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Experimental investigations on REB thermal behaviour

P. Brossier[a b c *], D. Niel [a b], C. Changenet [a], F. Ville [b], J. Belmonte [c]

*pierre.brossier@airbus.com
[a] Université de Lyon, LabECAM, ECAM Lyon, 69321 Lyon, France
[b] Université de Lyon, LaMCoS, INSA-Lyon, CNRS UMR5259,F-69621, France
[c] Airbus Helicopter, 13700 Marignane, France

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ABSTRACT

Temperature prediction is a major issue in the analysis of modern transmission systems. Rolling Element Bearings (REBs) are one of the essential components. In high speed REBs, power losses are mainly generated by: i) the contact between rolling elements and races; ii) the aerodynamic drag force generated between rotating parts and the oil-air mixture. Heat generated is evacuated through lubricant, inner and outer rings. The REB thermal equilibrium depends on many parameters such as rotational speed, applied load, lubricant properties and the surrounding environment.

In the present study, some measurements of REB thermomechanical behaviour are conducted on a dedicated test rig. Power losses for a specific REB are measured through the resistive torque. Some thermocouples are located on fixed parts (housing, REB outer ring) and other on rotating parts (REB inner ring and shaft) via a telemetry system. A deep groove ball bearing (DGBB) with a pitch diameter of 85 mm is tested under oil jet lubrication for different operating conditions. Measurements show a sudden increase of resistive torque for high speeds (figure 1).

An extended thermal network of the test rig was established to enable a closer understanding of the inside REB thermal behaviour. Based upon the first principle of Thermodynamics for transient conditions, the studied system is divided into lumped elements at uniform temperature connected by thermal resistances which account for conduction and convection. This model also allows the estimation of power losses and its distribution within REBs. This coupled analysis (thermal behaviour and local power losses) is compared with temperature measurements in order to analyse heat sources which generate this sudden increase.

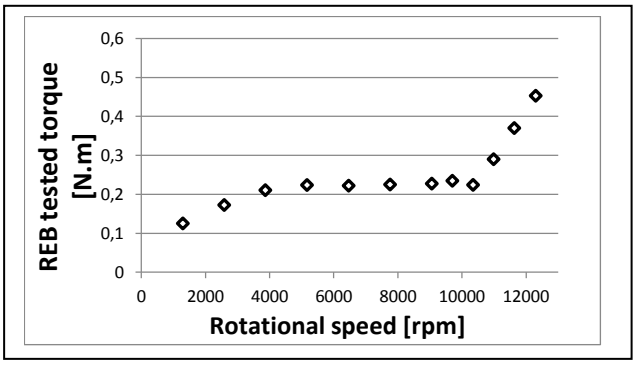

Fig.1: REB resistive torque
(radial load 400N, oil injection temperature 70°C, oil flow 25 L/h)

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REFERENCES

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