FUCHS Special Applications

GLEITMO

Solid Film Lubricants – the dry lubrication

LUBRICANTS. TECHNOLOGY. PEOPLE. FUCHS

MOVING YOUR WORLD

FUCHS LUBRICANTS GERMANY

We do not just develop lubricants. We develop intelligent solutions for highly complex challenges.

To this end, we have pooled our expertise and experience from a wide range of application areas: FUCHS SCHMIERSTOFFE and FUCHS LUBRITECH became FUCHS LUBRICANTS GERMANY.
Our goal: to keep our customers' world in motion. Efficient, sustainable, reliable.
Today and tomorrow.

What can we move for you?

FUCHS LUBRICANTS GERMANY

Facts and figures

Company: FUCHS LUBRICANTS GERMANY GmbH, a company of the FUCHS Group

Locations: Based in Mannheim, with sites in Bremen, Dohna, Hamburg, Kaiserslautern, Kiel and Wedel; approx. 1,400 employees

Product range: A full range of more than 3,000 products for all application areas

Certifications i. a.: ISO 9001, IATF 16949, ISO 14001, ISO 45001, ISO 50001, ISO 21469, HALAL, KOSHER (detailed certifications at www.fuchs.com/de/en)

CO_2 neutral production*

Since 1931, we have been pursuing the same goal: to keep the world moving. With innovative and technological lubricant solutions that have a sustainable impact on the future. Unconditional reliability is our top priority, it is the foundation of our company and basis for everything that defines us.

Reliability is both a driver and a demand. And it's a promise to all our customers in the fields of automotive suppliers and OEMs, mechanical engineering, metal processing, mining and exploration, aerospace, energy, construction and transport, agriculture and forestry, as well as the paper, steel, metal, cement, forging and food industries, but also qualified lubricant dealers, car dealerships and workshops.

Long-term experience, high development strength and the fulfillment of far-reaching standards are the basis for the special quality of our world-leading product brands. We deliver solutions that are simply more efficient and therefore more sustainable. We always think in holistic solutions. For the development of individual solutions, we enter into an intensive customer dialog with you. This is the way we live up to our claim of moving your world.

MOVING YOUR WORLD

*Partially also based on compensation

SOLID FILM LUBRICANTS – THE DRY LUBRICATION

In many instances where dry lubrication is required, solid film lubricants are the best choice. The solid film lubricant coating has proven its worth millions of times and nowadays constitutes a reliable, almost indispensable design element.

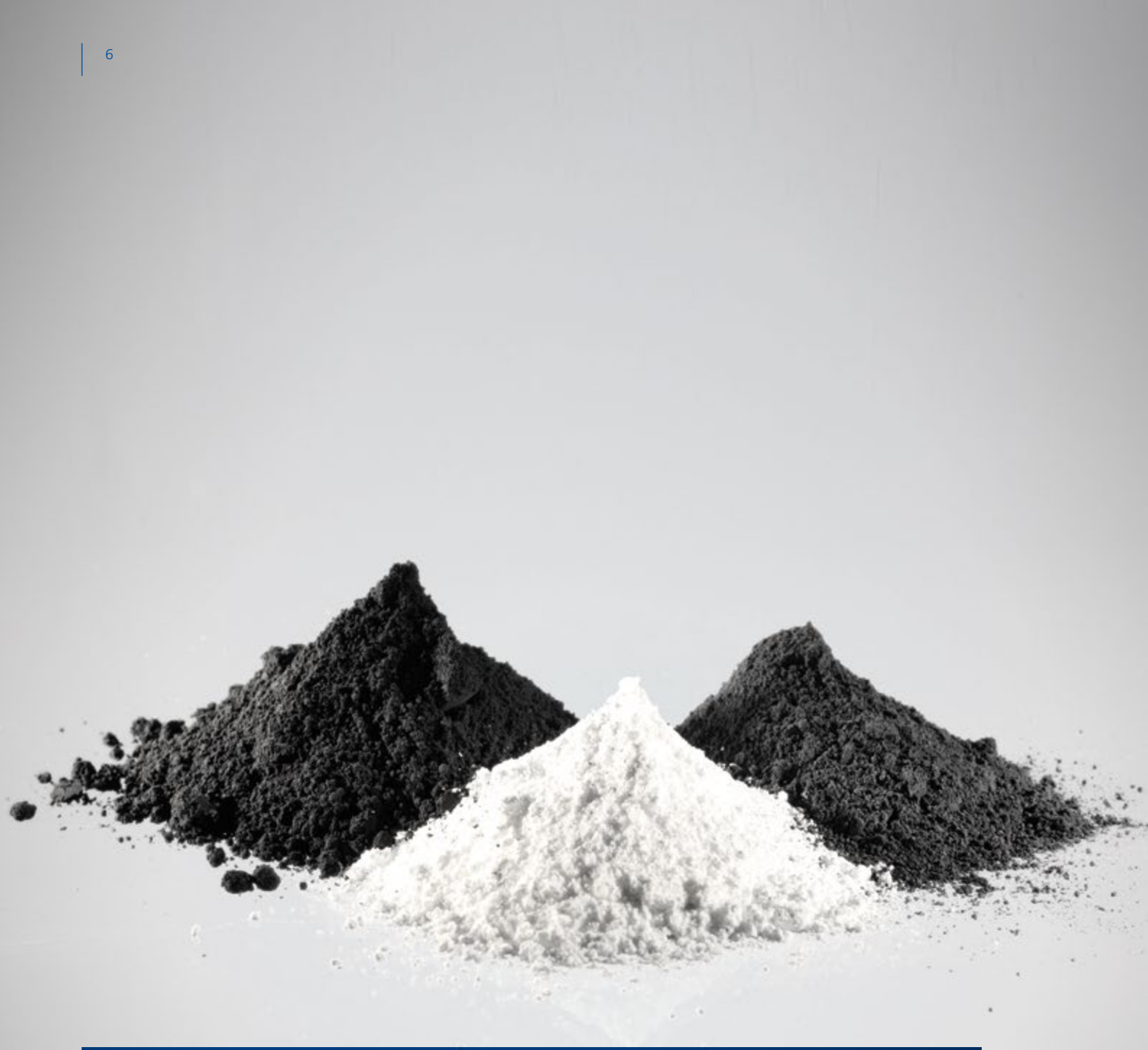
Increased automation in production and assembly makes solid film lubricants ever more important. They provide many components with dry, efficient lubrication and, compared with conventional lubrication using greases or oils, allow designs to be simpler. They assist in the running-in of heavy-duty machine elements, simplify installation and, in many cases, guarantee maintenance-free lifetime lubrication.

Benefits of solid film lubricants

- dry and clean lubrication
- are resistant to contamination
- protect against corrosion
- lubricate under extreme conditions (high and low temperatures, vacuums)
- are suitable for the surface finishing of a large number of matewrials (metals, plastics, elastomers, ceramics, glass, etc.)

Benefits of using solid film lubricants

- facilitate the assembly and disassembly of fitted parts
- improve the running-in performance of heavy-duty components
- make maintenance-free lifetime lubrication possible
- prevent the occurrence of stick-slip and thereby contribute to a reduction in noise
- attain precise coefficients of friction with low scattering for threaded connections
- guarantee additional safety through emergency lubrication in combination with oil and grease lubrication



SOLID FILM LUBRICATION – THE DRY ALTERNATIVE

Our solid film lubricants are state of the art and meet various technical requirements of the most diverse sectors such as industrial and system engineering, the metal-processing industry, machinery construction and the consumer goods and automotive industries. Moreover, they comply with the constantly increasing requirements for environmental compatibility.

Range of capabilities and structure of solid film lubricants

Solid film lubricants allow the coating and storing of lubricated parts ready for assembly. They are extremely resistant to pressure and temperature. They are also resistant to ageing and at the same time clean to handle.

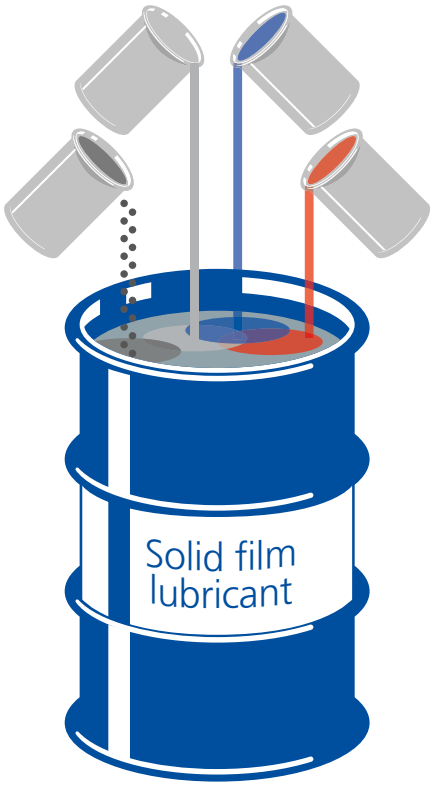
Structure and composition of solid film lubricants
Solid film lubricants are dispersions of selected solid lubricants in solutions of organic or inorganic binders in solvents. Apart from the main components – binders, solid lubricants and solvents – solid film lubricants can also contain functional additives such as corrosion inhibitors or UV-active additives.

Solid lubricants
Molybdenum disulphide, graphite, polytetrafluoroethylene …

Binders
Epoxy, polyurethane, amide-imide, silicone resins …

Solvents
Organic solvents, water …

Additives
Corrosion protection, wetting, preservation, UV detection …



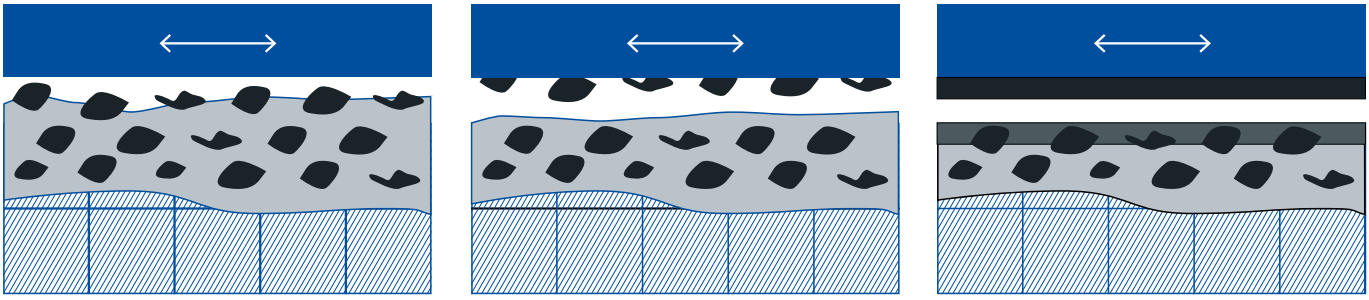
Functionality of solid film lubricants

After drying and curing solid film lubricants form a dry lubricant film of a few microns reliably adhering to the base material. This film acts as a friction- and wear-reducing, separating and lubricating layer between the friction partners.

A smoothing of the surface of the solid film lubricant initially takes place as a result of the relative movement of the contact partners. By means of a partial separation of lubrication-efficient components from the solid film lubricant layer a so-called transfer film is formed on the counterpart. The buildup of a lubricating film between the sliding partners leads to a reduction of the coefficient of friction.

The solid film lubricant offers the advantage of dry, and therefore clean, lubrication and in many instances can replace the use of greases or fluid lubricants, particularly where slow sliding movements are involved. In addition, solid film lubricants can be used in combination with fluid or pasty lubricants. In such cases they improve the running-in lubrication during initial operation and ensure separation of the metallic friction partners in solid body contact at very low speeds or during downtimes.

Functionality of a solid film lubricant

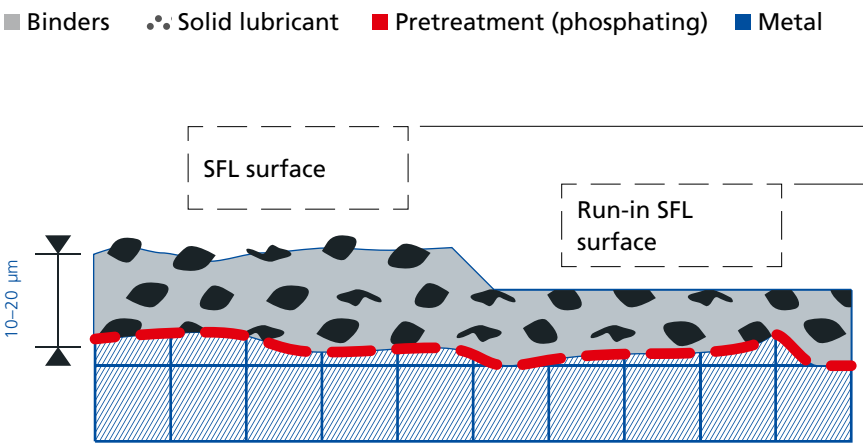


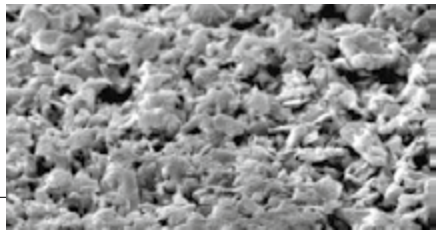
Partial separation of solid lubricant from the SFL

Transfer of solid lubricant to the counterpart

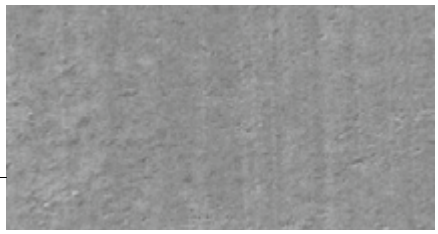
Formation of the transfer film

Solid film lubricant on metal





Scanning electron micrograph of the surface of a MoS_2 solid film lubricant layer before tribological loading by the friction partner.



Scanning electron micrograph of the surface of a MoS_2 solid film lubricant layer after tribological loading by the friction partner – smoothing of the surface of the solid film lubricant.

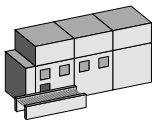
OVERVIEW OF THE COATING PROCESS

The application of solid film lubricants is a complex topic and should be carried out by a specialist. Like a professional industrial coating, the application of solid film lubricants passes through various processing steps, each of which considerably contributes to the quality of the coating result. FUCHS LUBRICANTS GERMANY has its own contract coating plant. If you require a contract application please do not hesitate to contact us.

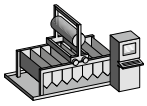
Processing steps

PROCESSING STEPS

Cleaning



Pretreatment



Chemical pretreatment

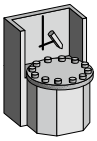
Sand blasting

Plasma treatment

Application

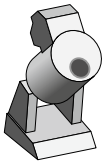
Spraying

Robots



Rotary table

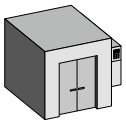
Centrifuge



Drum

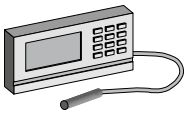
Hardening

Drying

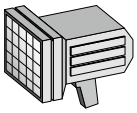


Curing

Final inspection



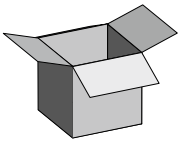
Layer thickness inspection



UV light

Microscope

Packing



Cleaning and pretreatment

Surface preparation is the first step in the coating process. It plays a special role in solid film lubricant coating, because good adhesion and the associated long lifetime can only be achieved with a pretreatment of the surface tailored to the component and the solid film lubricant used. Thorough removal of all grease residues, dust, dirt, rust and scale is a fundamental part of the surface pretreatment.

Pretreatment of metal parts

Degreasing can usually be effected using organic solvents, such as white spirit, acetone, etc. More environmentally and user-friendly cleansing can be achieved by using alkaline or neutral, aqueous cleaners. The effectiveness of the cleaners can often be intensified when combined with ultrasound or heat.

Rust and scale can be removed mechanically or chemically. Grinding and shot blasting have proven themselves as mechanical pretreatment methods. Rust and scale can be removed chemically through pickling in acids or leaches.

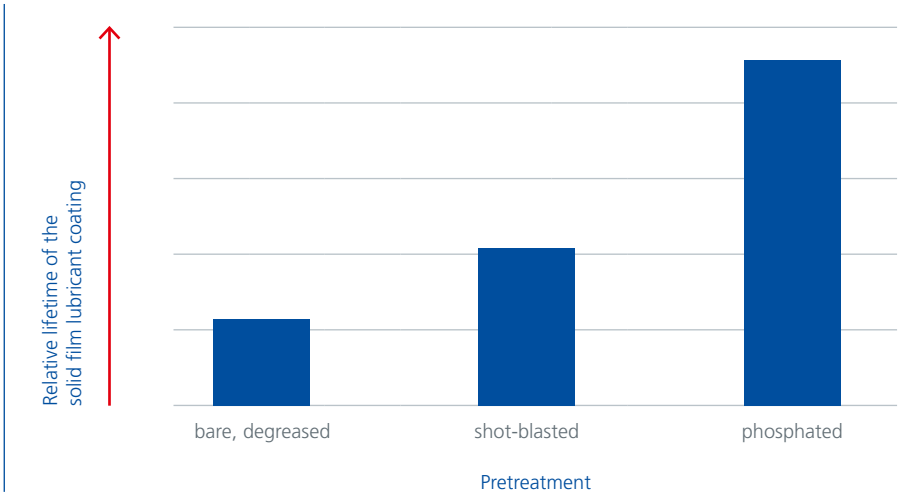
Through phosphating as pretreatment, the adhesion of the solid film lubricant to the metal surface can be significantly improved in comparison with degreased or shot-blasted surfaces. In many applications this results in a considerable increase in the lifetime of the solid film lubricant coating (see diagram below). In addition, the corrosion protection effect of the solid film lubricant coating is significantly enhanced by phosphating. Zinc or manganese phosphation is commonly used.

Pretreatment of plastic and elastomer parts

Plastics and elastomers can be degreased in washing processes with aqueous cleaners or solvents. When using solvents, however, it is essential to ensure that they are compatible with the materials to be cleaned.

The adhesion of the solid film lubricants can be improved by roughening the surface area, for example. Suitable methods are grinding or shot blasting with CO_2. Attention should be paid to avoiding deformation of the parts or surface damage. Alternatively, physical methods such as plasma activation, corona treatment or flame impingement can be used for the pretreatment of plastics and elastomers.

Relative lifetime as a function of the pretreatment of a metal surface



Methods of applying solid film lubricants

Decisive for the selection of a suitable application method are primarily the geometry of the parts and the specific application properties of the selected solid film lubricant. Coating is mainly performed using processes that are customary in coating technology, such as spraying, dip spinning, tumbling and dip centrifuging.

Spray coating

Spray coating is usually done using conventional spray guns in a manual or automated process (e.g. with flat spraying devices, rotary indexing machines, chain conveyors). High-quality, homogeneous coating layers can be applied by spray coating. The typical dry layer thicknesses in the spray process range between 10 and 30 µm. Simple part geometries or large components are particularly suitable for this procedure. Due to the higher process costs, automatic processing of mass-produced small parts is preferable only if the coating is subject to extremely high demands.

Dip spinning

Dip centrifuging or dip spinning represents an ideal method for the coating of mass-produced small parts. Particularly suitable for this method are parts with complex geometries (such as with holes, recesses, etc.), where not all surfaces are accessible by spraying. This process is very cost-effective due to its fast material throughput and low losses of solid film lubricants. However, several coating cycles are often necessary in order to achieve homogeneous coating layers with higher coating thicknesses. The maximum achievable dry layer thicknesses usually lie within the range of 3 and 15 µm.

Drum coating

Coating in drums is particularly suitable for bulk goods which have a simple geometry (e.g. washers, bolts, pins, O-rings). A benefit of this process is the fact that a smoothing of the surface occurs on account of the reciprocal friction between the coated parts in the drum, resulting in homogenous layer surfaces. By combining it with a spray coating in so-called “spraying drums” the quantity of the solid film lubricant can be precisely controlled, thereby further improving the coating result. The achievable dry layer thicknesses using the drum coating method usually range between 3 to 15 µm.

Overview of the coating methods and their fields of application

	Individual components	Bulk goods/ small parts	Avoidance of sticking tendency	High coating quality	Increased layer thicknesses	Low consump-tion of SFL	Complex part geometries	Costs
Spray coating	■		■	■	■		■	
Drum coating		■	■	■		■		■
Dip coating	■	■		■	■	■	■	■
Dip spinning		■	■	■		■	■	■
Spray drum coating		■	■	■	■	■		■

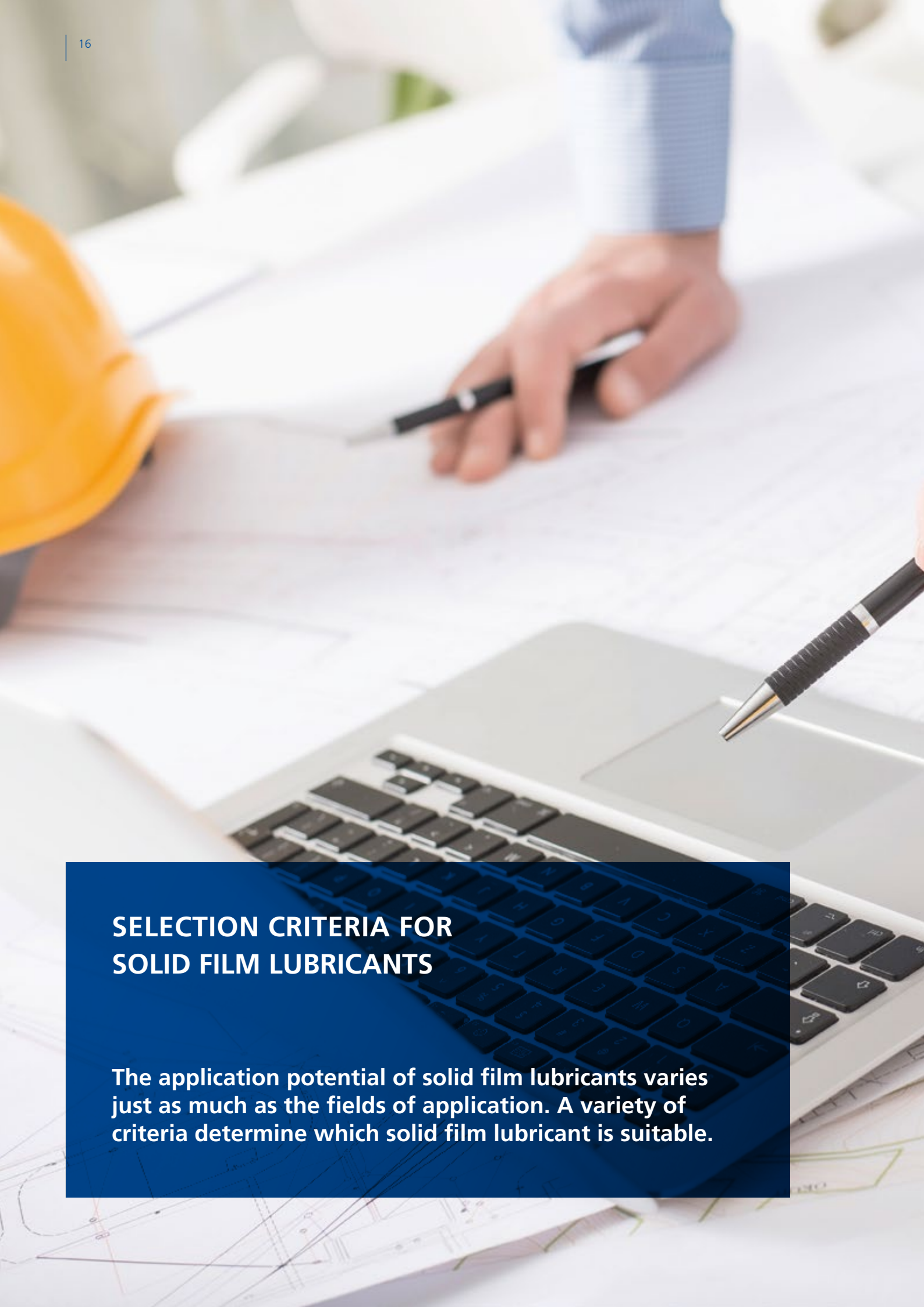
■ Very suitable ■ Conditionally suitable

Hardening and quality control

The final step of solid film lubricant coating is quality control. Following the execution of the application process, a drying or heat-curing process takes place, depending on the type of solid film lubricant, before the coating is subjected to quality control.

Air-drying solid film lubricants are dried at ambient temperature before being subjected to tribological stress, while heat-curing solid film lubricants are baked after coating. Subject to the chemistry of the solid film lubricant used, the regular baking temperatures range between 100 and 250°C. For more information about solid film lubricants from FUCHS LUBRICANTS GERMANY, please refer to the corresponding Product Information sheets.

The general parameters used for the quality control of solid film lubricant layers are the surface quality, the layer thickness as well as the adhesion to the base material. Transparent solid film lubricants usually contain a special UV tracer for coating inspection. This indicator can be made visible with the aid of a UV lamp and makes a “Yes/No” verification possible. The other inspection possibilities depend on the component and the relevant quality assurance requirements on the coating. In some cases, the coated components are checked with regard to the tribological or corrosion protection properties.



SELECTION CRITERIA FOR SOLID FILM LUBRICANTS

The application potential of solid film lubricants varies just as much as the fields of application. A variety of criteria determine which solid film lubricant is suitable.

The selection of a suitable solid film lubricant is mainly determined by these factors: type of component, coating purpose, surrounding conditions and quality assurance requirements. Solid film lubricants manufactured by FUCHS LUBRICANTS GERMANY have proved themselves in many fields and represent an optimum solution for dry and clean lubrication. Thus, for example, they can provide assembly-compatible lubrication for connectors, fitted parts and O-rings; help to minimise wear on gear components; and provide reliable lifetime lubrication for components essential for safety.

The assessment as to whether a solid film lubricant is suitable for providing lifetime lubrication for a component must usually be determined through trials on appropriate test rigs. Generally, solid film lubricants have a limited service life, which is indicated in the long-term test by an increase in the coefficient of friction and the appearance of signs of wear. In this context it should be noted that the loading and sliding speed of the component can have a great influence on the performance of the solid film lubricant.

Selection criteria for coatings

Component characteristics
- Geometry
- Weight
- Material
- Surface
- Coating costs

Quality assurance requirements
- Component testing
- Model testing
- Statistical process control
- Documentation

Type of coating

Coating purpose
- Running-in lubrication
- Assembly aid
- Lifetime lubrication
- Corrosion protection
- Wear reduction
- Decorative appearance
- Increase in value

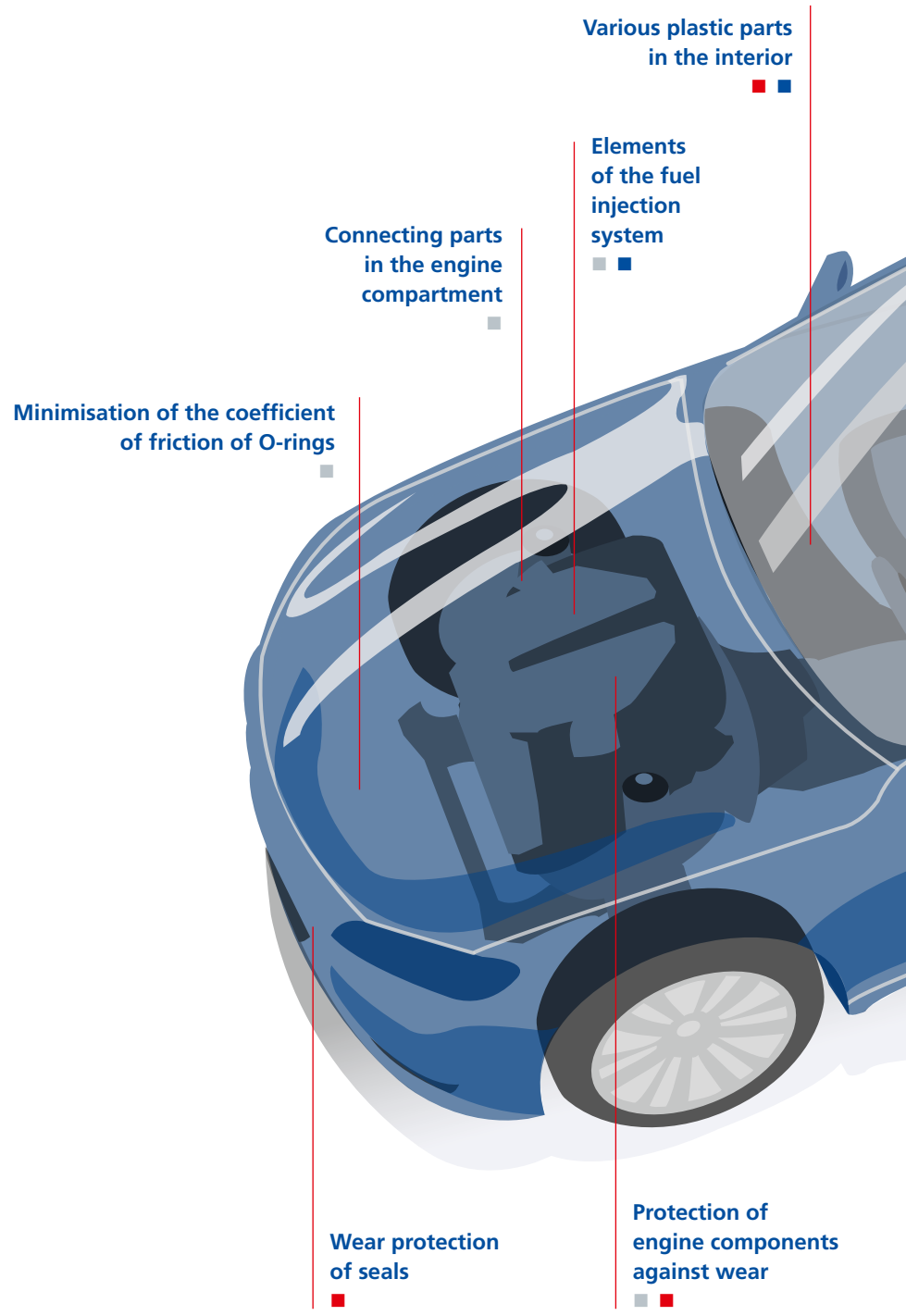
Surrounding conditions
- Temperature range
- Surrounding media
- Friction partners
- Loading
- Type of movement
- Load cycle number

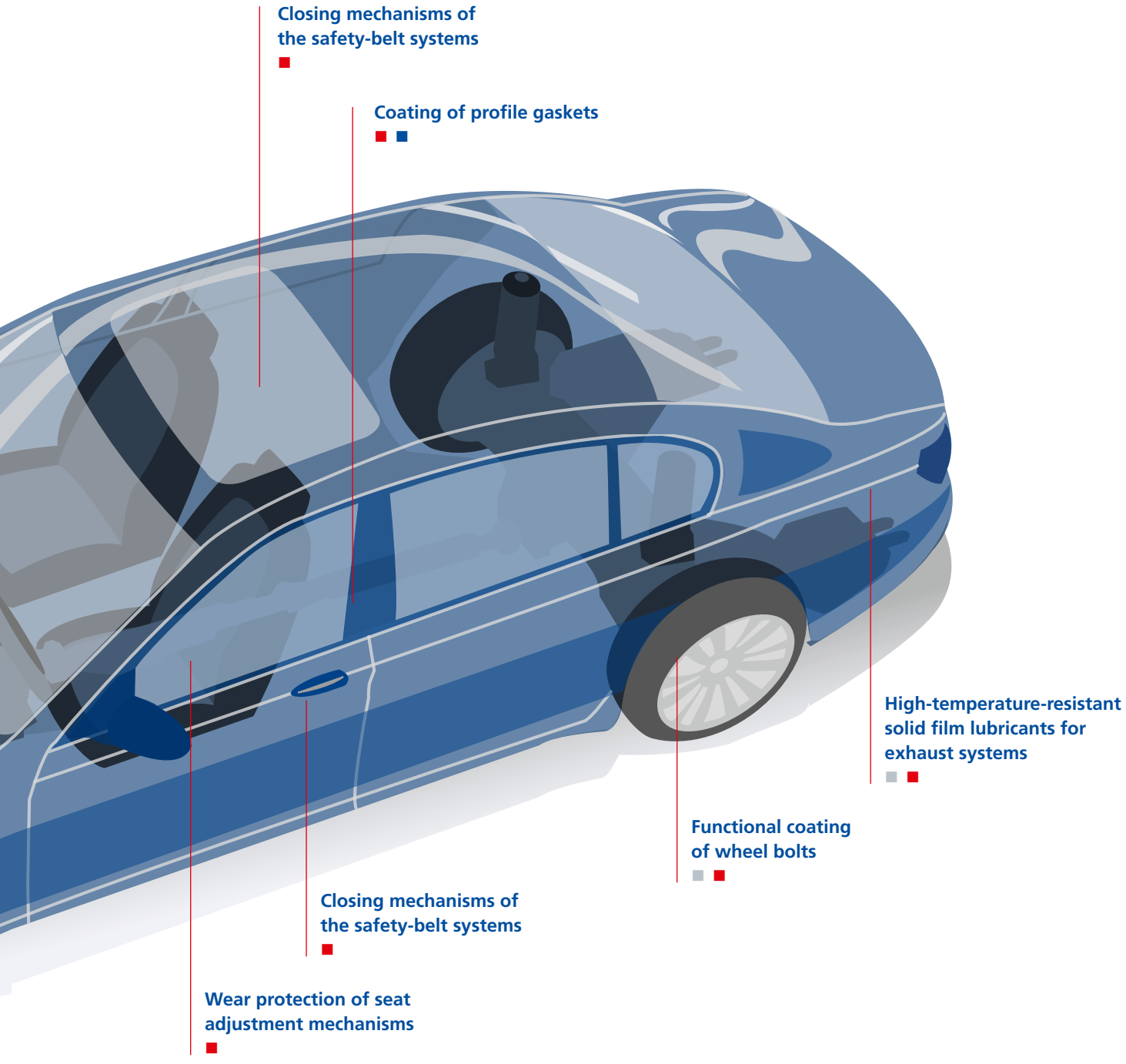
Industrial application of solid film lubricants

Solid film lubricants are used in many different industrial applications, for the coating of metallic parts or for use on elastomers and plastics.

Application possibilities taking the car as an example
The wide range of possible uses of solid film lubricants is particularly apparent taking the car as an example. Solid film lubricants facilitate the assembly of sealing and bolting elements, contribute to the reduction of noise in the passenger compartment, provide the best possible performance under extreme conditions (e.g. engine compartment, exhaust system) and guarantee reliable functional lubrication of components important for safety.

- Assembly lubrication/ running-in optimisation
- Lifetime lubrication
- Noise minimisation




Closing mechanisms of the safety-belt systems
Coating of profile gaskets
High-temperature-resistant solid film lubricants for exhaust systems
Functional coating of wheel bolts
Closing mechanisms of the safety-belt systems
Wear protection of seat adjustment mechanisms

Solid film lubricants for metals

Solid film lubricants can be used on metallic components in almost all industrial sectors. Major users are above all the automotive industry, mechanical engineering and the bolt and screw industry.

With regard to the functionality of the solid film lubricant, a distinction is essentially made between a coating with lifetime lubrication, running-in lubrication or a pure assembly aid. In addition to the optimisation of the coefficient of friction and wear, the demand for corrosion protection is frequently an important aspect where metallic components are concerned.

Coating of threaded connections

The friction coefficient of a threaded connection is extremely important for its function. The correct lubrication must already be taken into consideration when designing a threaded connection. The aim is to achieve the ideal tightening behaviour, i.e. the interaction between tightening torque and friction force, as well as the resulting clamping force. The tightening behaviour is usually tested on special screw test rigs. In addition to conventional lubrication with oils or greases, FUCHS LUBRICANTS GERMANY offers numerous products from the field of lubricating films and solid film lubricants for the coating of threaded connections.

The use of solid film lubricants on threaded connections results in the following benefits:

- specific adjustment of the coefficient of friction with low scattering range
- dry, technically clean coating
- wide operating temperature range
- high resistance in contact with technical media
- loosening of threaded connection after thermal load
- repeated assembly
- corrosion protection

Coating of metal components for lifetime lubrication

The individual components of many assemblies are no longer accessible for re-lubrication after installation or re-lubrication is generally not requested. In such cases, the solid film lubricant coating must function for the entire lifetime, either in continuous or in intermittent operation. In addition to the low coefficient of friction, an adequately high resistance of the solid film lubricant is then especially important. Such requirements apply, for example, to:

- bolts
- hinges
- springs
- lock components
- magnetic anchors
- shafts
- bearing elements
- spindles
- pistons
- disc springs

The suitability of a solid film lubricant for the lifetime lubrication of the component is often determined prior to its use, based on tribological test rig results as well as the customer"s special assembly test rig results. Using modern tribological test rigs the solid film lubricant coatings can be tested under different stresses, speeds, geometric fastening conditions and climatic conditions.

Solid film lubricants for elastomers and plastics

As modern materials, elastomers and plastics have become indispensable. There are many uses for dry lubrication with solid film lubricants for these materials, too.

Solid film lubricants for elastomer seals – clean and flexible
The necessity for lubricating seals (O-rings) for ease of assembly, as well as the reduction of friction in dynamic processes, is beyond question and in the past was primarily effected by classic lubricants (oils, greases).

In recent years dry lubrication with solid film lubricants has acquired increasing significance in this field. Compared with conventional lubrication, the application of a solid film lubricant has above all the advantage that, by coating mass-produced parts, it is possible to dispense with the preliminary treatment (oiling, greasing), which is often carried out by hand, during installation of the component.

Easier assembly is no longer the only requirement on the solid film lubricant coating of O-rings. Subject to the application case, a coating must also fulfil various general conditions.

In technical applications, such as in the automotive industry the coated O-ring frequently comes into contact with operating fluids. In other cases a coloured coating is required or the possibility of use in contact with drinking water or food.

Solid film lubricants for plastic parts – low-friction and noiseless

There are just as many possibilities to use solid film lubrication with plastics as there are in the coating of metals. For example, solid film lubricants reduce the assembly forces for plug-in connections in the furniture industry, they allow low-friction movements of plastic guides and protect switching mechanisms in household appliances against wear. In addition to their friction and wear-reducing properties, solid film lubricants from FUCHS LUBRICANTS GERMANY on plastics also contribute to a reduction of noise. Especially in car interiors, material combinations of different materials such as plastics, elastomers or synthetic leather often generate noise due to vibration when driving as a consequence of so-called “stick-slip” phenomena. This can be eliminated in advance by the application of a solid film lubricant.

Solid film lubricants from FUCHS LUBRICANTS GERMANY offer the ideal solution for elastomers and plastics

- pre-coating of mass-produced small parts
- dry and clean lubrication
- separation during automated feeding thanks to non-stick effect
- low assembly forces due to reduction of coefficient of friction
- avoidance of damage during assembly
- high resistance to wear and low coefficients of friction in use
- noise minimisation for the most diverse material combinations
- resistance to technical media
- identification by coloured coating is possible

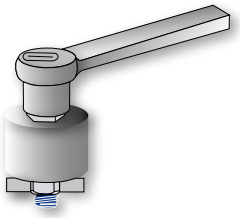
TESTING – ENSURING THE HIGHEST LEVEL OF QUALITY

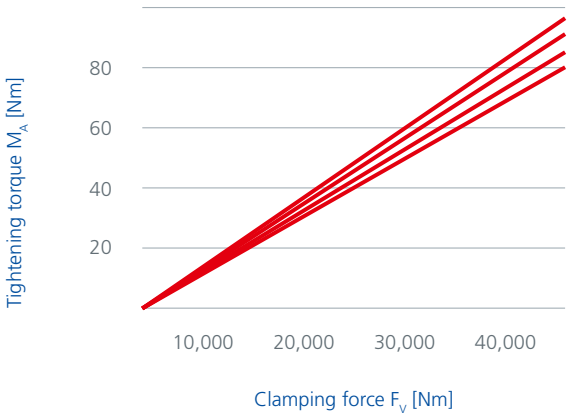
Different test methods are used to test the capability of solid film lubricants. The special characteristics of a solid film lubricant can be emphasized by selective variation of the test parameters.

Typical test methods for solid film lubricants

Testing on the bolt test rig

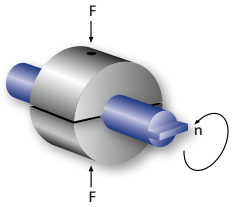
- DIN EN ISO 16047
- determination of coefficients of friction on threaded connections
- contact geometry: flat surface (thread and bolt head)
- test criteria: coefficient of friction, clamping force
- measurement of thread friction, under-head friction and total coefficient of friction

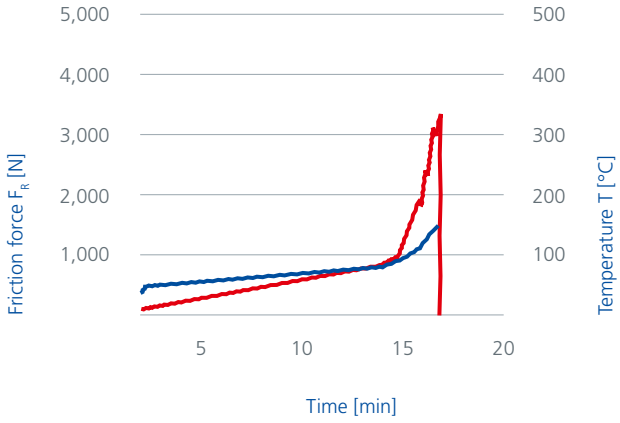




ALMEN WIELAND test method

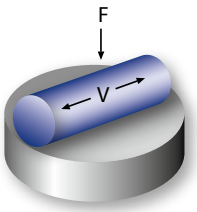
- LLS* 060
- rotating shaft (coated) fixed in two bearing shells
- contact geometry: flat surface
- test criteria: seizing load, coefficient of friction
- measurement at slow sliding speeds

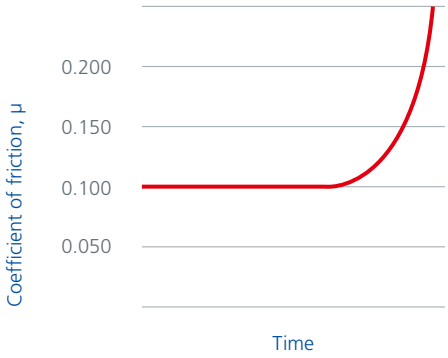




SAV Test Method

- DIN 51834-8
- oscillating friction partner on a coated plate
- contact geometry: line (alternatively flat surface or point)
- test criteria: coefficient of friction, wear
- service life testing at variable sliding speeds and surface pressures



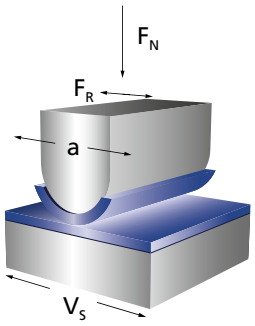


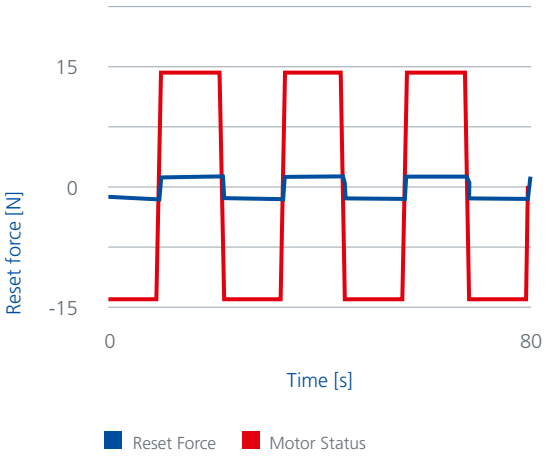
Corrosion testing

- DIN EN ISO 9227 (salt spray test)
- DIN EN ISO 6270-2 (constant water condensation test)
- determination of the corrosion resistance of coated test plates or components

"Stick-slip" test

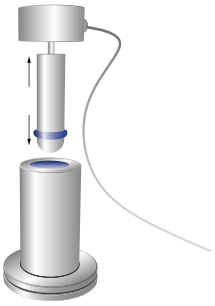
- VDA 230-206
- moving friction partners (coated) on plate
- contact geometry: flat surface, variable
- test criteria: determination of the "stick-slip" tendency of material combinations by the risk priority number (RPN)
- evaluation of the anti-squeak properties

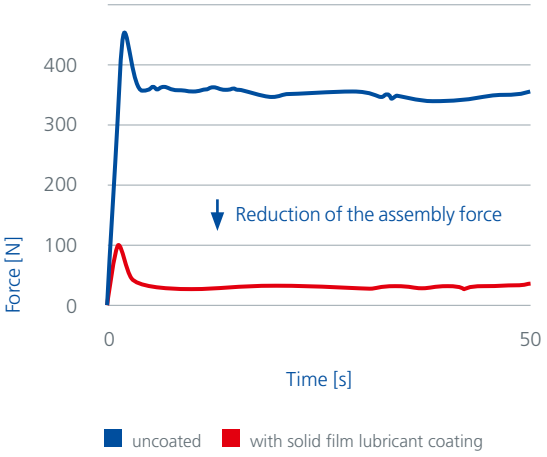




O-ring insertion test

- LLS* 140
- insertion of a coated O-ring
- contact geometry: flat surface
- test criteria: friction force
- measurement at low speeds





*LLS = FUCHS LUBRICANTS GERMANY Laboratory Specification

Fields of application of solid film lubricants

		GLEITMO 900*	GLEITMO 905	GLEITMO 920	GLEITMO SFL 9025	GLEITMO SFL 9540	GLEITMO SFL 9550	GLEITMO SFL 9563	GLEITMO SFL 9560	GLEITMO 960*	GLEITMO SFL 9580	GLEITMO 980*	GLEITMO SFL 9085	GLEITMO 2332V	GLEITMO SFL 9065	GLEITMO SFL 9070	GLEITMO SFL 9680	GLEITMO RLC 3000	GLEITMO RLC 3100
	Item no.	0117	0145	0149	5425	0540	5550	0563	0560	0185	5580	0120	5485	0342	5365	3570	5650	5300	5310
Functionality	Assembly aid	■	■	■	■					■		■	■				■	■	■
	Running-in optimisation	■		■	■	■		■		■									
	Lifetime lubrication					■	■	■	■						■	■			
	Noise minimisation (stick-slip)							■				■			■	■			
	Non-stick properties										■	■							
Component/Application	Screws, bolts, nuts	■	■	■	■		■			■		■	■	■					
	Universal joints / splined shafts			■		■	■	■											
	Threaded spindles	■	■	■	■	■		■	■	■									
	Chain bolts	■		■	■	■	■					■							
	Armatures				■					■									
	Electromagnetic cores							■	■										
	Bolt rivets	■			■			■				■							
	Hinges						■	■				■							
	Dowel pins	■		■	■							■							
	Plastic switches											■	■			■			■
	O-rings											■	■				■	■	■
	Bearing elements	■			■	■	■			■		■							
	Plastic/elastomer lubrication											■	■			■	■	■	■
	Springs/braces	■		■	■							■	■						
	Toothed racks	■			■														
	Lock components						■	■											
	Disc springs			■				■							■				
	Cylinder head gaskets		■																

* Also available as a spray

Characteristics of solid film lubricants

		GLEITMO 900*	GLEITMO 905	GLEITMO 920	GLEITMO SFL 9025	GLEITMO SFL 9540	GLEITMO SFL 9550	GLEITMO SFL 9563	GLEITMO SFL 9560	GLEITMO 960*	GLEITMO SFL 9580	GLEITMO 980*	GLEITMO SFL 9085	GLEITMO 2332V	GLEITMO SFL 9065	GLEITMO SFL 9070	GLEITMO SFL 9680	GLEITMO RLC 3000	GLEITMO RLC 3100
	Item no.	0117	0145	0149	5425	0540	5550	0563	0560	0185	5580	0120	5485	0342	5365	3570	5650	5300	5310
Solid lubricant (main ingredient)	PTFE							■	■		■	■	■		■	■		■	
	MoS_2	■	■	■	■	■	■												
	graphite									■				■					
Binders	organic			■	■	■	■	■	■				■		■	■	■	■	■
	inorganic	■	■							■	■	■		■					
	air-hardening	■	■		■					■		■	■			■			
	heat-hardening			■		■	■	■	■		■			■	■		■	■	■
	water-miscible		■		■								■	■	■	■		■	■
Load-carrying capacity (surface pressure)	low (<10 N/mm²)	■	▪	▪	■	▪	▪	■	■	■	■	■	■	■	■	■	■	■	
	medium (10–100 N/mm²)	■	■	■	■	■	■	■	■	▪	▪				▪	▪			
	high (>100 N/mm²)	■	■	■	■	■	▪	▪	▪										
	corrosion protection	▪		▪		▪	■	■	■		■				■				
Application	spraying	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
	dip spinning	■	■	■	■	▪	■	▪	▪	■		▪	■	■	■	■		■	
	drum coating	■	▪	■	■	▪	▪	▪		▪		▪	■	▪					
	spray drum coating	▪		▪	▪		▪			▪		■		▪			■	■	■
Coatable materials	ferrous products	■	■	■	■	■	■	■	■	■	■	■	■	■	■	▪			
	light alloys	■	■	■	■		■	■	■	■	■	■	■	■	■	▪			
	non-ferrous heavy metals	▪		■	■			▪	▪	■	▪	■	■						
	plastic materials	▪			▪			▪	▪	▪		■	■			■		▪	■
	elastomers											■	■			▪	■	■	■
Dry residue	in %	36	25	27	28	29	40	32	34	20	31	5	12	31	32	9	8	17	13
Hardening temperature	in °C	20	20	150	20	200	180	130	130	20	250	20	20	200	180	20	100	125	100
Temperature range for use [°C]	min.	-180	-180	-180	-180	-180	-180	-180	-180	-180	-180	-180	-70	-180	-180	-70	-70	-70	-70
	max.	400	400	250	250	300	250	200	200	350	250	250	250	1200	250	250	180	250	250
	temporarily up to						300	250	250	600	270						250		

* Also available as a spray

■ yes ■ very suitable ▪ conditionally suitable

FUCHS LUBRICANTS GERMANY

Innovative lubricants need Experienced application engineers

Every lubricant change should be preceded by expert consultation on the application in question. Only then the best lubricant system can be selected. Experienced FUCHS engineers will be glad to advise on products for the application in question and also on our full range of lubricants.

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