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Rolling bearings — Noise testing of rolling bearing greases —

Part 3: Test and evaluation method MQ

Roulements — Essais de bruit de graisse pour roulement —

Partie 3: Méthode d'essai et interprétation MQ

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 4, *Rolling bearings*.

This document is intended to be used in conjunction with ISO 21250-1.

A list of all parts in the ISO 21250 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

The rolling bearing life theory emphasizes the use of pure and homogeneous lubricants as essential for a long bearing service life. The lubrication of rolling bearings is described in several national standards. The GfT worksheet 3[11] contains theoretical and practical knowledge of rolling bearing lubrication.

Grease lubrication is the most common type of rolling bearing lubrication. The purity grade of rolling bearing grease is influenced by thickeners, base oils, additives and solid lubricant additives as well as the manufacturing process and is reflected in the running noise. Therefore, noise testing of rolling bearing greases is recommended.

In addition, grease noise testing after this document allows the grease manufacturers to develop low-noise lubricants with highest damping properties. This document can also support the rolling bearing manufacturers and end-users in the selection of low noise grease with better damping properties.

This document covers requirements for the testing assembly and the test machine of method MQ to determine and assess the noise characteristics of rolling bearing grease jointly with ISO 21250-1, ISO 21250-2 and ISO 21250-4.

Rolling bearings — Noise testing of rolling bearing greases —

Part 3: Test and evaluation method MQ

1 Scope

This document specifies the testing and evaluation method of rolling bearing grease noise in accordance with the method MQ.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 5593, *Rolling bearings — Vocabulary*

ISO 15242-1, *Rolling bearings — Measuring methods for vibration — Part 1: Fundamentals*

ISO 21250-1:2020, *Rolling bearings — Noise testing of rolling bearing greases — Part 1: Basic principles, testing assembly and test machine*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 5593, ISO 15242-1, ISO 21250-1 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

3.1
sampling rate
sample rate
<signal processing> frequency with which a continuous signal is sampled and converted into a time-discrete signal

Note 1 to entry: The unit is hertz (Hz) or samples (readings) per second [samples per second (samples/s)].

4 Symbols, abbreviated terms and subscripts

For the application of this document, the symbols, abbreviated terms and subscripts according to ISO 21250-1:2020, Table 1 and Table 2, the symbols and abbreviated terms contained in Table 1 and subscripts contained in Table 2 apply.

Table 1 — Symbols and abbreviated terms

Symbol	Unit	Description
GD	—	Grease damping
H[a]	—	High band, H-band (1 800 Hz to 10 000 Hz)
i	—	Consecutive number
L[b]	—	Low band, L-band (50 Hz to 300 Hz)
M[a]	—	Medium band, M-band (300 Hz to 1 800 Hz)
v	$\mu m \cdot s^{-1}$	Vibration velocity
$\overline{v}_i$	$\mu m \cdot s^{-1}$	Vibration velocity, twice smoothed to the counting point *i*

[a] Can be used as subscript, too, where necessary.

[b] The L-band is used in noise and vibration analysis in the ISO 15242 series. However, this document does not consider this frequency range for grease noise testing and its analysis.

Table 2 — Subscripts

Subscript-symbol	Description
MP	Measuring point
MQ	Method MQ according to ISO 21250-3
NL[a]	Noise level, average value (of vibration velocity)
NP[a]	Noise peak
pk	Peak value
ref	Reference, ungreased bearing
rms	Root mean square
0-32	Starting interval 0 s to 32 s
0-64	Interval 0 s to 64 s
32-64	Operating interval 32 s to 64 s
SUN[a]	Start-up noise of the greased bearing

[a] Noise values with this subscript can be expressed in $\mu m \cdot s^{-1}$ or in % based on the reference value of 16,9 $\mu m \cdot s^{-1}$.

5 Calculation method

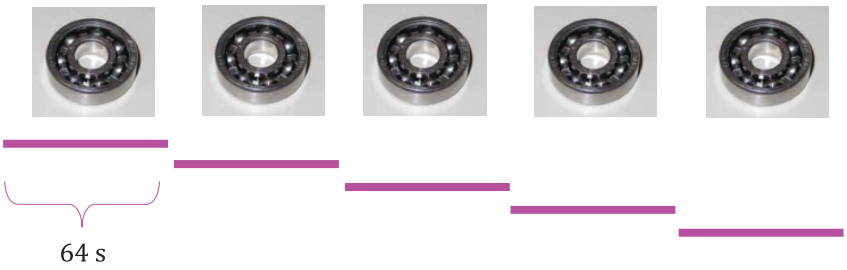
The formulae for calculation of grease damping and peak values are shown in ISO 21250-1:2020, Table 4 and Table 5, respectively.

A sampling rate of 8 readings per second shall be used, i.e. within 32 s, 256 points are required.

6 Test method MQ

6.1 General information

The procedure of MQ requires test bearings to be greased manually. The dosed/balanced quantities of grease shall be introduced in to the bearings by means of a manual grease dosing unit (feeder) or a spatula. There are five pre-greased bearings to be measured for a period of 64 s (each one with a run-in time), as shown in Figure 1.



NOTE Five doses of grease × 64 s = 320 s (including run-in-time) measurement: 4 096 measuring points (MP) at 32,768 kHz ≙ 0,125 s, thus 512 MP/grease dose and in total 2 560 MP.

Figure 1 — Duration of measurement— Process MQ

The process for the manual pre-greasing is represented in B.2.

6.2 Measuring principle

For the application of this document, the measuring principle, test bearings and amount of grease, test load, spindle speed, signal recording and display of measuring results according to ISO 21250-1:2020, Clause 7, applies. The peak detection algorithm for processing of the input signal is shown in ISO 21250-1:2020, Table 5).

An example of a test machine, the test set-up, electronic system and test reports is given in Annex A.

6.3 Testing procedure

6.3.1 Reference measurement of preserved, ungreased bearings

The testing procedure shall include the following steps:

1) The noise tester shall be turned on and warmed up until a spindle temperature of 30 °C is reached on the housing.

2) The MQ-test programme shall be started.

3) For five prepared (cleaned and newly preserved) test bearings (according to B.1), the reference state shall be measured. The noise levels and noise peaks shall be in accordance with the allowed values (see Table 3) for the test to proceed.

4) Mark an arrow on the outer ring side face of the test bearing with a permanent marker.

5) The test bearing shall be pushed on to the mandrel in such a way that the marking (arrow head) on the outer ring points exactly to the sensor.

6) Apply the axial test load according to Table 3 on the test bearing.

7) Lower the sensor and start to rotate the spindle.

8) After this, start the measurement procedure.

9) After the measurement shut off the noise tester, loosen the loading device and withdraw the test bearing from the mandrel.

10) Repeat steps 4) through 9) with the other four test bearings. The test bearings shall be sorted according to order of testing (place 1 to 5).

11) Bearings that are worse than the allowed values (Table 3) shall be rejected. The measurement shall then be repeated with an additional bearing, until five appropriate reference bearings are found.

Table 3 — Basic designation of the test bearings, axial loads, permissible noise level v_{NL} and permissible noise peaks v_{NP}

Basic bearing designation	Axial load N	Axial load tolerance %	Noise level µm · s^{-1}		Noise peak µm · s^{-1}	
			$v_{NL, M\ 0\text{-}64}$	$v_{NL, H\ 0\text{-}64}$	$v_{NP, M\ 0\text{-}64}$	$v_{NP, H\ 0\text{-}64}$
608	30	±10	≤8	≤12	≤2	≤3
6202	60	±10	≤14	≤16	≤3,5	≤4

6.3.2 Comparison measurement of greased bearings

Five appropriate test bearings shall be greased in the order of their reference measurements (in accordance with B.2). Their measurement shall be carried out immediately afterwards in the same sequence and as follows:

1) The test bearing shall be pushed on to the mandrel in such a way that the marking (arrow head) on the outer ring points exactly to the sensor.

2) Apply the axial load according to Table 3 on the test bearing.

3) Lower the sensor and start to rotate the spindle.

4) After this, start the measurement procedure.

5) After the measurement shut off the noise tester, loosen the loading device and withdraw the test bearing from the mandrel.

7 Evaluation of results

7.1 General information

For the use of measuring electronics equipment conforming to this document, the following applies:

1) The machine should have an automated test procedure.

2) The result shall be saved in a printable version and/or be printed on paper.

7.2 Description of results

7.2.1 Preserved bearings

For preserved bearings, the evaluation program indicates, in addition to the noise peaks from 0 s to 32 s, also the noise peaks from 32 s to 64 s and the noise level from 32 s to 64 s of all bearings in the M- and H-bands as well as start-up noise and maximum values.

7.2.2 Greased bearings

For greased bearings, the graphs shall be printed. In addition to the assessment parameters, which are the noise peaks from 0 s to 32 s, the noise peaks from 32 s to 64 s, the damping factors, the start-up noise values of all bearings in the M- and H-bands and the mean values, as well as the classifications to the grease noise class, also the maximum value shall be printed.

7.3 Grease noise classes — Rating scale

The calculation methods for the noise peak values $\nu_{NP,\ M\ 0\text{-}32}$, $\nu_{NP,\ H\ 0\text{-}32}$ and $\nu_{NP,\ M\ 32\text{-}64}$, $\nu_{NP,\ H\ 32\text{-}64}$ are given in ISO 21250-1:2020, Table 5, Formulae (7) to (10) . The calculation methods for the damping factors $GD_{M\ MQ}$ and $GD_{H\ MQ}$ are given in ISO 21250-1:2020, Table 4, Formulae (5) and (6). The assessment shall be carried out in accordance with Table 4.

Table 4 — Grease noise classes — rating scale

Grease noise class	Noise peak values %[a]				Damping factor —[b]	
	$\nu_{NP,\ M\ 0\text{-}32}$	$\nu_{NP,\ H\ 0\text{-}32}$	$\nu_{NP,\ M\ 32\text{-}64}$	$\nu_{NP,\ H\ 32\text{-}64}$	$GD_{M,\ MQ}$	$GD_{H,\ MQ}$
I	≤8,3	≤8,6	≤5,7	≤5,8	≥0,95	≥1,20
II	>8,3	>8,6	$5{,}7 < \nu_{NP,\ M\ 32\text{-}64} \leq 10{,}0$	$5{,}8 < \nu_{NP,\ H\ 32\text{-}64} \leq 10{,}5$	$0{,}70 \leq GD_{M,\ MQ} < 0{,}95$	$0{,}80 \leq GD_{H,\ MQ} < 1{,}20$
III	>8,3	>8,6	$10{,}0 < \nu_{NP,\ M\ 32\text{-}64} \leq 13{,}9$	$10{,}5 < \nu_{NP,\ H\ 32\text{-}64} \leq 15{,}0$	$0{,}50 \leq GD_{M,\ MQ} < 0{,}70$	$0{,}50 \leq GD_{H,\ MQ} < 0{,}80$
IV	>8,3	>8,6	$13{,}9 < \nu_{NP,\ M\ 32\text{-}64} \leq 18{,}0$	$15{,}0 < \nu_{NP,\ H\ 32\text{-}64} \leq 19{,}7$	$0{,}40 \leq GD_{M,\ MQ} < 0{,}50$	$0{,}40 \leq GD_{H,\ MQ} < 0{,}50$
>IV	>8,3	>8,6	>18,0	>19,7	<0,40	<0,40

[a] Based on the reference value 16,9 $\mu m \cdot s^{-1}$.

[b] Dimensionless.

For each individual test bearing, the grease noise class is emitted. This is calculated from the worst value of each of noise peak values and damping factors and the mapping of these in both the middle and high frequency ranges.

The total noise class corresponds to the arithmetic mean, from the mapping of the five test bearing results. The result of the grease noise class is rounded to a whole number (e.g. "I+I+II+II+I = VII/5 = 1,4" results in "I"; "I+II+II+II+I = VIII/5 = 1,6", results in "II"). The noise class shall be indicated in Roman numerals.

The start-up noise for each individual test bearing is displayed. The start-up noise with a slash appended is the starting value, expressed in Arabic numerals. The larger of the two averages ($\nu_{SUN\ H}$, $\nu_{SUN\ M}$) is printed, which is indicated in two decimal places, and rounded down to the integer number (e.g. 2,00 to 2,99 will be rounded down to 2). See also example in Annex D.

7.4 Accuracy of results

When two results are achieved under repeatable conditions, both results can be considered to be accepted provided that both pairs of values for the noise class and the pairs of values for the starting value do not deviate by more than one number in value.

In case of non-equal classes of noise, the result of the better class of noise and, at same noise classes and different starting values, the result with the better starting value shall be indicated.

Examples of results are shown in Table 5.