

# Investigation of the load of plain bearings in multistage side channel pumps

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Besides pure pump liquid delivery, the delivery of pump liquid with gas content of maximum 50% and operation under self-priming conditions are also considered as regular operating conditions for SERO side channel pumps. In both cases, self priming and delivery with gas content; the pump is not filled completely with the fluid. Therefore it might be possible, that the plain bearings, which are mounted in the casing of the side channel pumps and which are cooled and lubricated by the fluid, can run without lubrication temporarily.

Therefore, in this report, the influence of these operating conditions on the plain bearings is investigated. In addition, operating conditions without delivery and with misalignment of pump and driver are included.

Usually, the load of plain bearings is determined with strain gauges, which are mounted on the outside of the bearing seat. In the case of side channel pumps, this measuring technique cannot be applied, because the bearings are mounted into the casing. Instead of strain gauges, the load of the plain bearings was measured by thermocouples. These were mounted through holes in the casing and hub onto the outside of the bearing seats. The experimental setup with all measuring points is shown in figure 1.

The parameters for the measurements were specified in the following way:

- Maximum Flow:  $Q_{\max}=1,4*Q_{\text{opt}}$
- Minimum Flow:  $Q_{\min}=0,6*Q_{\text{opt}}$
- Maximum Gas Content: 20% (Barrier of the test rig)
- Time limit for self-priming: 600 seconds

In the case of operation with pure pump liquid and pump liquid with gas content measurements were taken for three different volume flows ( $Q_{\max}$ ,  $Q_{\min}$  and  $Q_{\text{opt}}$ ).

The results show that the highest bearing temperatures occur for maximum flow. That is insofar remarkable, as the hydraulic radial forces for maximum flow are less than for minimum flow, because of the lower hydraulic head. Because of the higher pressure level in the low flow rate range, a significant higher force acts on the bearings in the opposite direction to the exclusion of the shaft (Lomakin effect). But the absolute increase in temperature in the plain bearings is small. Neglecting the increase in fluid temperature, the increase of the plain bearing temperature is just 2°C or less. The tests for pump liquid with gas content delivery show the same results. Therefore, one can assume that also in the case of pumping a fluid with gas content, an adequate lubrication of the plain bearings is guaranteed.

Usually, operation with self-priming is limited to 60 or 120 seconds. For this investigation, the time interval was extended to 600 seconds. In order to realize such a long self-priming operation, the suction line of the pump was closed with a blank flange. During the self-priming operation, the increase of the plain bearing temperatures and the pump liquid temperature coincides. Therefore, also for self-priming the plain bearings are lubricated sufficiently.

For side channel pumps, the operation without delivery is prohibited. The tests for operation without delivery show that after 80 seconds the increase in temperature in the bearings is about 30°C. Subtracting the fluid temperature from the total temperature, the experimental data showed that the plain bearing temperature and the fluid temperature increase equally for a short amount of time. After about 40 seconds, the plain bearing temperature increases very fast, before converging to the pump liquid temperature again (Figure 2).

In the case of misalignment of pump and pump drive, the anti-friction bearing, which is located on the driving end, must absorb the resulting transversal forces. In general, the temperature in the plain bearings is not very high, but there were small peaks in the temperature curve observed, indicating a short rubbing of the shaft on the

bearings. This leads to increased wear in the bearing bushings and to negative rotor dynamic characteristics.

Concluding this investigation one can say that:

- Operating with pure pump liquid or pump liquid with gas content delivery does not lead to unacceptable load of the plain bearings if the limits for maximum and minimum flow are respected.
- High temperatures after a short operating time and wear in the bearing bushings must be expected for operation without delivery
- Misalignment leads to a short rubbing of the shaft in the bearing bushings; furthermore the load for the anti-friction bearing is too high.

Therefore, both operation without delivery and misalignment have to be avoided by appropriate arrangements in the system. It is recommended to install a bypass line on the pressure side or a device to monitor the electric load, for avoiding operation below the minimum flow rate. Also, an accurate alignment of the coupling of the pump and driver has to be assured when installing a side channel pump. In contrast to common apprehensions the plain bearings are also lubricated adequately for pump liquid with gas content or self-priming operation.

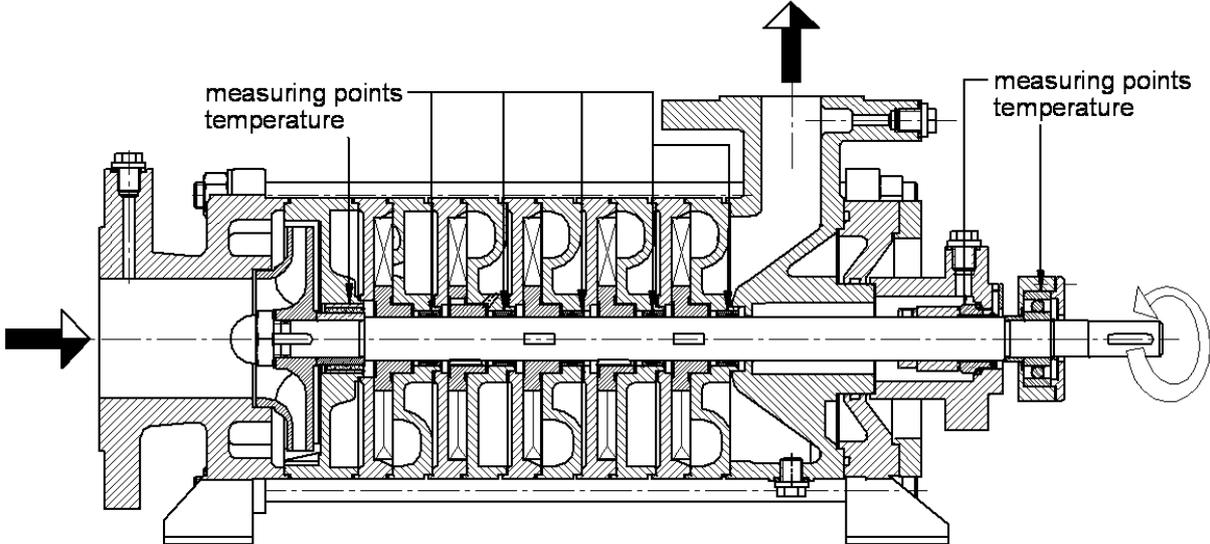
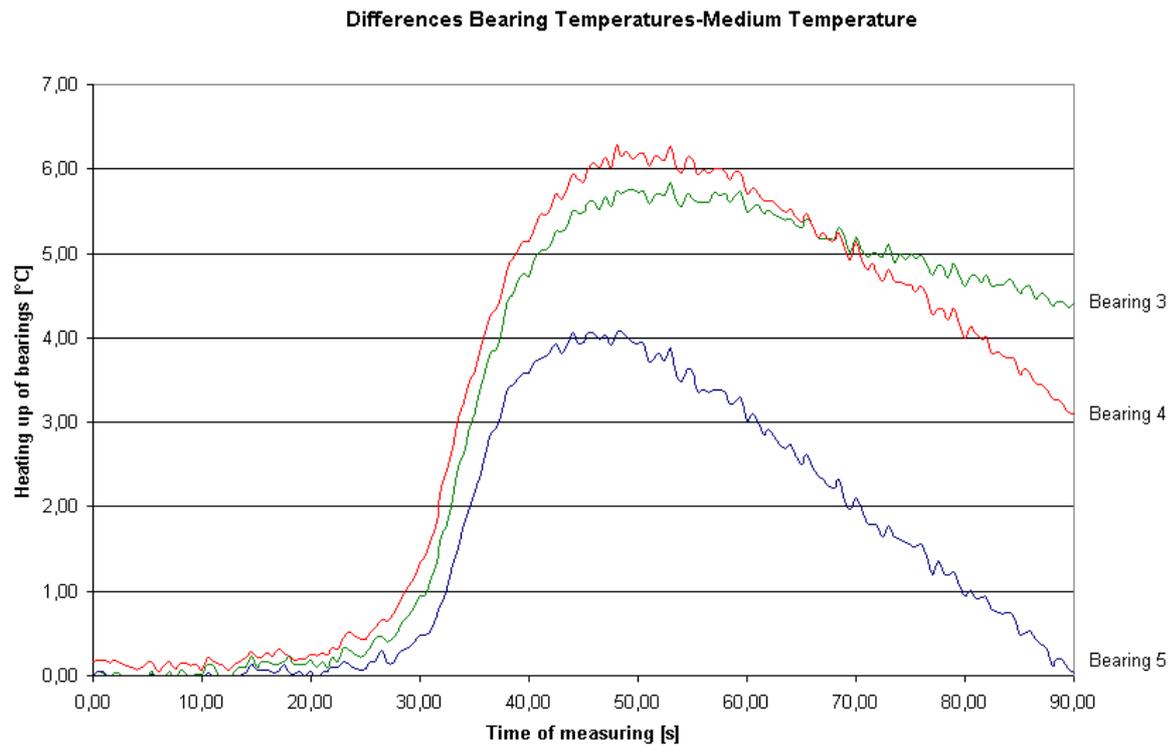


Figure 1: Points of Measurement at the SERO Test pump



**Figure 2: Heating up of bearings for operation without delivery**