Theoretical investigations on the fatigue behavior of a tailored forming steel- aluminium bearing component

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Abstract. Driven by the demand for resource efficiency, increased reliability, and a need for higher performance, rolling bearings offer optimisation potential with regard to component design and manufacturing processes due to their frequent use in mechanical engineering. Tailored forming technology enables mixed metal compounds to be functionalised in single components in order to partially meet the above-mentioned requirements better than conventional mono-material parts. For this purpose, a semi-finished aluminium -steel workpiece is first manufactured by co-extrusion, then formed subsequently, heat-treated, and finally machined. This hybrid product serves as a substitute for the outer ring of an angular contact ball bearing, providing optimised characteristics with regard to component weight and operating behavior by using locally adapted material properties. Here, the base material consists of aluminium, while the tribological loaded contact zone (ball - raceway) consists of a fatigue resistant steel. In order to estimate the application potential and possible application limits of this technology, theoretical investigations on the fatigue behavior are presented in this paper. A finite element simulation solves the contact problem between rolling element and tailored forming component in order to determine the resulting component stresses due to an external load numerically. In post-processing, these stresses are inserted to a fatigue life model for rolling contacts according to *Ioannides* and *Harris*. It can be shown, that manufacturing parameters, which are particularly determined by the machining process, such as residual stress conditions and radius ratios in contact (osculation), determine the fatigue life of the hybrid component under optimal lubrication conditions. Furthermore, the ratio of steel to aluminium has a high sensitivity to the fatigue life, whereby, as a function of the bearing load, a higher strength coaxial layer with a height of 3 mm steel already possesses the 90% performance of a solid steel component.