Aircraft systems in the environmental chamber

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Fraunhofer IBP's flight test facility is about to be expanded with the addition of a thermal test bench for studying the thermal behavior of aircraft systems. Credit: © Fraunhofer IBP

How can air transport be made more environmentally compatible, economical and sustainable? The Fraunhofer flight test facility in Holzkirchen is soon to be expanded with the installation of a thermal test bench for aircraft systems, with the aim of achieving efficient energy management onboard.

The plane takes off from Munich in bright weather, temperature 10 degrees Celsius, and lands in Anchorage, Alaska, in driving snow, temperature minus 15. Parked on the airfield overnight, the aircraft takes off the next morning at a freezing minus 25 degrees, heading for Dubai, where the weather is a sunny 32 degrees. The temperature on the

outside of the fuselage is over 80 degrees. The rapid changes in temperature pose a challenge for the technical systems and materials. How can it be ensured that the onboard equipment will function in all circumstances? Scientists at the Fraunhofer Institute for Building Physics IBP in Holzkirchen near Munich are finding answers to this question in their flight test facility. An additional piece of equipment – the thermal test bench – will help in the development of new systems such as the aircraft power supply, air conditioning and lighting. The project will be presented at the Paris Air Show in Le Bourget from June 20 to 26.

"The thermal test bench comprises a number of different elements, but the main one is the aircraft calorimeter, which is integrated into the low-pressure chamber of our flight test facility," explains project manager Dr.-Ing. Gunnar Grün from Fraunhofer IBP. "We can simulate environmental conditions inside the aircraft, as well as external conditions on the ground or in flight, and see how the equipment copes." The scientists hope to obtain fundamental insights into the effect of ambient temperature on the thermal behavior of aircraft systems. They will also study the interplay between components, materials and ambient temperature, particularly in the context of more electric architecture on aircraft. Three metal and fiber-composite fuselage sections of a Dassault business jet will be used to study the interplay of new electric systems and aircraft parts in different conditions. "For reasons of space, large electrical components are accommodated in the rear, while other systems are located in the cockpit," says Grün. "With the thermal test bench we will be able to show how the waste heat from the lights, the power electronics or the inflight entertainment impacts on the environment in the aircraft interior – and vice versa." This will enable the research scientists to draw conclusions about how the systems should be arranged and how the waste heat can be efficiently removed or reused. "Imagine you want to use a laptop in the sauna. It has to release heat in order to function. At the high temperatures the built-in fan no longer does the job

and so you have to find a different solution, for example heat conduction," the specialist continues. The test facility is part of the Clean Sky project, in which Fraunhofer IBP, European companies and other research establishments are studying the interplay of thermal and electrical systems.

To complement this research and obtain a comprehensive picture of the energy balance in aircraft, an electrical test bench is also being built under the Clean Sky project, by aircraft engine manufacturer Safran in Paris. "At present there is a mix of electric, pneumatic and hydraulic systems in airplanes which require extensive maintenance and cleaning. Some of the fluids used damage the environment. The aim for the future is to increasingly use electric systems in aircraft, saving weight and aviation kerosene. Electric systems are also more efficient," states Grün, describing the background to the project. To achieve these aims, research scientists will have to find answers to a lot of questions. For example, whether the onboard power system will remain stable under an increased electric load. "Imagine what would happen at home if you plugged ten hairdryers into the same power socket and switched them all on at the same time: the fuse is certain to blow," Grün explains.

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