METHOD FOR TESTING SURFACE FATIGUE USING NON-CIRCULAR SPECIMENS WITH INSTATIONARY SLIDING CONDITIONS

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ABSTRACT
The dimensioning of high-performance gears requires the maximization of the flank load capacity. Tribological influence factors on surface fatigue are diverse. However, according to the state of the art, the transfer of results from analogy tests (disk on disk) with stationary contact conditions is inadequate. An analogy concept with equivalent contact conditions would significantly improve result transfer and thus drastically reduce development costs for optimized tribological conditioning.

Within this contribution, an analogy concept is presented that allows the transfer of the internal loads of gear meshes to non-circular specimen. The concept utilizes the planar law of gearing to design specimen with an involute shaped contour. This leads to contact conditions where the contact point acts on a straight engagement line. The trajectory of the contact point is similar to gears. By adequate design the non-circular specimen allow for a good representation of the tribological contact conditions as the underlying involute gear. In total, the radii of curvature, speed ratios, and contact loads can be simulated. The resulting specimen are line symmetric with an active profile on the right and left flank. To close the trajectory between the both flanks, a transition contour is applied that enables a smooth transition between both engagement lines.

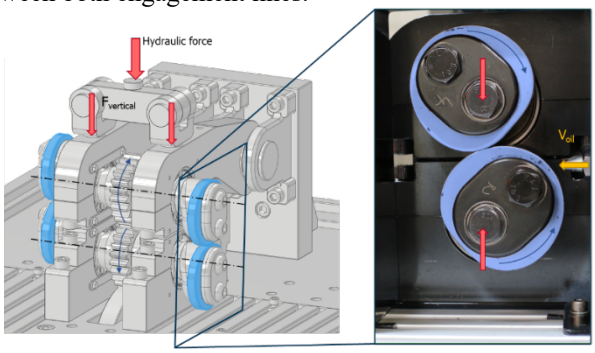

Figure 1: 2x2 test rig with non-circular specimen

The derived specimens can be tested on a 2x2 test rig [2]. On each shaft, two specimens with mirrored alignment are mounted. The shafts are driven with a constant axis of rotation and synchronized in position and speed with a gear stage of a ratio i_G = -1. The specimen are loaded with a constant force by a hydraulic cylinder. The 2x2 arrangement compensates for relative torsion of each specimen, **Fig. 1**.

In gears, the initiation of micropitting and pitting occurs in mesh positions of high specific sliding. The underlyding test program on micropitting confirms that the morphological effects of the non-circular specimen are similar to gears. A novel analysis method for characterizing worn damage surfaces supports the phenomenological evidence. In studies on pitting, both demonstrators exhibit the same load-carrying capacity, so the Woehler curves are congruent. For the analogy proof, both demonstrators were made from the same material. Grinding processes and heat treatment were also kept the same. Phenomenologically, the influence of sliding speed on local damage initiation is confirmed, **Fig 2**.

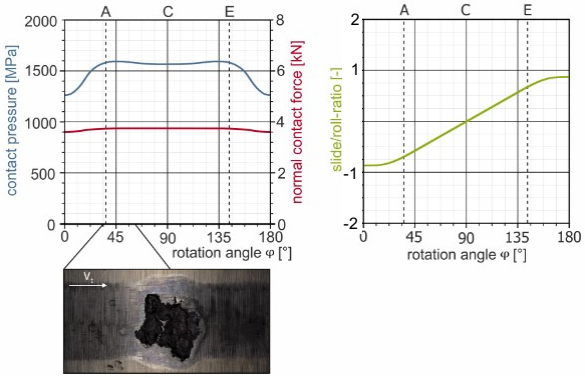

Figure 2: local loads and initiation of damage

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[1] Tenberge, P., "2-disc tribometer for various tests on sliding/rolling contacts with tribological loads such as in tooth flank contacts", VDI Conference of Gears, 2022