

DLR and Airbus flight-test new aircraft ventilation system

19 October 2011

The German Aerospace Center (Deutsches Zentrum für Luft- und Raumfahrt; DLR) and Airbus have flight-tested a new ventilation system for aircraft for the first time, with the objective of improving passenger comfort while saving energy and fuel. Achievement of the predicted benefits was confirmed with the help of 63 test dummies and 12 volunteers.

More and more electronic systems such as individual entertainment screens are being used in the cabins of modern aircraft; the additional heat that these devices dissipate needs to be removed from the cabin. Conventional ventilation systems are beginning to reach the limits of their capabilities; they are required to supply ever-greater amounts of cooled air, which can cause passengers to experience unpleasant draughts. Researchers from DLR Göttingen and Airbus have flight-tested a ventilation system that promises to provide a solution to this problem using DLR's Advanced Technology Research Aircraft (ATRA). The new system is known as 'displacement' ventilation. In contrast to existing systems, displacement ventilation delivers air into the cabin at a lower speed and through inlets at floor level. As it makes contact with passengers and other heat sources, the air heats up and slowly rises, arriving where it is needed without causing draughts.



Video: Cabin research

New ventilation system reduces draughts

"The anticipated benefits of displacement ventilation have been confirmed," says Johannes Bosbach of the DLR Institute of Aerodynamics and Flow Technology. "The speed of the airflow, and therefore the perception of draughts, is much lower than with conventional ventilation systems; this has been demonstrated both by sensor measurements and by the feedback from our volunteers." Maintaining the aircraft cabin at room temperature proved to be no problem.

During the test flight, ATRA flew at an altitude of 10 kilometres for four and a half hours. This duration and altitude correspond to those of a standard medium-haul flight. For the test, 63 mannequins were placed in passenger seats, with their seatbelts securely fastened. Each life-size dummy was wrapped with electrically heated wiring that dissipated 75 watts; this matches the average amount of heat given off by a seated passenger. Sensors, including ones positioned at ankle, knee and head height, measured air temperature and speed of airflow; a total of more than 220 sensors were used. Air pressure and humidity levels were also monitored, and laser lights were used to make the airflow visible. In addition to the mannequins, 12 people were on board as test subjects. They were asked to subjectively evaluate the 'feel' of the ventilation system.

Aircraft need to be cooled

In conventional 'mixing' ventilation systems, air is introduced into the cabin from above, and at a faster rate of flow. This could cause passengers, particularly those occupying aisle seats, to experience a cold shoulder. For the purposes of testing displacement ventilation, the air-conditioning system of the Airbus was modified radically; effectively, it was turned upside down. The air was introduced at floor level, with a lower flow rate than for mixing ventilation, and extracted from above. With displacement ventilation, a pool of fresh air builds up at floor level and this air flows upwards over warm surfaces – for example, the passengers – cooling them. This means that fresh air is available where it is most needed; it also ensures that the cooler incoming air flows across the objects that require cooling, which helps to increase the energy efficiency of displacement ventilation. Incoming air does not need to be cooled to the extent previously required, and commonly found, in aircraft cabins. DLR's André Heider summed it up with these words: "In a passenger aircraft, the air always needs to be cooled down, simply because passengers and electronic equipment produce a great deal of heat." Due to the reduced rate of airflow, this new system reduces draughts and greatly improves the cabin atmosphere. This type of ventilation is already employed in many public buildings such as cinemas and concert halls, but DLR and Airbus have now tested it in an airborne aircraft.

DLR Göttingen has been working for several years on computer simulation and experimental investigation of climate control on board aircraft. In Göttingen, DLR has a Do 728 research aircraft as well as various cabin cross-sections, including one of an Airbus A380. All the metrology techniques and the mannequins were developed by DLR at Göttingen. Every component had to undergo approval testing prior to in-flight use. For example, it had to be demonstrated that the test dummies would not ignite when subjected to temperatures of up to 200 degrees Celsius.

Next year, a flight is being planned in which conventional ventilation will be examined for comparison purposes.

Contacts

*Jens Wucherpfennig
German Aerospace Center (DLR)
Tel.: +49 551 709-2108
Fax: +49 551 709-12108
Jens.Wucherpfennig@dlr.de*

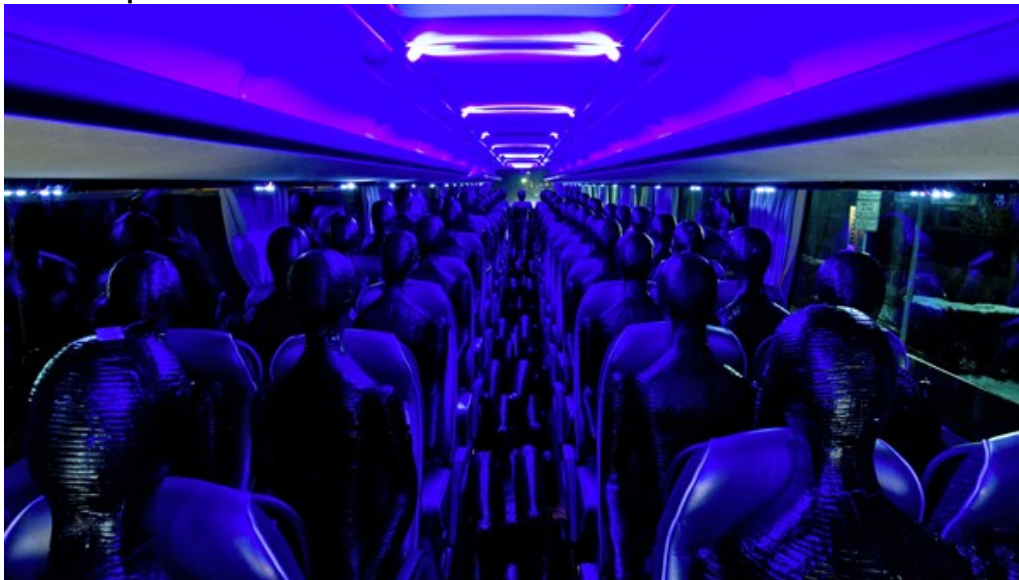
A laser makes airflow visible



DLR researchers Gerrit Lauenroth (front) and Felix Werner adjust the laser. This makes the airflow visible.

Credit: DLR (CC-BY 3.0).

Bus transport



Seldom do you find a group of travellers as quiet as these 63 mannequins.

Credit: DLR (CC-BY 3.0).

Mannequins in the ATRA test aircraft



Sixty-three mannequins took the place of passengers on board DLR's Advanced Technology Research Aircraft (ATRA).

Credit: DLR (CC-BY 3.0).

Johannes Bosbach



The advantages of displacement ventilation for aircraft cabins have been confirmed. Johannes Bosbach, of the DLR Institute of Aerodynamics and Flow Technology.

Credit: DLR (CC-BY 3.0).

Unusual travellers



Sixty-three high-tech mannequins were transported by bus from the DLR facility in Göttingen to the airport.

Credit: DLR (CC-BY 3.0).

Alone among the mannequins



DLR researcher André Heider took his seat alongside the mannequins.

Credit: DLR (CC-BY 3.0).

Carried by hand



All 63 dummies had to be carried from the bus to the aircraft.

Credit: DLR (CC-BY 3.0).

In the ATRA



DLR researcher Xhevahire Zani shows the position of the laser beam in the Advanced Technology Research Aircraft (ATRA).

Credit: DLR (CC-BY 3.0).

Measuring probes



Sensors, including ones positioned at ankle, knee and head height, measured the air temperature and speed of flow.

Credit: DLR (CC-BY 3.0).

Contact details for image and video enquiries as well as information regarding DLR's terms of use can be found on the DLR portal imprint.