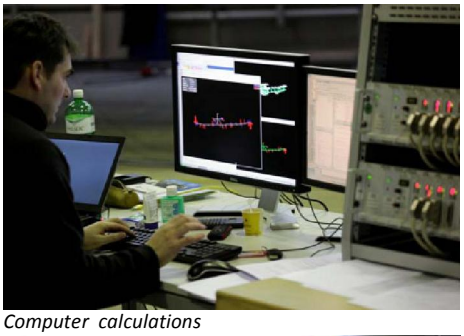
DATASHEET 5 -2008/2009

VIBRATION AND LOAD TESTS


Computer calculations


Vibrations tests


Fuselage


Load tests

Two series of tests

Modeling and computer simulations enabled the engineers to predict the aircraft's behavior and resistance in all flight conditions. But it was necessary to verify that the actual characteristics of the prototype matched those of the model as calculated by the engineers. For this reason, the aircraft was subjected to two series of tests: vibration tests and load tests. The vibration tests were conducted by the German aerospace center DLR, the only organization in Europe able to undertake such expert assessments.

Ground vibration tests

The first ground vibration tests (GVT) began in December 2008 on the skeleton of the fuselage, on the wing spars and on the horizontal and vertical stabilizers. A second series of tests was conducted a few months later once the fuselage, wing and tail had been fully assembled. Using special electrodynamic devices, experts imparted vibrations across the entire structure.

Seventy-one sensors at different points served to analyze a hundred or so vibration modes at frequencies between 8 and 20 Hz. The results were close to the computer model developed by the Solar Impulse engineers, but showed a lower elasticity, i.e. a greater rigidity of the structure, than expected - a favorable factor.

In the second series of vibration tests, André Borschberg took up position in the pilot's seat, to test live every potential vibration of the prototype. During flight, there is a danger of different aircraft vibrations resonating with each other. This phenomenon, known as aero-elasticity, can cause the aircraft to break apart. The two sets of vibration tests confirmed the accuracy of the digital models.

Load tests

Load tests were conducted in early 2009, following the first vibration tests. These load tests were intended to submit the aircraft's structure to forces comparable to those it would be subject to in conditions of atmospheric turbulence. The

Wingspar

Solar Impulse Team

tested forces were the equivalent of three and a half times the weight of the aircraft.

For the fuselage test, trays suspended from the cockpit at different points of the tail were gradually loaded with lead weights. Four degrees of load were analyzed, ranging from 25% to 100% of the maximum forces that can be encountered in real life conditions. The cockpit withstood a load of 900 kg, the tail three loads of 300 kg. The operation took place in complete silence, because of the need to detect the slightest creak of the structure.

The same load principle was progressively applied to the wing spar, with thirty trays distributed along its entire length. At 100%, with a total load of 5.5 tons, the deflection at each wing reached 1.20 m. This amplitude corresponded to that calculated by the engineers. The tests proved successful because everything had been methodically digitalized. Each test ended with a round of applause from the team.