COMPOSITES. Snecma Propulsion Solide offers leading-edge expertise in ceramic matrix composite (CMC) afterbodies on jet engines.

LIGHTER, QUIETER ENGINES

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Mixer for a CFM56-5C, which powers the A340-200/300 quadjets.

The French Ministry of Industry has selected Snecma Propulsion Solide's Arcoce R&D project, which aims to develop ceramic composite jet engine afterbody structures that will decrease commercial airplane engine weight and noise. Safran subsidiary Snecma Propulsion Solide, a specialist in solid propulsion and composite materials, is particularly well-known for its work on "high-temp" composites, namely carbon-carbon and ceramic matrix composites (CMC). In July 2007 it will test a CMC afterbody (exhaust nozzle assembly) demonstrator during engine ground tests. With this exciting new development, the company hopes to break into the civil aviation market.

Ceramic matrix composites are lighter than the metals or alloys usually used on jet engine nozzles, and offer better resistance to high temperatures. The first application of these composites reaches back to the late 1980s, when they were used for the secondary flaps on the nozzle of the M88 jet fighter engine. More than 2,300 CMC flaps have been produced to date (in series production since 1996) for this engine, powerplant of the new-generation Rafale.

"CMCs are very appropriate for civil aviation," explains Alain Allaria, head of civil aviation programs at Snecma Propulsion Solide. "They provide significant weight savings and excellent mechanical strength at high temperatures. Also, we can apply an acoustic treatment to use these materials on hot sections, and replace the metallic alloys used today. The exhaust temperature of modern jet engines continues to climb, and starting at 600°C metallic alloys begin to lose their mechanical properties, which is not the case of CMCs – in fact, these composites can easily stand up to temperatures exceeding 1,000°C!"

Testing a prototype on a CFM56

Building on this successful military application, in late 2002 the company targeted the civil aviation market by starting the development of a primary, mixer type nozzle prototype (see photo). Shaped like a daisy, this prototype was successfully tested in 2005 on a CFM56-5C engine, the model that powers the Airbus A340-200/300. Snecma Propulsion Solide then designed a CMC mixer demonstrator using ceramic fibers. It will be ready by the end of June 2007, and bench tests will start in July.

"Along with CFM International, we're considering an in-flight evaluation on an Airbus A340 testbed in 2008, in conjunction with the ground tests," adds Allaria. "Through this development we're capitalizing on our extensive experience to break through in the civil aviation market, as a supplier to Airbus and Boeing for instance. The nozzle market is a large one. By about 2015 or so, Boeing's new-generation single-aisle (NGSA) aircraft will replace older 737 models. We will also see the post-CFM56 generation of engines. They will have to burn less fuel and be lighter, but also deliver higher performance. If we could win half of the market, that would mean selling more than 10,000 parts over a 20-year period."

Work on ceramic matrix composites is included in CFM's LEAP56 research & technology program, designed to develop and test the technologies needed for the post-CFM56 generation. A CMC nozzle could offer weight savings of 30% to 40% compared with a conventional metal version.

In addition to signaling a diversification of the company's business portfolio, CMCs could lead to another major change for Snecma Propulsion Solide. Space and defense are high-tech markets par excellence, involving relatively limited production runs. "The volume production of CMC parts would force us to rethink our organization and set up a specific industrial structure," admits Allaria. "It's both a technological transformation and a major challenge – and we can't afford to miss the boat." ■

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