

Precise miniature motor control delivers stable fuel flow to high-performance aircraft

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High-performance aircraft demand reliable and accurate fuel flow to power their engines. To drive the fuel metering valve system and ensure stable control, a high-performance, ultra precise motion solution is vital for maintaining optimum control under demanding conditions in any environment. Common to most aviation projects, achieving a low-weight design is also crucial to enhance flight efficiency and maximise payload capacity.

When Portescap, a global provider of motion control solutions, was contracted by a leader in global aviation to provide a fuel metering system for their new aircraft, the engineering team knew that accurately specifying the motion solution would be crucial. An aircraft's continual, stable fuel flow depends on the accuracy and reliability of a fuel metering valve. Within this valve system, the performance of its integrated motor is imperative to control valve open and close rates with precision. The combination of these factors ensures that the aircraft can provide the required thrust when the pilot commands and enables efficient fuel flow. While decreasing fuel consumption reduces cost and minimises emissions, it also can help an aircraft extend its flight range or carry an increased payload.

Demonstrating control in a laboratory environment is one thing, but under the high physical stress of take-off and landing, as well as high altitude cruising at 30,000 feet and up, the motion system must perform within a demanding arena. This means that the motor, transmission, and control components must be able to withstand the repeated shock and vibration of thousands of flight hours. Facing temperatures of nearly -50°C/-122°F at high altitude, the system also has to maintain precision control throughout the duress of climatic extremes.

Upgrading a reliable solution

Portescap has continuously supplied miniature motors for the OEM's fuel metering valve system for over 10 years. Due to this long-standing partnership and the strong performance of the original product, the OEM approached Portescap to optimise the design and provide the same control, but with a reduced mass. Following close collaboration with the OEM, Portescap's engineers selected the 22ECT, an updated motor from the brand's Ultra ECTM brushless DC motor platform, that met the new requirements.

The Ultra ECT series is designed for ultra high torque density in a reduced size and weight package, making this motor range ideal for various aviation applications. The brushless slotless ECT motor achieves this through an optimised coil design with straight copper turns, maximising the effectiveness of the magnetic field. Meanwhile, the motor is based on a multipolar rotor, offering the high torque potential inherent to a high pole count design.

Smooth control

Fuel metering valve control typically demands gradual yet precise modulation. To suit this requirement, Portescap's design team selected the ECT motor because of its ability to provide high continuous torque at low to medium speeds, maximising power between 10,000 rpm and 20,000 rpm. This capability meant that the new solution could improve performance while minimising weight. In fact, combined with a gear system, the ECT motor can provide twice the continuous torque of equivalent-sized BLDC motors over the lower speed range. To ensure precision in control, the motor's slotless design would also minimise the effects of cogging, helping achieve smooth torque delivery.

Vital to the compact footprint, Portescap's engineers also needed to specify a motor that could optimise efficiency and minimise losses. As the ECT is constructed with an enhanced high-efficiency magnetic circuit, this significantly reduces iron and joule losses, the primary causes of motor stator heating. This feature would enable

it to stay cool even under high torque demands. As added protection, ECT motors also include an integrated temperature sensor.

Optimising real-world use

Along with its high performance and low mass, Portescap's engineers needed to ensure that the motor retained its high level of durability to meet demanding flying environments. While the benefit of the brushless design meant reduced mechanical wear and longer lifetime, durability could be extended by upgrading its bearings. The sealed motor body would also prevent any ingress from debris or water. To ensure safe and reliable design integration, the motors also emit very low electromagnetic noise, preventing any impact to onboard systems, such as avionics.

To achieve the precise performance that the aviation OEM required, specific customisation was also required. With the experience of delivering customisable off-the-shelf (COTS) projects, this not only meant that Portescap's engineers could deliver the exacting demands, but the resulting development and manufacture was completed in faster than expected time to market.

Ultimately, providing a higher torque motor with smooth control in a lightweight package has enabled the flight control OEM to deliver a fuel metering system that optimises the flight capabilities for aircraft in service around the world.

Image captions:



Image 1: A high-performance motor solution is required for a smooth operation of the fuel metering valve system and stable control (Source: AdobeStock_239232855)



Image 2: Portescap's BLDC Ultra ECT motor

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About Portescap

Portescap offers the broadest miniature and specialty motor products in the industry, encompassing coreless brush DC, brushless DC, stepper can stack, gearheads, digital linear actuators, and disc magnet technologies. Portescap products have been serving diverse motion control needs in wide spectrum of medical and industrial applications, lifescience, instrumentation, automation, aerospace and commercial applications, for more than 70 years.

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