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ILA: Airbus encouraged by laminar-winged A340 trial

By Michael Gubisch | 26 April 2018

Airbus says the drag-reducing effects of the experimental wings on its laminar-flow demonstrator aircraft are proving better than previously thought, making application of the technology on a next-generation aircraft more feasible.

In September 2017, the airframer began a flight-test campaign with an A340 that has been modified with reshaped outer wing sections to assess natural laminar flow on the aerofoil's upper surface.

Some 66 flight hours have been completed under the partly EU-funded project – dubbed Breakthrough Laminar Aircraft Demonstrator in Europe (BLADE) – said Airbus senior vice-president research and technology Axel Flaig, speaking at the ILA air show in Berlin on 25 April.

He says laminar flow could be observed from the aircraft's first flight and that the flow is more stable than expected.

While the theory and potential benefits of having an orderly, laminar, rather than turbulent, air flow in the boundary layer around the wings have been known since the 1980s, the challenge has been to manufacture wings on an industrial scale that are smooth and aerodynamically stable enough to sustain the benefits in regular airline operations.

A key area of the BLADE project has been to assess how robust the laminar flow is when the wing flexes and twists in the air, and which design methods can be employed to build such aerofoils.

Airbus and its industrial partners constructed the left wing laminar-flow section with an integrated upper-wing surface and leading edge, which was made of carbonfibre and required an extremely high degree of accuracy.

The right wing section followed a more conventional design with a carbonfibre upper wing surface and a separate metallic leading edge.

Flaig acknowledges small differences in aerodynamic effects between the two structures, but says both wings sustainably generate the desired effect.

The manufacturer is "very confident" that the project will achieve "more than we targeted", he says.

Airbus estimates that laminar-flow wings could reduce drag by around 10%, cutting fuel burn by up to 5% on an 800nm (1,480km) sector.

Furthermore, the aerodynamic benefits could be sustained during the flight tests at Mach 0.78 – a typical cruise speed for A320-family jets – while Airbus previously predicted that the aircraft would need to fly at M0.75 to deliver the fuel savings.

Flaig says the test have shown "the door is wide open" to employ the technology on a potential next-generation single-aisle aircraft from the late 2020s.

Test are scheduled to continue until 2019, with a plan to assess the effects of wing contamination on the laminar flow and to install a fixed Krüger flap.

Such a device is being considered as potential protection against insect contamination on the leading edge – which could disturb the laminar flow – and as a high-lift device for take-off and landing.

Source: FlightGlobal.com

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Airbus, which is showcasing its "Flight Lab" BLADE demonstrator aircraft for the first time at a major air show, has signed an accord with representatives of the numerous stakeholders to not only mark the joint success of bringing this unique programme to fruition, but also affirm their desire to build on this programme in the European framework of Clean Sky. The stakeholders present together with Airbus CEO Tom Enders at the ceremony included members of the European Parliament, the European Commission, the German Government, European Member States and industrial partners across Europe.

The BLADE project, which stands for "Breakthrough Laminar Aircraft Demonstrator in Europe", is part of the first phase of Clean Sky – a 1.6 billion Euro programme which has been running since 2008. BLADE has been tasked with assessing the feasibility of introducing laminar flow wing technology on a large airliner. It aims to improve aviation's ecological footprint, bringing with it a 10 percent aircraft drag reduction and up to five percent lower CO_2 emissions. Airbus worked with a team of more than 20 key partners* and around 500 contributors from all over Europe. Moreover, due to its size and complexity, this project was only possible thanks to the European Research initiative Clean Sky.

In September 2017 Airbus' A340 laminar-flow Flight Lab test demonstrator aircraft (A340-300 MSN001) made its successful maiden flight and since then has been engaged in successful testing to explore the wing's characteristics in flight. The test aircraft is the first in the world to combine a transonic laminar wing profile with a true internal primary structure.

On the outside the aircraft is fitted with two representative transonic laminar outer-wings, while inside the cabin there is a highly complex specialist flight-test-instrumentation (FTI) station. The extensive modifications to the A340-300 test-bed aircraft took place during the course of a 16-month working party in Tarbes, France, with the support of the numerous industrial partners across Europe. In terms of the testing technology, notable 'firsts' included the use of infrared cameras to monitor the laminar flow transition points and the acoustic generator which measures the influence of acoustics on laminarity. Another first is the innovative reflectometry system which measures overall deformation in real-time during flight. To date the Flight Lab has performed 66 flight hours. Flights will continue until 2019, dedicated to exploring the influencing factors on laminarity.

***Key industrial partners in BLADE:**

5 micron; Aernnova; Airbus; Airtex; ASCO; BIAS – Research and Development for Applied Beam Technologies; Dassault Aviation; DLR - German Aerospace Center; DNW - German-Dutch Wind Tunnels; ETW - European Transonic Windtunnel GmbH; EURECAT; FTI Engineering; GKN Aerospace; INCAS - National Institute for Aerospace Research; ITAINNOVA - Technological Institute of Aragon; NLR - Netherlands Aerospace Center; Onera; Romaero; SAAB; Safran; SERTEC Engineering; VEW - Vereinigte Elektronik Werkstätten.

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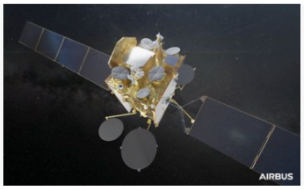

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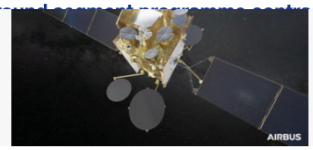

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Airbus 'BLADE Runner' Exceeds Expectations

by Ian Goold - July 18, 2018, 9:10 AM

BLADE wing extensions on this A340 aid laminar flow research at Airbus.

Airbus's (Outdoor exhibit 13, 25, K*/Hall 1, Stand 1105) flight-testing of a converted A340 quadjet confirms that "the door is wide open" to apply laminar-flow technology to future airliners, says research and technology senior vice president Axel Flaig. Ten months ago, the manufacturer embarked on a two-year project dubbed Breakthrough Laminar Aircraft Demonstrator in Europe (BLADE).

Conducted under the auspices of Europe's Clean Sky 1 joint-undertaking environmental research program, BLADE aims to achieve a reduction of 10 percent in aircraft drag and up to 5 percent in CO_2 emissions. After a successful early round of test flights in late 2017, Airbus has resumed operations with the "Flight Lab" test aircraft—the original prototype A340-300 (manufacturer's serial number 001)—with plans to analyze laminar flow over a contaminated wing and after modification with a fixed Krüger flap.

Initial flight tests permitted Airbus to assess aircraft-handling, extend the flight envelope, and record early indications of achieved natural laminar-flow (NLF). Flaig says that investment in the project is "really paying back."

The €1.6 billion ($1.9 billion) Clean Sky 1 program has been running for 10 years, and the BLADE exercise is assessing the feasibility of introducing NLF wing technology on a large airliner. Airbus believes it could be applied to a next-generation narrowbody aircraft by 2030.

The company claims its demonstrator aircraft, which has been modified with two slightly different NLF outer-wings, is the first in the world "to combine a transonic laminar wing profile with a true internal primary structure." It is testing the robustness and sustainability of NLF during flight operations to enable commercial-aircraft manufacturers to properly design laminar components (including wings) and to specify production-tolerance requirements.

The theoretical benefits of laminar (or non-turbulent) boundary-layer airflow are well known, challenging engineers to produce smooth and aerodynamically stable wing surfaces on what Flaig calls "an industrial scale." Now, the BLADE project is intended "to validate the area of 'laminarity' that can be achieved for a large variety of cruise-flight conditions with respect to altitude, Mach number, and wing loading," according to Clean Sky researchers.

Understanding that laminarity, particularly the factors influencing the phenomenon, is at the heart of continuing flight-testing by Airbus. By early May, the A340 Flight Lab—"the largest flight-test demonstrator ever launched in Europe"—had logged some 70 flight-hours and as of last month was almost midway through an expected 150 hours of testing that will continue until next year.

FLIGHT-TEST FINDINGS

The manufacturer notes a number of flight-testing firsts arising from the project. These include using infrared cameras to monitor laminar-flow "transition points," an acoustic generator to measure the influence of sound on laminarity, and a real-time "reflectometry" system to gauge overall flow deformation in flight.

Before the second phase of investigation began in April, the demonstrator aircraft had completed 23 test flights in the initial 13-week trials campaign last year, accruing 65 flight hours with up to three flights a week. Flaig reports that laminar flow—more stable than had been expected—was seen from the A340's very first flight.

Airbus has now concluded that the modified outer wings have reduced aircraft drag by more than was initially believed. This has encouraged the manufacturer to suggest that applying the technology to a future generation is more feasible than previously thought.

Flight-testing has demonstrated that the aerodynamic benefits of laminar-flow can be sustained at speeds of up to Mach 0.78, compared with a predicted requirement of Mach 0.75 to achieve targeted fuel savings. Despite slight differences in the increased aerodynamic efficiency of the two slightly different modified outer wings, Airbus confirms that the effects can be sustained.

The second flight-test phase now underway involves what Airbus terms aerodynamic "imperfections," involving laminar flow over a contaminated wing surface and after installation of a fixed Krüger leading-edge flap. This is intended to "extensively test and characterize" the robustness of laminarity in "representative operational conditions." The test aircraft is expected to fly at intervals of about three weeks, governed by changes to aircraft configuration.

Development of modifications for the test aircraft involved 21 European partners, 500 contributors, and some 6,500 components to produce the required parts:

- wing-joint "aero-fairings" that separate the "turbulent" inboard wing from the NLF sections;
- NLF-section wingtip pods that provide a defined flow pattern and accommodate flight-test equipment; and
- a digital mock-up of the new wing section outboard of the number-one (outer left) engine.

In April, having previously confirmed that the A340-based BLADE exercise has "no link to any possible future aircraft program," Airbus signed an "accord" with numerous stakeholders "to build on this program in the European framework of Clean Sky."

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