Optimization of Tolerance Grades of a Bearing and Shaft Assembly in a Washing Machine with Regard to Fatigue Life

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Abstract : The drum is one of the critical parts in a washing machine in which the clothes are washed and spin by the rotational movement. It is activated by the drum shaft which is attached to an electric motor and subjected to dynamic loading. Being one of the critical components, failures of the drum require costly repairs of dynamic components. In this study, tolerance bands between the drum shaft and its two bearings were examined to develop a relationship between the fatigue life of the shaft and the interaction tolerances. Optimization of tolerance bands was completed in consideration of the fatigue life of the shaft as the cost function. The following methodology is followed: multibody dynamic model of a washing machine was constructed and used to calculate dynamic loading on the components. Then, these forces were used in finite element analyses to calculate the stress field in critical components which was used for fatigue life predictions. The factors affecting the fatigue life were examined to find optimum tolerance grade for a given test condition. Numerical results were verified by experimental observations.