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HOW TO ANALYSE AND JUDGE SHAFTS FOR SEALING APPLICATIONS

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ABSTRACT

In times of faster and cheaper production strategies of shafts more and more often leakage occurs in radial lip seal applications. This work disclose those new issues and explain how they can be analysed, judged and most important how they can be prevented. Therefore leakage is prevented and components, machines and whole plants are safeguarded.

Keywords: Shaft, Radial Lip Seal, 2D-Roughness, 3D-Surface Parameters.

INTRODUCTION

The DIN 3761 defines only three different 2D-Roughness parameters of shaft counterfaces for radial lip seal applications. The ISO 6194 only two. Manufacturers and users accept these. The values were build up by empirical knowledge and are valid only for perfect plunge ground shafts. In times of faster and cheaper production, the three values are not sufficient any more. Due to the “new” production strategies, new failures occur.

With a perfect plunge ground shaft and a high quality elastomeric radial lip seal there is no wear and leakage at test rig runs for several thousand hours.

In Figure 1 a 2D-tactile profile measurement is shown. The measurement trace has regarding ISO 4287 a length of 4.8 mm (depending on the assumed roughness) and is executed in axial direction. We see the single grinding structures in the cross section. It is necessary for a recommended plunge ground surface to have a non-periodical surface in axial and circumferential direction with (almost) no waviness to build up a perfect tribology in the system.

However, in field applications more and more leakage occurs. Not only in automotive, but also in industry applications. Due to the need of faster and cheaper production, the shafts have not the same quality like years ago. Therefore some new problems occur. One example is that the surface roughness is not constant at the circumference or in axial direction or the waviness is much higher than before. The waviness was not defined in the standards at the time when they were developed, because the waviness was perfect. Therefore, the waviness is also not defined in engineering drawings and the manufacturers begin to deliver bad quality with a high waviness.
Figure 2 shows an example of a 2D-tactile profile measurement of a “bad shaft”. When the necessary filters (ISO 4287) are applied, Figure 3, we get the red line as waviness and the black line as roughness. It can be clearly seen, that even the roughness is not constant in axial direction, not to mention the waviness. When we compare Figure 3 directly with Figure 1 this issue is very clear.

As bad as this traces look, the manufacturers deliver like defined in the drawing! Anyway, leakage is the consequence.

Another example is that instead of single grinding structures, the surface is branded with circumferential grooves (Figure 4) around the whole shaft. This surface structure is also not defined in the standard, but leads always to big problems.

How can the user analyse and judge shafts nowadays? Are the 2D-tactile measurements still applicable or must 3D-optical analyses performed to get a good overview? Which measurement devices and which measurement strategies are the most helpful?

The presentation and the paper gives the background and a decision guidance for a modern comprehensive analysis of shaft surfaces for radial lip seal applications.

REFERENCES