

## New Mobility requires a new generation of customised specialty lubricants

Electromechanical components depend on reliable lubrication over long periods of time

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Particularly in cities, we can already see how the new era of mobility, in which a wide array of electric vehicles operate as part of a network, is increasingly changing the world around us. Yet this modern, eco-friendly means of transportation is only in its infancy. There are still no standardised processes or test regimes in place for many of the new technologies and components. This is also the case for lubricating greases used in actuators. There is a lot of room for improvement here.

For the lubricants used in this field, this means that existing solutions are not automatically adequate. The high potential of increasing electrification in the automotive industry especially increases the demand for customised specialty lubricants. The following article describes the special challenges facing lubricants in various environments using the example of the ball screw as a key component in the increasingly complex steering, clutch and braking systems in hybrid and electric vehicles.

## Ultimate precision for safety-relevant systems

Actuators are required to convert electrical signals and pulses into mechanical movement. For many years, ball screw spindles have been used for this purpose in applications such as machine tools, manufacturing robots, measuring and control systems as well as medical diagnostic scanners. The drive-by-wire technology used in automotive engineering has significantly expanded the area of application of ball screw spindles. In particular, this concerns the actuators of the steering, clutch and braking systems in electric or electrically supported motor cars, bikes and commercial vehicles of all classes. These are the vehicles which play a decisive role in New Mobility. Even if they are all based on similar systems, the vehicles within this group have hugely different requirements and service lives.

The spindle of a ball screw is actuated by the electric motor and translates its rotating motion into linear motion via the spindle nut. In order to operate safely, the components must be manufactured to utmost accuracy. The spindle nut contains balls or rollers which improve precision and load transfer. It is also critical to ensure precise positioning of the thread, repeatability and wear-free operation in the presence of high load ratings (C), impact loads and short strokes. Smooth operation at high speeds and accelerations and good corrosion protection are also decisive.

The lubricant requirements are also high as, unlike with ball screw spindles in handling systems and machine tools, relubrication is not possible in automotive applications. It must be ensured that only a few grams of lubricating grease are needed to reliably lubricate the system for the entire component life of up to 15 years. Vehicles require a low friction torque also at low temperatures.

	Clutch actuator	Brake actuator	Steering actuator
Lower service temperature [°C]	-40	-40	-40
Upper service temperature [°C]	80-130 peak of up to 190	120-160	130
Rotation rate [rpm]	2,000	up to 6,000	up to 2,000
Stroke [mm]	~ 20-30	~ 0-20	~ 200
Compatibility	Gear lubricant, EPDM bellow, NBR/HNBR bearing seals	Other lubricants, EPDM	Other lubricants and belt drives
Lifetime cycles	6 million	3 million	6 million
Vehicle mileage [km]	1.5 Mio (15 years)	300,000 (15 years)	300,000 (15 years)
Spindle diameter [mm]	13-20	5-10	20-30 mm

### Clutch actuator

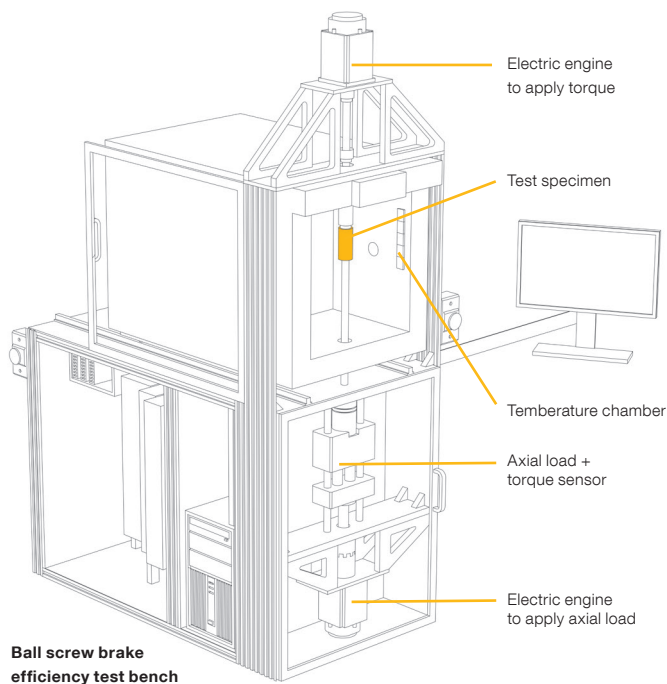
Spindle drives are most commonly used in the clutch actuators of buses and lorries. The focus here is on a long service life of 15 years and a mileage of at least 1.5 million kilometres with approximately 6 million switching cycles. The purpose of the lubricant is to minimise wear and keep shifting times consistently low.

Due to the compact design, it is also important to consider the possibility of contamination by other lubricants used in the component (e.g. in the ball bearing or gearbox), which can leak into the spindle under certain circumstances.

The Klübersynth HB 72-102 lubricating grease is used here. Alternatives for special requirements are available upon request.

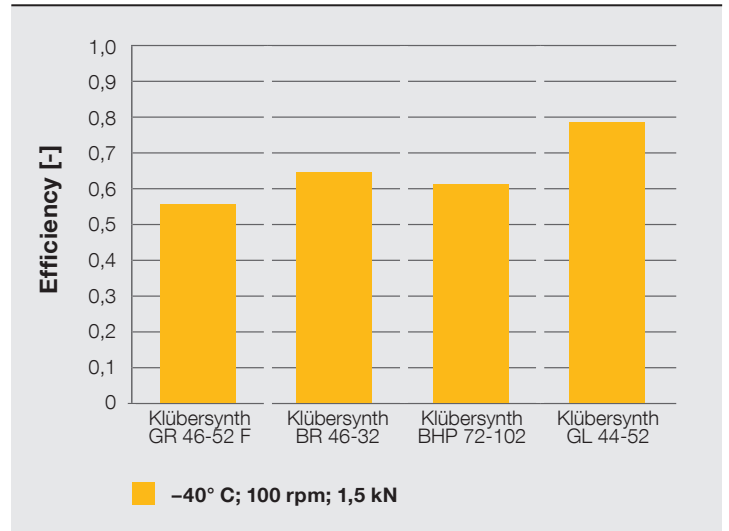
## Test technology by Klüber Lubrication

Most lubricating greases used for ball screw spindles are rolling bearing greases which are tribologically optimised with regard to low starting torque at low temperatures and damping. There are no standardised tests for their use in ball screws. For this reason, Klüber Lubrication has developed special test benches for the optimisation of performance and interaction between component and lubricant. This allows component optimisation benchmarks to be developed by means of new lubricants and corresponding test methods.



**Ball screw brake efficiency test bench**

### Ball screw brake efficiency test bench



Maximum torque: 20 Nm  
 Maximum axial load: 15 kN  
 Maximal rotation rate: 100 rpm  
 Temperature chamber: -40° C to 120° C  
 Stroke: 50 mm  
 Specimen height: 125 mm  
 Specimen diameter: 30 mm  
 Result: nut efficiency  
 (no wear tests planned)

## Brake actuator (electro-mechanical brake)

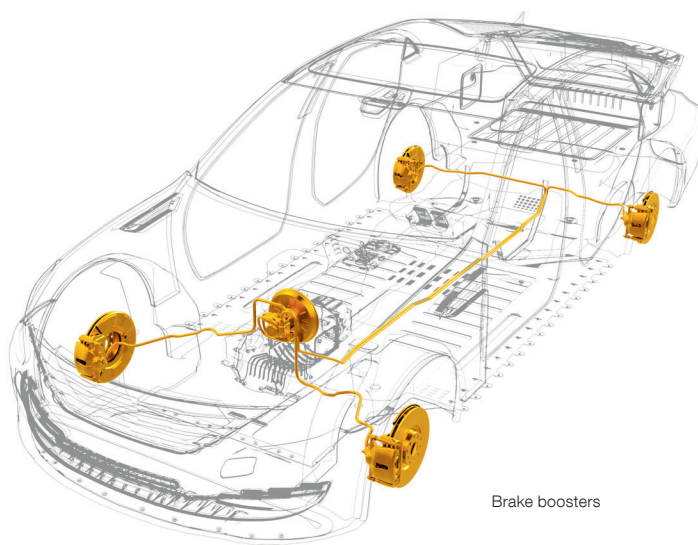
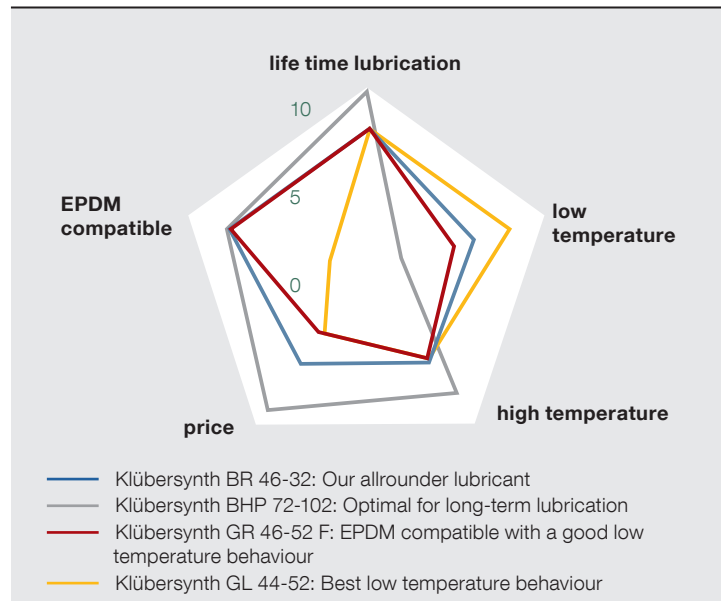
There are two main areas of use for grease-lubricated ball screws in brake applications:

### Brake boosters

Linear drives are used in electric brake boosters. Here, it is essential that the lubricant is compatible with EPDM seals. As a result, polyglycol base oil is usually favoured for this application. At the same time, it is important that the efficiency does not decrease too strongly at low temperatures (-40 °C) compared to room temperature.

In light of these conditions, Klübersynth BR 46-32 has proven itself on the market, combining good EPDM compatibility with good low-temperature behaviour.

#### Lubricant recommendations for brake actuators



### Service brake

This technology is still under development, but some of it is nearly ready for series production. Unlike hydraulic brakes, the ball screw spindle is driven via an electric motor in electro-mechanical brake systems.

This development means that brake fluid will no longer be necessary in the future. Therefore, since the compatibility of the lubricants with brake fluids and EPDM seals is no longer an issue, the development of new high-performance lubricants can focus on requirements for long grease service life and low frictional torque.

Klüber Lubrication is currently working with renowned component manufacturers to develop custom lubricant solutions for this specific application in actuators.

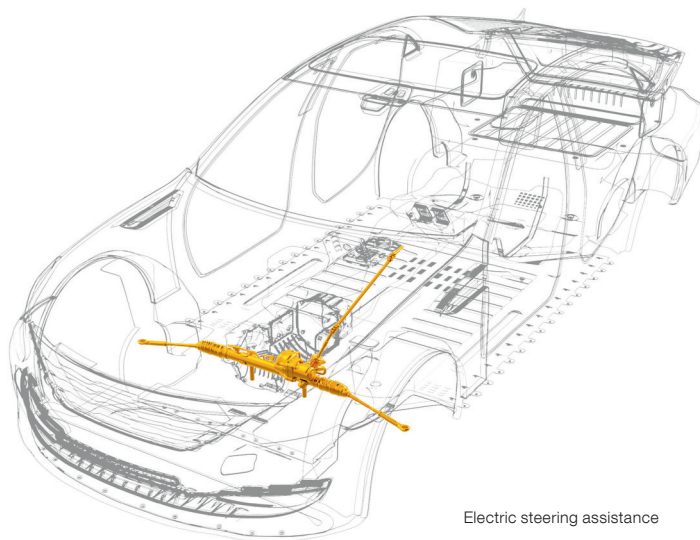
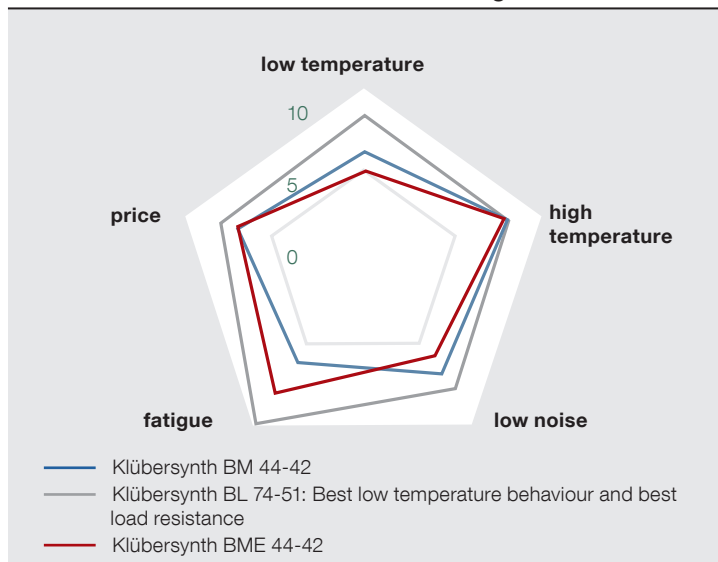


## Steering actuator

In the area of steering assistance, ball screws are mainly found in vehicles with higher axial loads. The demands placed on the lubricants used in this area are constantly growing, as they are subjected to increasingly higher stresses due to the ever-increasing axial loads and the associated higher loads in the ball screw.

Klüber Lubrication demonstrates this heavy load with a special rolling bearing fatigue wear test, which can approximately simulate the conditions of the „kerbing test“, where small movements of the spindle act on only a few balls.

### Lubricant recommendations for steering actuators



## Outlook

Increasing electrification in the automotive industry will continually increase demand for high-quality specialty lubricants. Klüber Lubrication has an extensive portfolio with efficient solutions for challenging requirements. The existing lubricants are under constant development, particularly with regard to temperature and long-term stability, higher loads and ever-increasing efficiency.

When developing custom solutions for specific requirements, Klüber Lubrication benefits from many years of experience in the automotive field.

For example, Klüber Lubrication is currently working with component manufacturers and automotive companies to optimise noise performance using special lubricating greases and develop a suitable measurement method for this, e.g. by means of a noise sensor installed directly on the ball screw.

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