



JAPANESE
INDUSTRIAL
STANDARD

Translated and Published by
Japanese Standards Association

JIS B 1753 : 2013

(JGMA/JSA)

**Acceptance code for gear units—
Test code for airborne sound**

ICS 17.140.20;21.200

Reference number : **JIS B 1753 : 2013 (E)**

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Date of Establishment: 1971-01-01

Date of Revision: 2013-11-20

Date of Public Notice in Official Gazette: 2013-11-20

Investigated by: Japanese Industrial Standards Committee
Standards Board
Technical Committee on Machine Elements

JIS B 1753:2013, First English edition published in 2014-04

Translated and published by: Japanese Standards Association
Mita MT Building, 3-13-12, Mita, Minato-ku, Tokyo, 108-0073 JAPAN

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Printed in Japan

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Foreword

This translation has been made based on the original Japanese Industrial Standard revised by the Minister of Economy, Trade and Industry through deliberations at the Japanese Industrial Standards Committee as the result of proposal for revision of Japanese Industrial Standard submitted by Japan Gear Manufacturers Association (JGMA)/Japanese Standards Association (JSA) with the draft being attached, based on the provision of Article 12 Clause 1 of the Industrial Standardization Law applicable to the case of revision by the provision of Article 14.

Consequently, **JIS B 1753**:1999 is replaced with this Standard.

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Acceptance code for gear units— Test code for airborne sound

Introduction

This Japanese Industrial Standard has been prepared based on the second edition of **ISO 8579-1** published in 2002 with some modifications of the technical contents.

The portions given sidelines or dotted underlines are the matters in which the contents of the corresponding International Standard have been modified. A list of modifications with the explanations is given in Annex JA.

1 Scope

This Standard specifies the instructions and the standardized conditions necessary for the determination of the airborne sound emission of gear units and gearmotors. This Standard also specifies the allowable measurement methods together with the operating conditions and the mounting conditions used for the test.

The emission characteristics include the emission sound pressure levels at specified positions and the sound power level. The determination of these quantities is necessary for

- a) manufacturers of gear units or gearmotors, in order that they may be able to declare the emitted sound,
- b) for comparing the sound emitted by gear units and gearmotors under service operating, and
- c) for the purpose of noise control at the design stage.

This Standard has the aim of ensuring, with its use, the reproducibility of the determination of the airborne sound emission characteristics within specified limits determined by the grade of accuracy of the basic measurement method used. The sound measurement methods allowed by this Standard are the engineering methods (Grade 2) and the survey methods (Grade 3).

NOTE : The International Standard corresponding to this Standard and the symbol of degree of correspondence are as follows.

ISO 8579-1:2002 *Acceptance code for gear units—Part 1: Test code for airborne sound* (MOD)

In addition, symbols which denote the degree of correspondence in the contents between the relevant International Standard and **JIS** are IDT (identical), MOD (modified), and NEQ (not equivalent) according to **ISO/IEC Guide 21-1**.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this Standard. For standards with the year indication, only the editions of the indicated year shall be applied and the revisions (including amendments) made thereafter shall not be applied. For those without the indication of the year, the most recent editions (including amendments) shall be applied.

JIS C 1509-1 *Electroacoustics—Sound level meters—Part 1: Specifications*

JIS C 1509-2 *Electroacoustics—Sound level meters—Part 2: Pattern evaluation tests*

JIS Z 8404-1 *Measurement uncertainty—Part 1: Guidance for the use of repeatability, reproducibility and trueness estimates in measurement uncertainty estimation*

JIS Z 8404-2 *Measurement uncertainty—Part 2: Measurement uncertainty for metrological applications—Repeated measurements and nested experiments*

JIS Z 8733 *Acoustics—Determination of sound power levels of noise sources using sound pressure—Engineering method in an essentially free field over a reflecting plane*

NOTE : Corresponding International Standard: ISO 3744:1994 *Acoustics—Determination of sound power levels of noise sources using sound pressure—Engineering method in an essentially free field over a reflecting plane* (MOD)

JIS Z 8736-1:1999 *Acoustics—Determination of sound power levels of noise sources using sound intensity—Part 1: Measurement at discrete points*

NOTE : Corresponding International Standard: ISO 9614-1:1993 *Acoustics—Determination of sound power levels of noise sources using sound intensity—Part 1: Measurement at discrete points* (IDT)

JIS Z 8736-2:1999 *Acoustics—Determination of sound power levels of noise sources using sound intensity—Part 2: Measurement by scanning*

NOTE : Corresponding International Standard: ISO 9614-2:1996 *Acoustics—Determination of sound power levels of noise sources using sound intensity—Part 2: Measurement by scanning* (IDT)

ISO 3743-1:1994 *Acoustics—Determination of sound power levels of noise sources—Engineering methods for small, movable sources in reverberant fields—Part 1: Comparison method for hard-walled test rooms*

ISO 3745:2003 *Acoustics—Determination of sound power levels of noise sources using sound pressure—Precision methods for anechoic and semi-anechoic rooms*

ISO 3746:1995 *Acoustics—Determination of sound power levels of noise sources using sound pressure—Survey method using an enveloping measurement surface over a reflecting plane*

ISO 4871:1996 *Acoustics—Declaration and verification of noise emission values of machinery and equipment*

ISO/TS 7849-1:2009 *Acoustics—Determination of airborne sound power levels emitted by machinery using vibration measurement—Part 1: Survey method using a fixed radiation factor*

ISO/TS 7849-2:2009 *Acoustics—Determination of airborne sound power levels emitted by machinery using vibration measurement—Part 2: Engineering method including determination of the adequate radiation factor*

ISO 11203:1995 *Acoustics—Noise emitted by machinery and equipment—Determination of emission sound pressure levels at a work station and at other specified positions from the sound power level*

3 Terms and definitions

For the purposes of this Standard, the terms and definitions given in **JIS Z 8733**, **JIS Z 8736-1**, **JIS Z 8736-2**, **ISO 3743-1**, **ISO 3745**, **ISO 3746**, **ISO 4871** and **ISO 11203**, and the following apply.

3.1 background noise

any sound at the measurement points which does not originate from or is not directly emitted by a gear unit

3.2 band pressure level

effective sound pressure level corresponding to the sound energy contained within a specific band (frequency band)

3.3 measurement surface

imaginary surface enveloping the housing on which the measurement points lie

3.4 measurement surface quantity

correction value of sound pressure level to the unit measurement area (1 m²) (see **C.4.5**)

3.5 nearfield

zone near the sound source where a sound pressure fluctuates in the vicinity of the average value

NOTE : Since in a nearfield, a phase shift is generated among the sound waves arrived from different points on a sound source, those sound waves are mutually overlapped or cancelled, and the mutual interference occurs. For this reason, the limit of nearfield is determined by the shape of sound source and the sound wavelength. Beyond a nearfield, a sound pressure decreases in inverse proportion to the distance from a sound source. If the distance is doubled, the sound pressure level will be reduced by 6 dB.

3.6 frequency spectrum of the sound

spectrum showing the sound pressure level distribution throughout a certain frequency range

NOTE : The spectrum changes according to the bandwidth characteristics of the analyser to be used.

3.7 sound pressure level, L_p

level defined according to the following formula

$$L_p = 20 \log_{10} \left(\frac{p}{p_0} \right)$$

where, L_p : sound pressure level
 p : r.m.s. (root mean square) value of sound pressure measured
 p_0 : reference sound pressure expressed with the unit same as p

NOTE : The sound pressure level is expressed in decibel (dB).

3.8 A-weighted sound pressure level

reading of sound pressure level given by a sound level meter complying with **JIS C 1509-1** and **JIS C 1509-2**, to which A-weighting is applied

3.9 sound power level, L_w

level defined according to the following formula

$$L_w = 10 \log_{10} \left(\frac{P}{P_0} \right)$$

where, L_w : sound power level
 P : sound power measured
 P_0 : reference sound power expressed with the unit same as P

NOTE : The sound power level is expressed in decibel (dB).

3.10 sound intensity

energy of sound that passes through the unit area in sound field in unit time

NOTE : The sound intensity is expressed by the product of sound pressure and particle velocity. The particle velocity can be approximately obtained from the sound pressure difference between two adjacent points.

4 Gear configuration and acoustic environments

4.1 Gear configuration

This Standard is concerned with industrial gear units with gearing of cylindrical, bevel and worm types, and gearmotors. There are following three gear configurations.

- Gear unit independent of driving device and driven device
- Gearmotor with motor integral to gear unit
- Gear-drive system where motor or driving system is installed on a common base-plate with other required auxiliary equipment

The purchaser and the manufacturer shall agree on whether sound is to be measured as the gear-drive system or as the gear unit alone.

Safety guards, coupling guards or insulation hoods, where applicable, shall be mounted during the determination of emitted sounds.

4.2 Acoustic environments

In this Standard, the following three acoustic environments shall be applied to each gear configuration.

- On-site (see 7.2.4)
- On shop test stand (see 7.2.3)
- In specific facility intended for acoustic measurements (see 7.2.2)

5 Sound power level determination

5.1 General

Unless otherwise specified, an A-weighted sound power shall be determined with the test being conducted in the manufacturer's test facility using the method chosen by the manufacturer.

5.2 Methods

In determining the method to be used, the grade of accuracy of measurement is to be considered. Each ISO Standard method gives specific uncertainty limits for the grades with Grade 2 being more precise than Grade 3. An example described in JIS Z 8736-2:1999 is as given in table 1.

Table 1 Uncertainty in determination of sound power level

Octave band centre frequencies Hz	One-third octave band centre frequencies Hz	Standard deviations (s)	
		Grade 2 (engineering method) dB	Grade 3 (survey method) dB
63 to 125	50 to 160	3	—
250	200 to 315	2	—
500 to 4 000	400 to 5 000	1.5	—
—	6 300	2.5	—
A-weighted ^{a)}	—	1.5 ^{b)}	4
The uncertainty of A-weighted estimate herein does not apply if the total A-weighted power in the one-third octave bands outside the range of 400 Hz to 5 000 Hz exceeds the total within this range. In this case, individual uncertainties shall apply. Notes ^{a)} 63 Hz to 4 kHz or 50 Hz to 6.3 kHz ^{b)} The true value of A-weighted sound power level is expected to be in the range of ± 3 dB about the measured value with a certainty of 95 %.			

The preferred methods for determining the sound power level are Grade 2 methods in the following standards.

- ISO 3743-1
- JIS Z 8733
- JIS Z 8736-1 or JIS Z 8736-2

If Grade 2 cannot be attained, one of the following Grade 3 methods may be used.

— **ISO 3746**

— **JIS Z 8736-1** or **JIS Z 8736-2**

If none of the above methods are practicable, methods of **ISO/TS 7849-1** and **ISO/TS 7849-2** may be used.

For the selection of standard to determine the sound power level of industrial gear unit or gearmotor, table 2 or table 3 shall be used.

Table 2 addresses gear units and gear-drive systems which presents a more challenging measurement procedure. Table 3 represents the relatively more easily achieved measurements for a “close-coupled” gearmotor configuration where the sound of the gear unit is not separated from the sound of the motor. The term “gearmotor” may also include other close-coupled arrangements (close-coupled gears and generators, and close-coupled hydraulic motors) where sounds cannot be separated.

Table 2 Selection of standard for sound power level determination of gear units and gear-drive systems

Acoustic environment	Grade of accuracy	Standard for sound power level determination		
		Input power level of gear unit or gear-drive system kW		
		0.1 or over to and incl. 10	Over 10 to and incl. 300	Over 300
Specific facility ^{a), b), c)}	2	<i>JIS Z 8733</i> ^{d)} <i>ISO 3743-1</i> ^{e)} JIS Z 8736	<i>JIS Z 8736</i> JIS Z 8733 ^{d)}	JIS Z 8736
Shop test stand ^{a)}	2	<i>JIS Z 8736</i> ^{b)}		Impracticable
	3	<i>JIS Z 8736</i> ISO 3746 ^{f)}		<i>JIS Z 8736</i>
On-site	2	<i>JIS Z 8736</i> ^{f), b)}		Impracticable
	3	<i>JIS Z 8736</i> ^{f)} ISO 3746 ^{f), g)}	<i>JIS Z 8736</i> ^{f)} ISO/TS 7849-1 and ISO/TS 7849-2 ^{h)}	

NOTE 1 The standard indicated in italics is the preferred standard to be used wherever practicable.

NOTE 2 For each measurement situation, the standard selection order of preference is indicated by the order of listing.

NOTE 3 **JIS Z 8736** refers to either **JIS Z 8736-1** or **JIS Z 8736-2**.

Notes ^{a)} The power available for test may not be sufficient to represent on-site conditions.

^{b)} The size of the gear unit may prevent proper measurement.

^{c)} **ISO 3745** could be used for Grade 2 accuracy in a specific facility.

^{d)} Normally requires an anechoic environment above a reflective plane.

^{e)} Normally requires a reverberant room.

^{f)} The background noise may be too erratic for proper measurement.

^{g)} There may not be sufficient access between units for measurement.

^{h)} The time to make all the necessary measurements may be too extensive.

Table 3 Selection of Standard for sound power level determination of gearmotors

Acoustic environment	Grade of accuracy	Standard for sound power level determination	
		Rated power level of gearmotor to be determined kW	
		0.1 or over to and incl. 300	Over 300
Specific facility ^{a), b), c)}	2	<i>JIS Z 8733</i> ^{d)} <i>JIS Z 8736</i>	<i>JIS Z 8736</i> <i>JIS Z 8733</i> ^{d)}
Shop test stand ^{a)}	2	<i>JIS Z 8733</i> ^{d)} <i>JIS Z 8736</i>	<i>JIS Z 8736</i> ^{b)}
	3	<i>ISO 3746</i> ^{e)}	<i>JIS Z 8736</i> ^{b)}
On-site ^{b)}	2	<i>JIS Z 8736</i> <i>JIS Z 8733</i> ^{f)}	<i>JIS Z 8736</i>
	3	<i>ISO 3746</i> ^{f)} <i>JIS Z 8736</i>	<i>JIS Z 8736</i> <i>ISO 3746</i> ^{f)}
NOTE 1 The standard indicated in italics is the preferred standard to be used wherever practicable. NOTE 2 For each measurement situation, the standard selection order of preference is indicated by the order of listing. NOTE 3 JIS Z 8736 refers to either JIS Z 8736-1 or JIS Z 8736-2. Notes ^{a)} The power available for test may not be sufficient to represent on-site conditions. ^{b)} The size of the gear unit may prevent proper measurement. ^{c)} ISO 3745 could be used for Grade 2 accuracy in a specific facility. ^{d)} Normally requires an anechoic environment above a reflective plane. ^{e)} Normally requires a reverberant room. ^{f)} The background noise may be too erratic for proper measurement.			

NOTE : Overview of standards for measuring methods of sound power level.

ISO 3743-1: Based upon a hard-walled room and low background noise. This Standard gives specifications for sound pressure level measurement in octave bands in order to enable the sound power level to be calculated.

JIS Z 8733: Based upon a non-reverberant environment and low background noise. This Standard specifies a method for calculating the sound power level from the measured A-weighted sound pressure level or the sound pressure level in octave or one-third octave bands.

ISO 3745: Based upon a special anechoic or semi-anechoic test room. This Standard gives specifications for A-weighted sound pressure level measurement in order to enable the sound power level to be calculated.

ISO 3746: Less demanding. It gives specifications for A-weighted sound pressure level measurement only and provides an A-weighted sound power level with Grade 3 accuracy.

JIS Z 8736-1: Can be used in all environments including, to a large extent, reverberation or extraneous sound sources. It gives specifications to sound intensity and sound pressure measurements. Depending on the

level of the reverberation and extraneous sound, it provides the sound power level either as an A-weighted, overall level or in octave bands. For Grade 3 measurements only, the overall A-weighted sound power level is applicable.

JIS Z 8734: Requires measurements of sound intensity and, simultaneously, of sound pressure at discrete points. In this case, the number of measurement points is generally higher than the number of measurement points used for the standards based on sound pressure measurements.

JIS Z 8736-2: Requires measurement of sound intensity and, simultaneously, of sound pressure by scanning. This could be made on a partial or global surface, depending on the configuration of the machine. This method generally reduces the measurement time.

ISO/TS 7849 standards group: Used only when the other methods are impracticable. This method is based upon the measurement of vibration velocity of the relevant parts of gear unit or gearmotor. It provides an estimation of A-weighted sound power level or sound power level in octave, or one-third octave bands.

5.3 Reference box, measurement surface, microphone positions and intensity probe considerations

5.3.1 General

When any of **JIS Z 8733**, **ISO 3746**, **JIS Z 8736-1** or **JIS Z 8736-2** is used, **5.3.2** to **5.3.4** are applicable.

5.3.2 Reference box

The reference box is a hypothetical surface, generally the smallest simple volume (parallelepiped or box) containing the gear unit or gearmotor to be measured, but excluding auxiliaries, transmission elements and the driver for the gear unit. The reference box for a gear-drive system would just include the structure supplied by the gear-drive manufacturer. The box encloses the sound source and terminates on the reflecting plane (hard ground or water). Examples of reference boxes are as given in figure 1 to figure 3.

NOTE : Small components of the sound source which do not contribute to the sound radiation can lie outside the reference box.

5.3.3 Measurement surface

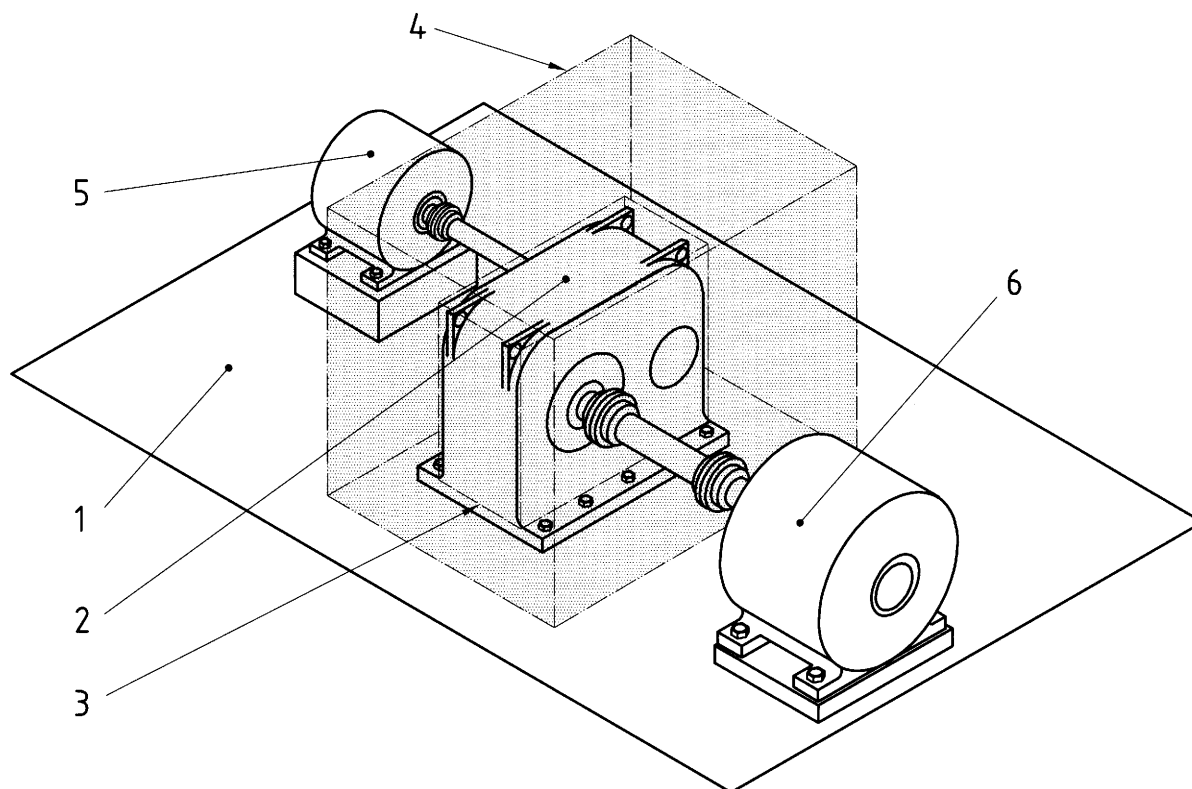
The measurement surface is a surface generally enveloping the reference box at a given distance.

The distance between the measurement surface and the reference box is called the measurement distance. This distance depends on the basic method to be used as follows.

- For **JIS Z 8733** based on a sound pressure level measurement, the distance d shall be 1 m.

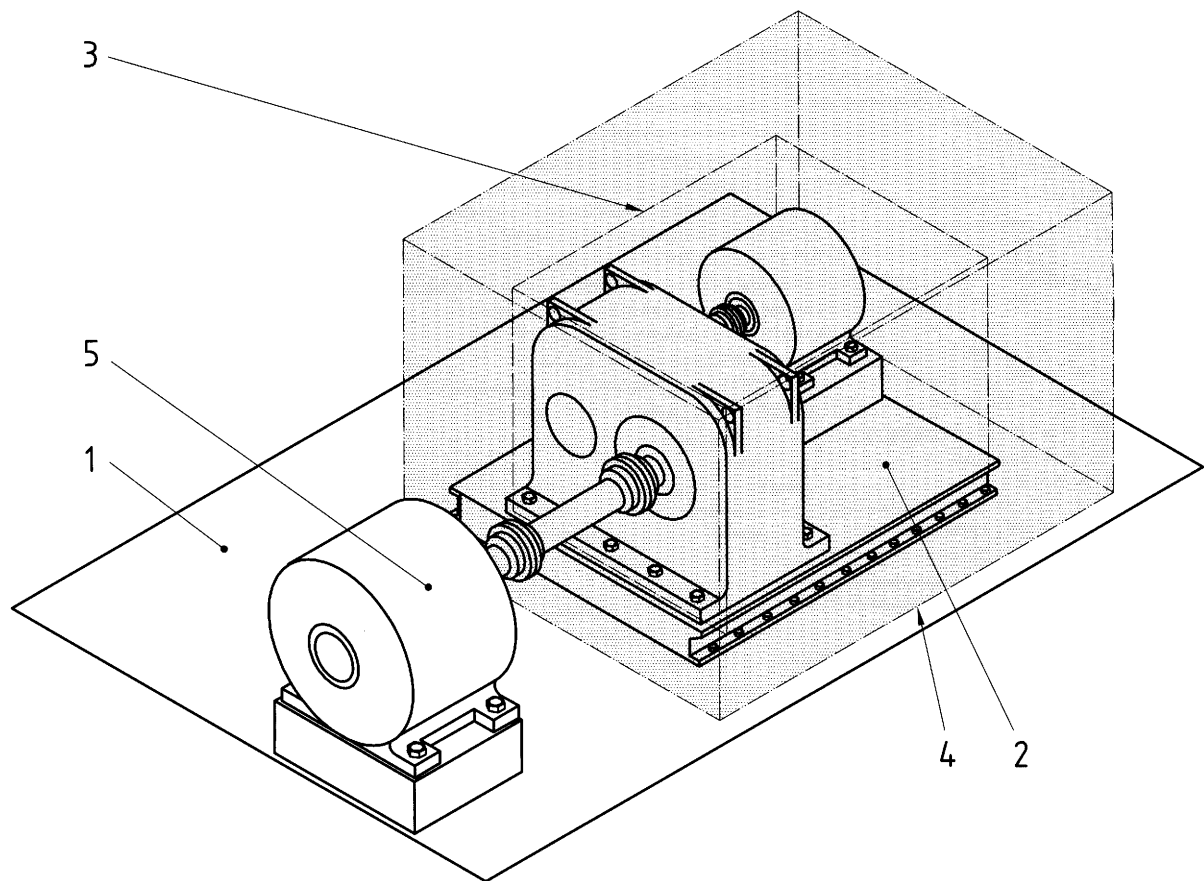
- For **JIS Z 8736-1** or **JIS Z 8736-2** based on a sound intensity measurement, the distance d shall be as follows.
 - For **JIS Z 8736-1**, $d \geq 0.5$ m
 - For **JIS Z 8736-2**, $d \geq 0.2$ m

For typical measurement surfaces, figure 1 to figure 3 shall be referred. Measurement surfaces terminate at reflecting planes, which lie at or within the measurement distance.



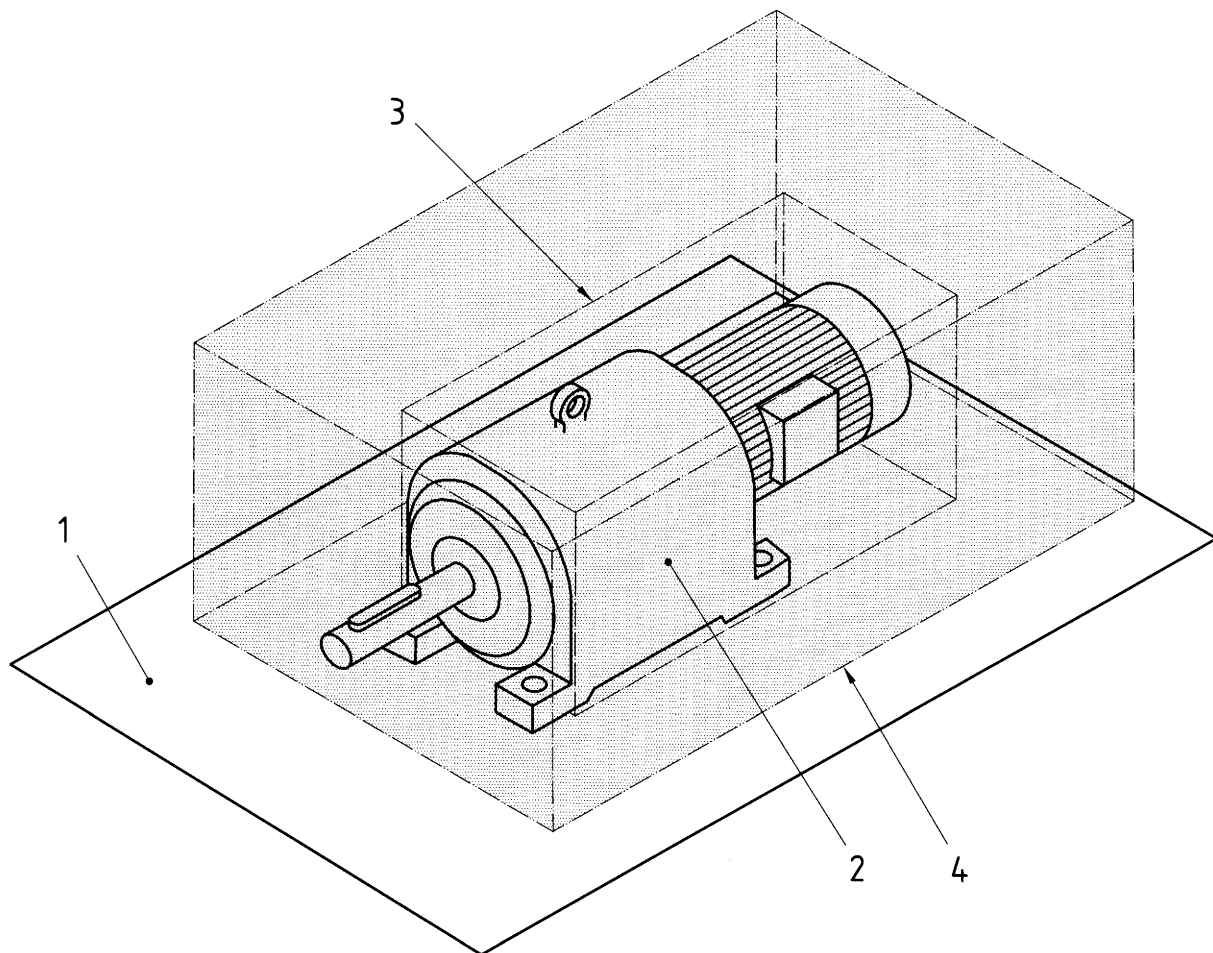
- 1 Test floor
- 2 Gear unit
- 3 Reference box
- 4 Measurement surface
- 5 Motor
- 6 Load unit

Figure 1 Reference box and measurement surface for gear unit



- 1 Test floor
- 2 Gear unit
- 3 Reference box
- 4 Measurement surface
- 5 Load unit

Figure 2 Reference box and measurement surface for gear-drive system



- 1 Test floor
- 2 Gear unit
- 3 Reference box
- 4 Measurement surface

Figure 3 Reference box and measurement surface for gearmotor

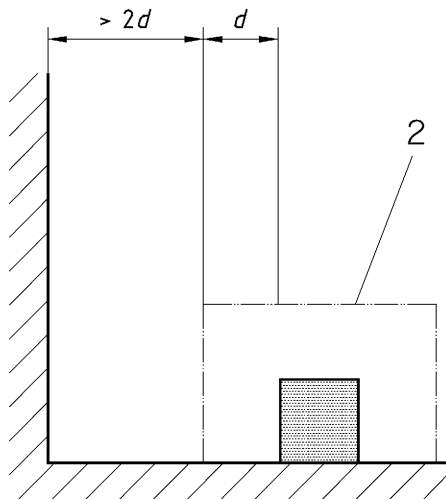
5.3.4 Positions of microphones and intensity probes

The positions of microphones and intensity probes on the measurement surface shall be those specified by the measurement standard to be used.

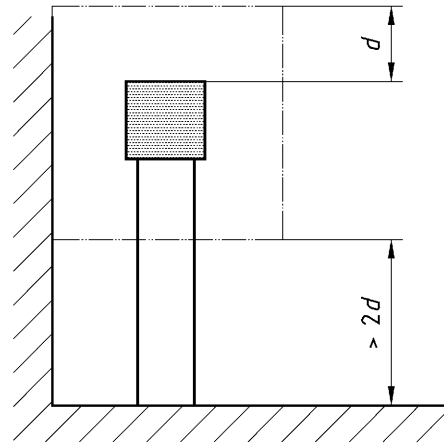
Examples of arrangement of machinery are as given in figure 4, figure 6, figure 8 and figure 10. Examples of typical positions of microphones for corresponding sound pressure level measurements are as given in figure 5, figure 7, figure 9 and figure 11. The positions of intensity probes and the distance d in the case of the intensity measurement may differ from those in the case of the sound pressure measurement.

Caution should be taken in selecting the proper positions of the microphones and intensity probes. They shall be chosen with care and should be appropriate for the arrangement of machinery and the location of walls or sound reflecting surfaces. Otherwise, the determined sound power level may not accurately represent that radiated from the gear configuration only.

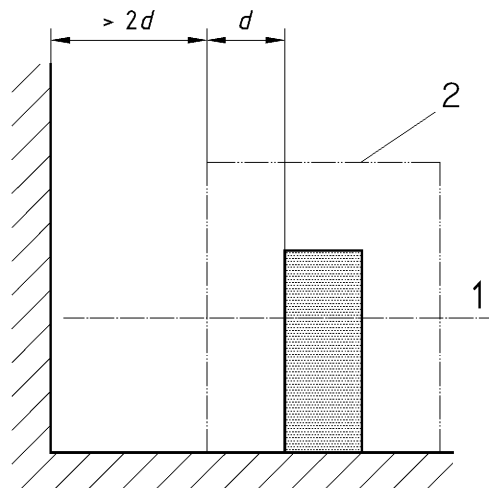
Additional examples of practical microphone positions for various types and sizes of gear are according to Annex A.



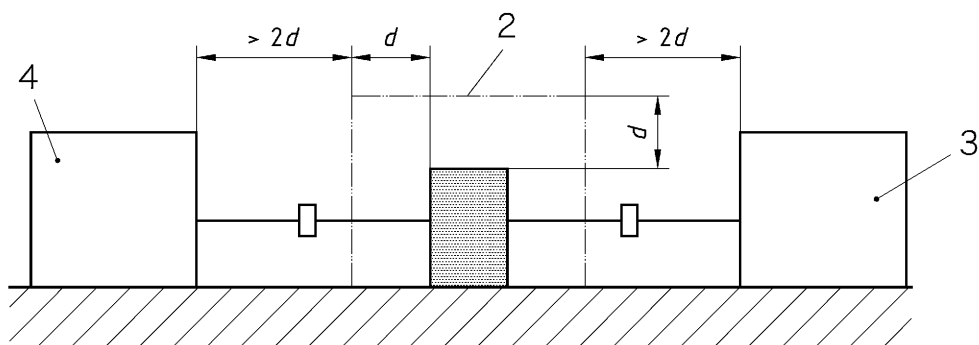
a) Example of machinery mounted on hard floor near hard wall



b) Example of machinery mounted above away from hard floor near hard wall



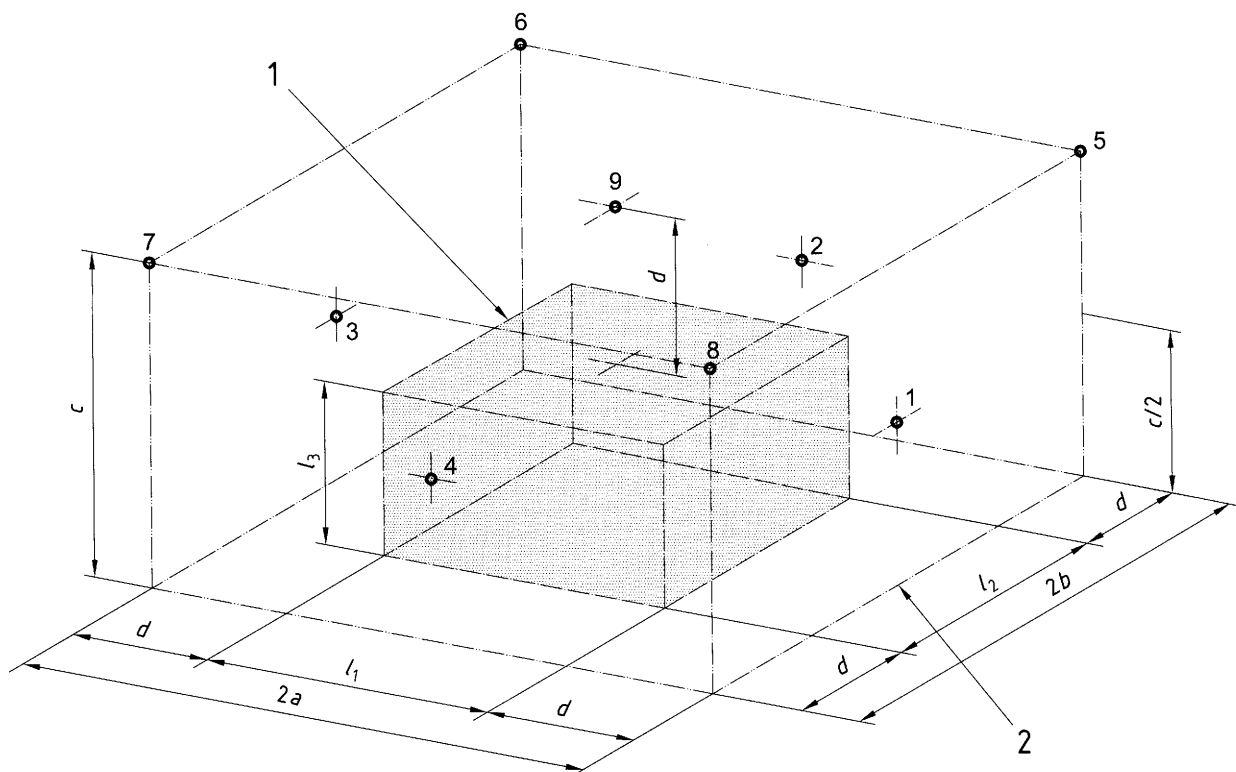
c) Example of machinery mounted on hard floor near hard wall and projected also above flooring grill



d) Example of machinery mounted on same hard floor together with drive unit and load unit

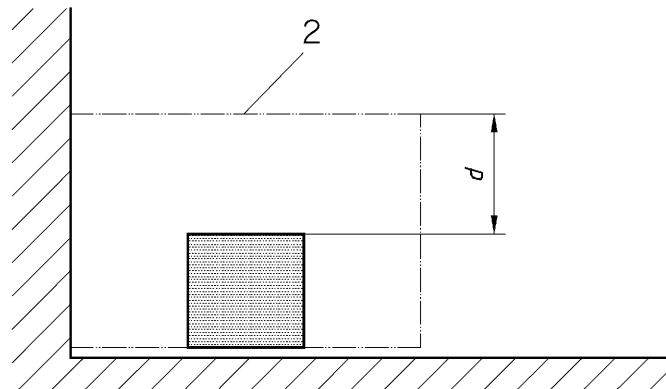
- 1 Flooring grill
- 2 Measurement surface
- 3 Drive unit
- 4 Load unit

Figure 4 Examples of machinery mounted on floor or near wall

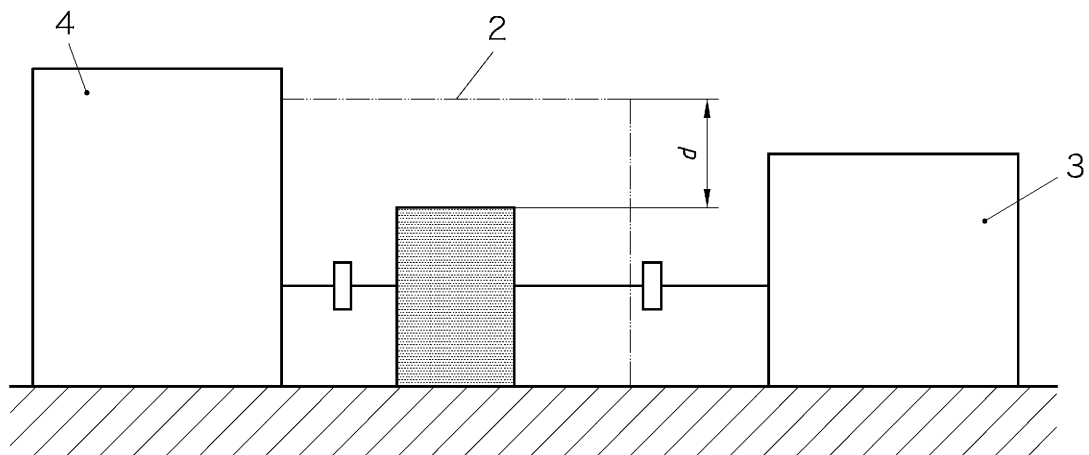


- 1 Reference box © Microphone position
2 Measurement surface

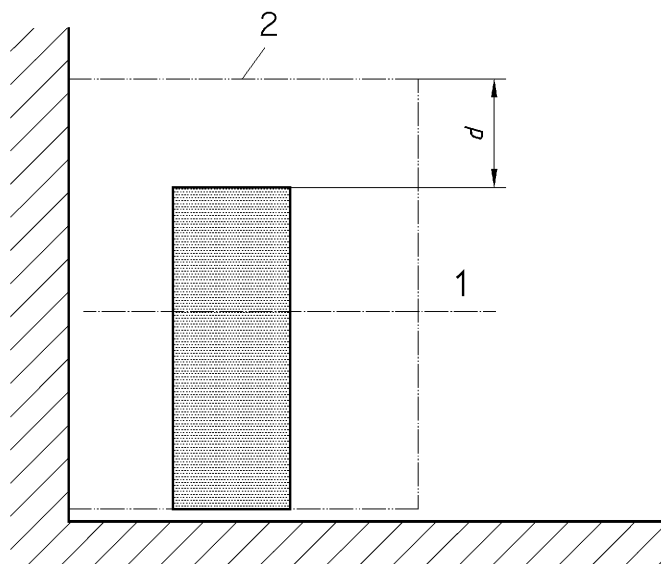
Figure 5 Measurement points arrangement for figure 4



a) Example of machinery mounted afloat from hard floor near hard wall



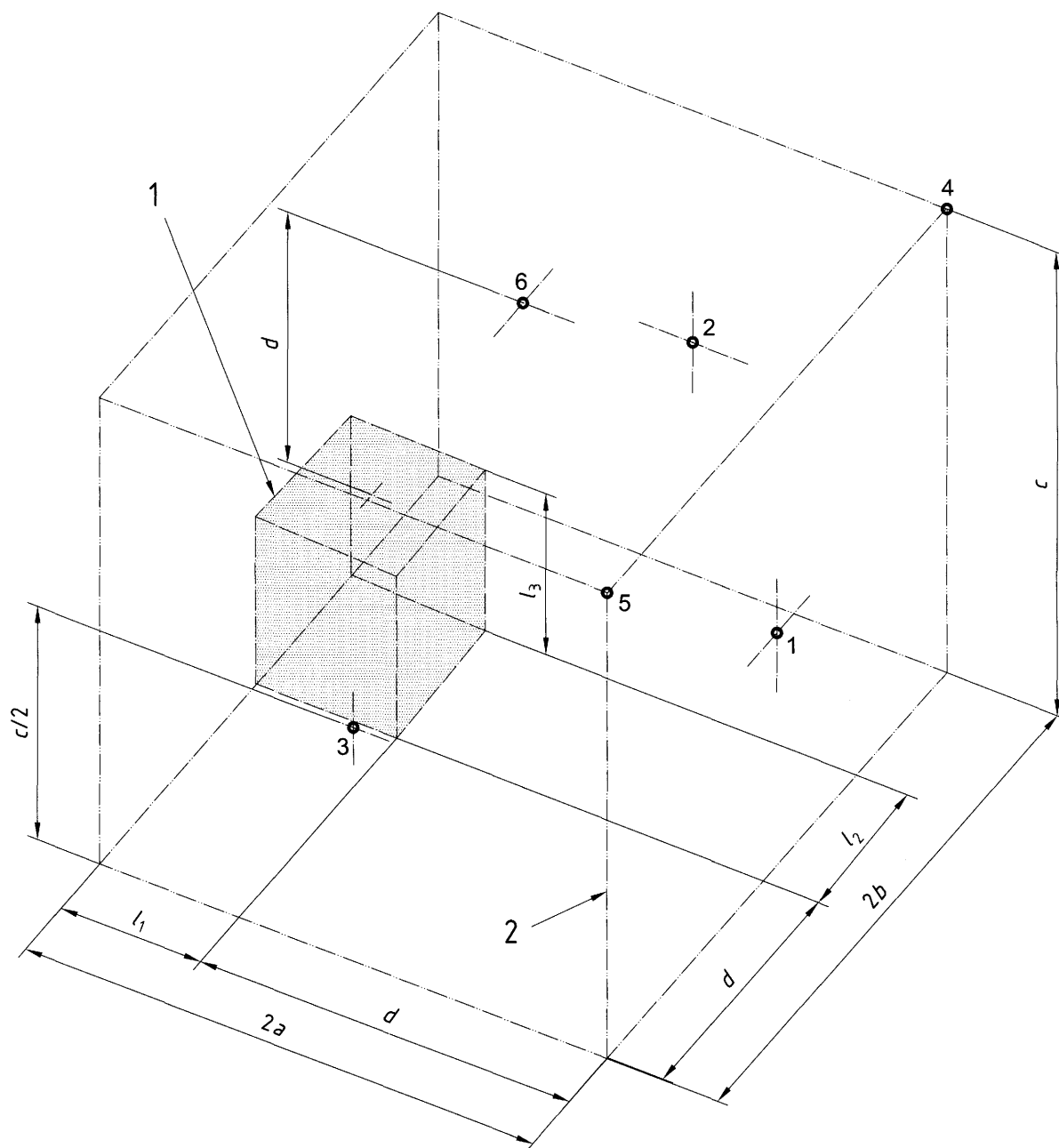
b) Example of machinery mounted in close vicinity to drive unit or load unit on hard floor



c) Example of machinery mounted projected above and below flooring grill near hard wall

- 1 Flooring grill
- 2 Measurement surface
- 3 Drive unit
- 4 Load unit

Figure 6 Examples of machinery mounted on floor or by wall



- 1 Reference box © Microphone position
2 Measurement surface

Figure 7 Measurement points arrangement for figure 6