Commercial aircraft engines use innovative materials

Currently being tested on a part of a CFM56 engine, thermostructural composite materials, which are extremely resistant to high temperatures, are opening up new opportunities for engine and aircraft manufacturers alike. Safran already uses this innovative technology extensively for military and aerospace propulsion systems.

A year ago, Herakles (Safran) achieved a world first in commercial aircraft design when it developed an engine fitted with an exit cone made from ceramic matrix composites (CMCs), new variants of thermostructural composites. The intrinsic properties of CMCs make them the perfect match for this type of part subjected to the engine's heat, as they withstand temperatures from 1,000 to 1,500 °C. CMCs are set to replace the metal parts currently in use, since they are between 30 and 50% lighter. "Up until now, we've only ever used this type of thermostructural material for military aircraft," explained Yann Richard, "CMC Exhaust" Program Manager, Herakles. "Like all disruptive technology, this requires thinking in the very long term. We started to look closer at applications for commercial aircraft in order to produce a series of parts for the next generation of LEAP engines, in addition to the new engines designed by Safran in the run up to 2020-2030."

Innovative properties
Unlike in a military context, where flight times are more constrained, commercial aircraft engines are used over much longer periods of time. In addition to being extremely resistant at high temperatures, engine parts need to last for dozens of years. "We use carbon fiber-based thermostructural materials for military engines. However, they tend to oxidize over time. In order to meet the needs of the civil aviation industry, we use silicon carbide continuous fiber, resistant to oxidation," explained Yann Richard. "These new materials can also repair themselves, in other words the oxygen in the air reacts with the molecules, thereby "healing" any fine hairline cracks that may form in the part in real time. Such a unique feature is key to attaining the 100,000 hours of operation time required by a commercial engine part." Herakles is set to be awarded EASA – European Aviation Safety Agency – certification sometime within the next four to six months to test the exit cone on commercial flights, in partnership with Air France. "The airline has shown a great deal of interest in these new materials and has been following our program closely," underlined Yann Richard. "This partnership also provides Safran with an opportunity to further enhance its profile."

The Rebecca project
Herakles is conducting some of its work on CMCs (ceramic matrix composites) as part of the French "Rebecca" project, one of the Aerospace Valley competitiveness cluster's seven collaborative R&D projects involving twelve industrial and academic partners. In the Aquitaine region, "Rebecca" is part of a close cooperation between Herakles, several regional SMEs and research laboratories, including the i2m/DUMAS department at the Centre des Arts et Métiers ParisTech in Bordeaux.

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