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Engine tests from the ground up

8 min
Testing is the last and indispensable step in the development process for any new aircraft engine. To be certified by airworthiness authorities and then enter service, jet engines have to undergo a wide range of both ground and flight tests. These tests make sure that the engine complies with the performance, safety and reliability specifications demanded by the authorities that issue flight certificates.
INTRODUCING AN EXCITING PROFESSION

I first saw the request in a note from my son Thomas’ school. He's in 9th grade at the Melun junior high near Paris.

« To help our students define their educational and professional goals, our school is organizing a
I'm Thomas' mom and an engineer at Safran Aircraft Engines, in charge of the ground and flight testing division for engines from Safran's Villaroche production plant in the greater Paris area. All of a sudden, there I was in front of 20 teenagers, hoping to help them discover this profession— one that I've always loved!
THOUSANDS AND
THOUSANDS OF
HOURS...
To illustrate my presentation on certification tests, I use the example of the LEAP, Safran’s new-generation turbofan that powers the best selling Airbus A320neo and Boeing 737 MAX single-aisle twin-engine commercial jets, as well as China’s upcoming Comac C919.

"My team's role is to check that the engine meets all predefined criteria in terms of flight safety and performance. My division is given the ‘first engine to test’, or FETT, which is simply the first complete engine ready for ground testing. It will undergo a long series of tests, not only on the ground, but also in flight."

Our task is to make sure that the engine performs the way the engineers designed it. "After checking each part and each module, we're ready to test the complete engine under conditions representing all operational
phases: taxiing, takeoff, cruise, descent and landing."

One of the students raises his hand: "How many engines do you need to carry out all those tests?" A very astute question, and I explain to him that, in this case we needed about 30 different engines to perform all the tests.
The Villaroche plant has six ground test stands, also called test cells, and Safran also operates an open-air test rig at the Istres air base in southern France. This outdoor installation allows engineers to carry out tests under natural conditions, including wind, rain, hail and more.

The first question seems to have unleashed the students' curiosity, and a classmate then asks: "And what if the engine explodes?"

Not hard for me to answer: "A test stand is like a concrete bunker so there's no risk. But a jet engine also operates like a giant vacuum cleaner, sucking in some 500 cubic meters of air a second. In other words, you probably don't want to be standing in front of one during a test!"

Another student asks: "How are the tests conducted?"

"A technician remotely operates the test rig from a control room, while others are in front of their screens, checking all the parameters picked up by the sensors in the engine."
"Day after day, we subject the engine to as much as it can take, a sort of trial by heat, cold, icing, hail… so we can observe and measure its endurance qualities. We also perform various critical tests, such as how it reacts when it loses a fan blade ("fan blade out"), those blades on the spinning part you see in front of the engine, that make up the fan. Another key measurement is how it reacts to bird ingestion… yes, as surprising as it may seem, a bird flying into an engine can cause serious accidents."

As I expected, the usual question pops up, «"You don't really send live birds into a jet engine do you?"

"No, of course not." And I explain to the fascinated teens that we use dead birds from organizations certified by animal protection and veterinary authorities. We
can also use chunks of gelatin to represent the birds.

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COMPREHENSIVE TESTING
Then I explain to them about flight tests as part of the engine development process.

The first step is what we call a flying testbed, in our case a four-engine aircraft on which we replace one of the engines with the one to be tested. The aircraft is outfitted with a full suite of data monitoring and recording equipment, operating throughout the flight.

"We record some 1,500 different measurements, which will subsequently be analyzed by our design engineers. Our LEAP turbofan engines were also tested in flight on the three different twinjets for which they were designed. Everything was meticulously checked to make sure of a safe flight, including specified speeds, loads and altitudes. After racking up more than 8,000 hours of tests on the ground and in the air, the three versions of the LEAP earned their dual Euro-American certification, the legal authorization for entry into service, from EASA.
As I turn off the projector, I can see that many youngsters seem to be fascinated by my profession. A couple of them have already raised their hands to ask if Safran Aircraft Engines accepts interns in the ground and flight testing division of course!
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