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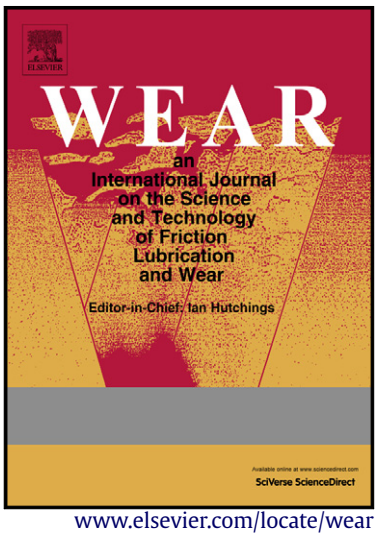

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C. Delebarre, V. Wagner, J.Y. Paris, G. Dessein, J. Denape, J. Gurt-Santanach

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An experimental study of the high speed interaction between a labyrinth seal and an abradable coating in a turbo-engine application.

C. Delebarre*[a,b], V. Wagner[b], J.Y. Paris[b], G. Dessein[b], J. Denape[b], J. Gurt-Santanach[a]

[a] *TURBOMECA, Avenue Joseph Szydlowski, 64510 Bordes, France*
[b] *Université de Toulouse, Laboratoire Génie de Production, Ecole Nationale d'Ingénieurs de Tarbes, 47 Avenue d'Azereix, BP 1629, 65016 Tarbes Cedex, France*

Abstract

A new high-speed test rig was designed to simulate the interactions between labyrinth seals and abradable coatings in similar turbo-engine operating conditions. To determine a solution for turbo-engine efficiency enhancement, we investigated the clearance reduction between the rotary parts in air systems, the successive starts and stops, the thermal expansion and the vibrations that might cause direct rub interactions between a rotary seal, known as a labyrinth seal, and a turbo-engine housing coated with a sacrificial abradable material. High interaction speeds from 0 to $130\,\mathrm{m}\cdot\mathrm{s}^{-1}$ were obtained using a 5-axis milling machine fitted with a unique magnetic bearings spindle developed specifically for the study. The purpose of this paper is to study the interaction phenomena between an abradable material (Al-Si 6%) and a nickel alloy (Alloy 718) to obtain a first contact assessment under different turbo-engine operating conditions. The experimental results are first presented by visual observations of the posttest samples, as specified by accurate profile measurements. A quantitative approach to the interaction forces recorded during the tests and micrographic observations complete the preliminary study. This work provides new basic data for a preliminary study of the interaction between labyrinth seal teeth tips and abradable coatings in turbo-engine applications.

Key words: Labyrinth seal, thermal spray coatings, high speed interaction

1. Introduction

For decades, a major concern of turbo machinery manufacturers has been to increase engine efficiency by developing new materials capable of performing at higher temperatures and new technologies for fuel management and airflow direction. The technological level has been reached in the previous topics, and turbo-engine designers are seeking new solutions to increase turbo-engine efficiency and reduce polluting gas emissions. One method of improving engine efficiency is to control the airflow direction by reducing the clearance between the rotary parts in the air systems [1, 2]. In secondary air and sealing systems, the control pressure differences and the levels of cooling between the engine modules are crucial to turbo-engine operation. These dynamic sealing systems are composed of a particular type of rotary seal, called the labyrinth seal.

*C. Delebarre
Email addresses: corentin.delebarre@turbomeca.fr (C. Delebarre), corentin.delebarre@enit.fr (C. Delebarre)

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