

Whitepaper

Low-noise bearings

How specialty lubricants can improve noise generation in bearings

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Brief summary

In most applications today, bearings are not only expected to deliver long service life or enable high speeds. Low-noise operation is increasingly also regarded as a standard feature. These requirements can only be met by optimally configured rolling bearings and the best possible mounting conditions. This poses major challenges to the design of bearings as well as their lubrication. After all, the lubricant constitutes an „extended design element“ and plays a decisive role in determining whether a bearing runs quietly or emits unwanted noise.

End users' demand for low-noise bearings is on the rise. In many areas, for example in automotive applications or electrical appliances, bearings have to meet particularly stringent standards in terms of noise. Having know-how in the design of low-noise bearings is therefore an asset for any bearing manufacturer. It is also advisable to dedicate adequate care to finding a lubricant matching the specific bearing design.

Low-noise bearings increasingly in demand

Noise generation in electrical appliances can have many different causes, bearings and their lubricants among them. Precision bearings with narrow functional tolerances are indispensable for low-noise operation. The lubricating grease, however, also plays a major role for smooth running. Even minute particles can be a cause of interference. Any particle in the lubricant over which the rolling elements have to roll will cause an impulse. In many cases, the particle will be pushed out of the raceway and no longer be felt. In other cases, however, it will be pressed into the raceway, increasing the noise generated.

To eliminate sources of undesirable noise in machines, greases must be able to reduce the generation of noise in bearings significantly. Such products are referred to as low-noise greases. While conventional lubricating greases may contain solid particles, low-noise greases never will. The latter show a high degree of purity and undergo a carefully designed production process taking place under suitable conditions. Noise minimisation is comparable to what happens when a car moves along a smooth asphalt road rather than on a bumpy street with cobblestones.

How is low-noise behaviour in rolling bearings measured?

For rolling bearing manufacturers, but also for companies integrating rolling bearings into their products, it is quite helpful to have a scale ready at hand for a comparative grading of the noise emissions attained with different bearing greases.

Many bearing manufacturers have their own methods for testing low-noise greases. The SKF-MoreQuiet and the SKF-BeQuiet+ methods, for instance, are primarily specified with European bearing manufacturers. Japanese manufacturers of low-noise bearings use the andrometer to test both their bearings and the greases used in them. Chinese bearing manufacturers use the BVT-1A and the S0910-III methods for such tests. Since noise testing in bearings is so far not subject to any standardisation, further methods might arise in the future. Klüber Lubrication supplies low-noise greases to all relevant bearing manufacturers and can perform and qualify batch measurements with any test method requested. The aim of grease noise testing is to determine the quality of the grease noise. These tests can, however, also be used in support of developing and improving low-noise greases.

Short-term noise tests

Although there are differences, the various testing methods have important elements in common. It is always fresh grease that is subjected to the test as long as the test is not for a grease's long-term performance. Of course, various greases are tested in a bearing of standard design and size to ensure comparability. The bearing condition, e.g. in terms of age or wear, also has to be comparable. Due to unpredictable parameters, noise tests on used greases are more of a challenge, which is why most test standards apply to tests with fresh grease.

For each test method, the grease quantity is determined depending on the bearing size. The test procedure is largely automatic to eliminate subjective operator influences and the risk of contamination with its potential negative effect on the result. What matters in this context is controlled grease metering and measurement of peak values combined with a test bearing showing particularly good noise characteristics.

The following parameters should be observed and can be used for comparison with other lubricants:

- Smooth running classification of lubricants related to rolled-over particles
- Damping characteristics of the lubricant
- Starting-up behaviour
- Evenness of running noise
- Determination of permanent damage to the bearing due to the lubricant



Typical applications of low-noise greases

Low-noise greases have been used in bearings of computer fans, hard disks and computer drives for many years. Another field of application is in bearings in household appliances such as vacuum cleaners. In the constantly growing number of rolling bearings in electric motors, low-noise greases are used for better user comfort. It should be noted that low noise is also an essential requirement in electric vehicles. Consequently, there are noise specifications applying to many of the bearing greases intended for use in vehicles. Specific car components such as the steering mechanism are subject to noise standards of the manufacturers and required to undergo corresponding component testing.

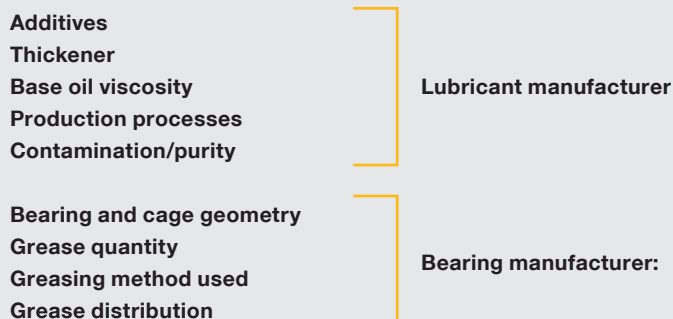
The low-noise characteristics of greases established by various test methods are used as a quality criterion in both incoming goods and finished goods inspection. The lubricant manufacturer inspects each batch; then the bearing manufacturer's will quality-check the greased and sealed bearing in the form of a running-in and noise test.

There are many factors contributing to the noise-damping effect of a lubricant. Higher base oil viscosity goes along with a better damping effect. Furthermore, the thickener type and its micro-structure as well as additives can contribute to the product's damping characteristics.

Which factors can influence the noise generated by a rolling bearing?

The following chart provides an overview of the factors influencing the noise generated by a bearing: It shows that the lubricant manufacturer can have an even stronger influence on the performance of the greased bearing than the bearing manufacturer.

Influences on noise in a bearing



Overview of widely used low-noise test methods for 1-minute short-term tests

Test	Bearing type	Measurement method	Main criterion	Rating scale	
				Good	Poor
SKF MoreQuiet	608	Noise class/ starting-up behaviour	Damping behaviour and peaks/starting-up	I/1	> IV/9
SKF BeQuiet+	608	Noise class	Number and intensity of peaks	GN4	GNX
BVT-1A	Variable bearing type, inner diameter min. 3 mm, outer diameter max. 170 mm	Noises class/ starting-up behaviour/ peak	Damping behaviour, peaks, starting-up	1, 1, 1	> IV,9,9
Anderometer (test method of Klüber Lubrication)	Variable bearing type, inner diameter min. 3 mm, outer diameter max. 15 mm	Noises class/ starting-up behaviour/ peak	Damping behaviour, peaks, starting-up	1, 1, 1	> IV,9,9
S0910 III	608, variable	Noises class/starting- up behaviour/peak	Damping behaviour, peaks, starting-up	1/1/1	4/4/4

Changing noise generation in the course of grease life

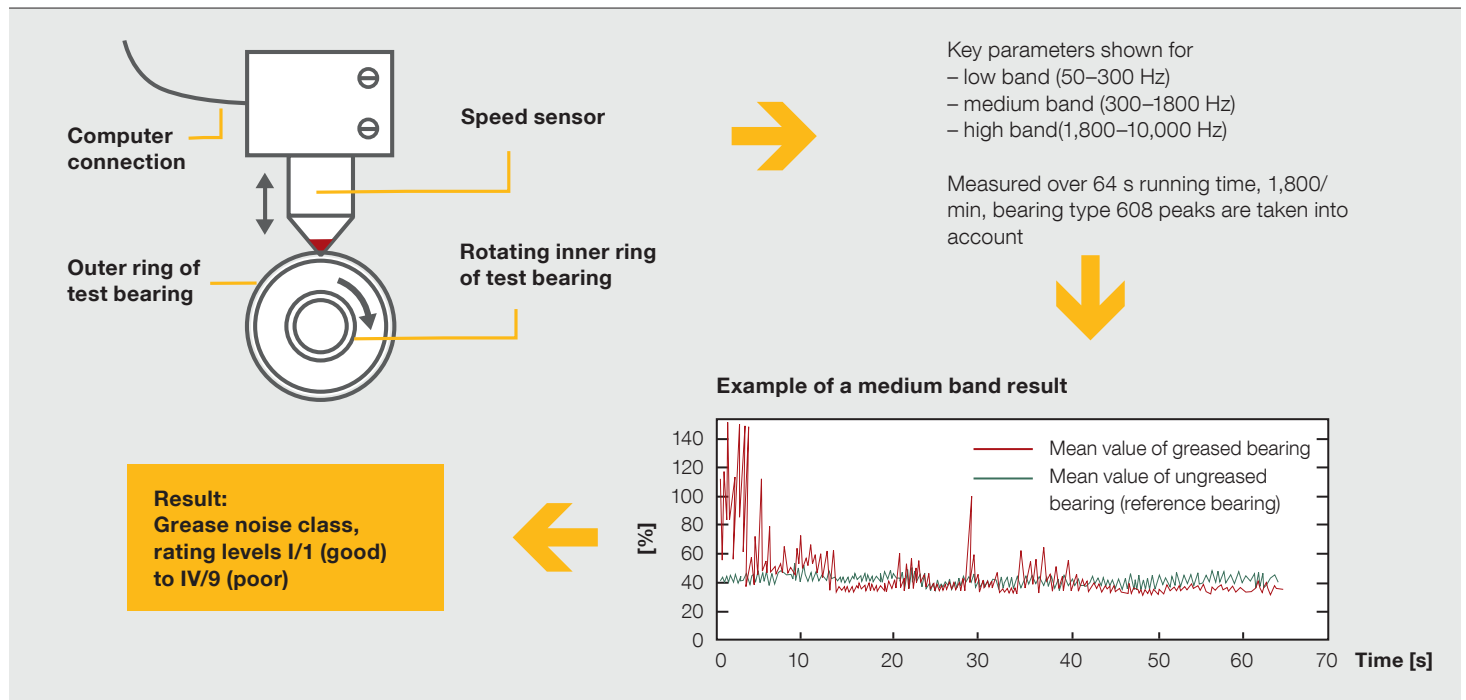
It is a well-known fact that particles in the bearing or the grease generate or increase noise as they are constantly being rolled over. This means that with wear intensifying during a bearing's life, noise will increase as well. So bearing wear and noise go often hand in hand. Massive contamination can cause bearings to break down due to wear. In these cases, the actual useful life of the bearing is far shorter than its calculated service life. Vice versa, louder noise can be a sign that should alert operators to excessive wear or even imminent bearing breakdown.

Besides the standardised short-time noise testing methods listed in the „Overview of widely used low-noise test methods for 1-minute short-term tests“ (see page 3), further tests should be

conducted to obtain reliable results regarding the noise behaviour over the whole bearing life. The short-term tests determine if there are particles that are rolled over. This can be prevented either by making sure the grease is manufactured without any particles entering, or by rheological* concepts impeding particles from being moved around.

Grease distribution is responsible for a particle being moved into the contact zone or not. Grease distribution, in turn, depends on the product's rheological characteristics. Klüber Lubrication has matching test methods in its portfolio that enable a better insight into a grease's rheological characteristics. It is therefore possible to conclude from the formulation and manufacturing process whether a grease has a tendency to move particles around or not.

Principle of testing. Example: SKF MoreQuiet



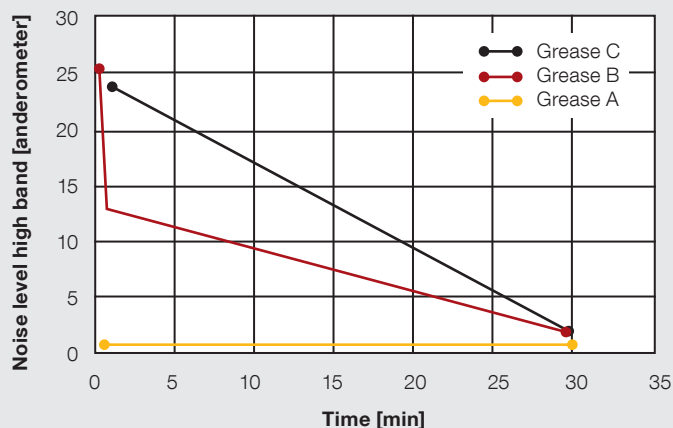
* Rheology undertakes to examine the deformation and flow behaviour of a material.

With many greases, however, grease distribution is not complete after a one-minute noise test run. An extended noise test provides a better understanding of the running-in process.

This rolling bearing test measures the noise generated over the first 30 minutes, telling the operator when grease distribution is complete. Our example shows three lithium soap greases, each with its specific running-in behaviour.

Example of 30-minutes test method

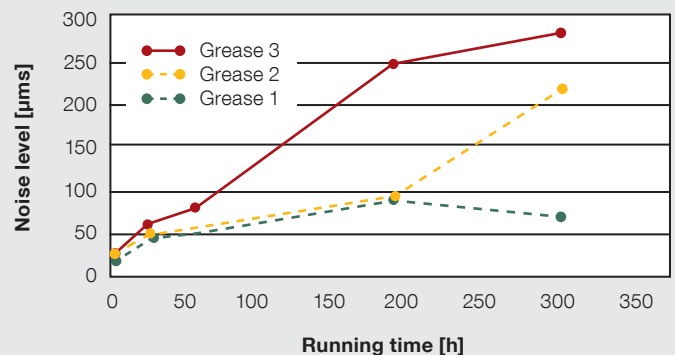
Grease A shows a very low noise level throughout the running-in within 30 minutes. Greases B and C are not low-noise greases, however after several minutes they adapt to the low-noise grease. Grease B takes approx. 2 minutes for initial running-in, but 30 minutes to reach a similar noise level as grease A.



To obtain information on the noise development throughout a grease's lifetime, Klüber Lubrication conducts a combination of for-life testing in rolling bearings and a noise test (in this case BVT-1A). As far as noise is concerned, this testing method is not so much aimed at the rolling-over of particles, but rather the formation of a lubricant film after several hundred hours. The thinner a lubricant film is, the more likely is it that the system will be running under mixed-friction conditions. This means roughness peaks between bearing ring, rolling elements and cage are in contact, which may lead to higher bearing vibrations.

Example of 300-hours test method

The figure illustrating the 300-hours test shows three greases, each with a different noise behaviour over the running time. After 64 seconds, all three greases perform similarly well in the short-term test. Grease 2 shows a rapid increase of the noise level after approx. 180 hours, hinting at weaknesses in grease distribution (lubricant starvation) or wear. Grease 3 shows such signs of wear through a heightened noise level already after a few minutes. This means that the low-noise behaviour of a grease may change significantly over the bearing life.



Which grease for which requirements?

Why can't there be a low-noise grease to serve all applications? Because besides noise there are other application-specific parameters that need to be taken into account for the selection of the right grease. These include the capacity for long-term lubrication, use at high or low temperatures, high speed factors as well as compatibility with bearing cage materials or elastomer seals.

For many years, Klüber Lubrication has been offering a range of low-noise greases made with optimised raw materials and using special production techniques for particularly high purity. They meet a variety of requirements for various applications.

Do you need a low-noise grease for your application, and, at the same time, have to take into account a variety of other requirements such as long service life, good wear protection or smooth running? Then why not send us your requirements specifications? The experts at Klüber Lubrication will be pleased to advise you on the selection of a lubricant matching your needs.