

## Characterization and modeling of the needling of fibrous structures based on oxidized Polyacrylonitrile for an aeronautical application

### Context

Carbon/Carbon (C/C) 2.5D ceramic matrix composites have been used for many years in aeronautical braking applications (Krenkel, W (2008)). The use of these high-performance materials in a complex environment such as aircraft brakes required extensive academic and industrial work on the part of Safran Landing System to master this technology. It is still a research axis to meet the current challenges of the aeronautics sector, including the reduction of its ecological footprint, through the optimization of performance and the reduction of the mass of its products.

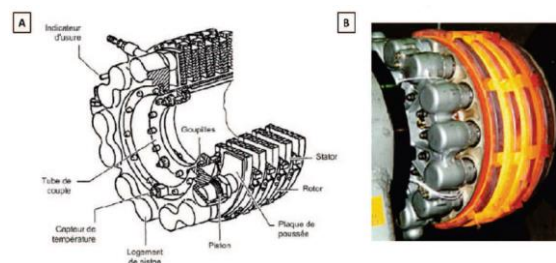


Fig 1: Principle of a heat well (Raud 2018)

Needling is a central operation in the production of brake discs and in the control of braking. As part of the improvement of the performance of its products, SAFRAN wishes to further strengthen its knowledge of the needling process.

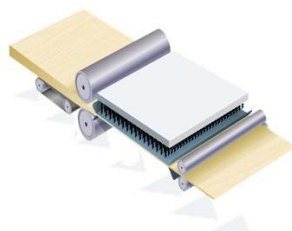


Fig 2: Principle of the needling process ([www.edana.org](http://www.edana.org))

### Objectives

With the objective mentioned, a thesis taking place at the Dupuy de Lôme Research Institute (iRDL) in Brest and with the support of both Safran Landing System (Villeurbanne) and Safran Ceramics (Bordeaux) will aim to understand the main mechanical/chemical/thermal phenomena that govern the interaction of fibers and needles during the realization by the needling process of the textile structure to different layers (cables, unidirectional layers and multidirectional layers). This thesis will also be intended to develop a multi-scale modeling approach to the needling process. The models put in place will have the dual objective of improving the understanding of the process parameters but also of going back to the material health of the preform at the end of needling.

### **Diploma required**

Bac + 5 in mechanical engineering, materials engineering.

### **Nationality requirement**

Applicants must hold a nationality of a country of the European Union.

### **Skills in demand**

In the first place, the candidate must have an appetite for manufacturing processes as well as for the realization, development and analysis of mechanical and computational mechanics of materials. In addition, the following skills are expected:

- Knowledge of methods for characterizing the mechanical behavior of materials.
- Knowledge of continuous media mechanics, materials mechanics and nonlinear mechanics.
- Very good level in English (B2 minimum).
- Ability to work in a research team with different partners.

### **Requested documents**

- CV
- Cover letter
- Copy of the candidate's identity document
- Transcript of grades for the last two years

### **Duration**

36 months from October 2022.

### **Financing**

SAFRAN Group.

### **Localization of theses**

Research Institute Dupuy de Lome – Ecole Nationale d'Ingénieur de Brest, France.

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#### **iRDL**

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