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Taking to the high skies with maxon motors.

At an altitude of 11 kilometers above the surface of the earth, the air is very thin. Modern pressure cabins and an environmental control system (ECS) ensure a pleasant atmosphere in commercial aircraft. In the new Boeing 787, also known as the Dreamliner, a special air-conditioning system further improves the comfort of the passengers on long flights. Brushless maxon DC motors, spur gearheads and resolver combinations ensure a good climate at great heights.

Environmental control systems in aircraft encompass three components: air exchange, pressure control and temperature control. At altitudes up to and beyond 11,000 meters, providing the passengers with the required atmosphere in the cabin, with high enough air pressure, adequate oxygen supply and a satisfactory ambient temperature, means that each commercial aircraft needs a climate control system. Air-conditioning systems in aircraft therefore differ greatly from ordinary air-conditioning systems, both where the design and the energy source are concerned, as aircraft ACs require an energy source with much higher power capacity and have to meet higher safety requirements.

Pressurized cabins in commercial vehicles ensure that the air pressure is at a level that is tolerable for passengers. The circumference of the aircraft expands due to the pressure compensation. This puts great stress on the airframe. During the flight, the pressure in the cabin is successively reduced slightly as the altitude increases. Thus the passengers experience an amplitude increase to approx. 2400 meters. However, the climate control also depends on the amount of oxygen required by a human and the number of seats on the aircraft.

But oxygen alone does not ensure a pleasant atmosphere. The temperature and humidity also play an important role. Modern computer-controlled systems regulate the temperature with a precision of one degree. A considerable amount of heat is contributed by the passengers themselves. Each person radiates 80 to 100 W on average. On the ground, the air-conditioning unit is supplied with compressed air by the auxiliary power unit (APU) and during the flight, on most aircraft, by the jet engines.

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Dreamliner increases comfort of long-distance flights

Last year, aircraft manufacturer Boeing launched a new long-distance aircraft: the Boeing 787, also called the Dreamliner. Unlike any other aircraft before it, the Dreamliner fuselage consists largely of carbon fibre. This aircraft offers an improved cabin atmosphere and different pressure conditions. This makes long-distance flights more tolerable for the passengers.

According to Boeing, the new innovative plastic body of the aircraft is stronger than a thin aluminum shell. The cabin pressure corresponds to a height of 1800 m. This is deemed to be more passenger-friendly than the customary 2400 m. Furthermore, the corrosion-resistant shell allows 15 percent air humidity in the interior, instead of the customary 4 percent. Therefore the climate system also works a little bit differently.
On the Boeing 787, the air is not drawn from the jet engines under pressure, but is instead, fresh air from the outside atmosphere. On board electric motors power compressors to prepare the cabin air for a comfortable flight experience. In other words, the air-conditioning system is operated entirely electrically. The jet engines have very strong generators to ensure adequate power supply. The climate system for the Dreamliner is manufactured by the American AC manufacturer Hamilton Sundstrand. Such a system supplies enough power to cool or warm 25 private households.

Figure 1: In the Boeing 787, 48 maxon motors ensure a good climate. © 2011 Boeing

maxon motors for a perfect climate

Motors for aeronautic and astronautic applications differ greatly from standard motors. They have to withstand greater temperatures and vibrations, have a longer life span and have to be very reliable. All in all, 48 motors by maxon are at work in the climate control system of each Boeing 787. Specific motor modifications were required for the highly complex air-conditioning system. This includes drives for the cabin ventilation, for cooling the electronics and for closing and opening the air inlet on the outside of the aircraft. The motors have to withstand temperatures of -55 °C to +85 °C and the vibrations during take-off and landing - throughout the decades of the aircraft's service life. Therefore it is vital that the motors have a long life span. The cabin ventilation system consists of 36 shut-off valves that are driven by maxon EC 45 flat motors. These light brushless motors have been designed to fit into even the smallest spaces.

The EC flat motors achieve speeds of up to 20,000 rpm and, thanks to their open design, offer excellent heat dissipation at high torques. In the case of the climate control system of Hamilton Sundstrand, the motors achieve a speed of 4,000 rpm. In particular the stator of the flat motors installed in the air-conditioning system has been adapted; the printed circuit board has been modified with low-temperature Hall sensors and the motor has been given a special protective conformal coating. A modified stator magnetic path prevents movement when the motor is unpowered further improving overall efficiency. The linear drives for the air inlets use modified EC32 motors which have also been equipped with low-temperature Hall sensors. Furthermore there is a flame barrier at the output shaft of the motor, a special vibration-resistant fastening screw threads and cogging detent-brake modules.

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Figure 2: The cabin ventilation system of the Boeing 787 (Dreamliner) is driven by means of EC flat motors. © 2012 Hamilton Sundstrand

Figure 3: The linear drives for the air inlets use modified EC32 motors which have also been equipped with low-temperature Hall sensors. © 2012 Hamilton Sundstrand

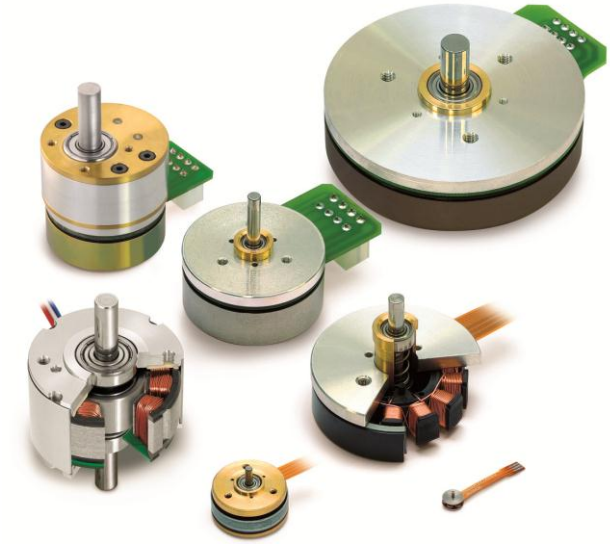

Figure 4: The brushless EC flat motors by maxon motor are the perfect solutions for many applications, thanks to the flat design.
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