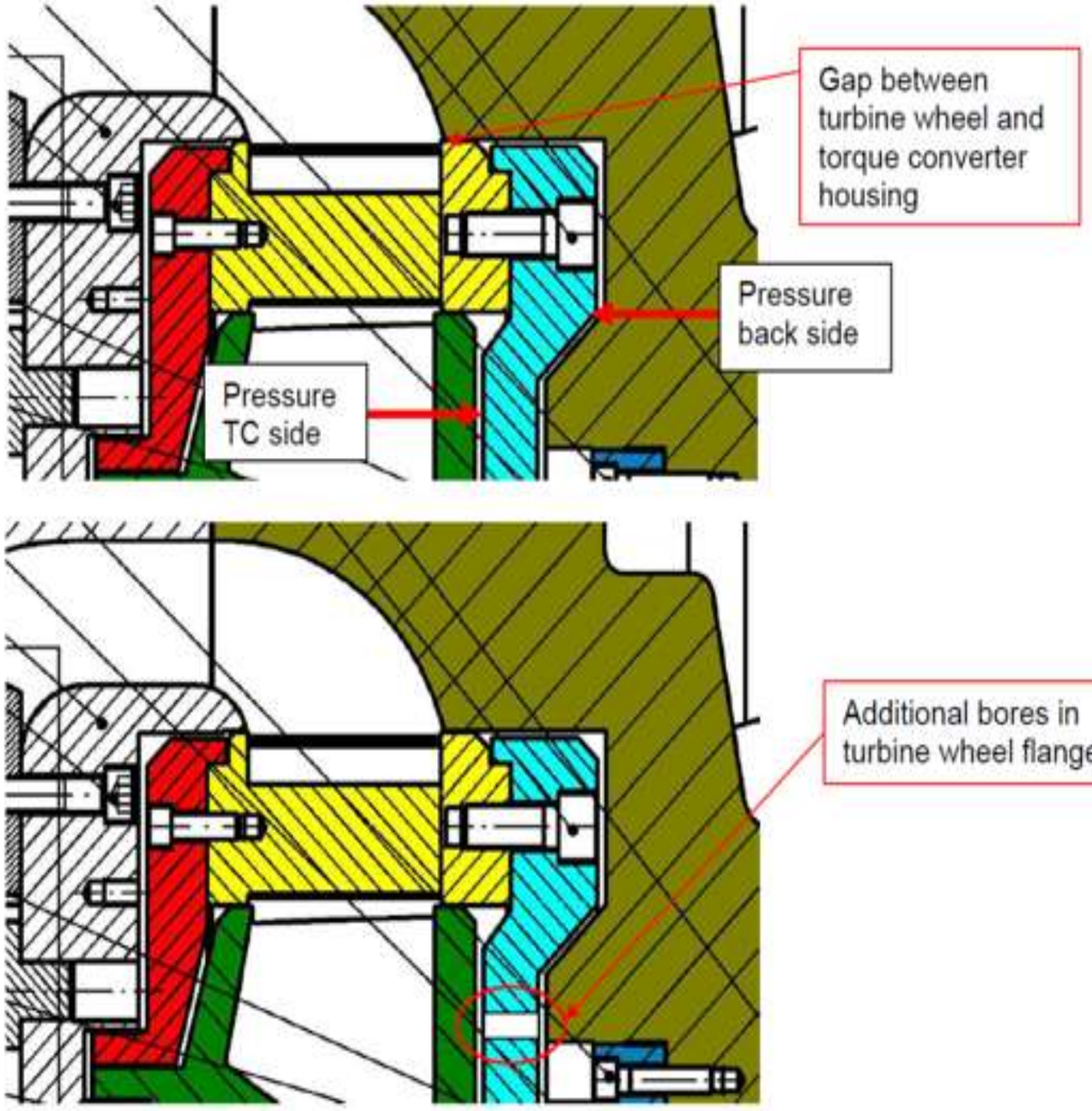
figure 25: bearing B13.2 - inner ring - circumferential damage

figure 26: bearing B13.2 - rolling elements - abrasive wear on all balls

RCA

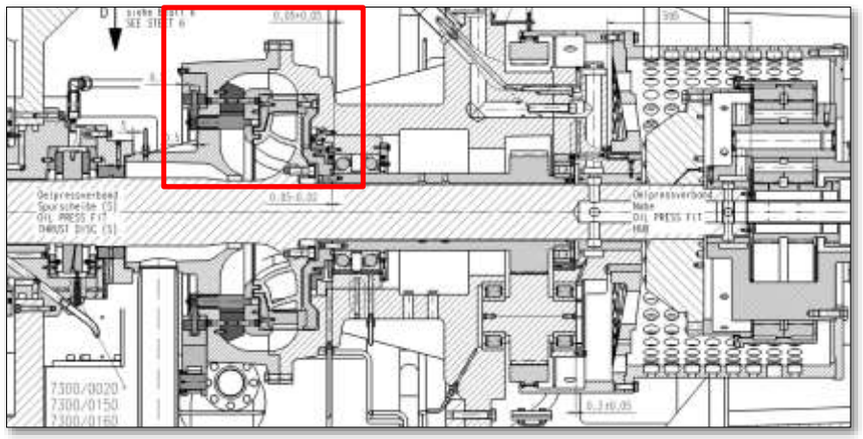


Increase gap and add one hole and install vibration probe



Reduce Working Pressure from 14.6 to 8.1 Bar by

Orifice



Actual Test

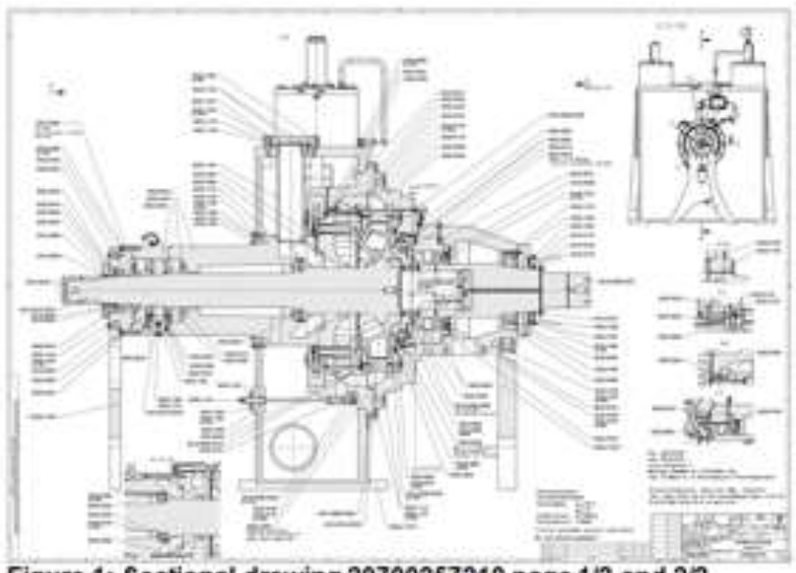
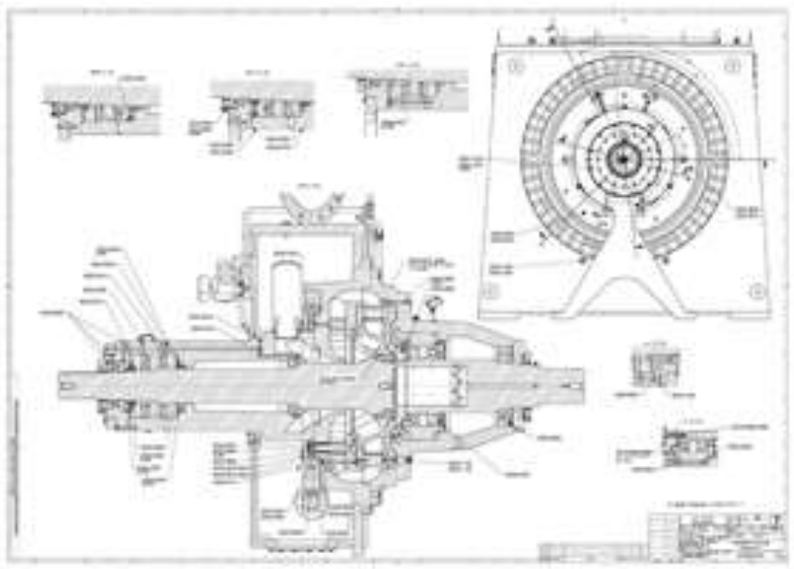


Figure 1: Sectional drawing 20700257210 page 1/2 and 2/2



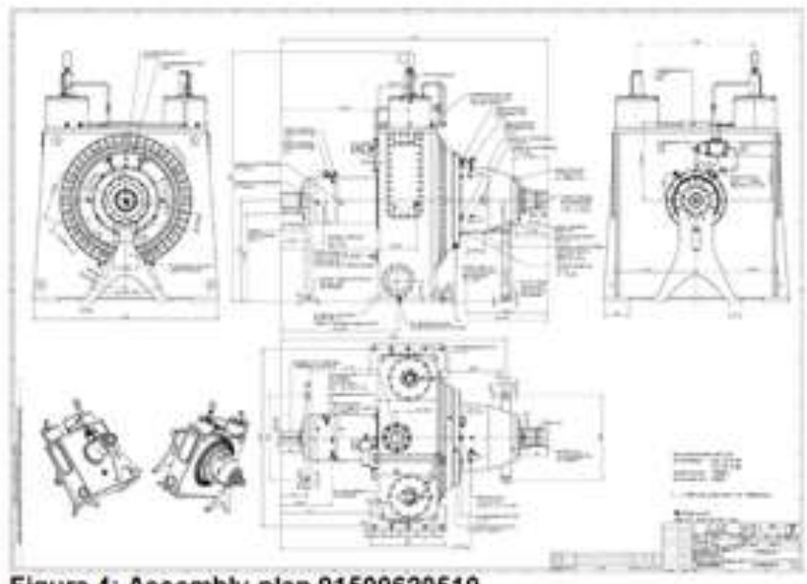
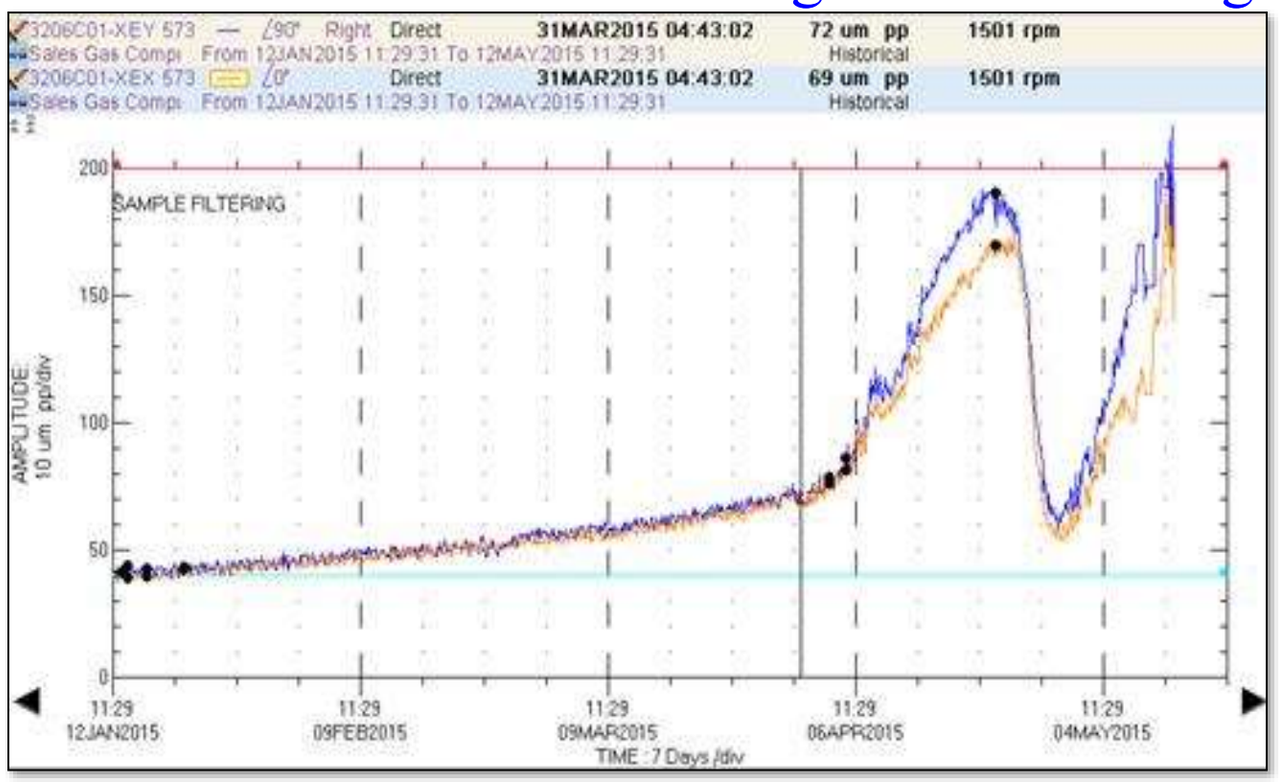


Figure 4: Assembly plan 91500620510

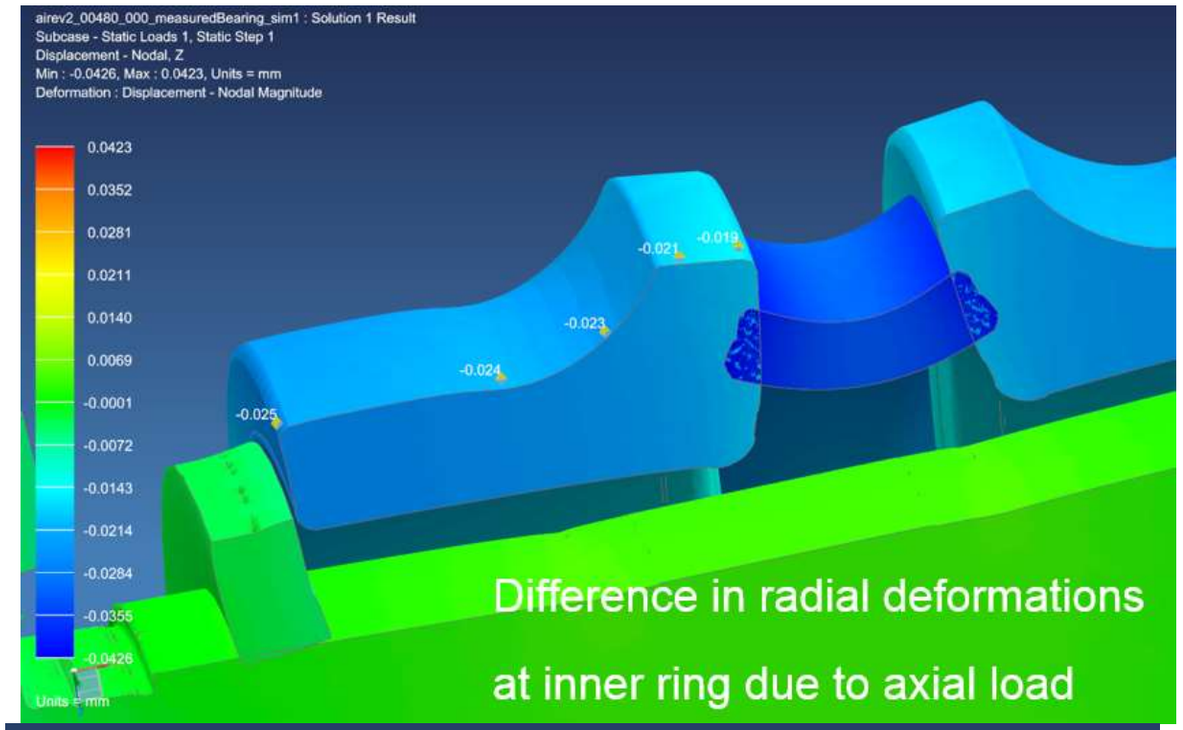
With Load fro Test Bearing Life Time is 88987 Hrs or >10 Years

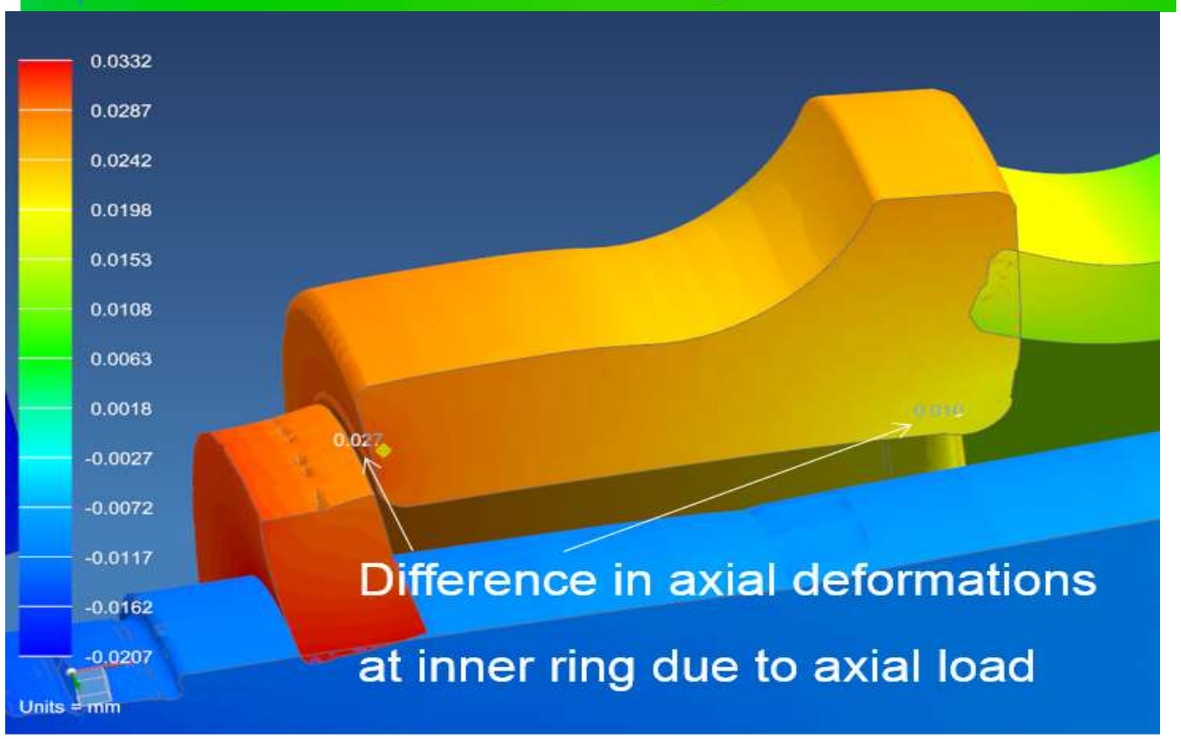
3nd Problem

On May 2015 gear box was shutdown due to high differential pressure on filter and we found vibration on angular ball bearing increasing significantly.

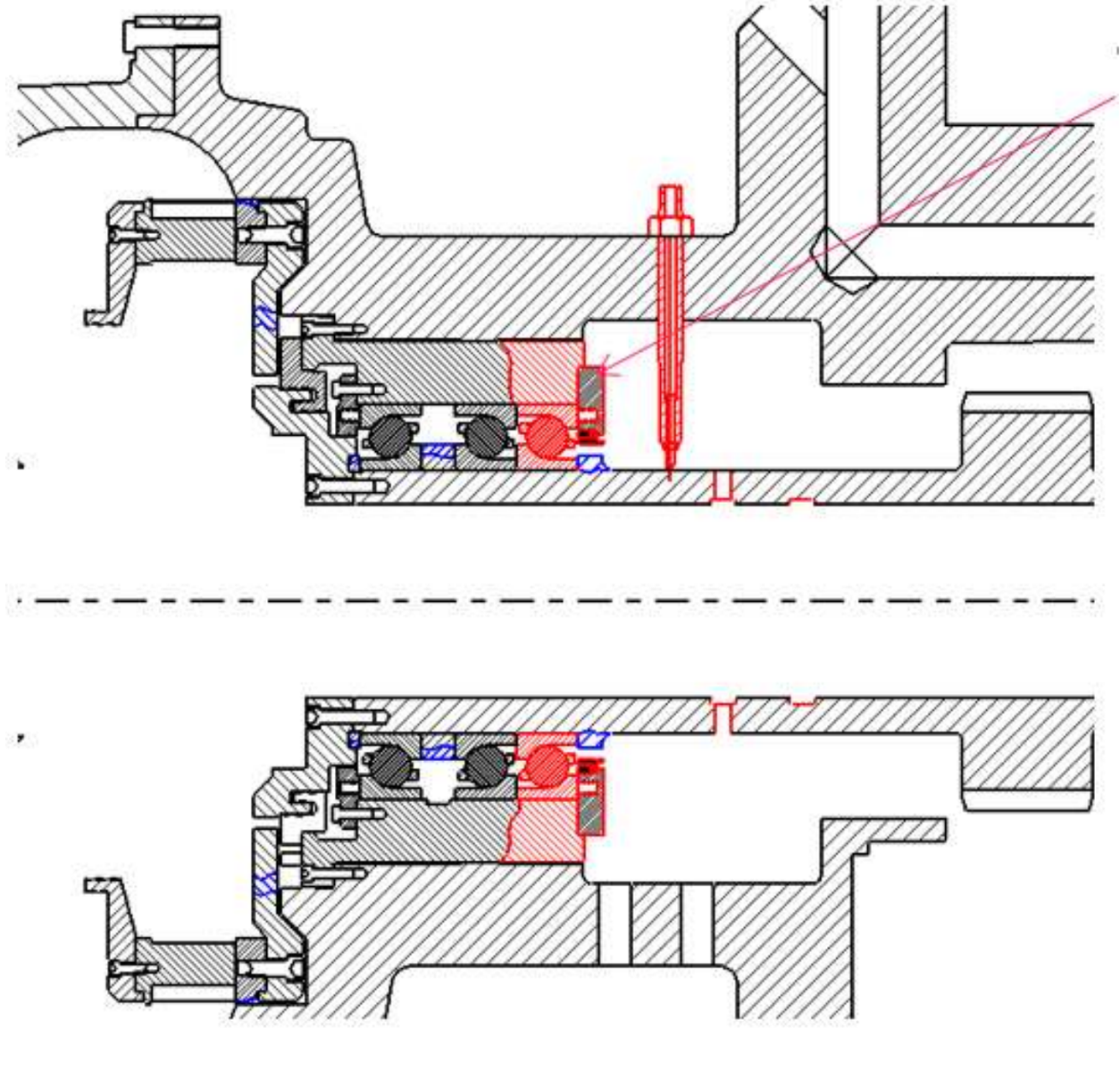


Modified Solution





Install Tandem Bearing



Case 0 : Result of Bearing Calculation after Modified from Second Failure

- Calculated bearing lifetime: 88987 hours (> 10 years, L_{hm} modified reference bearing lifetime, 90% of bearings will last longer)
- Based on 7 load cases, axial thrust taken from torque converter measurements.

Load case	Shaft speed	Axial thrust
1	1,047 rpm	59,220 N
2	1,047 rpm	60,850 N
3	853 rpm	61,440 N
4	701 rpm	3,250 N
5	818 rpm	64,650 N
6	619 rpm	68,860 N
7	342 rpm	82,000 N

Weak Point

- Not Include Temperature Effect.
- Model of Bearing is not from Bearing Manufacturer.
- Oil condition is not considered.
- No any addition external force.

Case 1 : Validation Result from 3rd Failure till lifttime approx. 3.5 year as actual

Taking original Bearinx model from bearing manufacturer + data from oil check + data from temperature measurements + operating data from site (2828 load cases → very slow):

- Measured axial thrust + 10 kN: bearing lifetime 45,560 hours (5.2 years)
- Measured axial thrust + 15 kN: bearing lifetime 35,133 hours (4 years)
- Measured axial thrust + 15 kN + temperature increase by 5 °C at shaft & inner ring: bearing lifetime 3.5 years (observed in reality)

Case 2 : Tandem Arrangement with all validation data from case1

Taking **modified Bearinx model with tandem arrangement** → discuss model with bearing manufacturer → data from temperature measurements → operating data from site (2828 load cases):

- Starting with all data from BearinX2 which produced 3.5 years of lifetime
- the bearing lifetime (system lifetime of two tandem bearings) is 150,960 hours (17 years)