BHR Group
EXPERTS IN FLUID ENGINEERING

Dynamic Seal Design for Aircraft Landing Gear

Physical measurement and numerical prediction of tribological behaviour of new nano-coatings for short-stroke strut seals

The Challenge

The aviation industry is facing environmental pressure to replace chrome plating coatings on landing gear struts with alternatives such as High Velocity Oxygen Fuel (HVOF) or other nano-coatings. These coatings must be capable of the thickness equivalent to chrome plating, depositing a good quality finish that can be machined to the required tolerances for use.

BHR is working with Liebherr-Aerospace, Lindenberg Gmbh to evaluate a new generation of nano-coating systems for use on aircraft landing gear shock absorbers. The sealing systems used in these shock absorbers are normally expected to last 20,000 flight cycles without the need for replacement – this demands a life expectance of 10 years without the need for maintenance. To achieve this it is essential that the sealing system is designed for low friction and minimal leakage, requiring an intimate understanding of the sliding contact between the 'soft' elastomeric seal and 'hard' counterface of the landing gear strut.

The Approach

BHR is studying the tribological characteristics of the new generation of nano-coating sealing systems by replicating the long-term performance of the nose landing gear system. This requires both computational and experimental investigations focussed on the conditions of short stroke dynamic motion in the sliding tube component, as this is known to be the part of the flight cycle where most seal damage will occur. Investigation of seal friction on chrome and HVOF coated rods under conditions of short stroke reciprocating motion

The work covers a comparison of friction measurements of a commercially available elastomer seal arrangement on a conventional chrome countersurface and alternative hard HVOF coated WCCoCr and NiCr-BSi surfaces. Experiments under transient short stroke conditions have been made in real time considering in-stroke and outstroke friction at 30bar fluid pressure over a wide range of operating temperatures (-40 to + 40 ^{o}C). Analysis of the results have been used to establish the relative performance of the sealing system by considering among other factors, variation in friction with duty cycles, impact of surface roughness, and variation of the friction profile with stroke

The Results and Benefits

Computational models of the sealing system have been developed by BHR and embedded into the Abaqus Finite Element Analysis (FEA) code. This is being used to predict contact behaviour of the sealing systems when subjected to various pressure conditions, and friction and wear behaviour under lubricated conditions, as well as predicting the life of seals based on changes in the physical condition of the seal and its operating environment. The project has enabled Liebherr to accelerate the design selection of its next generation of coating and establish new standards and protocols for surface finishes for nano-coatings.

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