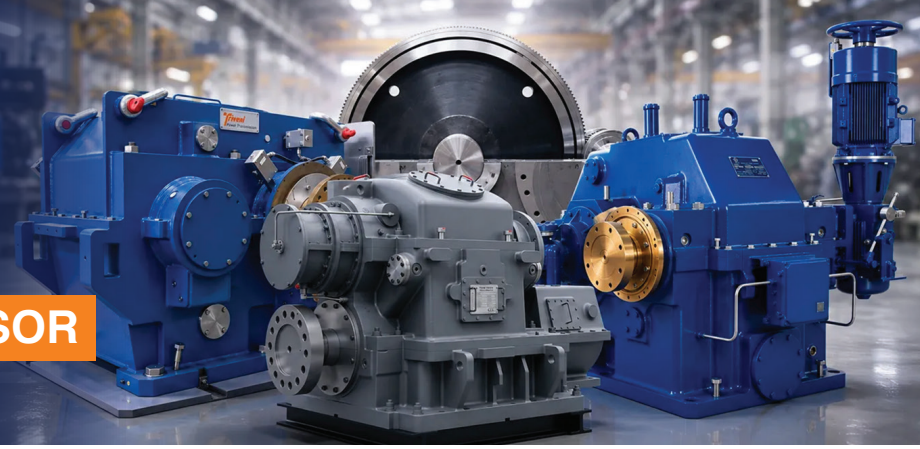
POWER TRANSMISSION LTD.



PROCESS AIR COMPRESSOR GEARBOX

1 TECHNICAL DATA:

Equipment	Process Air Compressor Gearbox
Power	6700 KW
Type	Speed Increaser
Input/Output Speed	7324 / 10844 RPM
Ratio	1 : 1.48
Driving Equipment	LP Compressor
Driven Equipment	HP Compressor

2 PREAMBLE / PROBLEM REPORTED

The gearbox, supplied along with the turbine, LP, and HP compressor in 1990, initially operated smoothly for the first 10 years.

Gradually, the axial float of the output shaft began to increase, as observed in online axial measurements. The clearance was found to increase by 0.08mm within one year from the time of overhauling. Despite repetitive adjustments of the Distance Between Shaft Ends (DBSE) at the coupling, this thrust clearance problem persisted

Additionally, the radial bearing on the input Drive End (DE) side began to fail. Although this bearing was replaced, the same issue recurred within 2-3 months, leading to repetitive failures

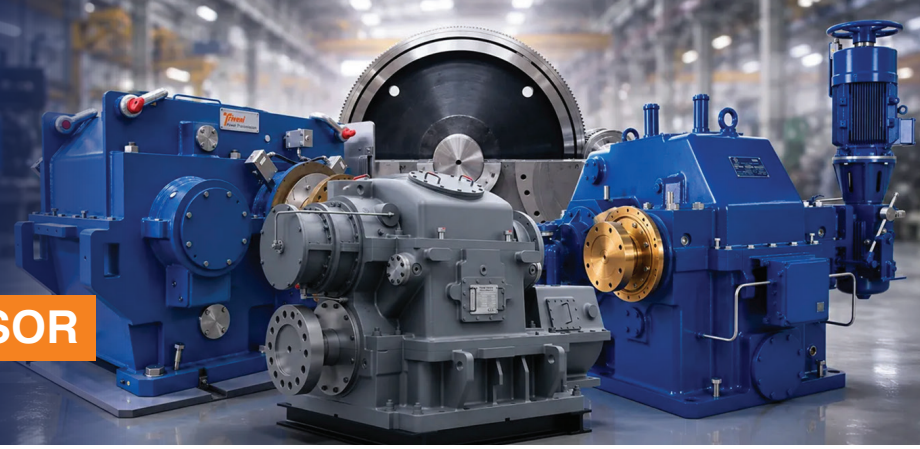
The following were the problems reported :

- The recurring failure of the input shaft drive end bearing.
- A significantly high failure rate, with approximately one bearing failing every two months.
- Repetitive increases in thrust clearance in the output shaft.
- Gear pitting and burning observed in the input shaft..

3 DIAGNOSTICS STEPS UNDERTAKEN / OBSERVATIONS MADE:

Triveni deployed a team comprising members from Design, Quality Assurance (QA), and Service departments, and the following activities were performed.

1. Collection of historical running data of the gearbox, including vibration levels, bearing temperatures, etc.
2. Study of past maintenance records to identify any recurring issues or patterns.
3. Conducted an open inspection of the gearbox, including studying gear and bearing clearances, inspecting gears, and verifying alignment between the driver, gearbox, and driven equipment.
4. Dimensioning of gear internals, bearings, and casing components to assess their condition and potential issues.
5. Validation of the design of gear internals, bearings, and casing components to ensure they meet operational requirements and standards.
6. High casing vibration observed at the input shaft drive end bearing.



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7. An increase in gap voltage noted in the shaft vibration probe.
8. Heavy spike energy levels observed at the input drive end compared to the non-drive end.
9. The horizontal growth of the gearbox shaft does not match the calculated values.
10. Unlike the output shaft side, the pressure dam in the low-speed shaft radial bearing is not connected with the split line.

4 ANALYSIS:

The casing vibration and gap voltage showed a direct correlation. The increase in gap voltage, attributed to an increase in bearing clearance, resulted in higher shaft and casing vibration.

A systematic increase in gap voltage suggested a possibility of bearing overload. Despite the set running smoothly for many years, changes in dynamics such as machine level or expansion issues could overload the bearings.

Uneven increases in bearing clearance across the shaft could cause a shift in dynamic tooth contact, thereby overloading the gears and leading to pitting over time. The high spike energy observed in the input side of the helix was likely due to this effect.

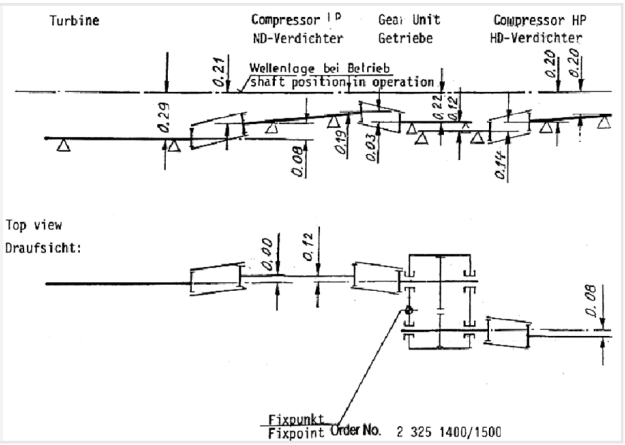
5 CONCLUSION:

The bearing load was checked and found to be on the higher side, measuring at 34 kg/sq.cm. To address this, the bearing diameter and width were increased to bring the load within the acceptable range of 27 kg/sq.cm.

The pressure dam of the input shaft is now connected to the joint line.

Furthermore, the alignment protocol was modified. While maintaining the same vertical offset, the horizontal offset was reduced by 50% of the original protocol. This adjustment aimed to minimize the load on bearings related to growth.

- Gear box shaft offset of 0.06 w.r.t I/P shaft in horizontal plane is maintained considering the thermal growth of the casing.
- Existing foundation dowels replaced with new dowel plates having proper fit in the slot.



DBSE was maintained by aligning the input and output shafts at their axial mean positions..
All running parameters of the gearbox were found to be within permissible limits.
No further failures have been reported in the gearbox since then.