

SKF Grease Test Rig BeQuiet+

Test rig to assess the grease noise in rolling bearings

MVZ 22A



General description

As underlined by SKF's Life Theory, the use of clean lubricants for rolling bearings is essential for ensuring a long bearing life. In lubrication with grease, many factors can affect the degree of cleanliness during operation, but clean grease will always be required for the initial lubrication as well as for relubrication. Also in applications where bearing fatigue life is not at stake (e.g. because of very low loads), the need for clean greases can still be extremely important, as they contribute to low bearing noise which is required for many electric motor applications.

In all of these cases, practice has shown that it is essential to select and check the grease grade/batch for its quiet running behaviour. For this purpose SKF has developed a new test rig which – compared with other available noise testers – has two major advantages. Firstly it gives a quantitative assessment of the noise characteristics of the grease, and secondly it provides the user with the tools he or she needs for reliable and fast analysis.



1. Quantitative assessment of the quiet running characteristics

The SKF rig is able to measure the specific disturbances – called vibration peaks – caused by over-rolling of particles. The key component of the rig is the proprietary SKF peak detection algorithm, which enables these vibration peaks to be singled out from the overall bearing vibration signal. The number of peaks detected and their intensity are used to assess quantitatively the quiet running behaviour. The user is then able to compare the result with a definable target.

In a further step, a measurement of “Damping Ability” is also determined. The aim is to relate the bearing noise of the dry bearing in certain frequency bands to the bearing noise of the greased bearing.

2. Reliable and fast analysis

Efforts have been made to achieve a high degree of automation and to minimise the risk of other sources of contaminant adversely affecting the result. The key to this is the use of controlled grease dosages and peak measurements on a single test bearing of special low noise quality. The entire process is controlled by dedicated software on a personal computer (PC) which also stores all peak data and subsequently evaluates the results to produce either tabular reports or line charts.

After the test bearing has been mounted in the adapter on the spindle, the syringe placed with the grease sample in the dosage unit, and the syringe connected to the adapter, the PC program asks the operator to define the test parameters. Default parameters are also provided. The entire operation proceeds thereafter automatically according to the sequence shown below. In the new BeQuiet+ equipment there are three different measurement modes available:

Start-up mode

This mode enables the user also to identify the grease noise during the speed-up phase of the bearing. The switching-on of the spindle is triggered automatically when the user starts the measurement.

As a result the user obtains the grease noise as a function of the running time, including the behaviour at the very beginning without any run-in time.

BeQuiet mode

Measurement mode is identical to that of the existing BeQuiet equipment. Keeping the functionality the same in the new BeQuiet+ equipment is essential because it guarantees that all existing measurements obtained using previous equipment can still be used, repeated, compared, etc. The results of this mode are the peak values and the grease quality classification.

BeQuiet+ mode

In addition to the results of the BeQuiet mode, a measurement for the “Grease Damping Ability” is determined. M- and H-band values are calculated for both conditions – the dry bearing and the greased bearing. The relationship between these values serves as a measurement of the ability of the grease to damp bearing vibrations.

The sequence of the BeQuiet and BeQuiet+ modes

- 1 Blow-off: clears the test bearing to make space for the next grease dose
- 2 Dosage and pressure release: injects a defined volume of grease from the dosage unit into the test bearing
- 3 Running-in: after each dosage the bearing is run-in for a defined period (default: 10 s) to distribute the grease in the bearing
- 4 Peak reset: zeroing of the peak detector for the next measurement
- 5 Peak reading: storage of the highest peak value recorded during the test period (default: 3,2 s)
- 6 More readings?: the program checks whether the defined number of peak readings has been collected (default: 10 readings)
- 7 More cycles?: the program checks whether the defined number of dosages has been carried out (default: BeQuiet mode 10 dosages, BeQuiet+ mode 2 dosages)

Upon completion of the test, the recorded peak readings are ranked by the program according to a quality scale. The default scales are the SKF BQ scale and the GN scale.

Features of the BeQuiet+

1. Grease quality classes

The P-values of greased 608 bearings are determined using the standard BeQuiet mode. This allows the application the grease quality classes as specified for 608. The P-values identified for the greased 608 bearings are shown in $\mu\text{m/s}$ and the bearings are classified according to the following procedure. The outcome of the P-measurements is given in:

- % of the peaks $\leq 5 \mu\text{m/s}$ ($5 \mu\text{m/s}$ was the limit of the previous BQ1 class)
- % of the peaks $\leq 10 \mu\text{m/s}$ ($10 \mu\text{m/s}$ was the limit of the previous BQ2 class)
- % of the peaks $\leq 20 \mu\text{m/s}$ ($20 \mu\text{m/s}$ was the limit of the previous BQ3 class)
- % of the peaks $\leq 40 \mu\text{m/s}$ ($40 \mu\text{m/s}$ was the limit of the previous BQ4 class)

The grease noise is then classified according to GN classes (standing for Grease Noise) as follows:

GNX: anything worse than GN1

GN1: > 95% of all peaks \leq 40 $\mu\text{m/s}$

GN2: > 95% of all peaks \leq 20 $\mu\text{m/s}$;
> 98% of all peaks \leq 40 $\mu\text{m/s}$

GN3: > 95% of all peaks \leq 10 $\mu\text{m/s}$;
> 98% of all peaks \leq 20 $\mu\text{m/s}$;
100% of all peaks \leq 40 $\mu\text{m/s}$

GN4: > 95% of all peaks \leq 5 $\mu\text{m/s}$;
> 98% of all peaks \leq 10 $\mu\text{m/s}$;
100% of all peaks \leq 20 $\mu\text{m/s}$

2. Grease damping value

In the BeQuiet+ mode, "Grease Damping Ability" is also identified. The aim is to relate the bearing noise of the dry bearing (in reference conditions) to the bearing noise of the greased bearing according to the following equations:

$$\text{GDM} = [(M_{\text{reference}} - M_{\text{greased}}) / M_{\text{reference}}] \text{ and}$$

$$\text{GDH} = [(H_{\text{reference}} - H_{\text{greased}}) / H_{\text{reference}}]$$

where:

GDM Grease Damping Medium band

GDH Grease Damping High band

$M_{\text{reference}}$ M-band value in $\mu\text{m/s}$ (average of 50 reference measurements)

$H_{\text{reference}}$ H-band value in $\mu\text{m/s}$ (average of 50 reference measurements)

M_{greased} M-band value in $\mu\text{m/s}$ (average of 100 grease measurements)

H_{greased} H-band value in $\mu\text{m/s}$ (average of 100 grease measurements)

3. Calibration of the equipment

The BeQuiet calibration manual gives detailed instructions on how to calibrate the mechanics and electronics of the equipment. For the monthly check, the sensor must be calibrated together with the measuring electronics CMME 7000 A for BeQuiet+. There are four different calibration levels:

D daily or for a new measurement series

C monthly by local calibrator

B yearly by local SKF QT specialist

A 3-year check by SKF QT

For this the calibration screen of the new BeQuiet+ electronics can be entered by the user via an extra password (ISO requirement). The pick-up must be clamped into an external calibration device which produces a well-known vibration signal (fixed frequency and defined amplitude). The amplitude is then keyed into the CMME 7000 A/ BeQuiet+ and compared with the measured amplitude from the pickup. A correction factor is automatically determined by the electronics.

Machine description

The machine is a semi-automatic device for laboratory use. It includes a cabinet which incorporates the PC, the keyboard, the screen and some room for tools, the calibration unit and a printer. The second cabinet incorporates the electrical installations, the pneumatics and the actual measuring unit.

- 1 LCD monitor
- 2 Electronics cabinet with CMME 7000 A
- 3 Keyboard
- 4 Cabinet for printer, calibration unit and tools
- 5 Testing mechanics
- 6 Grease dosing unit
- 7 Control panel
- 8 Cabinet for electrics, mechanics and pneumatics



MoreQuiet grease noise evaluation system

The bearing industry mainly uses a system from FAG and/or SKF to evaluate the quality of the grease noise behaviour in bearing applications. With the new MoreQuiet Software, evaluation can be carried out according to the FAG MGE 11 system with the BeQuiet+ mechanics. The grease dosing and blow of function is not used, the grease is filled manually into five bearings.

The SKF BeQuiet+ system

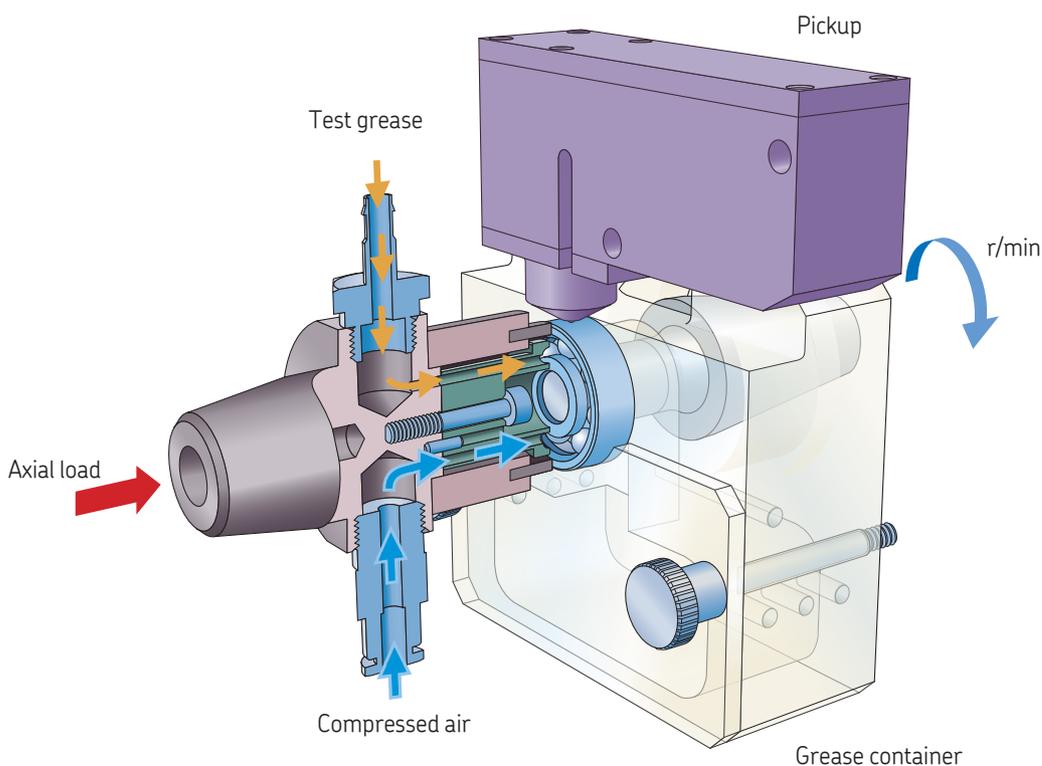
The BeQuiet+ calculates the highest peak value in a certain frequency range using the envelope techniques and the damping characteristics of the grease.

The FAG MGE 11 system

The FAG system evaluates the same sampled values in a different way. The result also shows the damping factor, the grease start-up behaviour, and the average value in the middle and high band.

Functional principle of the SKF BeQuiet+ system

(for the FAG MGE 11 evaluation the grease is manually filled into five bearings)

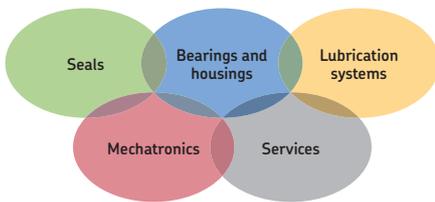


All important parts of the machine can be accessed from the front side. The rig has the following main components:

- A high-quality spindle rotating at 1 800 r/min.
- A special adapter to hold the test bearing, featuring grease inlet and outlet and an inlet for compressed air.
- A pneumatic loading device for the test bearing.
- A grease dosage unit comprising a linear actuator driven by a speed-controlled servo motor which acts on a disposable syringe containing the grease sample.
- The SKF CMME 7000 A electronics with the SKF peak detection algorithm to identify the vibration peaks.
- A special interface to carry out the measurements in a fully automatic way as well as to store the observed peak data and evaluate the results.
- Printer/plotter (optional).

Technical specifications

- Mechanics
 - Spindle: Hydrodynamic oil spindle
 - Axial test load: 30 N default, adjustable from 10 ... 60 N
 - Spindle speed: 1 800 r/min
 - Paint: Blue RAL 5015, white RAL 9002
- Electronics
 - Measuring electronics: CMME 7000 A; for details see datasheet CMME 7000 A
 - Pickup: MEA 200 (velocity proportional sensor)
 - Software: BeQuiet+ optional MoreQueit software, operating system Windows 7
- Tools
 - Test bearing for all modes: BY-608/VQ607
 - Tools: Modified MVH tools with additional possibility for grease dosage and blowoff
- Dimensions and weights
 - Dimensions (H × W × D): 1 700 × 1 405 × 650 mm
(66.9 × 55.3 × 25.6 in.)
 - Weight: Appr. 420 kg (926 lbs)
- Requirements
 - Electrical system: see rating plate, 3 × 400 – 460 V/50, 60 Hz/1,5 kVA
 - Pneumatic system:
Air pressure: 5,5 bar (79.8 psi) at least, clean and dry air
- Measurement results
 - Start-up mode: Start-up behaviour of greases (P, BQx-classification, GNx-classification)
 - BeQuiet mode: P-values, BQx-classification, GNx-classification
 - BeQuiet+ mode: L-, M-, H-band values and P-value, BQx-classification, GNx-classification, Bearing damping classification GDM and GDH
- Calibration tools
 - Sensor calibration tool MEA 6A: To calibrate the sensor and CMME 7000 A electronics
 - Tachometer: To calibrate the spindle speed



The Power of Knowledge Engineering

Combining products, people, and application-specific knowledge, SKF delivers innovative solutions to equipment manufacturers and production facilities in every major industry worldwide. Having expertise in multiple competence areas supports SKF Life Cycle Management, a proven approach to improving equipment reliability, optimizing operational and energy efficiency and reducing total cost of ownership.

These competence areas include bearings and units, seals, lubrication systems, mechatronics, and a wide range of services, from 3-D computer modelling to cloud-based condition monitoring and asset management services.

SKF's global footprint provides SKF customers with uniform quality standards and worldwide product availability. Our local presence provides direct access to the experience, knowledge and ingenuity of SKF people.

Technical specifications subject to change without notice.

For more information on your specific application, please contact our engineers at SKF QT.

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