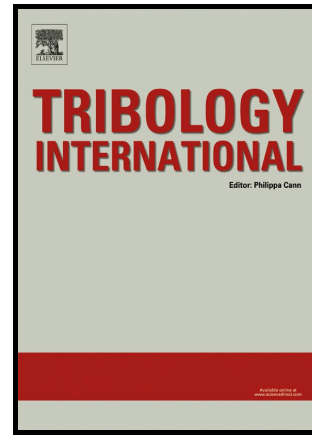


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Influence of Cage Clearance on the Heating Characteristics of High-speed Ball Bearings

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Abstract: This paper presents a five degree-of-freedom (5-DOF) quasi-dynamic model to analyse the relationship between the cage clearance and heating characteristics. First, a mathematical model is constructed for analysing the various heating rates associated with different working conditions, the elasto-hydro-dynamics of the cage is considered. Then, numerical studies are used to validate the precision and efficiency of this method. Second, an experimental system is developed to evaluate the theoretical method. Finally, the various heating characteristics associated with the guide and pocket hole clearances, are analysed quantitatively. The results show that there is a critical value for both the guide and pocket hole clearance and that the heating is obviously decreased and gradually stabilizes when the clearance exceeds this value.

Keywords: High-speed ball bearings; Quasi-dynamic; Cage clearance; Heating

1. Introduction

For more than 20 years, high-speed machining has offered new high productivity solutions to manufacturers, including better fabrication quality [1]. Fabrication processes and machine tools had to be developed to reach the new minimum requirements for the demanded cutting speed and feed rate. High-speed ball bearings work as the fundamental supporting structure in movement transformation and load support in mechanical systems due to characteristics that include low energy consumption, high stiffness and large carrying capacities. They support the rotating components via rolling contacts between themselves and the components and are widely used in fields including aerospace, precision machine tools, and other precision instruments [2,3,4]. In recent years, as the requirements for rotation accuracy and speed of revolution have sharply increased for ball bearings, heating has become the main cause of precision loss, severe abrasive damage, fatigue, and life reduction. The effect of cage parameters on the heating properties of bearings increases with the bearing speed. As a consequence, constructing an analytical model of the cage mechanical properties at high speeds and then studying the mechanism behind the cage parameter's influence on the heating properties has become an important research topic. The guide and pocket

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