TMG/BEQUIET⁺

Grease Noise Tester

Why?

As underlined by SKF's Life Theory, the use of clean lubricants for rolling bearings is essential for obtaining a long bearing life.

In the case of grease lubrication many factors can affect the degree of cleanliness during operation, but a clean grease for the initial lubrication as well as for relubrication, will always be required. Also in applications where the 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 these cases, practice has shown that it is really necessary 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 noise testers available - has two major advantages. Firstly it gives a quantitative assessment of the noise characteristics of the grease and it provides the user with the tools for reliable and fast analysis.

SKF Österreich AG

Quality Technology Centre

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1. Quantitative assessment of the quiet running characteristics

The SKF rig is able to measure the specific disturbances caused by overrolling of particles, called vibration peaks. The key component of the rig is the proprietary SKF Peak Detection Algorithm which enables these vibration peaks to be singled out from the total bearing vibration signal. The number of peaks detected and their intensity are used to assess the quiet running behaviour in a quantitative way. The user is then able to compare the result with a definable target.

In a further step a measurement for the "Grease Damping Ability" is also determined. The idea 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 risks that other sources of contaminant adversely affect 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 producing either tabular reports or line charts.

After mounting the test bearing in the adapter on the spindle and having placed the syringe with the grease sample in the dosage unit and connected the syringe 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 to identify the grease noise also during the speed-up phase of the bearing. The switch-on of the spindle speed 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 very first behaviour without any run-in time.

BEQUIET mode: This measurement mode is an exact copy from the existing BEQUIET equipment. Keeping all existing functionality also in the new BEQUIET$^+$ equipment is essential because it guarantees that all existing measurements obtained with old 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 relation of these values is considered as a measure for the ability of the grease to damp bearing vibrations.

The sequence of the BEQUIET and BEQUIET$^+$ mode:

1. Blow-off: clears the test bearing to make space for the next grease dose

2. Dosage and pressure release: takes care of the injection of a defined volume of grease from the dosage unit to 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 s)

6. More readings?: the program checks if the defined number of peak readings has been collected (default: 10 readings)

7. More cycles?: the program checks if 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 on a quality scale. The default scales are the SKF BQ scale and the GN scale.

New features of the BEQUIET$^+$

1. Grease Quality Classes

The P-values of greased 608 bearings are determined with the standard BEQUIET mode. This allows the application the grease quality classes as specified for 608. The P-values identified of the greased 608 bearings are shown in mm/s and the bearings are classified according to the procedure as follows. The outcome of the P-measurements are given in:

- % of the peaks <= 5 µm/s (5 µm/s was the limit of the previous BQ1 class)

- % of the peaks <= 10 µm/s (10 µm/s was the limit of the previous BQ2 class)

- % of the peaks <= 20 µm/s (20 µm/s was the limit of the previous BQ3 class)

- % of the peaks <= 40 µm/s (40 µm/s was the limit of the previous BQ4 class)

The classification of grease noise is then set in GN classes (standing for Grease Noise) in the following way:

GN0: anything worse than GN1
GN1: > 95% of all peaks are <= 40 µm/s
GN2: > 95% of all peaks are <= 20 µm/s;
    > 98% of all peaks <= 40 µm/s

GN3: > 95% of all peaks are <= 10 µm/s;
    > 98% of all peaks <= 20 µm/s;
    100% of all peaks <= 40 µm/s
GN4: > 95% of all peaks are <= 5 µm/s;
    > 98% of all peaks <= 10 µm/s;
    100% of all peaks <= 20 µm/s

2. Grease Damping Value

In the BEQUIET$^+$ mode "Grease Damping Ability" is also identified. The idea 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:

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

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

where:

GDM .... Grease Damping Medium band

GDH .... Grease Damping High band

$M_{reference}$ ..... M-band value in µm/s (average of 50 referencemeasurements)

$H_{reference}$ ..... H-band value in µm/s (average of 50 referencemeasurements)

$M_{greased}$ .... M-band value in µm/s (average of 100 greasemeasurements)

$H_{greased}$ .... H-band value in µm/s (average of 100 greasemeasurements)

3. Calibration of the equipment

The bequiet calibration manual gives detailed instructions how to calibrate the mechanics and electronics of the equipment. For monthly check the sensor must be calibrated together with the measuring electronics MEB 95A for BEQUIET$^+$.

There are four different calibration levels:

D daily or for a new measurement series

C monthly

B yearly by local calibrator

A 3 year check by QTC

For this the calibration screen of the new BEQUIET[+] electronics can be entered by the user via an extra password (ISO requirement). The sensor must be clamped into an external calibration device which produces a well known vibration signal (fixed frequency and certain amplitude). The amplitude is then keyed into the MEB95A/BEQUIET[+] and compared with the measured amplitude from the pick-up. A correction factor is determined by the electronics automatically (this procedure is identical to the standard VKL calibration procedure).

Machine Description

The machine is a semiautomatic equipment for laboratory use. There is 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.

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 1800 rpm

- 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 MEB 95A electronics with the SKF Peak Detection algorithm to identify the vibration peaks

- a PC with a special interface and program to carry out the measurements in a fully automatic way as well as to store the observed peak data and evaluate the results

- a printer/plotter (option).
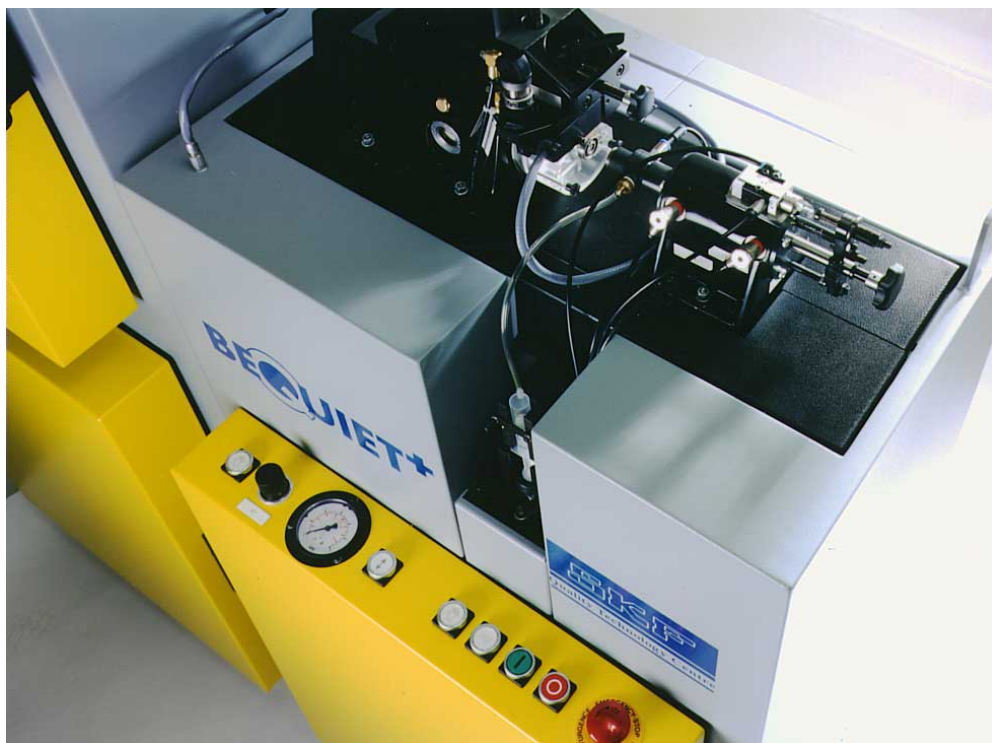
Mechanics	
Dimensions	length 1405 mm width 650 mm height 1700 mm
Transportation	fork lift truck
Spindle system	hydrodynamic oil spindle
Axial loading system	pneumatic, max. 30 N
Spindle speed	1800 rpm

Tools	
Test bearing for ALL modes	608/QE4
Tools for BEQUIET mode, BEQUIET$^+$ mode, Start-up mode	modified MVM / MVH tools with additional possibility for dosage and blow-off

External Connections	
Electrical supply	3 x 400-460 V/50, 60 Hz
Air supply	pneumatic system min. 5.5 bar clean and dry air

Measuring Electronics	
Electronics	MEB 95A; for details see datasheet MEB 95A
Sensor	MEA 200 (velocity proportional sensor)
Measuring modes	Start-up mode / BEQUIET mode / BEQUIET$^+$ mode
Operating system	©Windows NT

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

Technical Data

Calibration Tools	
MEA 6A	transportable device to calibrate the sensor to the measuring electronics
Tachometer	to check the spindle speed

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

QTC, the "Quality Technology Centre" in Steyr, develops, manufactures and markets systems, which are used to ensure the quality in these special fields:

- Roundness and Form Analysis
- Noise and Vibration Control
- Optical Inspection
- Nondestructive Material Testing
- Dimensional Measurement
- Washing
- Laser Marking
- Grease Testing
- Demagnetization
- Cleanliness
- Assembly
- Packaging

QTC supplies the latest technology and highly innovative equipment to customers worldwide and is also the Competence Centre for measuring and quality-related equipment for the SKF Group on a global scale.

QTC, Quality Technology Centre, is located in Steyr - Austria.
You are always welcome to visit us.
The best way to reach us is a flight to Linz via Vienna, Frankfurt or Zurich.

We will, of course, arrange the pick up at the airport.