


your global specialist

Perfect match for a long lifetime.
Greases for gear applications





Gear grease applications	3
Gear grease composition	4
Fluid greases for steel gears	6
Stiff greases for steel gears	7
Greases for the food industry	8
Biodegradable greases	9
Greases for robotics	10
Greases for machine tools	11
Greases for plastic gears	12
Greases for plastic gears and actuators	13
Hints for grease selection	14

Gear grease applications

Gear greases are as diverse as their applications

Grease-lubricated gears are the most diverse gearbox type. They come in all sizes, and various plastics and metals are in use as gear materials. Their variety goes from open girth gears with diameters of several meters, which are used in the mining and cement industries, to miniature plastic gearboxes used in the medical industry. Further fields of application are:

- E-bike drivetrains
- Handheld power tools
- Open winches in the marine industry
- High-precision industrial robots
- High-speed machine tools
- Windshield wiper actuators and window lifters in cars
- Power steering in vehicles
- Actuators of any type

The high diversity in applications demands different gearbox types, which in turn have their specific requirements regarding greases. The following challenges have to be met by the lubricant:

- Reduction of friction and increase in efficiency
- Temperature reduction and heat transport
- Extension of service life through wear minimisation
- Corrosion protection of components
- Noise reduction and damping
- Adhesion on gears and in bearings
- Defined backflow to lube points
- Tight gearboxes and self-sealing effect
- Compatibility with seals and plastics

Grease as a gearbox design element

Design engineers favour greases as gear lubricants if loads are transmitted in start-stop operation. In this mode there is enough time for the grease to flow to the lube points and for the gearbox to cool down. In contrast oil-lubricated gearboxes are often operated continuously 24x7 where the better lubricant supply and faster heat transfer of the oils is needed.

With greases two lubrication types are common: Grease sump and gear teeth greasing, or a combination of both.

Grease features and challenges

Characteristic	Pros and cons	
Grease collar formation	- Basic sealing design sufficient - Seals casing against environment	✓
	- Limited lubrication and cooling of radial shaft seals	✗
Defined backflow behaviour	- Low risk of leakage - Grease stiffness and filling quantity as adjustable tool	✓
	- Gears can form channels in the grease sump - Limited heat transfer	✗
Frequently for-life lubrication	- No design efforts for lube change	✓
Adhesion on lube points	- Low influence of gear mounting position - Grease present at lube point from the start - Possible reduction of losses due to gear churning and via seals - Grease type and stiffness as options to influence adhesion	✓
	- Wear particles remain in lube point - Possibility of starved lubrication if grease is flung off the gears	✗
High lube film thickness at low speeds	- Reliable operation in start-stop mode or at low speeds	✓
Easy addition of solid lubricants in oil-thickener matrix	- Reduction of friction in the mixed and boundary lubricating regime	✓
Grease viscosity not as temperature dependent as oils	- Wide service temperature range	✓
Resistance to water washout	- Reliable operation in wet environments or in case of water ingress	✓

Gear grease composition

To obtain a gear grease, its base oil is thickened to adjust its backflow behaviour and other properties to match the specific gear application. Depending on the gearbox type, there are individually specialised greases which differ in their chemical composition.

The base oil

The gearbox application is a decisive factor for the base oil viscosity used in grease production. High speeds and low temperatures require low viscosities (15 to 68 mm²/s at 40°C) to keep resistance low. In contrast, low speeds, high loads and temperatures require highly viscous base oils (320 up to >1000 mm²/s, at 40 °C) for a proper lubricant film formation. All base oils show a drop in viscosity with increasing temperature, but to a different extent. This is what the viscosity index (VI) describes. Products with a high VI value may operate in a wider temperature range.

The base oil significantly influences the grease properties

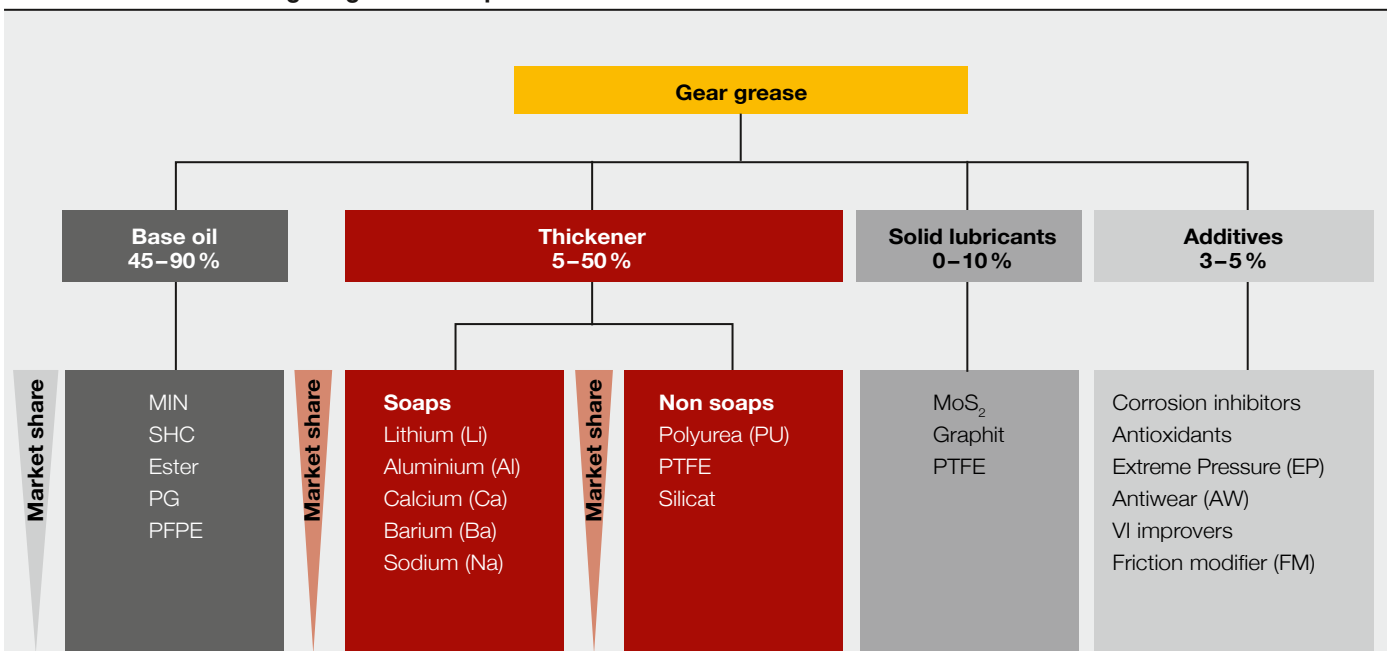
Base stock	Viscosity temperature behaviour (VI)	Aging properties e.g.	Friction properties	Raw material costs
MIN	100	2,000 h	+	1
SHC	150–190	6,000 h	++	4
PG	230	8,000 h	+++	3
Ester	150	6,000 h	++	4
PFPE	260	12,000 h	++	> 10

+: Average ++: Advanced +++: Excellent
SHC: Synthetic hydrocarbon, PG: Polyglycol, PFPE: Perfluoropolyether

Hint

Base oil type and viscosity significantly influence the grease properties, but a gear grease can't be described just by its base oil.

Overview of chemical gear grease composition



MIN: Mineral, SHC: Synthetic hydrocarbon, PG: Polyglycol, PFPE: Perfluoropolyether, PTFE: Polytetrafluoroethylene, MoS₂: Molybdenum disulfide

The Thickener

Simple soaps, e.g. lithium soap, are generated during the grease production by reaction of the stearic acid with the alkaline lithium hydroxide and thicken the base oil. If two different acids react with, for example, lithium hydroxide, a lithium-complex soap is produced. Polyureas, PTFE and silicates are used as thickeners besides soaps.

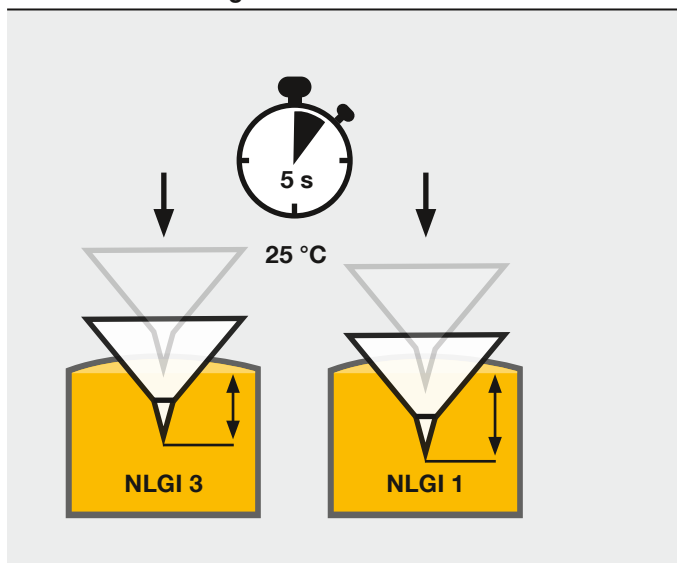
Grease consistency

The consistency of a grease significantly influences the backflow behaviour to the lube points if a grease sump is used, or the adhesive strength in case of gear teeth greasing. For determination of the grease consistency the so-called cone penetration is measured. Different penetration results are classified on the NLGI scale in order to make grease comparison as simple as possible. The NLGI grades of greases may be compared to the ISO viscosity grades of gear oils. If the consistency grade has to be higher for a specific application, the grease has to contain more thickener.

Influence of the thickener type on the grease properties

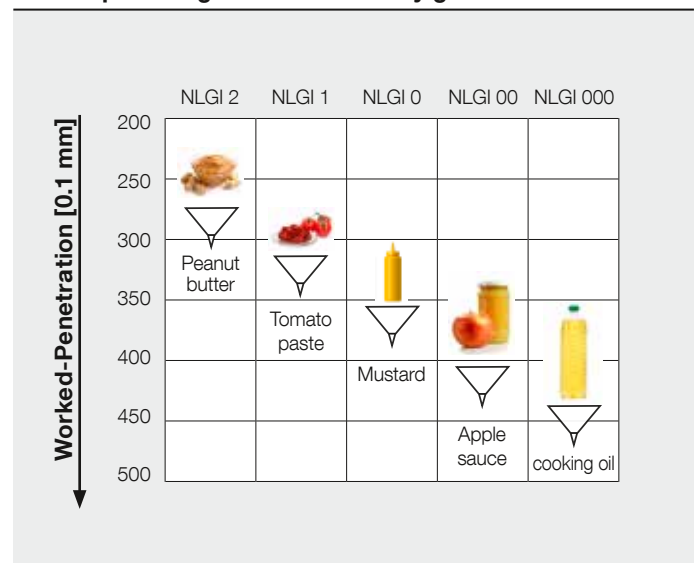
Thickener type	Features	Hints
Lithium soap	<ul style="list-style-type: none"> – Lower service temperature – Excellent friction behaviour 	Not resistant to steam
Lithium complex soap	<ul style="list-style-type: none"> – Upper service temperature – Excellent shear stability 	Industrial standard
Aluminium complex soap	<ul style="list-style-type: none"> – NSF H1 registration for food industry – Biodegradable – Water-resistant 	Shear thinning under high stress
Calcium complex soap	<ul style="list-style-type: none"> – Biodegradable – Water-resistant 	Some types may harden
Barium-complex-soap	<ul style="list-style-type: none"> – Water resistant – Corrosion protection 	Legal issues
Polyurea	<ul style="list-style-type: none"> – Upper service temp. – Excellent friction properties 	Some types may harden
PTFE	<ul style="list-style-type: none"> – Upper service temp. – No interaction with seals and plastics – Thickener is also incorporated solid lubricant 	High thickener content increases friction at high speeds
Silicate	<ul style="list-style-type: none"> – NSF H1 registration for food industry – Upper service temp. 	Shear thinning under high stress

Measurement of grease stiffness



To determine a grease consistency, a standard conus is placed on top and the penetration within five seconds is measured. The deeper, the softer the grease and the lower the NLGI class.

Examples for grease consistency grades



The NLGI classes can be compared with liquid or semi-solid foods. They range from creamy peanut butter to liquid cooking oil.

Fluid greases for steel gears

Fluid greases have NLGI grades from 0 through 000, which exhibit an excellent backflow behaviour. They are the preferred lubricant type for industrial gearboxes with steel gears if operated intermittently or if there are low temperatures due to slow speeds. Fluid greases lubricate the gears normally via a grease sump and may be applied by spraying in some cases. The risk of gear channelling in fluid greases is low compared to stiff greases of NLGI grades 1 or 2. In the event of leaking gearboxes lubricated by oils, a changeover to a fluid grease is often the straightforward approach to solve the leakage issue. This avoids downtime and costly seal replacement.

How to seal fluid greases

Radial shaft seals are most commonly used with fluid greases. Therefore the grease and sealing material in use have to be compatible. Incompatibilities and leakage issues are rare with fluid greases compared to oils due to the higher stiffness of the greases and lower operating temperatures. For greases of NLGI grade 0, a sealed bearing may already offer sufficient tightness. The specialists from Klüber Lubrication and Freudenberg Sealing Technologies are eager to help you find matching sealings and fluid greases.

Hint

Gearboxes running under high loads in continuous operation may show a temperature increase in case of a changeover from oil to fluid grease due to the limited heat transfer capabilities.

Fluid greases for steel gears

	NLGI	Thickener type	Base oils	Base oil viscosity at 40 °C [mm ² /s]	Service temperatures [°C]	Four ball load [N]	Scuffing protection	Wear protection	Application examples
CENTOPLEX GLP 500	000	Li	MIN	110	-30/100	≥1600	++	+	Gearboxes, couplings, linear guides
CENTOPLEX CX 4/375 AU	0	Li	MIN	420	-30/120	≥3000	++	+	Gearboxes, garden tools
MICROLUBE GB 00	000	Li	MIN	700	0/100	≥4800	+++	+++	Bearings, gearboxes, couplings, guides
MICROLUBE GB 0	0	Li	MIN	590	0/100	≥4200	+++	++	
Klüberplex GE 11-680	00	AC	MIN	685	0/140	≥3000	+++	+++	Spur and bevel gears, toothed couplings
Klübersynth BEM 44-4600	00	LiS	SHC	500	-50/140	-	+++	+++	Spur, bevel and worm gears, bearings
ISOFLEX TOPAS NB 5051	0-00	BaC	SHC	30	-60/130	≥2400	+	+	Plain and rolling bearings, gears, plastics
Klübersynth G 34-130	0	CaC/PU	MIN/SHC	130	-30/130	≥3000	++	+	Power tools, spur, bevel and planetary gears
Klübersynth GE 14-110	0	AC	SHC / Ester	72	-55/140	≥4000	+++	++	
Klübersynth GE 46-1200	00	Li	PG	120	-30/120	≥3000	+++	+++	Spur, bevel and worm gears
STRUCTOVIS P LIQUID	000	Li	PG	360	-35/130	≥4000	+++	++	Bevel and worm gears

Li: Lithium, AC: Aluminium complex, LiS: Lithium special, BaC: Barium complex, CaC: Calcium complex, PU: Polyurea, MIN: Mineral oil, SHC: Synthetic hydrocarbon, PG: Polyglycol, +: Average, ++: Advanced, +++: Excellent

Stiff greases for steel gears

Stiff greases are of NLGI grade 1 or 2 and reduce the need for sealing in the gearbox design compared to oils or fluid greases. If used in a grease sump, these greases may be easily contained with shielded or sealed bearings.

For sump lubrication, greases are frequently used that become softer due to shearing by the gears and bearings. This improves backflow to the lube points where they are needed. In the non-stressed housing areas they form a solid grease collar that has a sealing effect.

Shear thinning greases are used to lubricate, for example, hand-held power tools. The challenge here is that a single grease has

to reliably lubricate bearings, gears, seals and the impact unit in any possible tool orientation. Therefore, the grease has to flow to the lube points easily without causing leakages as these are unacceptable for the end users. Additional challenges lie with the application's high temperatures of 140 °C in the impact unit area combined with contaminants like dust and other ambient media.

If there is no housing, gear teeth greasing is the method to lubricate open gears. The used stiff greases offer good adhesion preventing them from being flung off even at high speeds or temperatures

Stiff greases for steel gears

		NLGI	Thickener type	Base oils	Base oil viscosity at 40 °C [mm ² /s]	Service temperatures [°C]	Four ball weld load [N]	Scuffing protection	Wear protection	Adhesive strength	Application examples
Gear teeth greasing	ISOFLEX TOPAS NB 52	2	BaC	SHC	30	-50/120	≥3000	++	++	+++	Rolling bearings, machine tools, e-bikes, spur and bevel gears
	ISOFLEX TOPAS NB 152	2	BaC	SHC	100	-40/150	≥3000	++	++	+++	Rolling bearings, machine tools, e-bikes, spur and bevel gears
	Klüberplex AG 11-461	1	AC	MIN	460	-20/150	≥3600	+++	+++	++	Open gears, rack and pinion
	Klüberplex AG 11-462	2	AC	MIN	460	-10/150	≥3600	+++	+++	+++	Open gears, rack and pinion
	Klübersynth AG 14-61	1	AC	SHC	65	-50/120	≥3000	++	++	++	Spur and bevel gears, rack and pinion
Grease sump lubrication	Klüberplex BEM 34-131 N	1	CaC/PU	SHC/MIN	134	-35/150	≥3000	+++	+++	++	Rolling bearings, spur, bevel and planetary gears
	Klüberplex BEM 41-141	1	LiS	MIN/SHC	130	-40/150	≥3400	+++	+++	++	Rolling bearings, spur, bevel and planetary gears
	Klübersynth GE 14-111	1	AC	SHC/Ester	110	-55/140	≥4000	+++	++	+	Power tools, spur, bevel and planetary gears
	Klübersynth GE 14-112	2	AC	SHC/Ester	110	-45/140	≥4000	+++	++	++	Power tools, spur, bevel and planetary gears
	Klübersynth GE 14-151	1	AC	SHC/Ester	170	-35/140	≥4000	+++	++	+	Power tools, spur, bevel and planetary gears
	Klübersynth PEG 46-121	1	Li	PG	120	-50/120	≥3000	+++	+++	+	Spur, bevel, planetary and worm gears

Li: Lithium, AC: Aluminium complex, LiS: Lithium special, BaC: Barium complex, CaC: Calcium complex, PU: Polyurea, MIN: Mineral oil, SHC: Synthetic hydrocarbon, PG: Polyglycol, +: Average, ++: Advanced, +++: Excellent

Greases for the food industry

In the food industry, contaminated goods do not just cause expensive complaints; they may even harm the consumer's health and may affect the brand image. In order to provide more safety to our customer, Klüber Lubrication offers a broad portfolio of greases that are NSF H1-registered. These lubes are tailor-made for applications where an unintended contact with food or beverages may occur. The mentioned NSF registration requires the use of approved thickener types, base oils and additives for the greases.

The international standard ISO 21469 guides the production of lubricants to be used in the food industry. Klüber produces H1-registered lubricants at six approved production sites around the globe.

In order to avoid gearbox leakages and the severe threats they pose, gear greases and seals must be compatible.

Stiff greases for food industry

A vital criterion in the selection of H1 gear greases is their performance in rolling bearings because the greases lubricate the bearings as well. Due to the high hygienic requirements in the food industry, cleaning efforts are extreme. Radial shaft seals protect gearboxes from dirt ingress and lubricant leakage. The greases' water washout properties are crucial if water ingresses the gearbox or bearings due to the use of pressure cleaners.



Greases for the food industry

	NLGI	Thickener type	Base oils	Base oil viscosity at 40 °C [mm ² /s]	Service temperatures [°C]	Four ball weld load [N]	Scuffing protection	Wear protection	Application examples
PARALIQ GA 3400	00-000	AC	MIN	235	-45/110	-	++	++	Spur, bevel and worm gears, chains
Klübersynth UH1 14-1600	0-00	AC	SHC	160	-45/120	-	++	++	
Klüberfood NH1 94-6000	000	CaC	SHC	60	-45/120	≥2000	++	++	
Klüberfood NH1 94-120	0	CaC	SHC	120	-45/140	≥2400	+++	+++	Spur, bevel and planetary gears, bearings
PARALIQ GA 351	1	AC	MIN	230	-25/110	≥2200	++	++	Bearings, gears, joints, seals
PARALIQ GA 343	2	AC	MIN	240	-20/110	-	++	+++	
Klübersynth UH1 14-151	1	AC	SHC/Ester	170	-45/120	≥2400	++	+++	Bearings, spur, bevel and planetary gears
Klübersynth UH1 14-222	1-2	AC	SHC/Ester	150	-25/120	≥2300	++	++	
Klüberfood NH1 94-301	1	CaC	SHC	300	-40/140	≥3000	++	++	Bearings, seals, gears, guides
Klüberfood NH1 94-402	2	CaC	SHC	400	-30/160	≥3000	++	++	

AC: Aluminium complex, CaC: Calcium complex, MIN: Mineral oil, SHC: Synthetic hydrocarbon, +: Average, ++: Advanced, +++: Excellent

Biodegradable greases



Open gears commonly used for winches and cranes onboard ships or in port facilities face extreme challenges and requirements. Where gears operate offshore, they must be protected from the extreme ambient conditions.

Saline and humid air, extreme temperatures, water spray and constant contact to seawater take their toll. Therefore, open gear lubricants have to be tailor-made for these challenges. Another requirement is its biodegradability if a grease is washed into the ocean. Lubricants have to comply with the requirements for biodegradability, toxicity and microbiological growth to be classified

as Environmentally Acceptable Lubricants (EAL).

The industry standard was published by the US Environmental Protection Agency in its 2013 General Vessel Permit.

Specialty lubes are not flung off the open gears and help to maintain a clean deck.

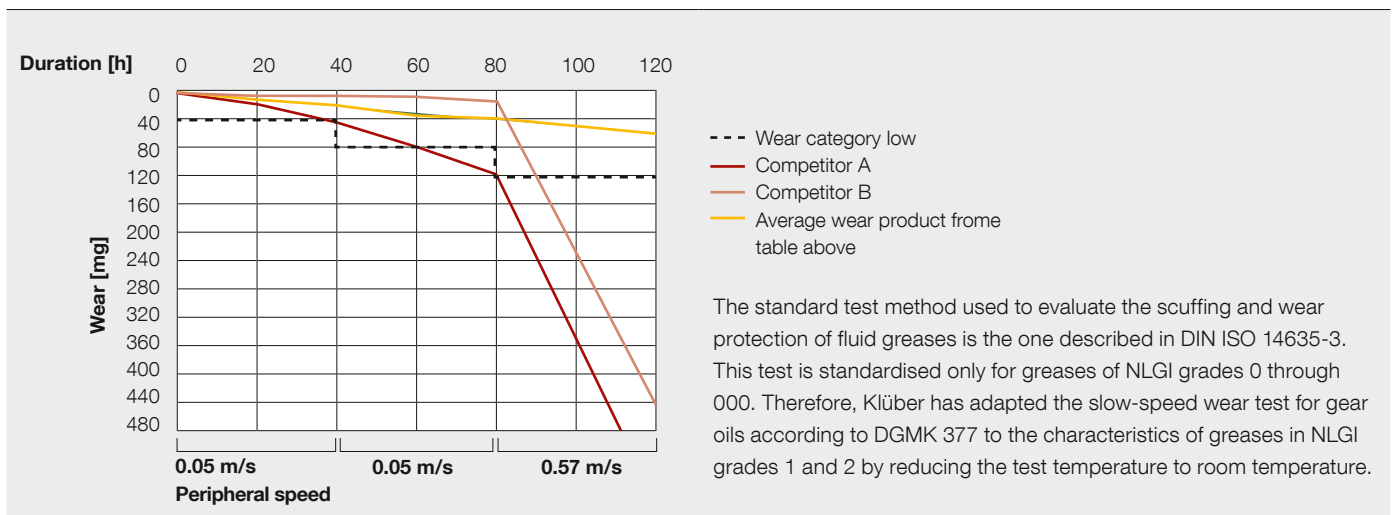
Biodegradable greases

		NLGI	Thickener type	Base oils	Base oil viscosity at 40 °C [mm ² /s]	Service temperatures [°C]	Four ball weld load [N]	Scuffing protection	Wear protection	Adhesive strength	Corrosion protection	Water washout resistance
GT	Klüberbio LG 39-700 N	0	CaC	Ester	680	-30/100*	≥5500	+++	+++	++	++	++
	Klüberbio LG 39-701 N	1	CaC	Ester	680	-30/100*	≥5500	+++	+++	+++	++	+++
	Klüberbio AG 39-602 N	1-2	CaC	Ester	600	-20/120	-	+++	+++	+++	+++	+++
	Klüberbio AM 12-501	1	AC	Ester	500	-20	-	+++	+++	++	++	++
S	Klüberbio BM 32-142	2	CaC	Ester	140	-40/120	≥2200	++	+++	++	++	+

GT: Gear teeth greasing, S: Sump, AC: Aluminium complex, CaC: Calcium complex, +: Average, ++: Advanced, +++: Excellent

* relubricated acc. to intervals

Outstanding wear protection



Robotics greases

Industrial robots are expected to position their tools with ever higher speed and precision. Precision must not decrease despite progressing wear over the service life, which may last several years. Constant bidirectional and start-stop operation place high demands on robotic gears.

In most cases, robots contain high-precision gearboxes, e.g. cycloidal or, in smaller units, wave generators. These gearboxes do not contain actual gears and enable high-speed transmission within a minimum of space while exhibiting high rigidity and minimal backlash. Planetary gears are classical toothed gears that are used in robotics. In order to compete with the other gear types in terms of precision, double helical gears are an option. Gear greases for robotics often combine low base oil viscosities with fully synthetic base oils. The low viscosity helps to keep losses during starts and fast movements low. These greases often contain high quantities of extreme pressure (EP) and anti-wear (AW) additives to protect the gears at high sliding speeds. The grease's backflow behaviour in the highly loaded lube points is key for a long gearbox life. Therefore, different grease consistency grades are available to fit every gearbox design.

Sealing these gearboxes is another challenge, that's why the specialists from Klüber Lubrication and Freudenberg Sealing

Technologies offer aligned product solutions under the motto Lube & Seal.

Greases for robotic gears are not limited to this field of application but may be used also in other gears with steel gears or bearings running at high speeds.



Robotic cycloidal gear

Robotics greases

	NLGI	Thickener type	Base oils	Base oil viscosity at 40 °C [mm ² /s]	Service temperatures [°C]	Four ball weld load [N]	Scuffing protection	Wear protection	Back-flow behaviour	Application examples
Klübersynth GE 44-50	0	Li	SHC	50	-40/120	≥ 1800	+++	+++	+++	Wave generators, cycloidal, spur, bevel, planetary gears, rolling bearings, power tools, machine tools
Klübersynth GE 44-51	1	Li	SHC	50	-40/120	≥ 1800	+++	+++	++	Wave generators, cycloidal, spur, bevel, planetary gears, rolling bearings, power tools, machine tools
Klübersynth GE 44-52	2	Li	SHC	50	-40/120	≥ 1800	+++	+++	+	Wave generators, cycloidal, spur, bevel, planetary gears, rolling bearings, power tools, machine tools
Klüberfood NH1 94-51	1	CaC	SHC	50	-40/120	≥ 3000	++	++	++	Wave generators, cycloidal, spur, bevel, planetary gears, rolling bearings, food-processing industry
Klüberfood NH1 94-52	2	CaC	SHC	50	-40/120	≥ 2400	++	++	+	Wave generators, cycloidal, spur, bevel, planetary gears, rolling bearings, food-processing industry
ISOFLEX LDS 18 SPECIAL A	2	Li	MIN/ Ester	15	-50/120	-	++	++	++	Wave generators, cycloidal, spur, bevel, planetary gears, rolling bearings, low temperatures

Li: Lithium, CaC: Calcium complex, MIN: Mineral, SHC: Synthetic hydrocarbon, +: Average, ++: Advanced, +++: Excellent

Greases for machine tools

Gears for drilling and milling heads play an essential role in the transmission of forces and torques from the machine's drive spindle to the tool. The gears operate intermittently at sometimes extreme peripheral speeds of greater than 20 m/s. The main requirements for these gears are: reliable operation throughout a long component service life, high peripheral speeds and high accelerations.

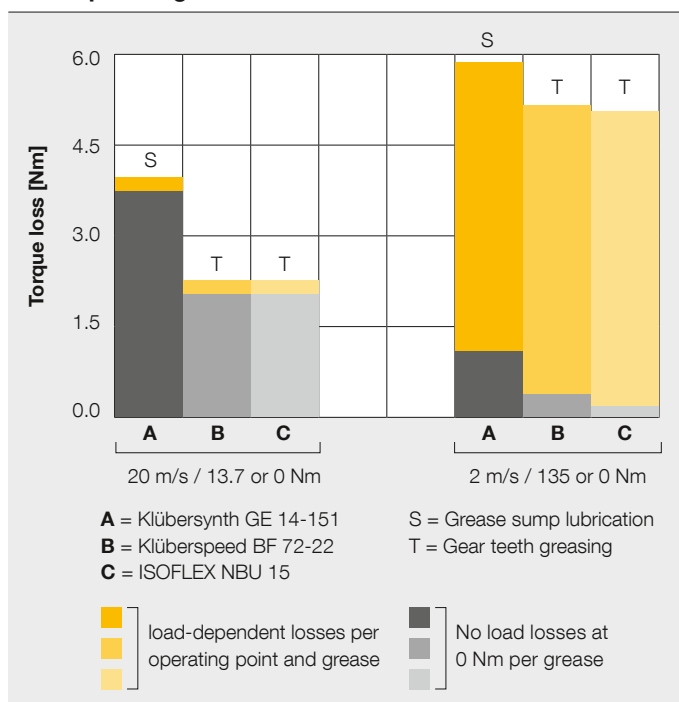
Spur, bevel and hypoid gears are most commonly used for these applications. In order to avoid high power loss at the mentioned speeds, the gearboxes are designed without radial shaft seals or a grease sump. Instead, adhesive greases are applied directly to the gear teeth. The challenging operating conditions make for-life lubrication impossible. This is why the gears need relubrication at regular intervals. The gear greases are subject to contamination by water and cooling fluids due to the application and open gearbox design. They must not be washed out. In this wet environment corrosion protection plays an important role. Frequently a single grease is used to lubricate drilling and milling heads as well as the spindle bearings, because gears and bearings are not separated by the machine design.

The use of a single lubricant or at least compatible lubricants may offer additional benefits: The use of the wrong product or incompatibilities of mixed lubricants can be avoided.

Increased efficiency attained with machine tool greases

Low no-load losses are one of the many success factors for the greases ISOFLEX NBU 15 and Klüberspeed BF 72-22 in machine tools. This has been underscored by investigations performed at the Gear Research Centre TU Munich on its FZG back-to-back test rig with gear type C. Also gear teeth greasing is more efficient than a grease sump.

Gear losses related to lubrication type and operating conditions



Greases for machine tools

	NLGI	Thickener type	Base oils	Base oil viscosity at 40 °C [mm ² /s]	Service temperatures [°C]	Four ball weld load [N]	Scuffing protection	Wear protection	Adhesive strength	Application examples
Klüberspeed BF 72-22	2	PU	SHC/ Ester	22	-50/120	≥2200	++	++	+++	Rolling bearings, machine tools, spur, bevel gears
Klüberspeed BF 72-23	3	PU	SHC/ Ester	22	-50/120	≥1400	++	++	+++	
ISOFLEX NBU 15	2	BaC	MIN/ Ester/ SHC	21	-40/130	≥3000	++	++	+++	
VARILUB NBU 15/300	1	BaC	MIN/ Ester/ SHC	23	-30/130	≥3000	+	+	++	Machine tools, spur, bevel gears

PU: Polyurea, BaC: Barium complex, MIN: Mineral, SHC: Synthetic hydrocarbon, +: Average, ++: Advanced, +++: Excellent

Greases for plastic gears



Plastic gears are gaining popularity in gear design because of cost savings in mass production. Through production by injection moulding, any gear design becomes possible. The load carrying capacity of plastic with a soft appearance is increased significantly by fibre reinforcements.

Plastic gears are mainly lubricated for life by means of gear teeth greasing, therefore greases of NLGI grades 1 or 2 are the preferred choice. The grease's adhesive strength even at critical operating conditions is of utmost importance.

For plastic gear lubrication, the compatibility of the grease and the plastic type used is key for success. In case of incompatibilities a rapid ageing of the plastic may occur, which leads to brittle gears. The altered teeth dimensions combined with increased surface roughness reduce gearbox efficiency. In the worst case scenario, stress cracks in the gear combined with high loads cause tooth breakage, which will lead to immediate standstill. Base oils should have the right polarity for the plastic materials used and additives be selected for their compatibility. This is essential for maintenance-free gear service life.

Greases for plastic gears

	NLGI	Thickener type	Base oils	Solid lubricants	Base oil viscosity at 40 °C [mm ² /s]	Service temperatures [°C]	Low-temperature starting torque	Load carrying capacity	Adhesive strength	Application examples
Klüberlub LM 41-32 N	2	Li	MIN	No	30	-40/120	++	+	++	Window lifter, seat adjustment, steering, central lock
Klüberlub LM 41-102	2	Li	MIN	No	100	-40/120	+	+++	+++	
POLYLUB GLY 151	1	LiS	MIN/SHC	No	150	-50/150	++	+++	++	Bearings, gears, pneumatics, seals
Klüberplex RA 41-151	1	LiS	MIN/SHC	No	150	-50/130	++	++	++	Multi-purpose, no smell
Klübersynth LR 44-21	1	LiS	MIN/SHC	No	24	-55/130	+++	+	+	Multi-purpose, window lifter, seat adjustment
ISOFLEX TOPAS L 32 N	2	Li	SHC	No	17	-60/130	+++	+	++	Window lifter, sun roof, headlight adjustment
ISOFLEX TOPAS L 152	2	Li	SHC	No	100	-50/150	++	+++	+++	Rolling bearings, gearboxes, guides
ISOFLEX TOPAS NCA 52	2	CaC	SHC	No	31	-50/130	++	+++	+++	
ISOFLEX TOPAS NCA 51	1	CaC	SHC	No	30	-60/140	+++	++	++	Rolling bearings, gearboxes
ISOFLEX TOPAS NCA 5051	0	CaC	SHC	No	30	-50/120	+++	+	+	Rolling bearings, gearboxes, guides
Klübersynth LE 44-31	1	Li	SHC	Yes	30	-50/130	++	+	++	Worm gears, door opener
Klübersynth LMI 44-42	2	Li	SHC	Yes	45	-40/130	++	++	++	Window lifter, sun roof, cooler
Klübersynth LI 44-22	2	Li	SHC	Yes	18	-60/130	+++	+	++	Multi-purpose, spur gears, central lock, seat adjustment
Klübersynth LF 44-22	2	Li	SHC	Yes	17	-60/130	+++	+	++	
Klübersynth LF 44-32	2	Li	SHC	Yes	31	-60/120	+++	+	++	
Klübersynth RP 44-41	1	LiS	SHC/Ester	No	36	-50/150	++	++	+++	Planetary gears, seals, bearings

Li: Lithium, LiS: Lithium special, CaC: Calcium complex, MIN: Mineral, SHC: Synthetic hydrocarbon, +: Average, ++: Advanced, +++: Excellent

Greases for plastic gears and actuators



Besides multi-purpose greases for plastic gears, there are greases tailor-made for their specific application. For example, greases for electric-powered steering in vehicles are developed on gear test rigs designed for this application. For extreme low-temperature requirements, greases on the basis of PTFE/PFPE have proven effective.

Actuators combine an electric motor with a gear stage and are designed to drive components with maximum efficiency in terms of space and costs. Most actuators operate for a short time only and perform an oscillating motion. Greases for actuator lubrication have high consistency grades due to the poor tightness of the housings. Actuators for vehicle brakes are frequently based on PG oils because of their chemical similarity to the brake fluids.

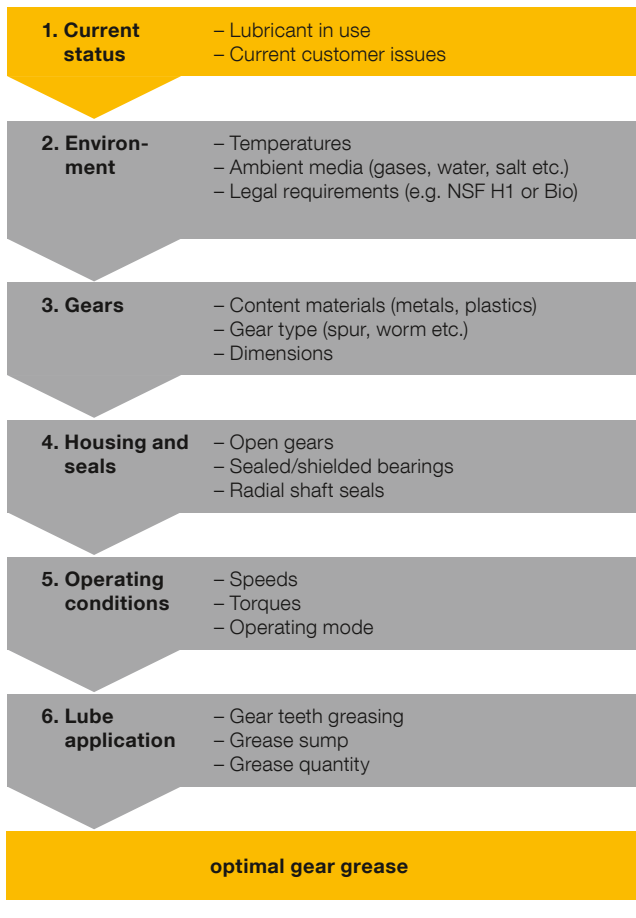
Greases for plastic gears and actuators

		NLGI	Thickener type	Base oils	Solid lubricants	Base oil viscosity at 40 °C [mm ² /s]	Service temperatures [°C]	Low-temperature starting torque	Load carrying capacity	Adhesive strength	Application examples
Plastic gears	Klübersynth LE 14-161	1	AC	SHC	No	180	-40/85	++	+++	++	Worm gears, steering gearboxes
	Klübersynth LEH 14-161	1	AC	SHC	No	200	-40/135	++	+++	++	
	Klübersynth LIP 84-42	2	PTFE	SHC	Yes	30	-60/140	+++	++	+++	Spur, worm gears, high-temperature requirements
	Klübersynth LIP 84-42 R	2	PTFE	SHC	Yes	30	-60/130	+++	++	+++	
	Klübertemp GR M07 N	1	PTFE	PFPE	Yes	40	-65/180	+++	++	+++	High-temperature applications, excellent compatibility
	Klübertemp GR M 30 N	2	PTFE	PFPE	Yes	160	-60/200	+++	+++	+++	
	Klübersynth MR 96-31	1	Silicate	PG	No	30	-40/120	++	++	++	Vehicle brakes, parking brakes
Actuators	Klübersynth BR 46-82	2	LiS	PG/Ester	No	82	-40/180	+	+++	+++	Rolling bearings, brake actuators, ball screws, gears
	Klübersynth BR 46-32	2	LiS	PG/Ester	No	29	-45/130	++	++	+++	
	Klübersynth BR 46-32 F	2	LiS	PG/Ester	Yes	29	-45/130	++	++	+++	
	Klübersynth GR 46-52 F	2	LiS	PG/Ester	Yes	50	-40/130	++	++	+++	Ball screws, worm gears, IBC booster
	Klübersynth LRG 46-21	2	Li	PG	Yes	20	-50/120	+++	+	++	Spindles, drum EPB, gears
	Klübersynth LRG 86-21	1	PTFE	PG	Yes	20	-50/120	+++	++	++	Cable guides, spindles, drum EPB
	Klübersynth RG 86-121	1	PTFE	PG/Ester	Yes	120	-40/140	+	+++	+++	Plastic gears, booster EPB
	Klüberalfa LM 83-41	1	PTFE	PFPE	Yes	40	-80/170	+++	+++	++	Bearings, extreme temperature requirements
Klübertemp LB 83-41	1	PTFE	PFPE	Yes	40	-80/180	+++	+++	++		

+: Average, ++: Advanced, +++: Excellent, EPB: Electric Park Brake, IBC: Integrated Brake Control, EBB: Electric Brake Booster
 PFPE: Perfluoropolyether, PG: Polyglycol, Li: Lithium, AC: Aluminium complex, LiS: Lithium special, PTFE: Polytetrafluoro ethylen, PG: Polyglycol, SHC: Synthetic hydrocarbon,

Hints for grease selection

Grease selection



Compatibility:

Interactions of lubricants and plastics used for gears or housings significantly influence the gearbox's service life. In addition, compatibility with the sealing compounds in use is important to reduce the risk of leakages. In general, similar polarities of base oils and sealing compounds as well as plastics must be avoided. In the case of ester, the polarity strongly depends on the type. FKM shows good compatibility with all common base oils.

Interactions of rubber seals and lubricants are stronger than those of lubes and plastics, so they require special care.

Hints for grease selection according to the sealing type and operating conditions

Sealing of the housing	Lubrication type and quantity	Peripheral speed in m/s		NLGI-Klasse
		Continuous operation	Intermittent operation	
Radial shaft seal (oil-tight)	Grease sump, filling level 10 to 30% higher than gear oil	4 to 8	5 to 10	0/00/000
Sealed/shielded bearings	Grease sump up to 80% filled housing	4 to 8	20 to 25	0/1/2
No seal	Geer teeth greasing	-	2 to 8 >20 with relubrication	1/2/3



Publisher and Copyright:
Klüber Lubrication München SE & Co. KG

Reprints, total or in part, are permitted only prior consultation with Klüber Lubrication München SE & Co. KG and if source is indicated and voucher copy is forwarded.

The data in this document is based on our general experience and knowledge at the time of publication and is intended to give information of possible applications to a reader with technical experience. It constitutes neither an assurance of product properties nor does it release the user from the obligation of performing preliminary field tests with the product selected for a specific application. All data are guide values which depend on the lubricant's composition, the intended use and the application method. The technical values of lubricants change depending on the mechanical, dynamical, chemical and thermal loads, time and pressure. These changes may affect the function of a component. We recommend contacting us to discuss your specific application. If possible we will be pleased to provide a sample for testing on request. Products from Klüber Lubrication are continually improved. Therefore, Klüber Lubrication reserves the right to change all the technical data in this document at any time without notice.

Klüber Lubrication München SE & Co. KG
Geisenhausenerstraße 7
81379 München
Germany

Local first-instance court Munich, Germany
Certificate of registration 46624

Picture Copyrights:

Title: © Klüber Lubrication;
Page 5: © by-studio, <https://stock.adobe.com>;
Page 5: © Birgit Reitz-Hofmann, <https://stock.adobe.com>;
Page 5: © baibaz, <https://stock.adobe.com>;
Page 5: © Andrea, <https://stock.adobe.com>;
Page 5: © Martin Spurny, <https://stock.adobe.com>;
Page 8: © Mark Agnor, www.shutterstock.com;
Page 9: © Yuriy Gluzhetsky, www.istockphoto.com;
Page 10: © courtesy of Spinea;
Page 13: © AndreyProekt, www.shutterstock.com;

Klüber Lubrication – your global specialist

Innovative tribological solutions are our passion. Through personal contact and consultation, we help our customers to be successful worldwide, in all industries and markets. With our ambitious technical concepts and experienced, competent staff we have been fulfilling increasingly demanding requirements by manufacturing efficient high-performance lubricants for more than 90 years.

www.klueber.com

a brand of
 **FREUDENBERG**