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Performance Evaluation of Radial Shaft Seals of Automotive Transmission Systems

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Abstract

The effective sealing of components in relative motion poses a significant challenge in numerous engineering applications. One such application is the interfacial sealing of the driveshaft with the transmission casing. This contact conjunction is critical for retention of transmission oil. Excess leakage can lead to reduced transmission efficiency, wear and environmental contamination. To mitigate these untoward effects, radial lip seals are commonly used. The current research aims to improve the performance of radial lip seals through improved understanding of the complex driveshaft lip seal tribological conditions. This is achieved through topographical measurement of the counter face surfaces, using a focus variation measurement technique, combined with numerical analysis. The numerical analysis enables the determination of the effect of surface-specific roughness characteristics upon the lubricant film behaviour. It involves the use of an averaged Reynolds equation and a contact mechanics model. Various shaft surface finishing procedures are investigated and their resulting lubricant leakage and frictional performance are reported. The approach allows the evaluation of various surface finishing procedures, leading to recommendations based on pertinent topographical parameters for effective sealing.

Keywords: Radial lip seals; Automotive transmission; Surface roughness; Lubricant leakage; Friction; Average Reynolds model; Flow factors