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**Methods of noise measurement for
pumps**

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Foreword

This Japanese Industrial Standard has been 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 Turbomachinery Society of Japan (TSJ)/Japanese Standards Association (JSA) with a draft being attached, based on the provision of Article 12, paragraph (1) of the Industrial Standardization Act applied mutatis mutandis pursuant to the provision of Article 16 of the said Act. This edition replaces the previous edition (**JIS B 8310** : 1985), which has been technically revised.

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Methods of noise measurement for pumps

Introduction

This Japanese Industrial Standard has been prepared based on **ISO 20361** : 2019, Edition 3, with some modifications of the technical contents to ensure the consistency with relevant **JISs**.

Annex JA is unique to **JIS** and not given in the corresponding International Standard. The vertical lines on both sides and dotted underlines indicate changes from the corresponding International Standard. A list of modifications with the explanations is given in Annex JB.

1 Scope

This Standard specifies all the information necessary to carry out efficiently and under standardized conditions the determination, declaration, and verification of the airborne noise emission of pumps or pump units. It specifies the noise measurement methods and the operating and mounting conditions that shall be used for the test.

Noise emission characteristics include emission sound pressure levels at specified positions and/or the sound power level. The determination of these quantities is necessary for declaring the noise emission values, and purpose of noise control at source at the design stage. The determination of these quantities is also necessary for comparing the noise emitted by pumps on the market.

The use of this Standard ensures the reproducibility of the determination of the airborne noise emission characteristics within specified limits determined by the grade of accuracy of the basic airborne noise measurement method used. Noise measurement methods according to this Standard are engineering methods (Grade 2 of accuracy) and survey methods (Grade 3 of accuracy).

This Standard does not deal with the characterization of the structure-borne sound and liquid-borne noise generated by pumps.

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

ISO 20361 : 2019 *Liquid pumps and pumps units — Noise test code — Grades 2 and 3 of accuracy* (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

Part or all of the provisions of the following standards, through reference in this text,

constitute provisions of this Standard. The most recent editions of the standards (including amendments) indicated below shall be applied.

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 Normative reference in the corresponding International Standard : ISO 3744 *Acoustics — Determination of sound power levels and sound energy levels of noise sources using sound pressure — Engineering methods for an essentially free field over a reflecting plane*

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

NOTE Normative reference in the corresponding International Standard : ISO 9614-1 *Acoustics — Determination of sound power levels of noise sources using sound intensity — Part 1 : Measurement at discrete points*

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

NOTE Normative reference in the corresponding International Standard : ISO 9614-2 *Acoustics — Determination of sound power levels of noise sources using sound intensity — Part 2 : Measurement by scanning*

ISO 3743-1 *Acoustics — Determination of sound power levels and sound energy levels of noise sources using sound pressure — Engineering methods for small movable sources in reverberant fields — Part 1 : Comparison method for a hard-walled test room*

ISO 3743-2 *Acoustics — Determination of sound power levels of noise sources using sound pressure — Engineering methods for small, movable sources in reverberant fields — Part 2 : Methods for special reverberation test rooms*

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

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

ISO/TS 7849-1 *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 *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 *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 purpose of this Standard, the following terms and definitions, and those given in **JIS Z 8733** apply.

3.1

pump

body of the pump device and the area including the piping inlet, piping outlet and driver shaft ends

3.2

pump unit

equipment that is comprised of the pump and its driver (e.g. electric motor, engine, turbine) including transmission elements (e.g. coupling, gear), baseplates, and any auxiliary equipment supplied with the pump

4 Pumps covered and pump configuration

Pumps covered by this Standard are turbo pumps (except submergible motor pumps), rotary pumps and reciprocating pumps (except oil hydraulic pumps).

This Standard specifies measurement methods for pump (see Table 1) or pump units (see Table 2) installed in the following locations :

- a) on site (see **8.2.2**);
- b) on shop test stand (see **8.2.3**);
- c) in a specific facility intended for acoustic measurement (see **8.2.4**).

Safety guards, e.g. coupling guards, insulation hoods, etc., if any, shall be installed during noise emission determination.

5 Sound power level determination

5.1 Selection of determination method

The sound power level should be determined by using **ISO 3743-1**, **ISO 3743-2**, **JIS Z 8733**, **JIS Z 8736-1** or **JIS Z 8736-2** which specify measurement method for Grade 2 of accuracy. However, even when it is desired to obtain only emission sound pressure level, sound pressure level should be measured in a way that enables the determination of the sound power level.

NOTE 1 **ISO 3743-1** is based upon a hard-walled room and low background noise. This Standard gives specifications to sound pressure level measurement in octave bands in order to calculate the sound power level.

NOTE 2 **ISO 3743-2** is based upon special reverberation test room. This Standard gives specifications to sound pressure measurement in octave bands or overall A-weighted emission sound pressure level measurement in

order to calculate the sound power level.

NOTE 3 **JIS Z 8733** is based upon a non-reverberant environment and low background noise. This Standard specifies a method to calculate the sound power level from the measured A-weighted emission sound pressure levels, or sound pressure levels in octave or third octave bands (which does not take into account A-weighted sound pressure levels).

If it has been shown that the applicability requirements of these Grade 2 standards cannot be attained, e.g. too much background noise, then one of the following Grade 3 methods shall be used : **ISO 3746**, **JIA Z 8736-1**, **JIS Z 8736-2**, **ISO/TS 7849-1** or **ISO/TS 7849-2**.

NOTE 4 **ISO 3746** is less demanding (see Annex JA), it only gives specifications to the measurement of A-weighted emission sound pressure levels and provides A-weighted sound power levels with Grade 3 of accuracy.

NOTE 5 **JIS Z 8736-1** and **JIS Z 8736-2** can be used in all environments, including reverberation and extraneous noise sources to a large extent. These standards give specifications to sound intensity and sound pressure measurement. Depending on the level of the reverberation and extraneous noise, it provides the sound power level either as A-weighted overall level or in octave or third-octave band. For Grade 3 measurements, only the overall A-weighted sound power level is available.

NOTE 6 **JIS Z 8736-1** requires measurements of sound intensity and simultaneously sound pressure level (at discrete points). In this case, the number of points needs to be generally higher than the number of points used for the standards based on sound pressure measurements.

NOTE 7 **JIS Z 8736-2** requires measurement of sound intensity and simultaneously sound pressure level at continuous points. This can be made on partial or global surface depending on the configuration of the machine. The method generally reduces the measurement time.

NOTE 8 **ISO/TS 7849-1** and **ISO/TS 7849-2** are Technical Specifications that can be used only when the prescriptions of the other methods are not fulfilled. These methods are based upon measurement of vibration velocity of the relevant parts of the pump or pump unit. **ISO/TS 7849-1** provides an estimation (upper limit) of the A-weighted sound power level and **ISO/TS 7849-2** provides the A-weighted sound power level or sound power level in octave or third octave bands.

For selection of the basic standard for determination of the sound power level of a pump, Table 1 for pumps and Table 2 for pump units shall be used. The reflecting plane in the above standard shall be either a hard plane or a surface of water for pumps.

The standard, indicated in bold letters in Tables 1 and 2, describes the preferred method and shall be used where practical. If it is not practical, one of the other noted basic standards shall be used.

Table 1 Pumps — Selection of determination method of sound power level

Test arrangement	Grade	Pump power input P kW			
		$0.5 < P \leq 15$	$15 < P \leq 75$	$75 < P \leq 300$	$P > 300$
Specific facility for acoustic measurement ^{a)}	2	JIS Z 8733 ISO 3743-2 JIS Z 8736 ^{b)}	JIS Z 8736 ^{b)} JIS Z 8733 ISO 3743-2	JIS Z 8736 ^{b)} JIS Z 8733	JIS Z 8736 ^{b)} JIS Z 8733
Shop test stand	2	JIS Z 8736 ^{b)}			impractical
	3	JIS Z 8736 ^{b)} ISO 3746		JIS Z 8736 ^{b)}	
On site	2	JIS Z 8736 ^{b)}			impractical
	3	JIS Z 8736 ^{b)} ISO 3746		JIS Z 8736 ^{b)} ISO/TS 7849 ^{c)}	
Note ^{a)} A facility can be qualified as specifically designed for noise measurements if it yields Grade 2 measurements.					
Note ^{b)} JIS Z 8736 in this table means JIS Z 8736-1 or JIS Z 8736-2 .					
Note ^{c)} ISO/TS 7849 in this table means ISO/TS 7849-1 or ISO/TS 7849-2 .					

Table 2 Pump unit — Selection of determination method of sound power level

Test arrangement	Grade	Pump power input P kW			
		$0.5 < P \leq 15$	$15 < P \leq 75$	$75 < P \leq 300$	$P > 300$
Specific facility for acoustic measurement ^{a)}	2	JIS Z 8733 ISO 3743-2 JIS Z 8736 ^{b)}		JIS Z 8733 JIS Z 8736 ^{b)}	JIS Z 8736 ^{b)} JIS Z 8733
Shop test stand	2	JIS Z 8733 ISO 3743-1 ^{c)} JIS Z 8736 ^{b)}	JIS Z 8733 JIS Z 8736 ^{b)}	JIS Z 8736 ^{b)} JIS Z 8733	JIS Z 8736 ^{b)}
	3	ISO 3746 JIS Z 8736 ^{b)}		JIS Z 8736 ^{b)} ISO 3746	JIS Z 8736 ^{b)} ISO 3746
On site	2	JIS Z 8736 ^{b)} JIS Z 8733			JIS Z 8736 ^{b)}
	3	ISO 3746 JIS Z 8736 ^{b)}		JIS Z 8736 ^{b)} ISO 3746	
Note ^{a)} A facility can be qualified as specifically designed for noise measurements if it yields Grade 2 measurements. Note ^{b)} JIS Z 8736 in this table means JIS Z 8736-1 or JIS Z 8736-2 . Note ^{c)} ISO 3743-1 can be used for the test of pump units in a shop test stand at the condition that pipings are properly lagged.					

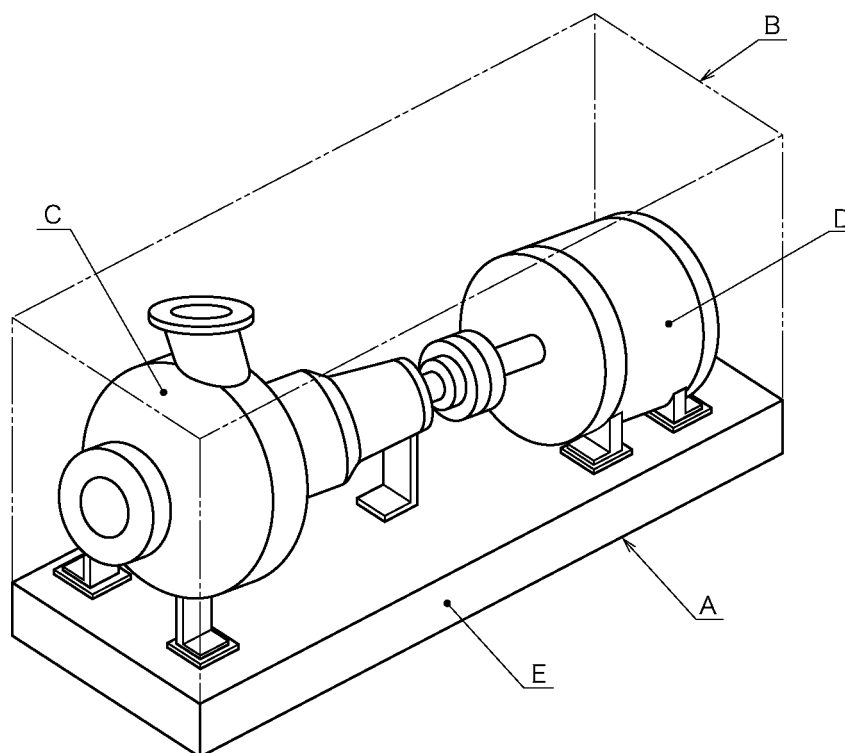
5.2 Reference box, measurement surface, position of microphones and intensity probe

5.2.1 General

When **JIS Z 8733**, **ISO 3746**, **JIS Z 8736-1** or **JIS Z 8736-2** is used, 5.2.2 to 5.2.4 shall be applied.

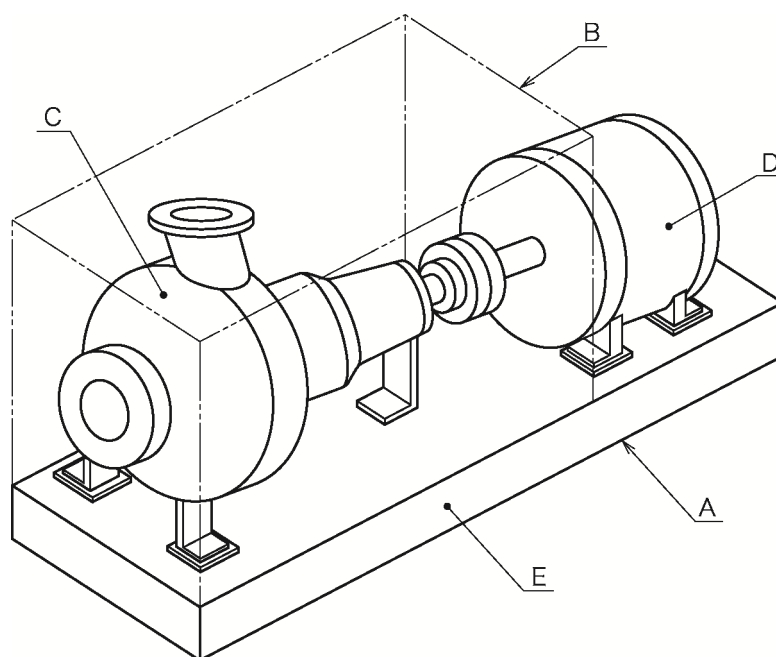
5.2.2 Reference box

The reference box is a hypothetical surface, the smallest simple volume (parallelepiped, box, cylinder, etc.) containing the pump unit or pump and the flanges of the machine but excluding the pipings, transmission elements, and driver for pumps (in the case of pumps) and small individual components of the source that do not contribute to the sound radiation. For **JIS Z 8733** and **ISO 3746**, the reference box is a parallelepiped. The box encloses the source and terminates on the reflecting plane (hard ground or water). For examples of reference boxes, see Figures 1 and 2.



Key
A : reflecting plane
B : reference box
C : pump
D : driver
E : baseplate

Figure 1 Reference box for pump unit (example)



Key
A : reflecting plane
B : reference box
C : pump
D : driver
E : baseplate

Figure 2 Reference box for pump (example)

5.2.3 Measurement surface and microphone positions

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

The distance between the measurement surface and the reference box is called the measurement distance. It depends on the basic method used.

For **JIS Z 8733** and **ISO 3746**, both of which are based on sound pressure level measurements, the measurement distance shall be chosen equal to 1 m. Where the background noise requirements of these standards are not met, a measurement distance smaller than 1 m but equal to or larger than 0.25 m can be chosen.

For **JIS Z 8736-1** and **JIS Z 8736-2**, both of which are based on a sound intensity measurement, the distance shall be

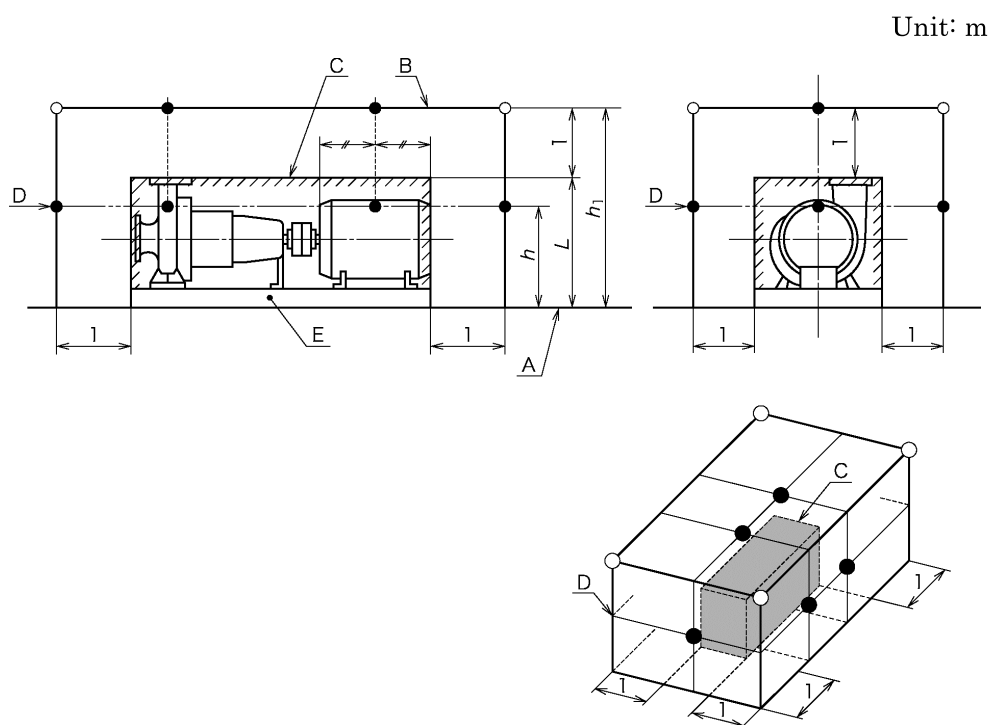
- $d_1 \geq 0.5$ m for **JIS Z 8736-1**;
- $0.2 \text{ m} \leq d_2 \leq 0.5$ m for **JIS Z 8736-2**.

For the measurement surface, see Figures 3 to 6. Reference shall also be made to Annex A.

In the case of the pump, Figure 4 indicates an example of the measurement surface

for pumps. Microphones shall not be placed on the face of the surface that faces the driver (see Annex A) unless measurement is carried out in a specific facility for acoustic measurement by taking action described in 8.2.4 to reduce the impact of the driver noise. The test report shall indicate which actions have been performed to reduce driver noise impact and the background levels at these locations shall be included.

The practical microphone positions for different pump types and sizes shall be those given in Annex B.



Key

- A : reflecting plane
- B : upper measurement surface
- C : reference box
- D : median measurement surface
- E : baseplate
- : microphone positions for Grade 3
- : additional microphone positions for Grade 2
- L : height of reference box
Equal to the highest pump-unit point.
- h : height of median measurement plane $h = (L + 1)/2$
- h₁ : height of upper measurement plane $h_1 = L + 1$

Figure 3 Typical measurement surface and planes for sound pressure level measurement for a pump unit