Next Generation Combat Aircraft Technologies - NGCAT

ENGHAGE

Engine heat management technologies

Duration of the project: 01/05/2025 - 01/02/2028

Key words: Thermal management, Energetic efficiency, Compactness, Electrification, Numerical simulation.

Budget: 5.744.868 €

of which RHID contribution: 5.232.000 €

PROJECT DESCRIPTION

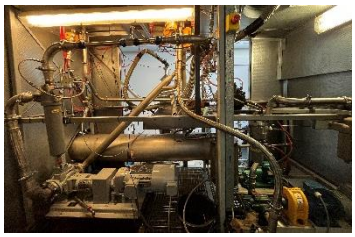
The next generation fighter aircraft must adhere to new operational constraints including higher core temperature, higher compactness, higher electrification. These new requirements in turn generate new challenges for the propulsion thermal management system and its components. The installation of an efficient Thermal Management System is now clearly a critical challenge for next engine architectures and technologies.

Heat Exchanger

Lube Unit

The objective of the project is to develop high-level performance and innovative components of the **thermal management system**, mainly the **heat exchanger** and the **lube unit**. We will also evaluate a new thermal management technology, the **condenser**, which could lead to a breakthrough thermal management system. The heat exchanger and lube unit shall meet a high level of energetic efficiency, be compact and will allow for easy integration whilst remaining low weight. Electrification of equipment is also an important issue, particularly in the context of military engines.

A cross-disciplinary approach will be implemented, covering design, materials and manufacturing processes as well as numerical simulation. The most promising concepts developed, will be manufactured and tested under laboratory conditions.



Test facilities (ULB)

The project shall be structured around the following main activities:

- **Concept studies & design:** advanced architecture Lube Unit studies (including compact bearing, high precision gears, electrification), innovative and integrated high performance heat exchanger (thermal efficiency, low drag, robust to distortion), breakthrough technology evaluation (condenser).
- Improved **material and processes** to improve equipment performance, allowing for operation in high temperature and harsh environments. Development of a Multi-laser Powder Bed Fusion numerical model. Additive manufacturing technologies.
- **Tests** in laboratory conditions of the most promising concepts of heat exchanger and lube unit in different configurations.

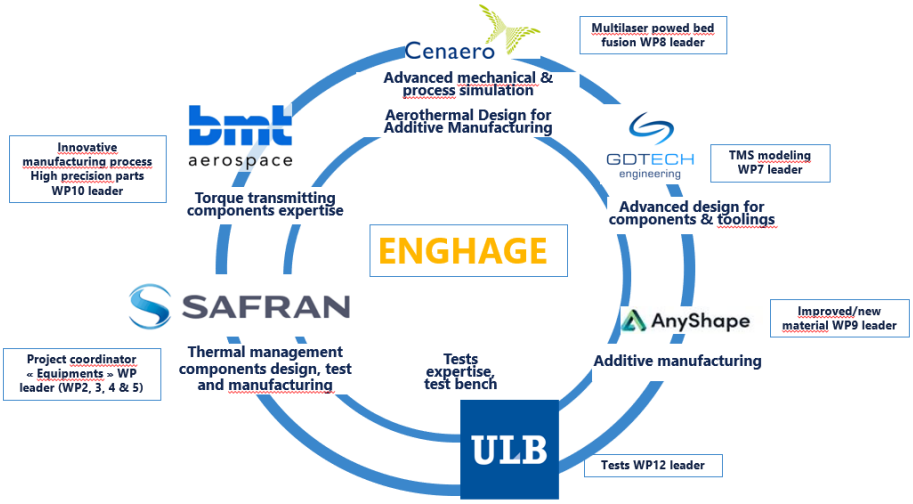
New expertise and skills will need to be acquired and implemented to carry out this project, in particular:

- Knowledge, evaluation and validation of integrated, high-performance equipment, enabling us to differentiate ourselves in the market.
- Model the thermal management system as a whole, starting by combining several pieces of equipment.
- Simulate the additive manufacturing process to improve part design, quality and industrialisation, and reduce development costs.
- Mastering additive manufacturing of very thin-walled exchange matrix (300µ), mastering post-processing methods associated with heat treatment and anodizing.
- Exploration of new materials for additive manufacturing, and mastering their implementation and characteristics.
- Mastering the manufacture of high-precision parts essential to achieving lube unit performance.

Within ENGHAGE, the consortium provides transverse expertise in all required areas for the project objectives:

- Safran Aero Boosters provides expertise in thermal equipment (design and manufacturability)
- BMT provides expertise in geared parts
- Cenaero provides expertise in numerical simulation

- GDTech provides engineering studies
- Any-Shape provides expertise in metallic additive manufacturing
- ULB provides expertise in laboratory testing for all components



The project's activities range from concept studies to bench testing of demonstrators, and include advanced design, materials studies, manufacturing processes and the development of digital technologies for both design and process simulation. Like the project itself, the consortium's skills range from design with SAB and GDTech, to manufacturing processes with Any-Shape, BMT and SAB, digital technologies with Cenaero and GDTech, and testing with ULB. The ENGHAGE consortium offers recognised and very high-level of expertise in each of these required skills. Each partner offers specific and complementary skills to make the project a success.

The main expected results of the project should be:

- Concepts of integrated high performances heat exchanger and lube unit
- Systems and processes modeling
- Improved materials and manufacturing processes

The deliverables will be formalised through:

- Technical and tests specifications
- Technical reports including concepts definition with associated drawings, calculation and study documents
- Technical reports on material and manufacturing processes assessment and capability
- Additive manufacturing trials
- Concept prototypes
- Test reports

The results of this research are intended for a New Generation Fighter propulsion and energy system, and could be used for other military transport aircraft propulsion, drone applications as well as for civil aviation.

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