

## M. Mazière

### Burst of disks in turboshaft engines

#### Ecole des Mines de Paris (France)

Contact : [enquiries@dymat.org](mailto:enquiries@dymat.org)

During design of turboshaft engines, regulation rules impose to manufacturers to prove integrity of rotating parts (disks and compressor impellers) by overspeed experiments : parts should burst under mechanical and thermal loads beyond the rotation speed imposed by the regulation. This requirement guarantees a safety margin of at least 20 % between burst rotation rate and operating conditions.

The regulation evolution will make it possible to use numerical predictions, validated beforehand by experimental testings. Simulations, performed using large deformations elastoplastic finite element calculations, over-estimate at the moment the burst speed of disks designed in Udimet 720, a Nickel based super-alloy.

More reliable predictions of burst speeds required a detailed knowledge of the elastoviscoplastic behavior of the material. The prediction of the burst speed of a rotating disk is obtained by limit analysis. Material parameters which affect the most this limit speed are provided in this work.

For operating conditions the average temperature of disks is close to 500. At this temperature, Portevin Le Chatelier (PLC) effect appears during tensile tests on specimens in Udimet 720. Simulation of this effect requires to use a model taking into account dynamic strain ageing. This model generally implies a localization of strain rate in bands. A localization analysis has been performed in order to use this model for rotating disks.

Two main results are provided in this work about simulation of burst of disks designed in Udimet 720 : (i) at ambient temperature, the burst speed is mostly affected by yield criterion and ultimate stress. (ii) at high temperature (500C), PLC effect changes the global response of disks without significantly modifying their burst rotation speed.

This work forms a part of the concerted research project between Turboméca, Onéra, Snecma and the Centre des Matériaux - Mines Paris - ParisTech entitled "Durée De Vie" (service life). This project is supported by the DGA and the DPAC.

www.dymat.org