

Challenge us.
Drive systems put to the test.



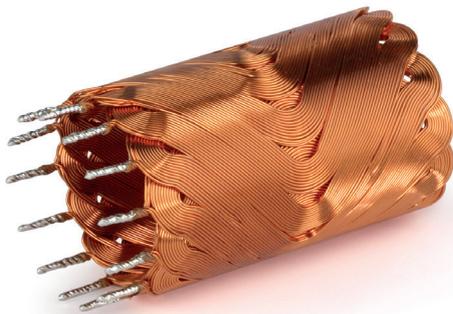
Founded in Switzerland. Available worldwide.

maxon – a strong global brand

maxon, with headquarters in Sachseln/Central Switzerland, has production sites in Switzerland, Germany, Hungary, South Korea, USA, France, Netherlands and China as well as sales companies in more than 30 countries. Our machines and product lines are developed in-house to guarantee cost-effective manufacturing of our products and enabling us to create custom solutions to fit your specific application needs.

Precision Drive Systems

maxon develops and builds precision drive systems. Our brushless and brushed DC motors with ironless windings are among the best in the world. Flat motors with iron cores complete our modular product portfolio. maxon's modular system includes planetary and spur gearheads, spindle drives, as well as encoders and control electronics.



We test our drives under the utmost extremes

In our test laboratory, we take motors, gearheads, encoders, and controllers to their limits

Deep-sea drilling. Mars rovers. Insulin pumps. Particle accelerators. Inspection robots. Hand prosthetics. This is only a small selection from the thousands of applications in which maxon's drive systems provide their power, precision, and robustness. However, before our DC motors, gearheads, sensors, and controllers are supplied to the customer, they have to withstand an array of abuse. During the development phase, we push our products to the max.

For us, complying with the standards is not enough. We cater to the wishes of our customers and offer additional testing and analysis specific to the intended application of the drives. All across the world, maxon sales engineers work closely with the customers to develop tailor-made drive solutions.

www.maxongroup.com



-130° C to +500° C

As tough as they come

Drive systems by maxon in the test lab

Our customers can rely on us and on our drives. That's why maxon submits its motors, gearheads, sensors, and controllers to extensive environmental testing. To this end, a wide range of conditions are simulated in our in-house laboratories. This brochure provides an overview of the test procedures. Freezing cold, scorching heat, severe shocks, vacuum, or tropical humidity: Our drive systems are tough enough to handle it all.

Extreme cold and heat

The biggest enemy of the drive system in a Mars rover is the cold: On the planet, temperatures can drop to -130°C. In contrast, the Solar Orbiter, a space probe that ESA is building on, will have to withstand temperatures of up to +500°C during its journey towards the sun. There are also many other applications where our motors have to cope with conditions that are far from standard room temperatures.

In our test lab, we test and stress motors in a temperature test chamber, usually at temperatures from -70°C to +180°C. A special unit can even provide temperatures from -130°C to +500°C. Repeated temperature cycling is also performed to simulate the behavior of the drives under conditions with extreme temperature fluctuations.

What happens to motors, gearheads, sensors, and controllers when they go directly from a hot environment to a cold one? To test this, we operate our drive systems in a temperature shock chamber. The unit is able to deliver sudden temperature changes of up to 300°C.

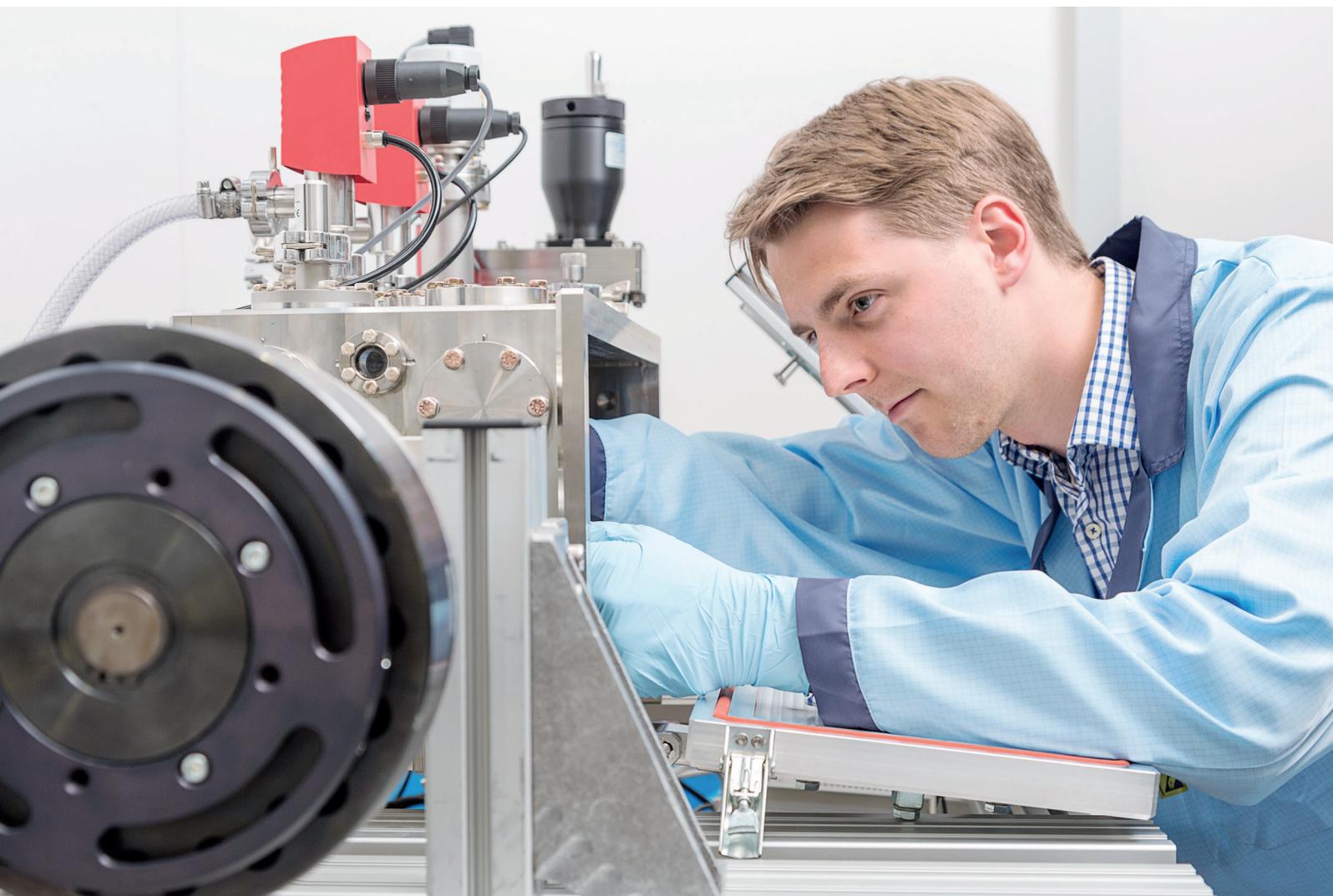
0.00000001 bar

Vacuum

The atmospheric pressure is more than 150 times lower on Mars than on Earth. On the surface of Mars, the mean pressure is only approximately 6 millibar, and the atmosphere consists almost exclusively of CO₂. In Earth's atmosphere, an altitude of 35 km is required to achieve similar pressures. In our vacuum chamber, we run our drives destined for space under these exact conditions. To ensure that the vacuum chamber meets our needs, it was developed and built by maxon engineers. Even an ultra-high vacuum of up to 10⁻⁵ millibar is possible.

Oil immersion and oil pressure

Drive systems in the gas and oil industry have to withstand a lot. In the gigantic drill heads, precision drive systems by maxon provide a feedback signal that is sent to the surface several thousands of meters above. This method is called Measurement While Drilling (MWD). For such applications, maxon has developed highly resilient brushless motors and gearheads: our heavy-duty (HD) drives. During development, we test how the drive systems behave in cold and warm oil bath, or under massive pressure of up to 2,500 bar. For comparison: In the Pacific Ocean's Mariana Trench, the lowest point of the Earth's oceans, the pressure is around 1,000 bar.





Sterilization

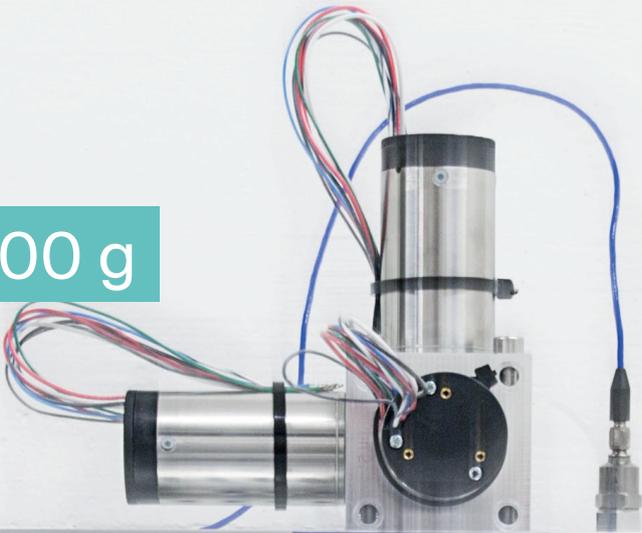
In medical technology, hygiene is vital. Many of our drive units – consisting of brushless motor, gearhead, and sensor – are therefore suitable for sterilization and tested accordingly. Special manufacturing technologies enable these drives to withstand approximately 2,000 sterilization cycles in an autoclave at temperatures of +135°C and a water vapor pressure of 2.3 bar. In 2017, maxon introduced the first sterilizable encoder to the market.

2,000 sterilization cycles

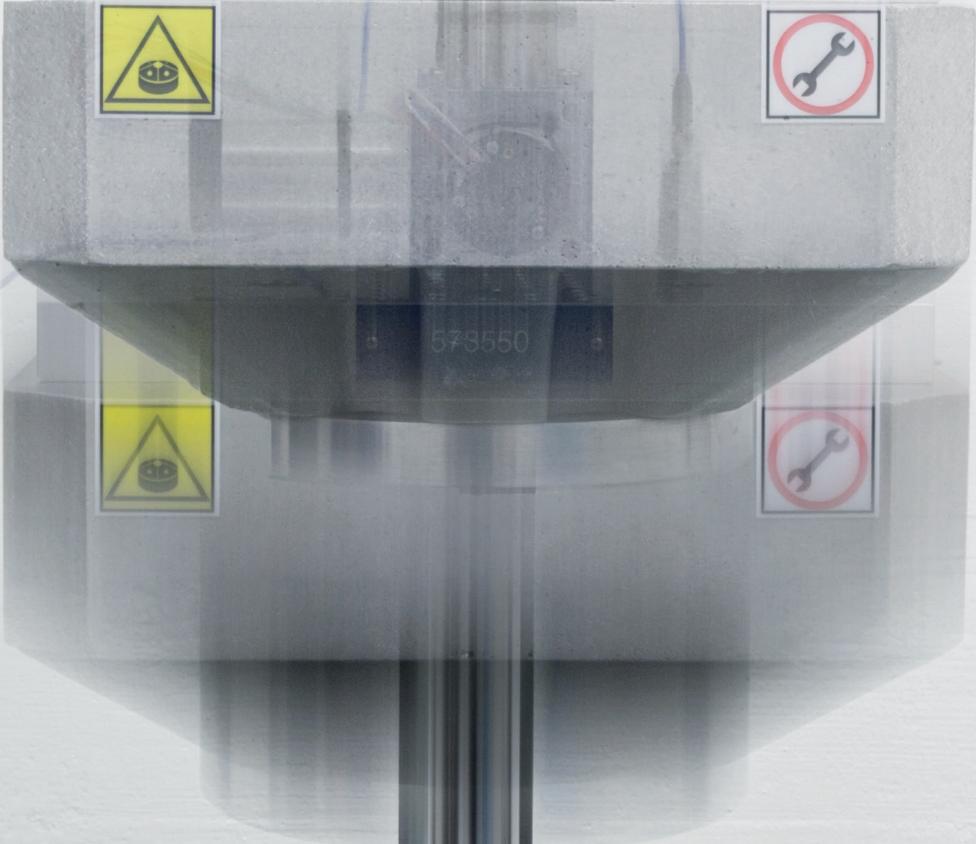
Environment

In an environmental test, realistic humidity and temperature conditions can be simulated. This is relevant when a motor is used in an extremely dry or humid environment. In the environment chambers, the motors are run in a relative humidity of up to 98 percent at variable temperatures. Especially for cases where long transportation or storage periods in harsh climate zones are required, we want to make sure that our drive systems do not suffer corrosion damage.

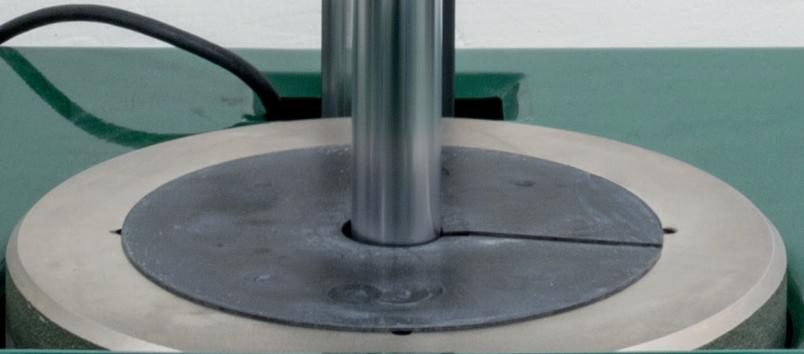
4,000 g



573550



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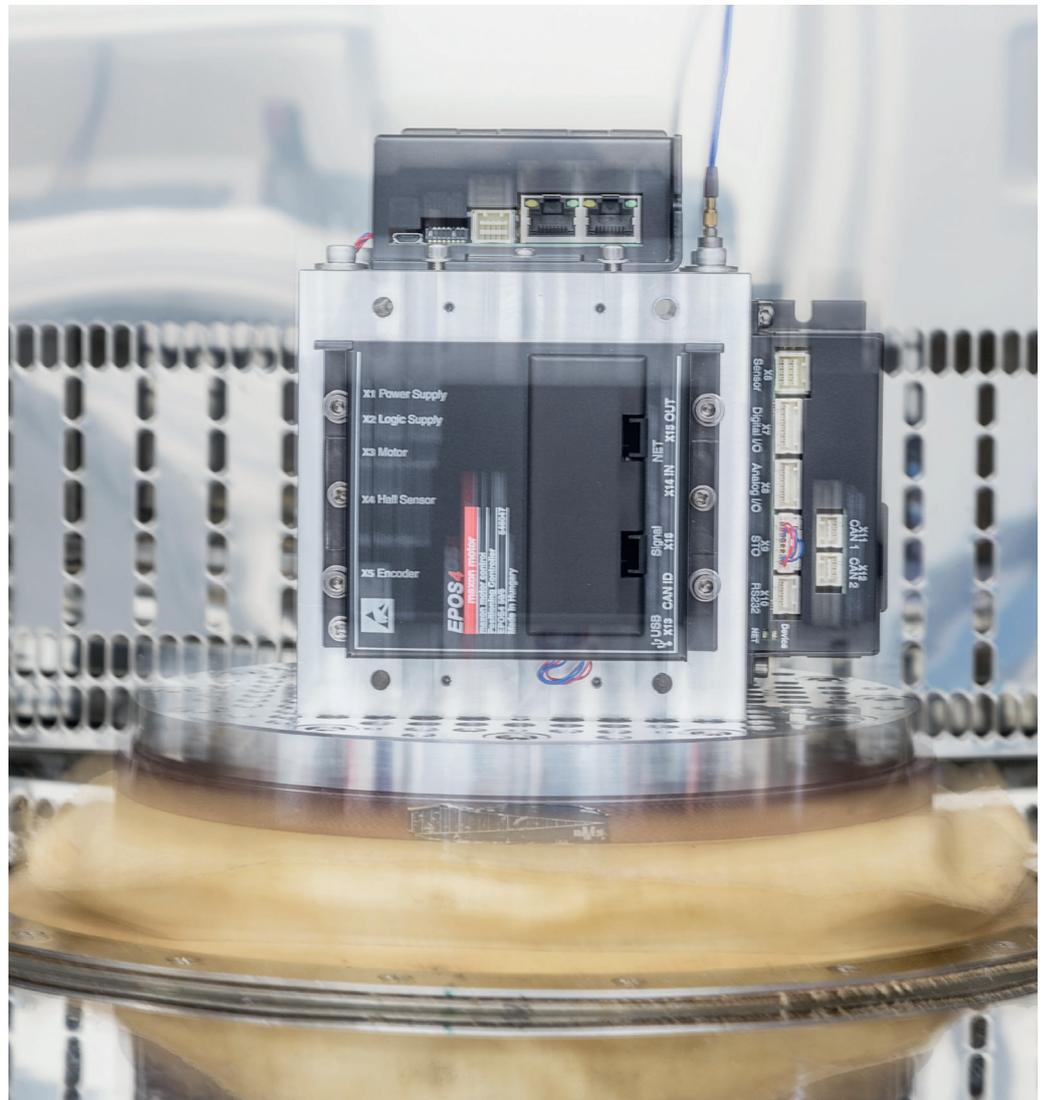


Shock and vibration

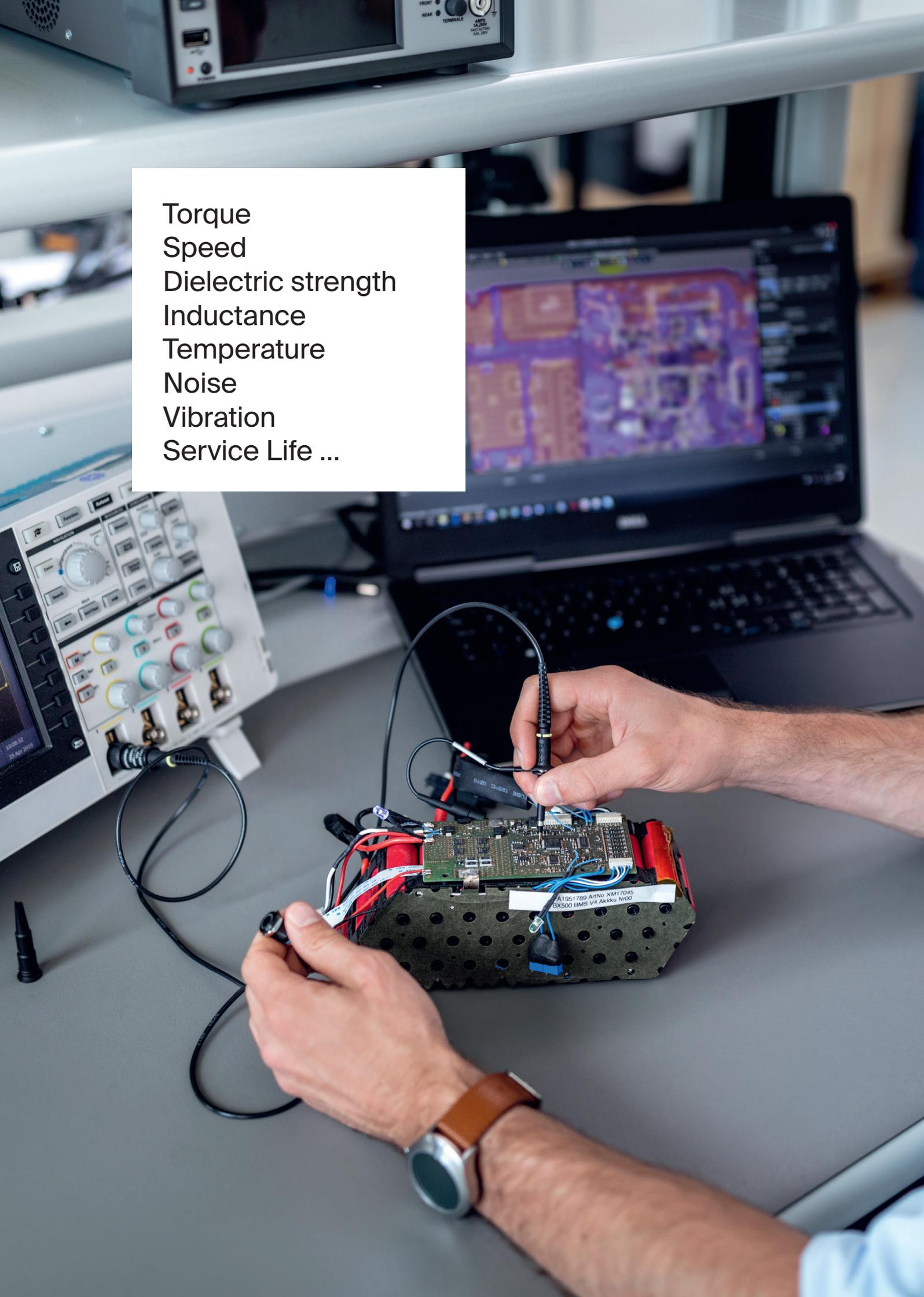
Even in everyday, unspectacular applications, our drive systems have to meet high demands. For example, precision motors in airplanes are subjected to constant vibrations during flight. During each landing or in the event of strong turbulence, they also suffer mechanical shocks. However, that's still nothing compared to the unpleasant conditions awaiting systems in the drill heads of the extractive industry or in space.

In our modern test systems, we can analyze the potential damage that such stresses can cause. It is possible to generate vibrations with frequencies from 5 to 5,000 Hz and shocks with a force of up to 5,000 N, at temperatures of -70°C to $+180^{\circ}\text{C}$. A mechanical shock testing system also simulates accelerations of up to 4,000 g – ideal for developing drive systems that will be sent on a journey through space.

5 to 5000 Hz



Torque
Speed
Dielectric strength
Inductance
Temperature
Noise
Vibration
Service Life ...



Product qualification

Not all our drive systems have to withstand a bath in hot oil or spaceflight at freezing temperatures. Nevertheless: Our catalog products are also subjected to extensive qualification tests during the development phase.

In addition to the standard measurements such as torque, speed, and inductance, this includes a thermal characterization. With IR cameras and temperature sensors, we record the temperature of the winding and the housing at different speeds and loads. The self generated vibration and noise are analyzed in detail. A special room in our lab is reserved for life testing. Here more than a thousand drive systems with different load profiles run day and night. Frequently our products reach a life time that is several times longer than expected. Our motors simply don't want to stop turning.

Our controllers also meet highest demands and have to fulfill diverse standards, e.g. for vibration, shocks, temperature, and – very important in many cases – on electromagnetic compatibility. The qualification is then confirmed by an independent testing institute.

- 1 Testing Battery Management System (BMS)
- 2 Noise characterization
- 3 Lifetime testing
- 4 Vibration analysis



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