High Speed Shaft Seal

Development of the B3S seal invented at the IMA to become a gas-lubricated high-speed shaft seal

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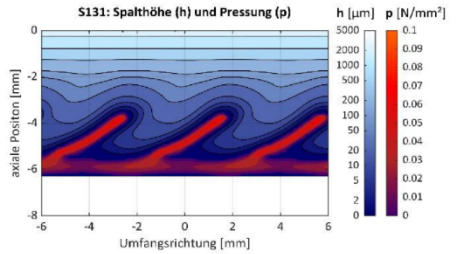
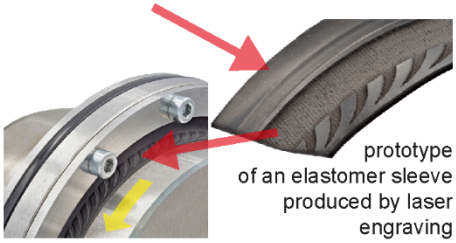
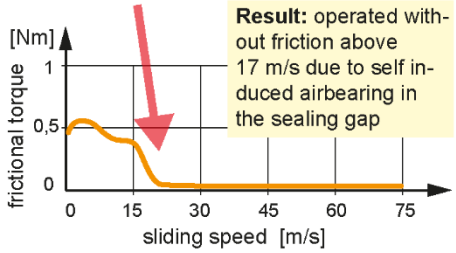


structure optimization by flow simulation

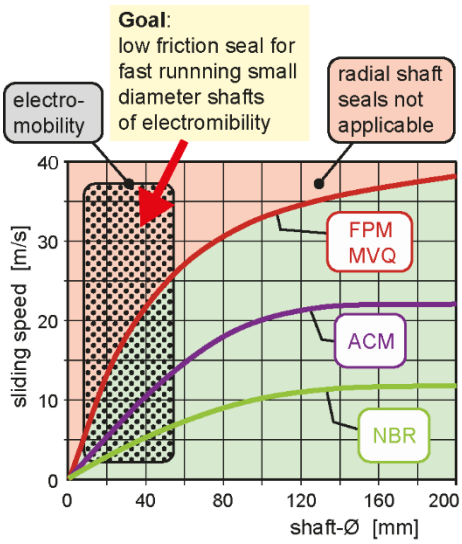


prototype of an elastomer sleeve produced by laser engraving

experimental test



Result: operated without friction above 17 m/s due to self induced airbearing in the sealing gap



recommended application limits according to DIN 3760 for radial shaft seals

Development of a low friction seal for small shaft diameters and high speeds

Motivation

A trend in electromobility is that the required power of electric motors can be achieved most economically at high speeds with a rather low torque. This means that fast rotating small diameter shafts have to be sealed in gearboxes.

Both, the high circumferential speed and the significantly poorer heat dissipation due to the small shafts quickly, push even high-performance sealing materials to their thermal limits.

A robust seal with reduced friction must therefore be developed for electromobility.

Expected results

At IMA a completely new approach for shaft seals was developed and tested, called "Back Structured Shaft Seal" (B3S).

The stiffness of the sleeve is controlled by adding / removing material on the back. As a result, the sleeve deforms during assembly on the shaft and fine channels sized in the micron range are formed in the sealing gap. These channels generate the required back pumping effect for dynamic tightness. The design was patented and funded in two WTT projects.

A study showed that an elastic elastomer sleeve can be used to generate a large number of load-bearing air cushions in the sealing gap and that the sleeve lifts off at a sliding speed of approx. 17 m/s and operates without friction. This creates the basis for universally applicable high-speed seals.

Approach

- Simulation of optimized structures for different sealing diameters and sealing materials
- Production of prototypes by means of laser engraving and experimental verification of functionality on the test bench
- Transfer of prototypes to mass production processes such as injection molding.