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Aerospace Manufacturing hears how OVE Plasmatec's new high-performance coatings are helping MT-Propeller to extend maintenance intervals for aircraft propellers.

→ MT-Propeller is a global market leader in composite aircraft propellers (above)

When flying a propeller-driven aircraft, being able to fully rely on the propellers' functionality is crucial - and one such functionality is the blades' pitch control mechanism.

MT-Propeller, a world-leading manufacturer, relies on seals coated by OVE Plasmatec to guarantee smooth and reliable operation of their propeller systems. A novel coating with top performance in all areas virtually eliminates friction and wear, extending maintenance intervals almost indefinitely.

"Just as passengers rely on a smooth flight, our customers - pilots - must be able to trust in the precise and synchronised pitch adjustment of the propeller blades. OVE Plasmatec's new coated seals have made this function even safer," begins Frank Grum, who works in design and engineering at MT-Propeller. The aircraft propeller manufacturer is based in Atting near Straubing, Germany.

Indeed, the adjustment of the blade pitch is vital. It maintains the set engine RPM, regardless of power, for optimal and cost-efficient engine performance. The more reliable and durable the seals on the pitch adjustment mechanics, the safer and more cost-effective the

aircraft's operation will be.

"Our new OVE40SL coating is ideal for these types of dynamic, safety-relevant applications," assures Carsten Ebert, technical director at OVE Plasmatec. But let's start at the beginning.

Adjustable at all times

MT-Propeller is a global market leader in composite propellers made of wood, and glass or carbon fibres. The company was founded by Gerd Mühlbauer in 1981 and is considered the industry's most innovative and creative supplier in the world. Thanks to numerous improvements and patents, MT-Propeller's high-performance propellers run safely and quietly. The Bavarian company was the first to introduce a five-blade propeller, and what was previously viewed with scepticism is now a global standard. They went on to develop seven-blade propellers, which have already been approved. Today, the company is testing variants with nine and eleven blades.

"Regardless of the number of blades on a propeller, it must be capable of continuous, real-time adjustment without any delay - quickly, synchronised and up to several times per second," explains

MT-Propeller's Andreas Seperant. To ensure the flawless operation of this mechanism, a high-performance NBR O-ring elastomeric seal is placed at each blade root, adjacent to the pitch control system. These seals must endure the most extreme conditions, including harsh weather and a wide temperature range, without hardening or experiencing the stick-slip phenomenon - even when the aircraft spends extended periods in the hangar or when the propeller sits on a shelf as a spare part for several years. To meet these requirements, O-rings are now typically coated. MT-Propeller has been relying on the specialists at OVE Plasmatec to supply these O-rings this since 1998. However, until recently, coated seals still required frequent service intervals.

Highly dynamic applications

But what the coating experts at OVE Plasmatec developed in 2019 has propelled these seals into a realm of nearly endless service life with minimal maintenance requirements. The new OVE40SL coating reduces the coefficient of friction of elastomeric O-ring seals by 75% over the previous top values, reduces wear by a whopping 99% and provides 100% stress relaxation.

"Improving the coefficient of friction and the wear at the same time is contradictory and a lot harder than it sounds," says Ebert. The friction-reducing effect required in highly dynamic applications, such as propeller pitch adjustment, lasts significantly longer. "We did not anticipate such vast improvements across all metrics," Ebert describes his surprise at seeing the first test results, long before the coating was used in series production. "When an independent laboratory confirmed all these surprising values, OVE40SL became the new superstar among our coatings."

This benefit is welcomed by Grum: "When you consider that replacing seals on a propeller with five or more blades can take at least a day, you soon realise just how important extending maintenance intervals is. Depending on the application and load, the propeller must be inspected every 4,500 flight hours or every 72 months. The maintenance intervals of uncoated seals are much shorter, and can only be minimally extended with lubricants, greases or oils. The lubricants can harden, or they are squeezed out of the groove. That is why seals have been coated for over 20 years, which has significantly extended their maintenance intervals."

OVE's new coating is a water-based and heat-resistant anti-friction coating, modified with special high-performance additives. It is applied with a coating thickness of 3-12µm and features an exceptionally robust lattice structure that resists wear.

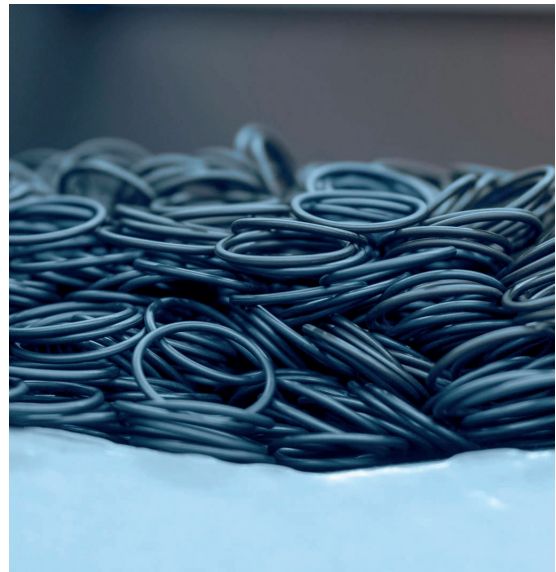
However, achieving a uniform, safe and durable application on an O-ring is an extremely challenging task. The seals are 60-170mm in diameter and 2-8mm thick. The first step is to wash and rinse them, which is followed by plasma cleaning, a process that OVE pioneered in series production back in 1995. Plasma cleaning also ensures that the surfaces of the elastomers are free of paint-wetting impairment substances, or PWIS for short.

Sophisticated processes

The next step is to halogenate the rings with iodine. This process, also known as DF treatment, hardens the NBR seals' surface and ages them artificially, giving them the emergency running properties required for aerospace applications. It also reduces friction. After another wash and plasma cleaning cycle, the sealing rings are ready for coating. Between 500 and 1,000 rings per batch are coated in special drums, ensuring reliable adhesion and optimal saturation of the coating.

"The more complex the operating conditions, the more demanding the cleaning and coating process," states Ebert. "This process is the only way for us to ensure that we can meet the exacting requirements of aviation technology."

With 87.5*103 ohms measured in accordance with the German DIN EN62631 standard (with an 18x2 EPDM O-ring), the coated elastomers achieve a resistance value that has previously only been achieved by special, highly



sophisticated and expensive elastomer mixtures. For the aircraft enthusiasts at MT-Propeller, the surprisingly low friction and wear resistance values are the most important properties of this new coating.

"For our customers, this means their aircraft can spend significantly more time in the air between maintenance intervals," concludes Grum. Ebert from service partner OVE Plasmatec is thrilled about this, too. "It's highly sensitive and safety-critical high-end applications like this that drive us to do our very best and require us to come up with creative solutions."

www.ove-plasmatec.de

➔ The new high-performance OVE40SL coating by OVE Plasmatec significantly reduces the coefficient of friction and wear of elastomeric O-ring seals (above)

➔ Today, five-blade propellers are a worldwide standard in general aviation (below)

