your global specialist

The element that rolls the bearing.

Tips and tricks for the lubrication of rolling bearings

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Rolling bearing lubricants made by Klüber Lubrication

Increasing demands on the rolling bearing and the lubricant

Despite its straightforward design, a rolling bearing is a fairly complex machine element. Most of the continuously increasing demands on the performance capabilities of today's rolling bearings have an impact on the lubricant as well. Longer bearing life, increasing speeds, higher operating temperatures and confined bearing space - each one of these parameters has repercussions on the selection of a matching lubricant.

Lubricants – getting it right from the start

Development engineers designing new rolling bearings will benefit greatly if they make lubricants part of their considerations right from the start. After all, it's not just the performance requirements of the bearing that must be met, but the lubricant used also has to match the specific conditions encountered. Compatibility with sealing materials, any possible interaction with ambient materials and, last but not least, legal requirements rooted in Chemicals Law are all factors to be taken into account. The specialists at Klüber Lubrication know that a rolling bearing can only be as good as the lubricant it contains. In cooperation with customers, Klüber Lubrication develops rolling bearing lubricants that are specifically tuned to the individual application.

Tribology

Tribology is the science that deals with friction, wear and lubrication. It is today highly interdisciplinary. Mechanical engineers, materials scientists, but also physicists and chemists are conducting research on so-called "tribo-systems", i.e. systems where friction bodies – normally two – plus a lubricant interact under defined conditions.

A small investment that can have far-reaching effects

Our specialty lubricants can do a lot for your rolling bearings: extend their lifetime, improve their reliability, reduce noise levels, permit higher speeds and make them withstand extreme influences. The cost for a specialty lubricant should be set against its large benefits. It is, correctly judged, a small investment that can have far-reaching effects.

Your global specialist!

We are where you are. Our specialists are there to support you, wherever you need them. We help you select the right product or develop a solution tailored to your requirements. "Made by Klüber Lubrication" stands for a consistent high quality level worldwide. We offer you products that are all made to the same high quality standard, no matter whether produced in Asia, Europe or the Americas.

Think about tomorrow today!

Using a high-performance lubricant in times of growing environmental awareness contributes to increasing efficiency, saving energy and reducing CO_2 emissions. The longer oil life that can be achieved leads to lower total lubricant consumption and hence less used oil disposal. There is less strain on natural resources, and both maintenance and disposal costs are reduced.

We are at your side - right from the start

With this brochure, we would like to provide you with valuable information on the lubrication of rolling bearings. We know that this is a complex subject, and therefore we offer you expert advice – right from the start.

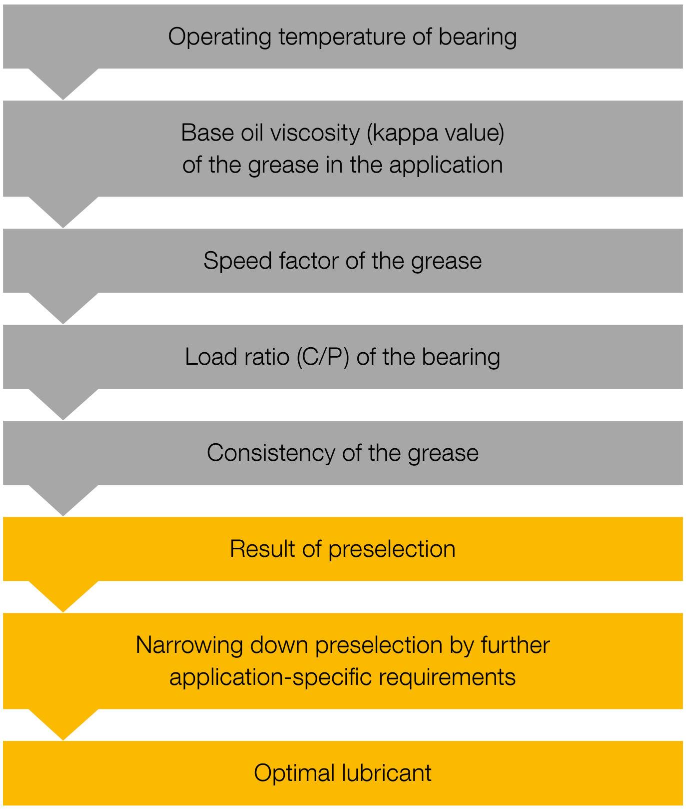
Criteria for the selection of bearing greases

The focus is increasingly on lubricants that are optimally tuned to a specific application. The variety of lubricating greases available is immense, which makes orientation increasingly difficult.

In the following, you are provided with the most important selection criteria that are to help you find the right grease in a few steps only. If you have any questions, but also for particularly complex applications, safety components, long service life requirements or applications subject to special conditions, please contact the Klüber Lubrication specialists, who will help you utilise the full potential of your equipment by choosing the matching lubricant.

For a preselection of products, the following basic parameters should be established. Subsequently, the selection should be narrowed down with further application-specific parameters and confirmed by field tests.

> **Hint:**
> The more we know about your application, the better we can determine which lubricant is the optimum choice in your case. We can provide our questionnaire "Rolling bearings" for you to enter all relevant data of your application. Just contact us.



Note:
C = dynamic load number in N
P = equivalent dynamic load in N

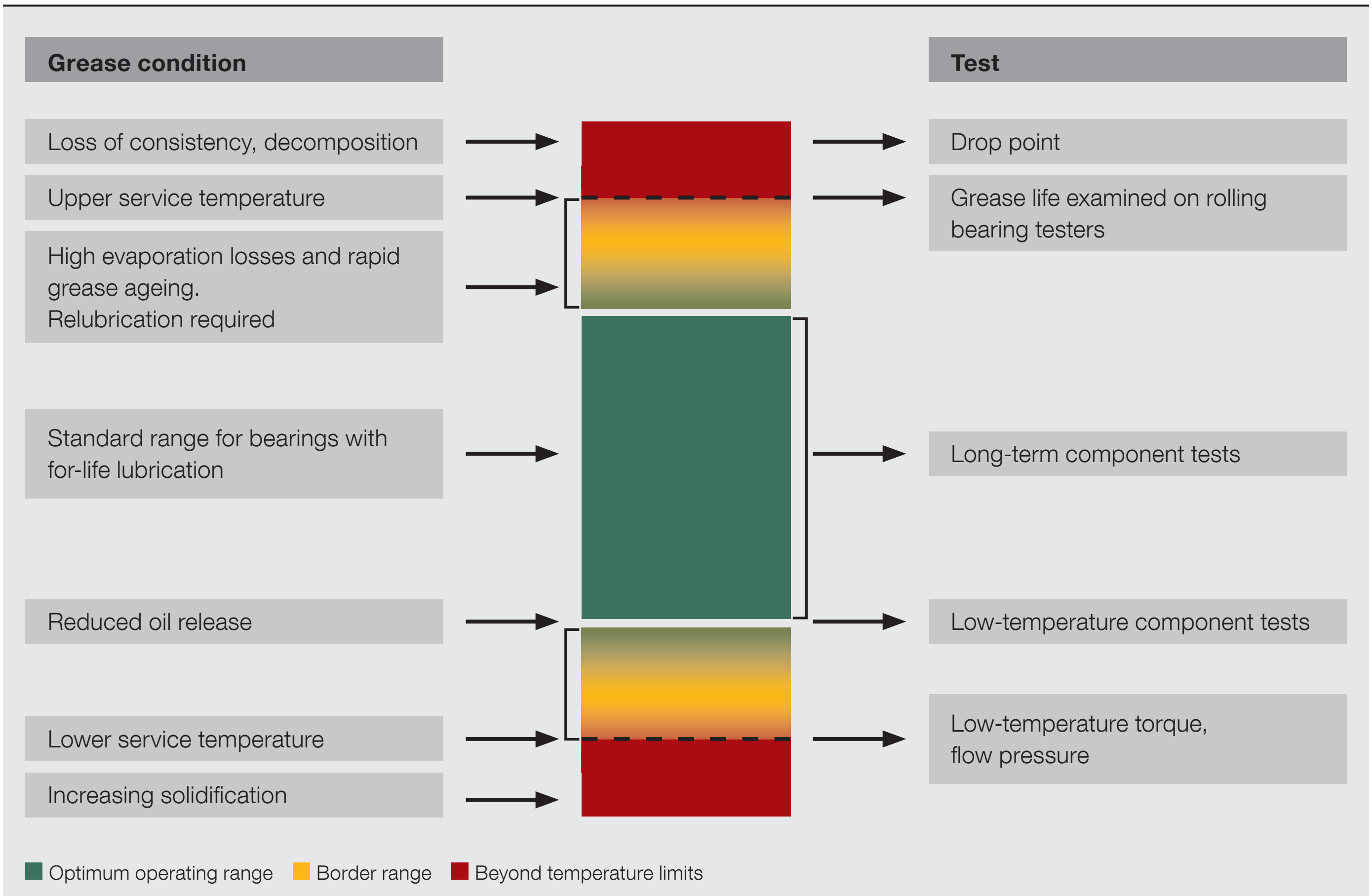
Operating temperature

The lubrication of rolling bearings should be carried out with utmost care. The resistance between the rolling elements and the raceways in a rolling bearing is not of a purely rolling nature. In practice, more or less pronounced partial sliding occurs between the rolling elements and the raceways as well as sliding between the cage and the rolling elements, churning and displacing the lubricant.

The internal friction generated normally heats up the bearing to an operating temperature of 35 to 70 °C. However, outside temperatures can influence the bearing such that its temperature is much higher or lower. The requirements to be met by the individual lubricant can vary greatly. A car manufacturer will have to deal with temperatures from –40 °C to 160 °C or even higher. In the aviation industry, requirements go far below –40 °C as bearings are frequently exposed to extreme cold at high altitudes. When paints are burned in, temperatures may easily rise to 200 °C. In some applications temperatures may be even more extreme. The specified service temperature range of a grease should always exceed the operating temperature required for a bearing by a generous margin.

Hint:
In order to attain a satisfactory grease life, a grease should be selected whose upper service temperature is considerably higher than the maximum operating temperatures to be expected. The following diagram shows the temperature ranges to be observed in more detail:

Grease conditions associated with different temperature ranges and relevant testing methods



Determining the minimum base oil viscosity

In a rotating rolling bearing, the lubricant film is largely formed by the base oil contained in the grease. Thickener and additives also play a role. Their contribution, however, can only be measured, not calculated, and therefore cannot be taken into account for the standard calculation of the minimum viscosity of the base oil.

Decisive factors for the formation of the lubricant film between the rolling elements and the raceways are the bearing speed and the mean bearing diameter d_m as well as the lubricant's base oil viscosity. As the viscosity of an oil depends on its temperature, this must also be taken into consideration.

Optimum conditions set in when the base oil viscosity is just high enough for a load-bearing lubricant film to form and the metal surfaces to separate. This is the area between mixed and fluid friction. Under these operating conditions, the bearing can attain its nominal service life. For a given bearing speed n and a mean bearing diameter d_m, this state is reached at a so-called "reference viscosity" ν_1.

According to DIN ISO 281, it can be calculated as follows:

$\nu_1 = 45{,}000 \cdot n^{-0.83} \cdot d_m$–0.5 for $n < 1{,}000$ min^{-1}
$\nu_1 = 4{,}500 \cdot n^{-0.5} \cdot d_m$–0.5 for $n > 1{,}000$ min^{-1}

with:
n = speed [min^{-1}]
d_m = mean bearing diameter [mm]

The operating viscosity, i.e. the actual base oil viscosity at operating temperature, can be read for the applicable V/T diagrams or determined with the appropriate calculation methods.

To assess the lubricant film in the bearing, the operating viscosity at operating temperature ν is set in proportion to the reference viscosity ν_1 to obtain the non-dimensional κ value (the Greek kappa).

Calculation of the κ-value taking into account the density [ρ] of the base oil:

$$\kappa = \frac{\nu}{\nu_1}\left(\frac{\rho}{0.89\frac{g}{cm^3}}\right)^{0.83}$$

Prediction of lubricating condition κ

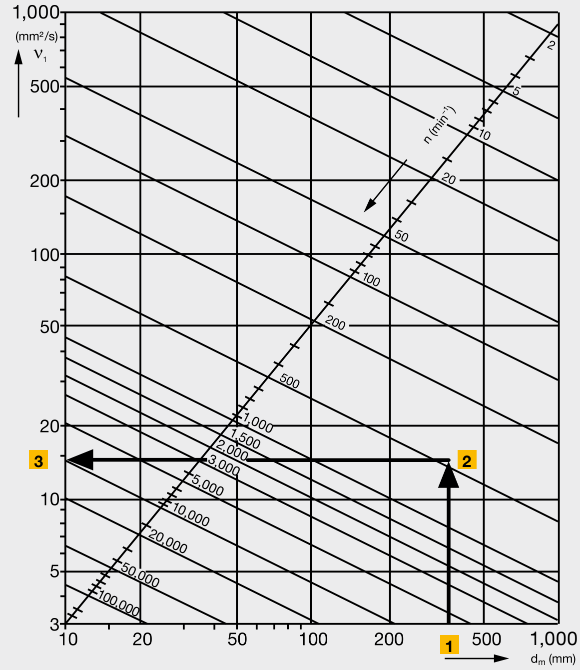
- $\kappa < 1$: Mixed friction, EP/AW additives or solid lubricants required
- $\kappa = 1$: Separation of metal surfaces sets in; nominal bearing life [fatigue life acc. to DIN ISO 281] is attained
- $\kappa = 2–4$: Decreasing mixed friction; desired condition with load-bearing lubricant film and low internal friction
- $\kappa > 4$: Full fluid-film lubrication; no fatigue damage to be expected, further increase will lead to higher internal lubricant friction and internal heating

Besides by calculation, the required minimum viscosity can also be determined by way of the following diagrams.

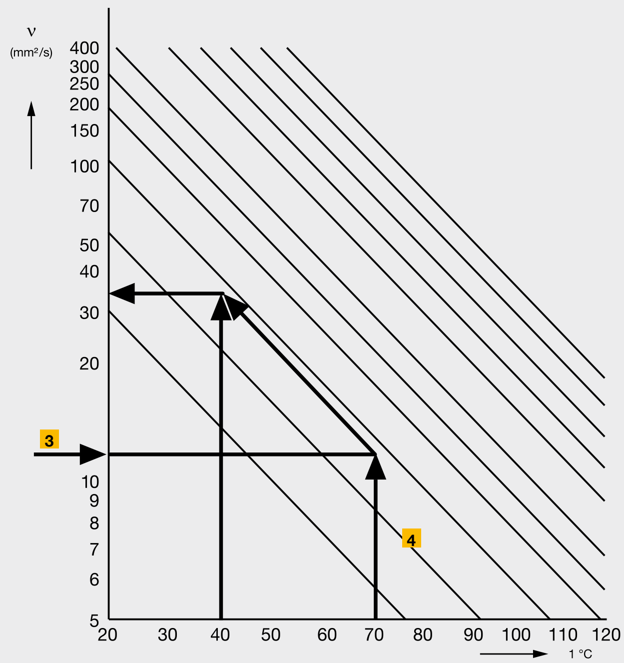
Starting from the mean bearing diameter and the speed, the reference viscosity for $\kappa = 1$ is determined in the diagram on the left. This value is then entered for the operating temperature in the diagram on the right . From the ν diagram, the required minimum base oil viscosity of the lubricant at 40 and/or 100 °C can be read. It normally makes sense to select a grease with a higher base oil viscosity (factor 2–4) than for $\kappa = 1$ to obtain the formation of a reliable lubricant film.

Hint:
If $\kappa > 4$ the elevated internal friction in the lubricant may lead to a higher operating temperature. This can lead to premature ageing of the lubricant.

Determination of base oil viscosity for κ = 1



ν_1



ν

Legend

Bore: 340 mm

Outer diameter: 420 mm

1 Mean bearing diameter: 380 mm

2 Speed: 500 min⁻¹

3 Base oil viscosity at operating temperature: 14 mm²/s

4 Operating temp.: 70 °C

1 – 4 indicate the series of steps to be taken for determining the base oil viscosity

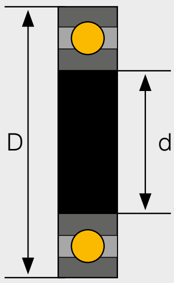
Hint:
The information stated (acc. to GfT worksheet 3) applies to mineral oil.

Speed factor

Speed factor $n \cdot d_m$ for rolling bearings

The speed factor $n \cdot d_m$ is determined by the speed of the bearing at standard operating conditions n (in min^{-1}) multiplied by the mean bearing diameter d_m (in mm).

Determination of the speed factor



d = inner diameter [mm]
D = outer diameter [mm]
n = speed [min^{-1}]

$$\frac{D + d}{2} \cdot n$$

= speed factor [$n \cdot d_m$]

Speed factor $n \cdot d_m$ for greases

The speed factor of a grease depends to a high degree on the base oil type, the base oil viscosity, the thickener and the type of rolling bearing to be lubricated. Important factors for successful lubrication at high speed include rapid oil backflow to the friction point, constant, defined oil release from the thickener as well as the adhesion of base oil and thickener to the component material. There are as yet no generally accepted test standards for the determination of maximum permissible speed factors. Besides our own experience, we use specific internal testing methods to specify the speed factor ranges of greases.

For the Klüber Lubrication rolling bearing greases, the maximum speed factors for use in deep groove ball bearings are specified. The speed factor in an application should always be lower than the maximum permissible speed factor. Should this not be the case in your application, please contact us.

Load ratio C/P

The ratio between a bearing's basic dynamic load rating C in (N) and its actual equivalent dynamic load P in (N) under standard operating conditions allows conclusions regarding the requirements to be met by the grease. The values in the following table should be observed for the selection of a suitable grease.

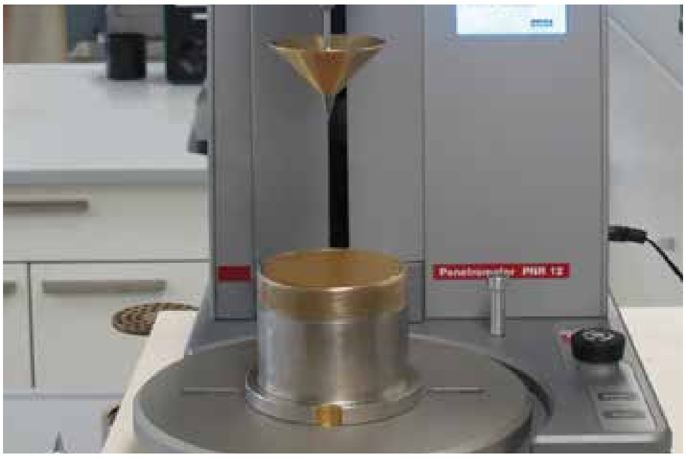
C/P	Load condition	Grease selection criteria
> 30	Very low load	Maximum permissible load ratio for silicone greases
20–30	Low load	Dynamically light greases
8–20	Moderate load	Greases with antiwear (AW) additives
4–8	High load	A grease with appropriate Extreme Pressure (EP) and AW additives should be selected. With such loads, a reduction of grease life / bearing life is to be expected.
< 4	Very high load	A grease containing EP additives and solid lubricants should be used. A significant reduction of grease life / bearing life is to be expected.

Source: Based on GfT worksheet No. 3

Consistency

The consistency of a grease is another selection criterion. What matters in this context is not just the function of the grease in the rolling contact, but also whether the grease has to be pumped through lines for application by automatic metering or centralised lubricating systems. If a grease is too stiff, pumping may be impeded.

A grease's consistency is determined by a standardised measurement. At first, the grease is churned, applying 60 double strokes. Subsequently a standardised cone is left to penetrate the grease's smoothened surface by its own weight over a defined period of time. The measured depth, i.e. the so-called "worked penetration", is stated in 0.1 mm units. To allow for the scattered results attained with this method, the consistency ranges for greases have been divided up into the so-called NLGI* grades.



Measurement of worked penetration acc. to DIN ISO 2137

NLGI grade	**0**	**1**	**2**	**3**	**4**
Worked penetration (1/10 mm)	385 ~ 355	340 ~ 310	295 ~ 265	250 ~ 220	205 ~ 175
Operating conditions	for centralised lubrication, false Brinelling (oscillation friction wear)	for centralised lubrication and fretting corrosion, for low temperatures	for general-purpose applications, for sealed bearings	for high temperatures, for general-purpose applications, for sealed bearings	for high temperatures, for labyrinth seals

Further selection criteria

The considerations outlined so far include the operating temperature range, the required minimum base oil viscosity, the speed factor, the load-carrying capacity and the consistency. This helps us to "sketch out" an idea of the lubricant required. To arrive at a more accurate description of a matching lubricant and narrow down the variety of available lubricant designs, further application-specific influences have to be taken into account. Besides the bearing type used, whose specific percentage of sliding friction (linear or point contact) requires higher or lower oil separation, it is also ambient media, the compatibility with plastics or elastomers, the bearing's mounting position, a rotating outer or inner ring, vibrations, oscillations, intended relubrication intervals and required grease lifetimes that may play a role for grease lubrication - in other words: a vast amount of factors.

It takes a lot of experience and detailed knowledge of lubricants with their chemical, physical and mechano-dynamical characteristics to find a matching lubricant for challenging applications.

This is what we at Klüber Lubrication regard as our core competence. We will sit down with you to discuss each application in great depth and compile a detailed requirements specification for the individual application. This will then translate into a concept for lubrication, which may well lead to a new product being developed. With our experts in chemical development and tribology, we are optimally prepared to take on your future projects. Talk to us!

* National Lubricating Grease Institute

Determining the theoretical service life F_{10q} of special greases

In most cases, the service life of a lubricant is determined by the service life of the grease it contains. It is therefore important to know the theoretical service life of a lubricant under the specific operating conditions.

In the bearing, greases are subject to an ageing process whose progress and characteristic depend on a variety of influencing factors. The most important factor is the temperature because it greatly affects the degree of oxidation, the activation and degradation of additives as well as the evaporation rate of the base oil. Further important factors are the grease quantity and grease distribution, the bearing design and the operating conditions.

In the following, we will explain to you how the theoretical grease life is calculated. The method rests on a fairly straightforward principle: On a standardised / specified bearing test rig (FE9 or R0F), the grease is tested at its upper service temperature and under otherwise constant conditions until the bearing fails. The test parameters are selected such that grease breakdown will be the primary cause of the bearing failure. The time until failure is determined in a Weibull evaluation and shown as the F_{10}[1] value.

Suitable reduction or enlargement factors can then be used to take into account the specific operating conditions of the application and determine on that basis the F_{10} service life to be expected.

An estimate of the grease life can be made by following these steps:

1st step: temperature [F_{10}]

It is generally known that the speed at which a chemical reaction takes place depends on the temperature. This fact is known as the reaction speed-temperature rule. It says that for a temperature increase in the approx. 10–20 Kelvin (K) range, reaction speeds, and consequently thermal grease ageing, will double.

The 15 K rule used in the calculation described below has been derived from this fact.

The F_{10} service life determined for the upper service temperature is applied to the application's operating temperature by doubling the expected lifetime for each 15 K temperature reduction. The lower limit at which the 15 K applies is at approx. 60–70 °C.

Running times for any temperatures in between can be determined with the following equation:

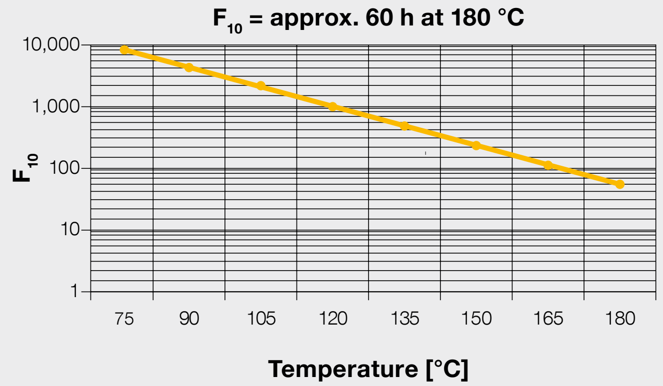
$$t = t_0 \times 2^{\left(\frac{T_0 - T}{15}\right)}$$

with:

- t = unknown running time [h]
- t_0 = test running time at upper service temperature of the grease [h]
- T = temperature for which the running time is to be determined [°C]
- T_0 = temperature of the test run [°C]

The following diagram shows the exemplary application of the 15 K rule. For each 15 K temperature reduction, the grease life doubles. The F_{10} value of approx. 60 h measured at 180 °C would at 120 °C theoretically go up to approx. 1000 h.

Example: F_{10} graph for a grease with FE9 runtime



[1] To avoid confusion with the fatigue life of rolling bearings (which is normally indicated as "L10"), we decided to use "F10" for the grease life. The F10 value qualified by further calculation is designated as F10q.

2nd step: speed factor [K_n]

The mean diameter dm of a bearing multiplied with the speed n is the speed factor $n \cdot d_m$ of an application. The speed factor enables two bearings of different sizes to be compared in terms of speed. As a relatively higher speed factor has a negative effect on the grease life, this influence can be included in the calculation in the form of a corresponding factor K_n:

$K_n = n \cdot d_m$ (test rig)/$n \cdot d_m$ (application)

with:
n = speed [min^{-1}]
d_m = (d + D)/2 [mm]
d = inner bearing diameter [mm]
D = outer bearing diameter [mm]

Due to our field experience, we would recommend to limit the K_n factor to a minimum of 0.5 and a maximum of 4, to keep the influence of this factor within a realistic range.

3rd step: bearing type [K_B]

By definition, rolling friction prevails in a rolling bearing. There is, however, always a constant proportion of sliding friction, which varies according to the bearing geometry, point-to-point or linear contact, friction between rolling elements and cage, or the rolling elements and the bearing rings. It can generally be assumed that a higher proportion of sliding friction has a negative effect on grease life because shearing in the grease is more pronounced. This is why the bearing type should also be taken into account when calculating the theoretical grease life. The German Society for Tribology (Gesellschaft für Tribologie, GfT) published the empirically determined reduction factors K_f in its Worksheet No. 3.

To determine the factor K_B for calculating the theoretical grease life, the K_f factor of the test bearing is set in relation to the K_f factor of the bearing in the application:

$K_B = K_f$ (test bearing)/K_f (application)

Bearing design	**K_f**
Single row deep groove ball bearing	0.9 to 1.1
Double row deep groove ball bearing	1.5
Single row angular contact ball bearing	1.6
Double row angular contact ball bearing	2
Spindle bearing a = 15°	0.75
Spindle bearing a = 25°	0.9
Four-point bearing	1.6
Self-aligning ball bearing	1.3 to 1.6
Thrust deep groove ball bearing	5 to 6
Thrust double row angular contact ball bearing	1.4
Single row cylindrical roller bearing	3 to 3.5
Double row cylindrical roller bearing	3.5
Full complement cylindrical roller bearing	25
Thrust cylindrical roller bearing	90
Needle bearing	3.5
Tapered roller bearings	4
Barrel roller bearing	10
Spherical roller bearing without flange "E"	7 to 9
Spherical roller bearing with centre flange	9 to 12

Source: GfT Worksheet No. 3

Grease application in rolling bearings

4th step: correction factors

Correction factors can add to the accuracy of the calculation. These factors are shown in the following overview.

To carry out the calculation and determine the theoretical grease life F_{10q}, the results of steps 1 to 4 are inserted into the following formula:

$$F_{10q} = F_{10} \cdot K_n \cdot K_B \cdot F_1 \cdot F_2 \cdot F_3 \cdot F_4 \cdot F_5 \cdot F_6 \text{ [h]}$$

We will be pleased to carry out the calculation for your application using our internal calculation software. Please do not hesitate to contact your Klüber Lubrication consulting engineer!

Correction factors	Classification	Value
Effect of dust and humidity on the functional bearing surfaces	moderate significant very significant	F_1 = 0.7 to 0.9 F_1 = 0.4 to 0.7 F_1 = 0.1 to 0.4
Influence of shock loads, vibrations and oscillation	moderate significant very significant	F_2 = 0.7 to 0.9 F_2 = 0.4 to 0.7 F_2 = 0.1 to 0.4
Effect of high loads	C/P = 10 to 7 C/P = 7 to 4 C/P = 4 to 3	F_3 = 1.0 to 0.7 F_3 = 0.7 to 0.4 F_3 = 0.4 to 0.1
Effect of air flowing through the bearing	weak flow strong flow	F_4 = 0.5 to 0.7 F_4 = 0.1 to 0.5
Rotating outer ring	significant	F_5 = 0.5
Vertical shaft	depending on sealing provided	F_6 = 0.5 to 0.7
For factors 1–6 having no effect, insert 1.		

Source: GfT Worksheet No. 3

Thermal ageing of the grease in a rolling bearing

Fresh grease

- Grease normally between the rolling elements
- Grease is consistent

Initial situation

Grease distribution / running-in "churning phase"

- Distribution in the bearing
- Depot formation e.g. in cavities, on seals
- Feeding of raceways with oil

Optimum lubrication

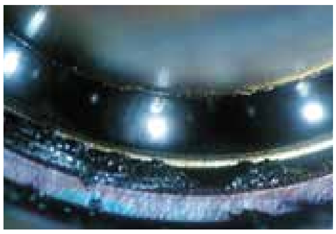
Grease ageing "oil separation phase"

- Loss of consistency
- Flow-off of oil and oxidation, evaporation
- Additive reaction
- Ageing of grease

Starvation

Grease failure

- Loss of base oil
- Additives used up
- Starved lubrication
- Lubricant film rupture
- Bearing failure



Metal-to-metal contact

As rotation commences, the grease is distributed inside the bearing. Depending on the grease type and quantity, the depot spaces are filled and the grease is churned and transported through the bearing. Shearing forces and a rise in the temperature cause base oil to ooze from the grease and wet the surfaces: the optimum lubricating condition is reached. The thermal and mechanical stresses then activate the additives, which are gradually used up. Ageing of thickener and base oil sets in. The mechanical and chemical decomposition of the grease will over time reduce its lubricity; lubricant starvation sets in. As operation continues, wear rises, the lubricant thickens, which leads to more friction and rising temperature in the bearing. The higher temperature will in turn accelerate the ageing process. Eventually, the bearing will break down.

Approx. 90 % of all rolling bearings are lubricated with grease. Grease lubrication presents far fewer sealing problems than oil lubrication and allows much simpler machine designs. A further benefit of today's greases is that high-speed formulations allow speed factors up to 2 million – more than twice of what used to be possible! It is therefore small wonder that greases keep gaining ground against the various types of oil lubrication.

With the various applications and machine environments of grease-lubricated rolling bearings, one differentiates between for-life lubrication and bearings requiring relubrication (total loss lubrication).

Rolling bearings lubricated for life

Depending on the bearing type, size and its intended application, the initial lubrication at the rolling bearing OEM (original equipment manufacturer) can be a rather costly affair – especially for low-noise bearings, high-precision bearings or high-speed spindle bearings. The rolling bearing OEMs have developed their specific application techniques based on the individual experiences made. The chosen technique normally involves a central lubricating system conveying the grease from the container to the filling station, from where it is applied to the bearing via nozzles (needles). Specialty greases made by Klüber Lubrication enable minimum-quantity lubrication and shorter running-in times, while a grease distribution run can in some cases be dispensed with.

Determination of grease fill quantity

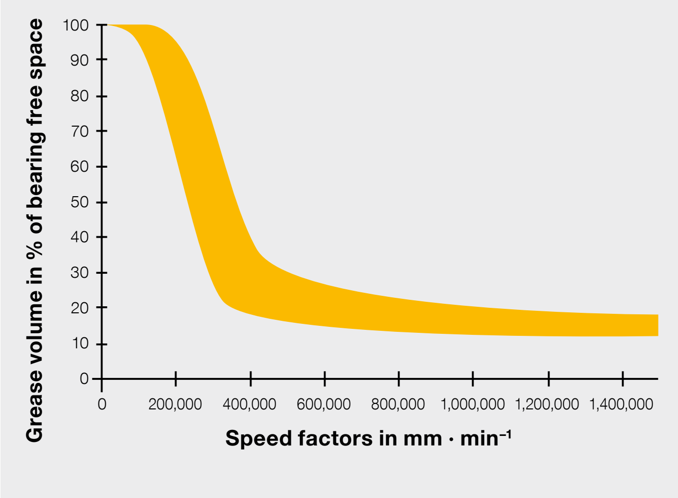
In capped or sealed bearings, overlubrication may lead to excessive internal heating with adverse effects on the bearing's lifetime. Accurate determination of the optimum grease quantity is therefore important. Besides the type of bearing, its specific design and the influences of the application environment or media, the speed factors plays a major role in this context.

For medium speeds, the grease fill normally takes up 25-35 % of the bearing free space.

As a rule, the grease fill is higher for a lower speed factor, and vice versa.

The following diagram shows how grease fill quantity and speed factor are interrelated.

Determination of grease fill quantity



The yellow-shaded area indicates the filling volume in relation to the speed factor.

The determination of relubrication quantities and relubrication intervals for loss-lubricated bearings as well as the selection of the right relubrication method are highly complex tasks. Numerous factors such as the compatibility and miscibility of different kinds of lubricants can play a role in this context. We will be pleased to support you with information matching your specific situation. Please don't hesitate to talk to us.

High-temperature greases

High-temperature greases made by Klüber Lubrication consist of thermally stable high-performance base oils, preferably synthetic oils with synthetic thickeners or inorganic thickeners. The upper service temperatures that can maximally be served by high-temperature greases from Klüber Lubrication are currently at approx. 300 °C. For lifetime lubrication, however, the upper operating temperature has to be much lower in order to attain the desired running times.

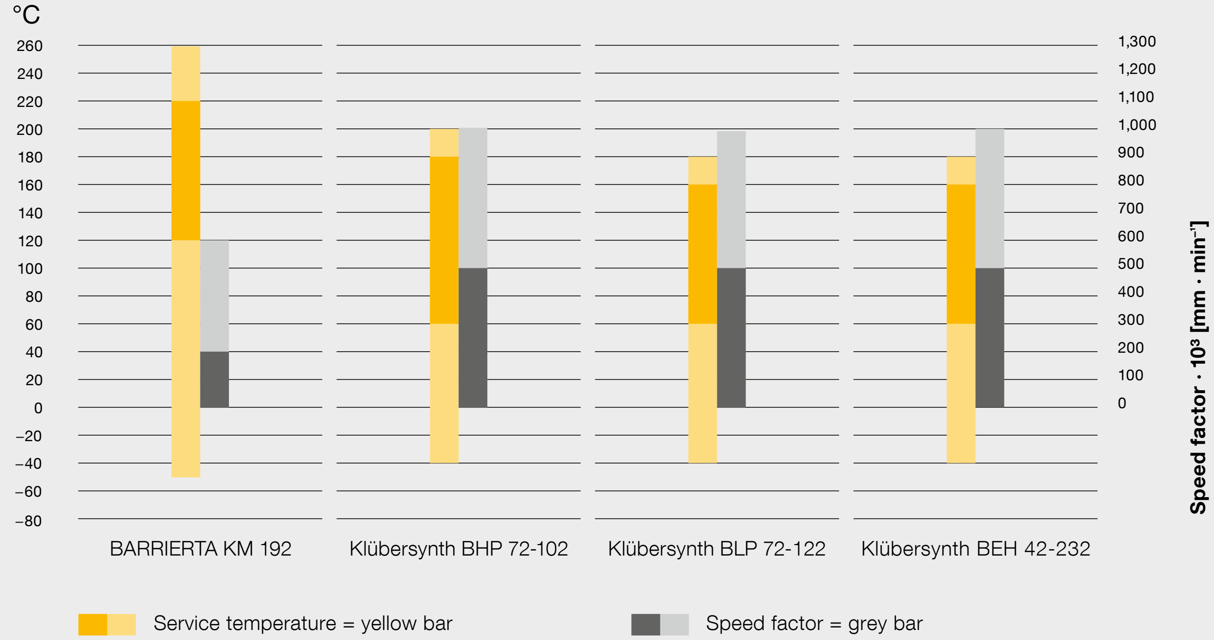
BARRIERTA KM 192 is a lubricating grease based on perfluoropolyether base oil and a PTFE thickener. For many years this grease has proven successful for high-temperature applications up to 260 °C. Before applying this type of grease, bearings have to be cleaned thoroughly because any contamination would significantly affect adhesion of the grease.

Klübersynth BHP 72-102 is one of a new generation of greases based on a hybrid grease formulation. These greases cover a wide service temperature range. Klübersynth BHP 72-102 is based on ester oil and PFPE oil. The thickener used is polyurea and PTFE

Klübersynth BLP 72-122 is based on a synthetic ester oil and a special polyurea thickener. Such greases have been successfully used for many years in the automotive industry for both low and high temperatures. They offer long grease life for lifetime lubrication at high operating temperatures in bearings with a rotating outer ring. This grease was designed with a particular focus on good elastomer compatibility with ACM seals.

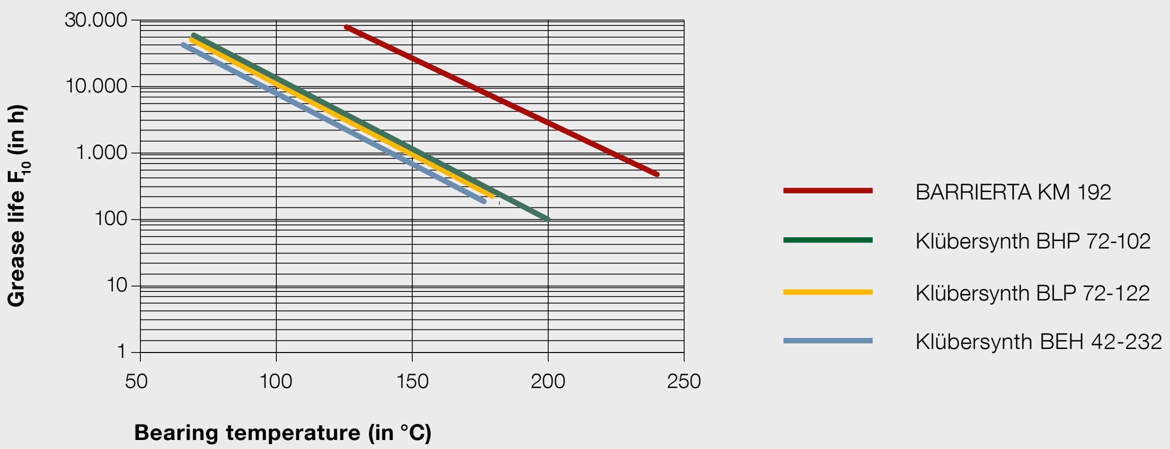
Klübersynth BEH 42-232 is an innovative high-temperature grease with a lithium thickener. It withstands temperatures up to 180 °C. With its Klübersynth BEH 42-232 grease, Klüber Lubrication has significantly pushed up the previous temperature limit for roller bearing greases. It is a good choice for all applications where roller bearings are expected to offer a long service life at extreme temperatures and high loads.

Service temperature and speed factor



The darker-shaded area shows the optimal application range

Grease life as a function of temperature



Grease life results > 30,000 h are in general no longer considered as sufficiently reliable.
The stated values are based on FE9 test results acc. to DIN 51821

High-temperature greases

Upper service temperature [°C]	**Lower service temperature [°C]**	**Speed factor $n \cdot d_m$ [mm·min⁻¹] approx.**	**Base oil viscosity DIN 51562 [mm²/s] at 40 °C approx.**	**Base oil viscosity DIN 51562 [mm²/s] at 100 °C approx.**	**Worked penetration DIN ISO 2137 [0.1 mm]**	**Base oil**	**Thickener**
260	–50	600,000	190	34	265 to 295	PFPE	PTFE
260	–40	300,000	420	40	265 to 295	PFPE	PTFE
200	–50	1,000,000	110	27	265 to 295	PFPE	PTFE
200	–40	1,000,000	130 [1]	20 [1]	240 to 270	PFPE, ester	PTFE, Polyurea
200	–40	500,000	400	40	280 to 310	Synthetic hydrocarbon	Polyurea
180	–30	1,000,000	55	8,8	280 to 310	Ester oil	Polyurea
180	–40	1,000,000	80	11	250 to 280	Ester oil	Polyurea
180	–40	1,000,000	80	11	280 to 310	Ester oil	Polyurea
180	–40	1,000,000	130	17	280 to 310	Ester oil, synthetic hydrocarbon	Polyurea
180	–40	600,000	100	22.5	265 to 295	Ester oil, ether oil	Lithium special soap
180	–40	700,000	95	14	265 to 295	Ester oil	Polyurea

[1] Base oil viscosity determined by calculation as base oils are not miscible

Product	Description / application examples
BARRIERTA KM 192	– Wide service temperature range – Very good corrosion protection – Long expected service life under strongly fluctuating operating temperatures
BARRIERTA L 55/2	– Long-term grease for rolling bearings under thermal stress – Very good runtime stability and corrosion protection – Approved and recommended by numerous manufacturers – Tested and listed as NSF H1 for use in food-processing industry
Klüberalfa BF 83-102	– For high permanent temperatures and speeds – Speed factors exceeding 1 million mm · min^{-1} were attained on test rigs
Klübersynth BHP 72-102	– Hybrid grease formulation for long-term lubrication – Also for use in wet and corrosive environment or with vibrations
Klübersynth HB 74-401	– For long-term lubrication over a wide temperature range – Good wear and corrosion protection – Preferably used for rolling and plain bearings operating under high load, e.g. in steel, cement or paper industries
Klübersynth HB 72-52	– For long-term lubrication of EPDM materials – For applications such as ABS electric motor bearings in vehicles
Klübersynth BEP 72-82	– Above-average protection against corrosion and wear – For applications in vehicles such as pulley, generator, clutch release bearing, fan bearing, wiper motor, Drive By Wire systems, etc.
Klübersynth BQP 72-82	– Above-average protection against corrosion and wear – For automotive and electric motor applications where noise is an issue
Klübersynth BLP 72-122	– For-life lubricated rolling bearings in vehicles – Engine peripherals, e.g. belt tensioning roller bearings – Very good ACM compatibility
Klübersynth BEH 42-232	– For lubrication of heavily loaded roller bearings – For high permanent temperatures over a wide range of speeds – Operates at a wide range of temperatures
Klübersynth HB 72-102	– For longerm lubrication in a wide service temperature range – Very good corrosion protection – Application examples include clutch release bearings in cars

Low-temperature greases

Lubricating greases whose consistency hardly increases at temperatures below zero are regarded as showing good low-temperature stability. Suitable base oils for such greases are, for example, synthetic ester, PFPE and polyalphaolefins - they show very good resistance to cold. The general criteria defining the low-temperature stability is the flow pressure acc. to DIN 51805 or the low-temperature torque measurement acc. to IP 186. The temperature at which a flow pressure of 1,400 mbar is achieved is considered the lower operating temperature limit for rolling bearing greases.

A grease which shows a good low-temperature stability will often perform poorly in high-temperature applications. The automotive industry in particular often demands temperatures of -40 °C while the operating point of a unit is for example +100 °C.

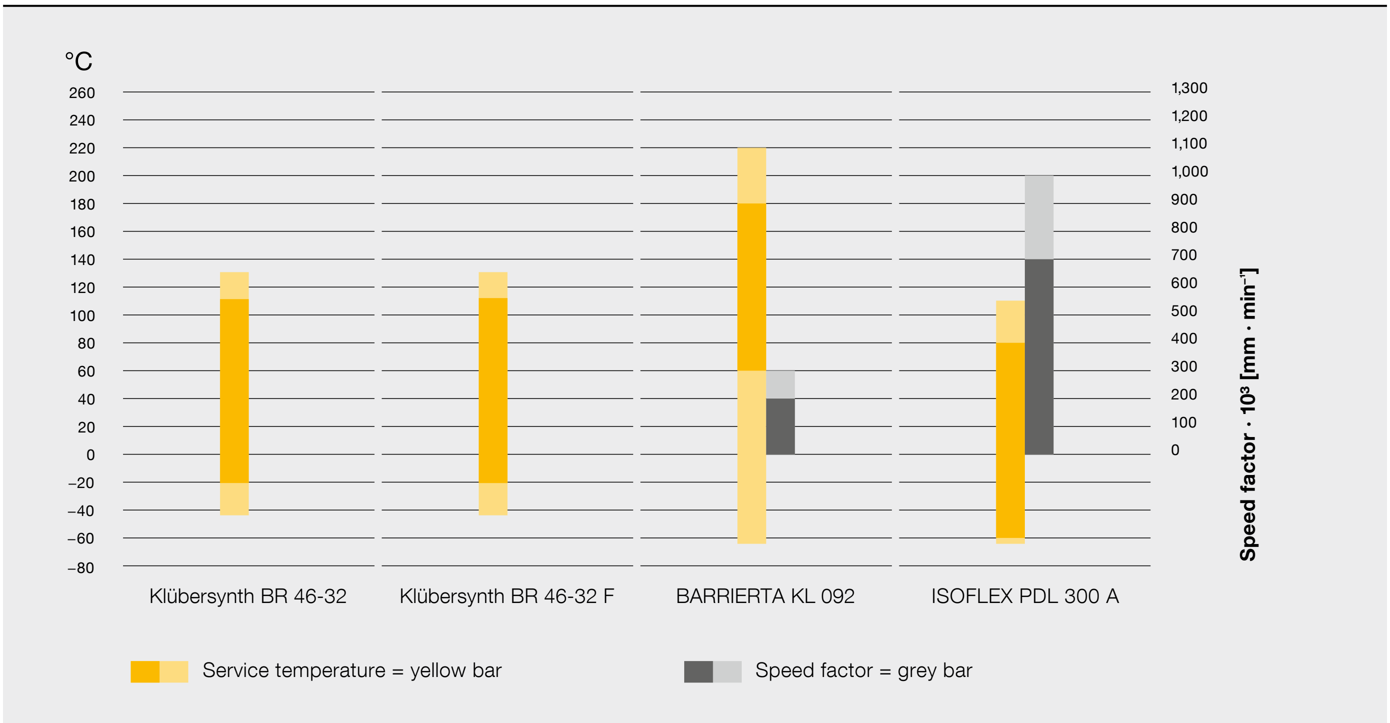
Examples of greases with a service temperature range going clearly lower than –40 °C are: ISOFLEX PDL 300 A, BARRIERTA KL 092, Klübersynth BR 46-32, Klübersynth BR 46-32 F.

BARRIERTA KL 092 and ISOFLEX PDL 300 A are greases developed with a focus on low-temperature applications. Our experts will be pleased to provide advice for an estimate of grease life.

Klübersynth BR 46-32 and Klübersynth BR 46-32 F are greases that were especially developed for ball screws and rolling bearings, with the difference between the two being the special solid lubricant contained in Klübersynth BR 46-32 F. The solid lubricant increases the grease's load bearing capacity while at the same time reducing wear. Since both greases are compatible with EPDM, both types are used in various applications in vehicle brakes. For use in rolling bearings, we would recommend to initially test the variant without solid lubricant. Speed factors are not indicated for these types of grease. Suitability must be tested for the application at hand prior to use.

Upper service temperature [°C]	**Lower service temperature [°C]**	**Speed factor $n \cdot d_m$ [mm·min⁻¹] approx.**	**Base oil viscosity DIN 51562 [mm²/s] at 40 °C approx.**	**Base oil viscosity DIN 51562 [mm²/s] at 100 °C approx.**	**Worked penetration DIN ISO 2137 [0.1 mm]**	**Base oil**	**Thickener**
180	–80	n/a	40	11	310 to 330	PFPE	PTFE
110	–70	1,000,000	9	2.6	280 to 320	Ester oil	Lithium soap
220	–65	300,000	90	25	265 to 295	PFPE	PTFE
130	–45	n/a	29	6	265 to 295	Ester oil, PAG	Lithium soap
130	–45	n/a	29	6	265 to 295	Ester oil, PAG	Lithium soap, solid libricant

Service temperature and speed factor

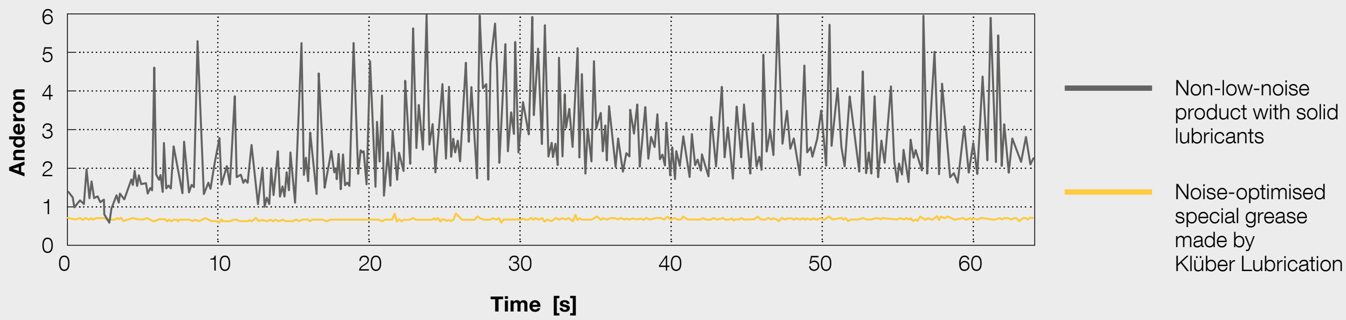


The darker-shaded area shows the optimal application range

	Product	Description / application examples
	Klübertemp LB 83-41	– For rolling bearings in vehicles with particularly low friction torque – For applications in a wide operating temperature range
	ISOFLEX PDL 300 A	– High-performance grease for rolling bearings at low temperatures and/or low friction torques
	BARRIERTA KL 092	– Low- and high-temperature greases for low running torques at low temperatures with sound long-term stability under high media-induced and thermal stress
	Klübersynth BR 46-32	– Special grease for applications in lifetime-lubricated rolling bearings as well as in ball screws, primarily in vehicles with a focus on clutch and brake actuators or similar requirements – Designed for low starting torques at low temperatures as well as good compatibility with EPDM
	Klübersynth BR 46-32 F	– Special grease for applications in for-life-lubricated rolling bearings and ball screws primarily in motor vehicles with a focus on clutch and brake actuators and similar requirements – Due to the special solid lubricant component contained, this grease offers better wear protection than Klübersynth BR 46-32 and a higher load-carrying capacity – Designed for low starting torques at low temperatures combined with good EPDM compatibility

High-purity, noise-optimised greases

Example for illustration: anderometer measurement of solid-borne sound



Noise specification of greases is determined by measuring solid-borne sound in rolling bearings

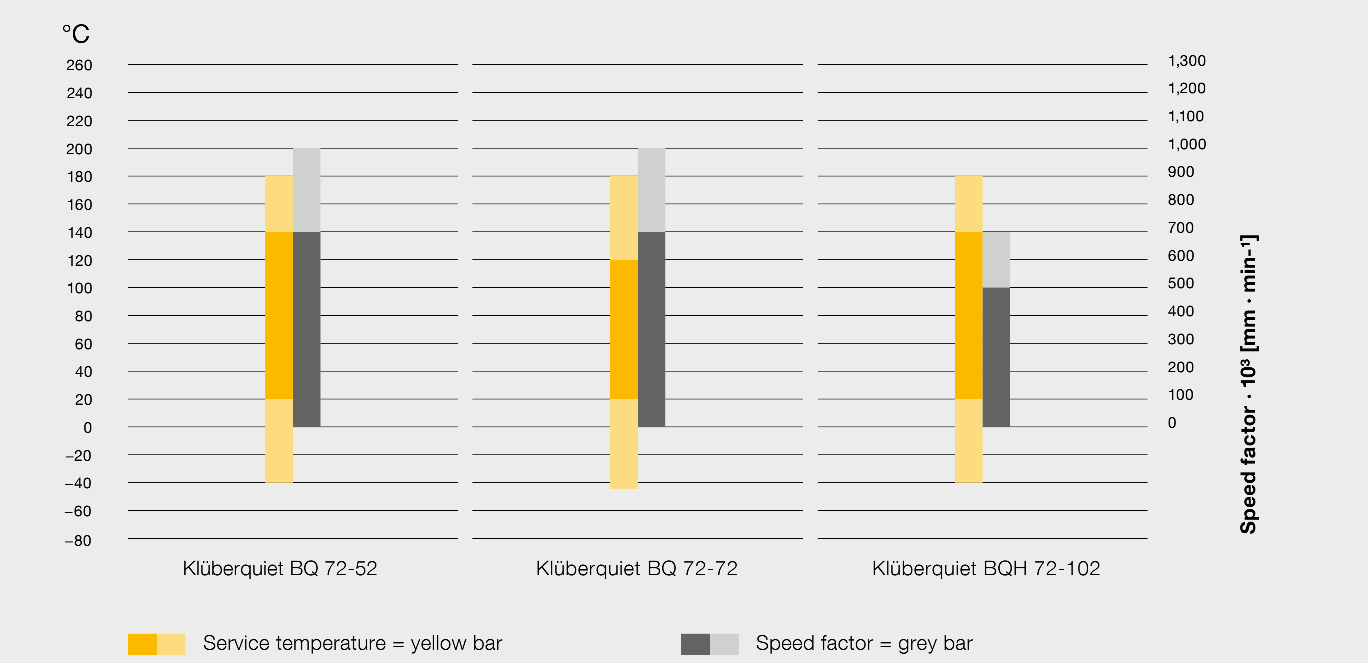
Such greases are used to reduce the running noise in a bearing. Noise requirements are particularly stringent for applications in consumer electronics or computer equipment. The automotive industry is also seeing increasingly higher expectations on the noise behaviour of numerous components. Low-noise greases are also characterised by a high degree of purity, which in turn has a strong positive effect on bearing life.

Factors influencing noise generation in rolling bearings

The noise behaviour of a rolling bearing is influenced by the lubricant as well as by specific features of the application and the bearing design. Typical factors in a lubricant that have influence are thickener, additives, grease quantity and grease distribution. As far as the rolling bearing is concerned, surface roughness, type and material of cage, bearing geometry and other features play a role.

Upper service temperature [°C]	Lower service temperature [°C]	Speed factor $n \cdot d_m$ [mm·min⁻¹] approx.	Base oil viscosity DIN 51562 [mm²/s] at 40 °C approx.	Base oil viscosity DIN 51562 [mm²/s] at 100 °C approx.	Worked penetration DIN ISO 2137 [0.1 mm] approx.	Base oil	Thickener	
180	–40	700,000	100	11	250 to 280	Ester oil	Polyurea	
180	–45	1,000,000	72	9.5	250 to 280	Ester oil	Polyurea	
180	–40	1,000,000	55	9	240 to 270	Synthetic hydrocarbon, ester oil	Polyurea	
160	–40	2,000,000	70	10	220 to 250	Synthetic hydrocarbon, ester oil	Polyurea	
140	–50	1,000,000	25	5	265 to 295	Synthetic hydrocarbon, ester oil	Lithium soap	

Service temperature and speed factor



The darker-shaded area shows the optimal application range

	Product	Description / application examples
	Klüberquiet BQH 72-102	– For long-term and lifetime lubrication at high temperatures – For rolling bearings capped and sealed on both sides – Application examples are electric motors, vehicle radiator fans, etc.
	Klüberquiet BQ 72-72	– For long-term and lifetime lubrication at low and high temperatures – For rolling bearings with low friction torque that are capped and sealed on both sides – Application examples are electric motors, fans, AC units, harddisks
	Klüberquiet BQ 72-52	– For long-term and lifetime lubrication at high temperatures – Energy savings due to low starting and running torques – For low-noise electric motors, vehicle and industrial fan bearings as well as for applications with high-speed requirements
	Klüberquiet BQ 74-73 N	– For lifetime lubrication – For high speeds, vertically mounted bearings and/or rotating outer ring
	ASONIC GLY 32	– For lifetime lubrication – Low starting and running torque – For low temperatures

High-speed greases and oils

There are now high-speed greases that can handle speeds normally only possible with oils. Their consistency is like that of common rolling bearing greases, e.g. NLGI 2 or 3. For years, high-speed greases have been very successfully used in a speed factor range up to 1 million mm · min^{-1}. By now, even speed factors higher than 2 million mm · min^{-1} are possible with grease lubrication.

Tried and tested products such as ISOFLEX LDS 18 SPECIAL A as well as the advanced Klüberspeed lubricants have for many years been setting service life and reliability standards in high-speed applications. Speed factors attained with Klüberspeed BF 72-22 are at 2 million mm · min^{-1}, and up to 2.3 million mm · min^{-1} for Klüberspeed BFP 42-32.

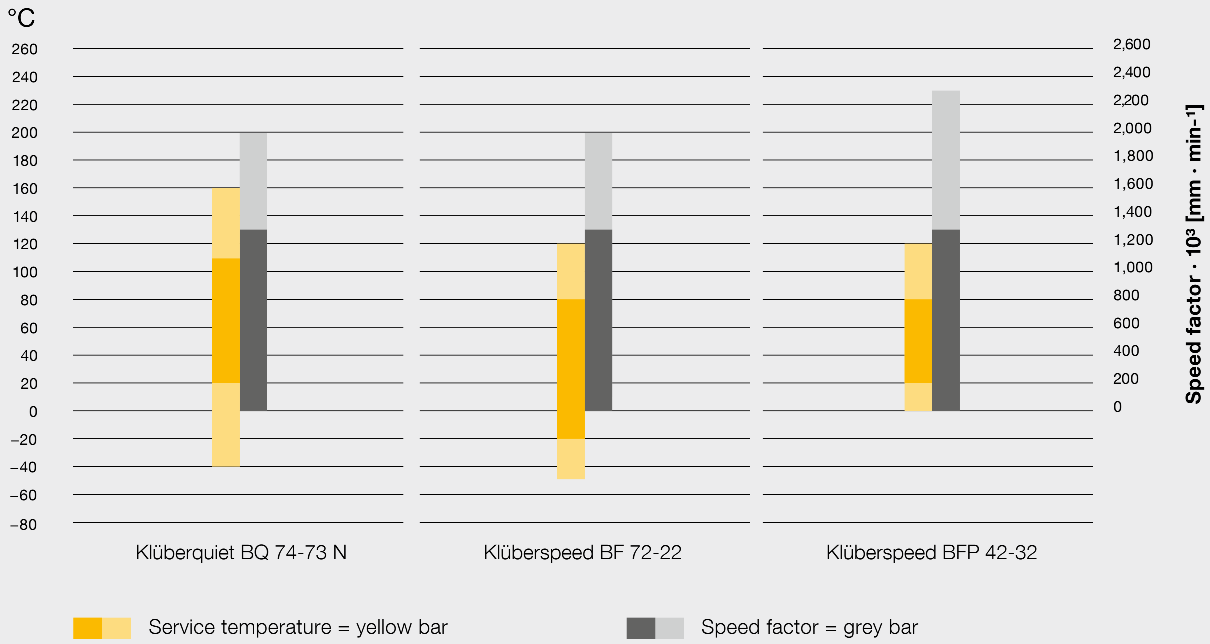
In recent years, Klüber Lubrication has included a new generation of fully synthetic spindle bearing oils in its portfolio. Klübersynth FB 4-32, 4-46 and 4-68 oils have been extremely fine-filtered and correspond to purity class 15/13/10 according to ISO 4406. Comprehensive tests confirm the high performance capabilities of this product series and confirm its use up to a high speed factor of 2.5 million mm · min^{-1}.

In applications with high speeds, i.e. speed factors of n · dm 1 million or higher, grease life is primarily determined by the high peripheral speeds and the resulting forces.

For high-speed greases, the focus is always on the maximum attainable speed. It is therefore not possible to indicate the "grease life as a function of temperature" for these products. To obtain an estimate of grease life in your application, please contact our technical consulting experts.

Upper service temperature [°C]	**Lower service temperature [°C]**	**Speed factor $n \cdot d_m$ [mm·min^{-1}] approx.**	**Base oil viscosity DIN 51562 [mm²/s] at 40 °C approx.**	**Base oil viscosity DIN 51562 [mm²/s] at 100 °C approx.**	**Worked penetration DIN ISO 2137 [0.1 mm] approx.**	**Base oil**	**Thickener**
140	–30	2,500,000	68	9.6	n/a	Synthetic hydrocarbon	none (the product is an oil)
120	0	2,300,000	30	6	250 to 280	Ester oil	Lithium soap
120	–50	2,100,000	22	5	220 to 250	Synthetic hydrocarbon, ester oil	Polyurea
120	–50	2,000,000	22	5	250 to 280	Ester oil, synthetic hydrocarbon	Polyurea
160	–40	2,000,000	60	9,5	220 to 250	Synthetic hydrocarbon ester oil	Polyurea
130	–40	1,600,000	21	4.5	265 to 295	Ester oil, synthetic hydrocarbon	Barium complex soap

Service temperature and speed factor



The darker-shaded area shows the optimal application range

Product	Description / application examples
Klübersynth FB 4-68	– Extremely fine-filtered synthetic machine tool spindle oil for high-speed bearings – Purity class 15/13/10 according to ISO 4406 – Preferably for oil-air lubrication of rolling bearings of machine tool spindle running at very high speeds – Also available with other base oil viscosities: 32 mm²/s and 46 mm²/s (40 °C)
Klüberspeed BFP 42-32	– For hybrid, angular contact ball and cylindrical roller bearings – For horizontal, diagonal or vertical mounting positions – For very high speed factors
Klüberspeed BF 72-23	– For high-speed spindle bearings – Especially for diagonal and vertical, but also for horizontal shafts in machine tools – Good corrosion protection and good resistance to water
Klüberspeed BF 72-22	– For high-speed spindle bearings in machine tools – Preferred for horizontal shafts – Good corrosion protection and good resistance to water
Klüberquiet BQ 74-73 N	– For high speeds, vertically mounted bearings and/or rotating outer ring – For lifetime lubrication at high temperatures
ISOFLEX NBU 15	– The spindle bearing grease for machine tools – Proven effective based on long-standing and wide-ranging experience

Special greases for heavy-load applications

These greases are subject to particular requirements regarding the load-carrying capacity. This capacity is particularly important when components operate under boundary or mixed friction to prevent fatigue- or wear-induced damage. To provide the capacity required, special EP (extreme-pressure) and AW (anti-wear) additives are used.

Besides, certain thickeners and the base oils – depending on their viscosity – have a positive effect on the load-carrying capacity.

For rolling bearings with a $C/P < 10$ load ratio, the use of extreme-pressure greases makes sense.

Heavy-load greases

Upper service temperature [°C]	Lower service temperature [°C]	Base oil viscosity DIN 51562 [mm²/s] at 40 °C approx.	Base oil viscosity DIN 51562 [mm²/s] at 100 °C approx.	Worked penetration DIN ISO 2137 [0.1 mm] approx.	Base oil	Thickener
160	–35	2,400	145	310 to 340	Synthetic hydrocarbon	Lithium special soap
140	–20	540	32	265 to 295	Mineral oil	Lithium soap
140	–30	130	15	265 to 295	Synthetic hydrocarbon, mineral oil	Lithium special soap, solid lubricant

Grease for heavily loaded rolling bearings in wet areas

Upper service temperature [°C]	Lower service temperature [°C]	Base oil viscosity DIN 51562 [mm²/s] at 40 °C approx.	Base oil viscosity DIN 51562 [mm²/s] at 100 °C approx.	Worked penetration DIN ISO 2137 [0.1 mm] approx.	Base oil	Thickener
140	–10	500	31	245 to 275	Mineral oil	Calcium special soap
160	–40	400	40	290 to 320	Synthetic hydrocarbon	Calcium special soap
140	–15	220	19	245 to 275	Mineral oil	Calcium special soap
130	–20	220	19	285 to 315	Mineral oil	Barium complex soap

The performance capabilities of heavy-load greases as are used, for example, in the cement industry can be verified on suitable test rigs such as FAG FE8.

Product	Description / application examples
Klübersynth BE 44-2001	– Semi-synthetic heavy-duty grease without black solid lubricants for extreme operational conditions. – For rolling bearings with line contact, a wide temperature range and low to medium speeds. – Good pumpability as well as low starting torque also under very low ambient temperatures.
Klüberlub BE 41-542	– For low to medium speeds
Klüberlub BEM 41-122	– For spherical plain bearings, plain bearings and rolling bearings with high surface pressure and/or oscilating movements – Reduces wear through formation of tribo-layers

Product	Description / application examples
Klüberplex BE 31-502	– For heavily loaded ball bearings in wet areas – At low speeds
Klübersynth HBE 94-401	– Synthetic special grease for long-term and lifetime lubrication in applications subject to high loads and elevated temperatures – Excellent wear and corrosion protection as well as very good resistance to water
Klüberplex BE 31-222	– For heavily loaded ball bearings in wet areas – At medium speeds
STABURAGS NBU 12/300 KP	– Long-term grease for plain and rolling bearings – Resistant to hot water – Good pressure absorption capacity

Special greases for further fields of application

Lubricating greases for oscillating movements

Oscillating motion causes extreme stress on rolling bearings. Permanent start/stop operation prevents the development of a stable separating layer between the friction partners, leading to what is known as boundary friction. The wear risk increases and the lifetime of the rolling bearing can decrease as a consequence.

In oscillating rolling bearings mounted on a horizontal shaft, the effect of gravity draws the lubricant gradually downwards. If the oscillating amplitude is small, the upper part of the rolling element may not be sufficiently covered with lubricant. Additionally, the amount of fresh lubricant entering the space between the friction partners is very small, potentially leading to lubricant starvation in the rolling contact. In such cases, lubricants with particularly good backflow behaviour and special additives should be used.

If oscillating amplitudes are constantly very small, the rolling element cannot rotate to redistribute the lubricant. The resulting effect may be bearing damage with ball or roller-shaped brinell marks occurring to the loaded bearing rings. This effect is referred to as the False Brinelling Effect.

The same effect is also observed when linear movement occurs (short stroke), e.g. in linear guides with ball and roller screw systems, ball bushings or ball screws.

Lubricating greases for oscillating movements

Upper service temperature [°C]	**Lower service temperature [°C]**	**Base oil viscosity DIN 51562 [mm²/s] at 40 °C approx.**	**Base oil viscosity DIN 51562 [mm²/s] at 100 °C approx.**	**Worked penetration DIN ISO 2137 [0.1 mm] approx.**	**Base oil**	**Thickener**
150	–40	130	14	310 to 340	Synthetic hydrocarbon, mineral oil	Lithium special soap
150	–35	134	16	310 to 340	Synthetic hydrocarbon, mineral oil	Calcium special soap
140	–40	300	31	310 to 340	Synthetic hydrocarbon	Calcium complex soap

Lubricating greases for roller bearings

Upper service temperature [°C]	**Lower service temperature [°C]**	**Base oil viscosity DIN 51562 [mm²/s] at 40 °C approx.**	**Base oil viscosity DIN 51562 [mm²/s] at 100 °C approx.**	**Worked penetration DIN ISO 2137 [0.1 mm] approx.**	**Base oil**	**Thickener**
180	–40	380	n/a	230 to 260	Synthetic hydrocarbon	Lithium special soap
150	–40	120	14	265 to 295	Synthetic hydrocarbon, mineral oil	Lithium special soap
140	–40	47	8	275 to 305	Synthetic hydrocarbon	Lithium special soap

A special lubricant for oscillating motion can provide protection against wear and component failure. Mechanically, this can be attained by combinations of solid lubricants. Furthermore, special additives can form protective reaction layers on the metal surfaces.

Ruptures in the separating layer quickly lead to failure. It is therefore essential to discuss operating conditions as precisely as possible to determine the right lubricant and the ideal lubrication method for the bearing design in each kind of application.

Lubricating greases for roller bearings

Roller bearings are a particular lubrication challenge due to their tribological characteristics, as they often operate under extreme conditions like high pressure at low rotational speeds.

Lubricants for these conditions need to have special characteristics to cope with rolling friction in the linear contact zone between the roller and the raceway and, in some cylindrical and tapered roller bearings, sliding friction at the flange. On the one hand, high pressure resistance is required, which can be attained with higher base oil viscosities and/or special additives. On the other hand, sufficient oil release must be provided to the sliding contact between the face of the roller and the flange.

Synthetic base oils combined with special soap-based thickeners like lithium, lithium complex, calcium complex or barium complex soaps have proven their effectiveness in practice. Barium complex soap greases are particularly resistant against potentially contaminating media.

Product	Description / application examples
Klüberplex BEM 41-141	– For heavily loaded rolling and plain bearings – For vibrations and oscillations – Applications are, e.g., wind turbine main bearings
Klüberplex BEM 34-131 N	– For long-term and lifetime lubrication of rolling bearings and linear guides – Very good lubricating effect in applications with micro-movements – For applications such as vehicle hub units and other rolling bearings where damage due to False Brinelling is to be expected
Klüberfood NH1 94-301	– NSF-H1 Registration No.: 140682 – For rolling and plain bearings operating under high loads and with micro-movements – Good wear and corrosion protection

Product	Description / application examples
Klübersynth BHE 46-403	– For highly loaded roller bearings and permanently high operational temperatures. – Optimised friction values e.g. for use in commercial vehicle wheel hub bearings.
Klüberplex BEM 41-132	– For long-term lubrication of tapered, cylindrical and spherical roller bearings in a wide range of applications – Tried and tested special lubricant for applications in the automotive industry as well as in many roller and ball bearing applications
Klübersynth BM 44-42	– For long-term and lifetime lubrication of rolling bearings and ball screws subject to high stresses, also for linear contact and small oscillating movements – Proven successful in automotive applications, e.g. in steering systems

Greases for the food-processing industry

Our specialty lubricants made for the food-processing and pharmaceutical industries were developed and tested drawing on our global experience and research and are registered as NSF H1/H2.

The manufacturing processes for Klüber Lubrication H1 lubricants are subject to strict hygienic requirements to avoid undesirable contamination. They follow almost exclusively the NSF ISO 21469 standard. This certification also supports compliance with hygienic requirements in your production plant.

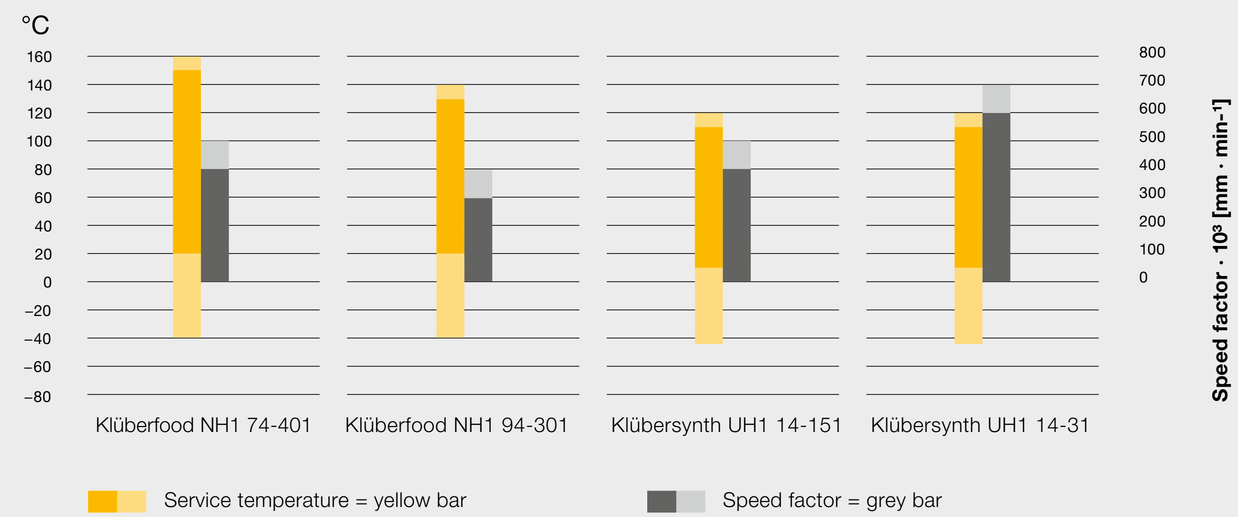
Klüber Lubrication was amongst the first few companies which were able to comply with the high requirements of this standard and has today more certified production plants than any other company.

For more process reliability in the manufacture of pharmaceutical products, NSF H1 lubricants should be exclusively used in such operations. This reliably prevents contamination of pharmaceutical products by lubricants that are not registered as NSF H1 since the risk of confusion is eliminated.

This means that the use of NSF H1-registered lubricants contributes to higher reliability of the production processes. Nevertheless we recommend conducting an additional risk analysis, e.g. HACCP.

Upper service temperature [°C]	**Lower service temperature [°C]**	**Speed factor $n \cdot d_m$ [mm·min⁻¹] approx.**	**Base oil viscosity DIN 51562 [mm²/s] at 40 °C approx.**	**Base oil viscosity DIN 51562 [mm²/s] at 100 °C approx.**	**Worked penetration DIN ISO 2137 [0.1 mm] approx.**	**Base oil**	**Thickener**
120	–45	700,000	30	6	310 to 340	Synthetic hydrocarbon, ester oil	Aluminium complex soap
120	–45	500,000	150	22	310 to 340	Synthetic hydrocarbon	Aluminium complex soap
140	–40	400,000	300	31	310 to 340	Synthetic hydrocarbon	Calcium complex soap
160	–40	500,000	400	40	280 to 310	Synthetic hydrocarbon	Polyurea
260	–40	300,000	420	40	265 to 295	PFPE	PTFE

Service temperature and speed factor



The darker-shaded area shows the optimal application range

	Product	Description / application examples
	Klübersynth UH1 14-31	– Smooth-running grease – Very good low-temperature behaviour – Good water resistance and good corrosion protection – Very good pumpability in central lubrication systems
	Klübersynth UH1 14-151	– Very good low-temperature behaviour – Good wear protection – Good water resistance reduces the risk of corrosion and premature bearing failure – For medium speeds
	Klüberfood NH1 94-301	– Good wear protection and load-carrying capacity – Good water resistance and good corrosion protection – For long-term lubrication of rolling bearings and linear guides, also with micro-movements – Good pumpability in central lubrication systems
	Klüberfood NH1 74-401	– For long-term lubrication over a wide temperature range – Good wear and corrosion protection. – For rolling and plain bearings operating under high loads
	BARRIERTA L 55/2	– Long-term grease for rolling bearings under thermal stress – Very good runtime stability and corrosion protection – Approved and recommended by numerous manufacturers

Electroconductivity

Rolling bearings: effective protection against electric erosion

The undesirable passage of an electric current and spontaneous discharge can cause severe damage in electric motor rolling bearings. It is with a view to these applications that Klüber Lubrication has developed new, electroconductive rolling bearing greases.

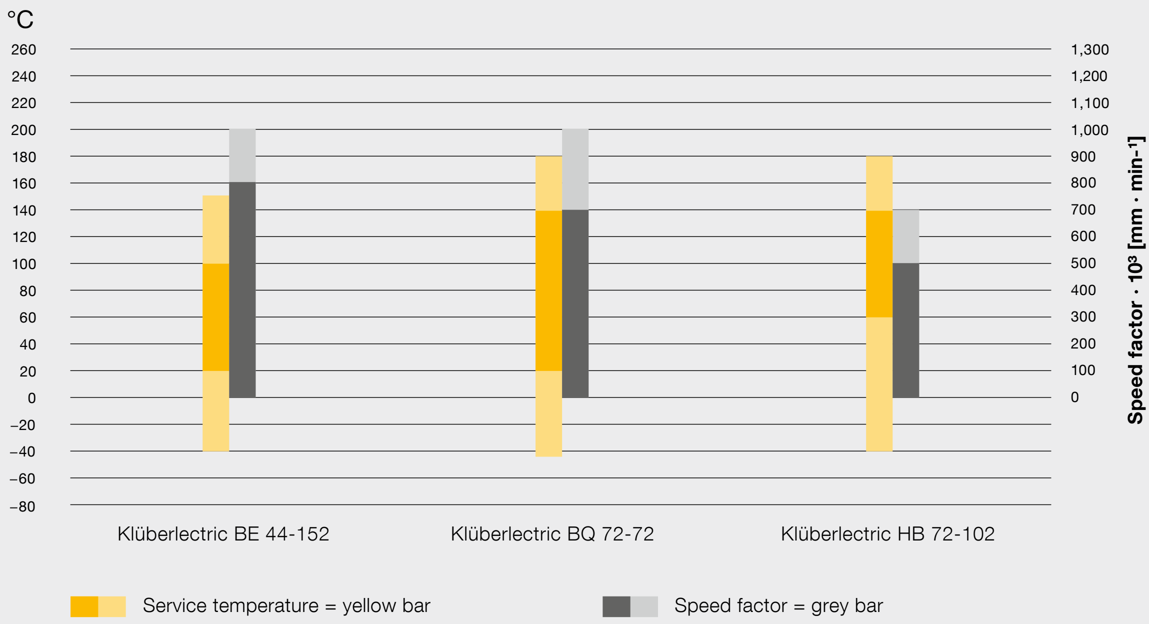
Rolling bearings in electrical components such as generators or motors not only have to meet ordinary bearing-related requirements, e.g. long-term performance at long relubrication intervals or even for-life lubrication at high temperatures or speeds. On top of all that, they also have to overcome a very specific problem, namely electric erosion. It is caused by the undesirable passage of current through the bearing, leading to significant bearing damage and changes in the lubricant properties. The damage suffered by rolling elements and raceways due to current passing through the bearing by way of electric arcs may come in the form of (often symmetrical) craters or scoring marks.

Innovative lubricant design ensures better conductivity

Especially developed lubricants such as Klüberlectric BQ 72-72 or Klüberlectric HB 72-102 reduce harmful electric currents considerably. As the energy impact of undesirable electric currents provokes not only damage to the bearings but also affects the lubricant's performance, another positive effect of lubricants containing IL additives is that they help extend grease lifetime. Comprehensive test rig examinations followed by tribological analyses provide information on the condition of the used lubricant as well as that of the bearing. Test rig results showed that bearing and lubricant damage arising from electric currents are considerably reduced when using Klüberlectric BQ 72-72 or Klüberlectric HB 72-102 compared with conventional lubricants designs.

Upper service temperature [°C]	Lower service temperature [°C]	Base oil viscosity DIN 51562 [mm²/s] at 40 °C approx.	Base oil viscosity DIN 51562 [mm²/s] at 100 °C approx.	Worked penetration DIN ISO 2137 [0.1 mm] approx.	Base oil	Thickener
180	–45	72	9.5	265 to 295	Ester oil	Polyurea
180	–40	95	14	265 to 295	Ester oil	Polyurea
150	–40	150	19	265 to 295	Synthetic hydrocarbon	Lithium soap, solid lubricant

Service temperature and speed factor



The darker-shaded area shows the optimal application range

Product	Description / application examples
Klüberlectric BQ 72-72	– Electroconductive rolling bearing grease for lifetime lubrication – Specific electrical resistance based on DIN EN 62631-3-1: < 1 · 10^7 Ω · cm – Low-noise
Klüberlectric HB 72-102	– Electroconductive rolling bearing grease for lifetime lubrication – Specific electrical resistance based on DIN EN 62631-3-1: < 1 · 10^8 Ω · cm – Good compatibility with seals and elastomers
Klüberlectric BE 44-152	– For long-term lubrication of rolling bearings where electric charges may occur, e.g. in electric motors, paper-making machinery, copying machines, fans, etc. – Electrical resistance based on (former) DIN 53482 is at < 10,000 Ω · cm (electrode gap = 1 cm, electrode surface = 1 cm^2) – Black grease

Cleaning, protection and assembly of rolling bearings

Why clean rolling bearings?

The lubrication of rolling bearings - both initial filling and relubrication - requires careful preparation. Prior to grease application, the friction point should be metallically blank, i.e. free of all residues and dirt particles since contaminated bearings are liable to damage and premature failure. Cleaning also eliminates the risk of incompatibility between the anticorrosive agent used and the subsequently applied grease. Furthermore, the lubricant will only optimally adhere to the bearing surfaces if the lubricated surfaces are free of contaminants. Cleaning prior to greasing is a prerequisite for optimum results to be attained with your lubricants.

This applies in particular to greases based on PFPE as this base oil is not compatible with other base oil types. The cleaning fluid Klüberalfa XZ 3-1 will evaporate quickly and without residues. It will leave the bearing in optimum condition for greasing with PFPE- / PTFE-based lubricants.

In addition, this solvent based on PFPE can also be used as a dispersing agent. This means the lubricant can be applied in very thin layers.

Cleaning

Solvent	Thickener	Product	Description / application examples
Organic	none	Klüberfood NK1 Z 8-001 Spray	– For the removal of oil, grease, wax and resin residues from plastic and metal surfaces – May also be used to remove glue residues as are frequently found on labelling machines
PFPE	none	Klüberalfa XZ 3-1	– Removes residues of grease and oil and prepares the surfaces of parts for optimal adhesion of PTFE/PFPE lubricants

Why do rolling bearings require protection?

Most components of a rolling bearing are made of steel. The most widely used type 100Cr6 is unprotected and therefore not resistant to corrosion caused by air humidity. This poses a risk to operational reliability. If the bearing is left unprotected, corrosion particles forming over time may penetrate into the bearing and lead to increasing bearing noise or premature bearing failure.

Why an anticorrosive agent should offer more than just protection against corrosion

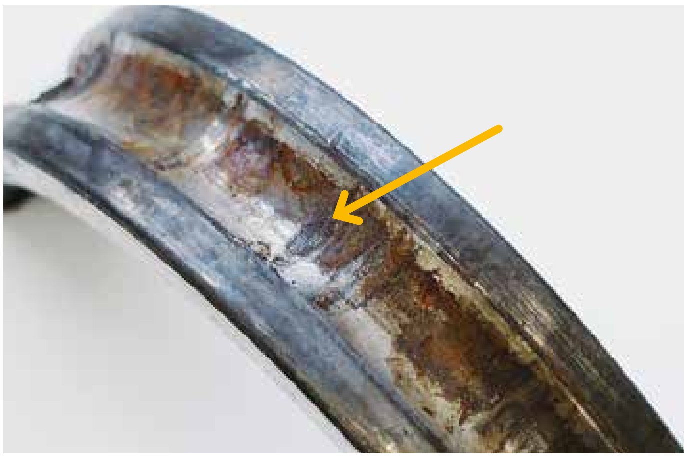
Compatibility with the lubricant used

In cases of incompatibility, insufficient grease adhesion may lead to loss of lubricant. The cause may lie with the anticorrosive oil applied. In this case, the grease may be "floating" on the anti-corrosive film and not be able to adhere to the metal surface.

False Brinelling and anticorrosive oil

An undesirable phenomenon that is sometimes encountered is the so-called False Brinelling. It is characterised by wear marks on the raceways caused by small oscillating motion under load. They are also referred to as stationary marks since they arise in non-moving bearings, e.g. vehicle wheel bearings during trans-port or in idle backup compressors.

False Brinelling can be prevented by an anticorrosive oil contai-ning special additives offering protection against this type of wear, for example Klübersynth BZ 44-4000. The anticorrosive oil also acts as an initial lubricant during the running-in phase until the grease is properly distributed inside the bearing.



Wear marks caused by vibrations in stationary bearings – so-called False Brinelling

Compatibility with plastics and elastomers

Just like the lubricating grease, the anticorrosive oil also has to be compatible with the plastic (cage) and elastomer (seals) mate-rials used in the bearing. We will be pleased to provide advice on this matter. High-performance corrosion protection will enhance and extend the functional performance of the bearing and even-tually enable cost savings for the user.

Protection

Base oil	Thickener	Product	Description / application examples
Synthetic hydrocarbon	Lithium soap	Klübersynth BZ 44-4000	– Lubricating and anticorrosive fluid for rolling bearings offering good wear protection under micro-movements
Ester oil, synth. hydrocarbon	none	Klübersynth MZ 4-17	– Synthetic lubricating and anticorrosive oil for protection of rolling bearings
PFPE	none	Klüberalfa YM 3-30 N	– PFPE oil with good wetting characteristics for conservation of rolling bearings

Assembly pastes help prevent fretting corrosion

Fretting corrosion results from two metal surfaces rubbing against each other under high pressure. It is aggravated by a combination of corrosion and the abrasive effect of corrosion residues. These effects are particularly frequent in components subject to vibration (e.g. bearing seats). As abrasive particles get into the bearing and its contact zones, bearing noise will increase and in many cases the bearing break down prematurely.

Assembling pastes

The simplest way of preventing fretting corrosion in the long term is the use of an assembly paste. Such pastes frequently contain solid lubricants to permanently separate surfaces from one another and thus prevent abrasion. As a result, the bearing can be used over a long period of time.

Fretting corrosion on inner ring

	Klüberpaste ME 31-52	**Klüberpaste HEL 46-450**	**Klüberpaste UH1 84-201**
Application	Tried-and-tested paste for protection against fretting corrosion. For press-fitting rolling bearings.	High-temperature paste for rolling bearing assembly and positive connections. Above 200 °C, the lubricant film will provide dry lubrication.	For use in the food-processing or pharmaceutical industries, preferably in combination with food-grade greases (see appropriate section).
Base oil	Mineral oil	Ester oil//PAG	Synthetic hydrocarbon
Thickener Solid lubricant	Calcium complex soap/ inorganic solid lubricants	Solid lubricant	PTFE/solid lubricant
Colour	white to beige	black	white
Structure	homogenous/short-fibred	homogenous/short-fibred	homogeneous/long-fibred
Service temperature range, approx.	–15 to +150 °C	–40 to +1,000 °C	–45 to +120 °C

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