




C-Lube Linear Way  
20,000km or 5 years without  
maintenance is achievable



Maintenance Free & Interchangeable  
C-Lube Linear Way



Maintenance Free C-Lube  
Linear Roler Way Super



Maintenance Free  
C-Lube Linear Ball Spline

## INTERCHANGEABLE SERIES IS AVAILABLE

C-Lube slide units can be supplied separately, and can be matched, replaced and added freely to the interchangeable track rail. This series will be useful in machine design, facilitating standardization of product specification and quick changes of specification.

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## MECHANICAL COMPONENTS

# Aircraft get sky friendly



SKF's Phil Burge looks at how bearing technology for engines, control surfaces, undercarriage parts, and in fly-by-wire systems is producing big weight savings for aircraft manufacturers

Escalating fuel prices, combined with the demand to drive down carbon emissions, is putting the aviation sector under growing pressure. Although improved airline operations and flight plans can help to tackle the problem, an effective solution also depends on the development of far more efficient aerospace technology. In particular, reducing the fuel consumption rates of engines is a critical factor, with studies showing that roughly two thirds of the contribution to more profitable and greener operation can come from engines that burn less fuel.

Equally important is making the plane itself as fuel efficient as possible, which is largely achieved by reducing the all-up weight of each aircraft. In practice, this can have a considerable impact, with the design team responsible for the construction of one of the world's biggest aircraft, the Airbus 380, calculating that every 10kg of weight saved would reduce fuel consumption by 0.5 litres per flight hour, with an associated fall in engine emissions.

As a result, component manufacturers such as SKF are actively developing a new generation of greener, lightweight products. These include titanium bearings for landing gear, engine support frames and ailerons, composite airframe rods, and fly-by-wire systems to replace hydraulic devices; combined, these can produce fuel savings of 100 litres per flight hour in an average long range commercial aircraft. Furthermore, if all the latest solutions from SKF alone were applied to all new long and short range commercial aircraft, the result



would be estimated fuel savings of 200 million litres per year, translating to about 600,000 tonnes of CO<sub>2</sub> emissions per year.

In particular, bearing performance plays a key part in making engines burn leaner and thus reducing emissions. As such, SKF Aerospace has been studying the technology of innovative hybrid bearings that offer longer service lives and reduced power losses. Comprising steel rings and ceramic rolling elements, these latest bearings require less lubrication and thus reduce the quantity of oil that needs to be fed to the engine, which means additional weight savings.

### Titanium bearings

A new generation of lightweight titanium bearings has also been developed by SKF specifically for use in the aviation sector, such as in landing gear, pylon attachments and wing assemblies. During the development of these bearings, SKF engineers tested numerous different material combinations and, in the early stages, were uncertain if titanium could be a viable material option. The key to producing a high performance bearing with a long and reliable operating life is the development of a coating to prevent galling, a severe form of adhesive wear that can occur during sliding contact between two surfaces.

This is a particular problem with titanium, which has a relatively high coefficient of surface friction combined with low tensile and shear strength. In addition, titanium is prone to oxidation, with the oxide formed as a layer that is transferred to the sliding surface, producing wear debris. To overcome these problems, SKF developed two different coatings to eliminate the galling issue and make possible the titanium-to-titanium contact needed for the self-aligning function of the bearings.

So effective were the titanium bearings that they are being used in the world's largest passenger aircraft, the 555 seat



Airbus 380, in the landing gear, engine support frame and ailerons. The use of the bearings in the landing gear alone led to a weight reduction of 110kg per plane, plus another 90kg from the frame and flaps. Together with the use of other SKF components and systems, the new bearings allowed Airbus to realise overall weight savings of nearly two tonnes, which translates to fuel savings of nearly 100 litres per hour.

In an effort to reduce the overall weight of aircrafts still further, while ensuring cost efficiency and maximum capacity, SKF has also developed the concept of composite airframe rods made of carbon fibre using a new production process called pultrusion. These innovative rods can reduce weight by as much as 40 percent compared with traditional rods, while also being extremely low cost – close to or even lower than that for metal rods.

Another key area for potential weight savings is through state-of-the-art electromechanical, or fly-by-wire, actuator systems for flight controls. Essentially, these systems provide the vital link between the pilot and the flight control computers but they also are used to optimise the aircraft's power requirements based on second by second flight conditions, leading to a reduction in fuel consumption of around five percent. For example, when compared with conventional hydraulic systems, it is projected that a business jet fitted with a