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JAPANESE INDUSTRIAL STANDARD SERIES FOR THE DETERMINATION OF SOUND POWER LEVELS OF SOUND SOURCES IN VARIOUS MEASUREMENT ENVIRONMENTS

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INTRODUCTION

During past three years, two National Standards, JIS Z 8732 and JIS Z 8733 have been established and one draft Standard JIS Z 8734 has been prepared in Japan. These standards specify the basic methods for the laboratory and field/in situ determinations of sound power levels of sound sources.

They have been prepared as the general standards based on the conventional p-squared methods and prepared by considering the essential conformity with corresponding ISO 3740 series. However, during the drafting of these standards, it was required to introduce some amendments and supplements based on the recent developments and experiences involved in the essential parts of the specifications. Also, from the practical point of view, it was demanded to re-examine the classification of the accuracy grades, especially the up-grade of survey methods in ISO 3740 series.

In this paper, the important specifications in these Japanese Industrial Standard series are described, laying emphasis on the characteristics in comparison with the corresponding ISO 3740 series.

CLASSIFICATION OF THE METHODS FOR DETERMINATION OF SOUND POWER LEVELS OF SOUND SOURCES

Table 1 shows the methods for the determination of sound power levels of sound sources classified by the principles of measurements. As is well known, ISO 3740 series are based on the conventional p-squared method. Recently, the application of the sound intensity method for the determination of sound power level has attracted strong attentions. In near future, basic standard series are expected to be re-established by the combination of the p-squared method and the sound intensity (direct) method. At the present stage of developments, it was decided to establish the Japanese Industrial Standard series within the scope of the conventional p-squared method.

Table 1. The methods for the determination of sound power level classified by the principle of measurement

method		measurement field or test room	ISO	JIS	principle
p^2 – method I	free field method	anechoic room	3745	Z 732	$I = P^2 / \rho c$ $P = \int I \, dS$
	hemi free field method	hemi anechoic room			
	approximately hemi free field method	large (dead) room outdoor	3744 3746	Z 8733 A&B	
p^2 – method II	diffuse field method	reverberation room	3741 3742	Z 8734	$E = \overline{p^2} / \rho c^2$ $P = cEA / 4$
	approximately diffuse field method	usual (live) room	(3743)	Z 8733 C	
sound intensity method (direct method)		anechoic room hemi anechoic room usual (dead) room	DP 9614		$P = \int I \, dS$

SYNOPSES OF JAPANESE INDUSTRIAL STANDARD SERIES ON SOUND POWER LEVEL DETERMINATION

Titles of Japanese basic standards for the determination of sound power levels of sound sources and the correspondence with ISO 3740 series are summarized in Table 2. Because of the annual schedule for the establishment of Japanese Industrial Standards, six standards of ISO 3740 series have been integrated into three JIS Z 8732 series.

Table 2. JIS Z 8732 series for the determination of sound power level of sound source

title	date of establishment	correspomdomg ISO standards
JIS Z 8732 Precision method for the determination of sound power level of sound source in anechoic and hemi-anechoic room	1986 – 02 – 01	3745
JIS Z 8733 Engineering and survey methods for the determination of sound power level of sound source in general sound fields	1987 – 02 – 01	3744 3746 3743*
JIS Z 8734 Precision method for the determination of sound power level of sound source in reverberation room	submitted as draft standard on 1987-03-15	3741 3742

* reference standard

DETAILS OF JAPANESE INDUSTRIAL STANDARDS JIS Z 8732 SERIES

JIS Z 8732-1986 Precision method for the determination of sound power level of sound source in anechoic and hemi-anechoic room

This standard has the essential conformity with corresponding ISO 3745. Several important amendments and supplements are introduced as follows [1].

(1) Procedures for checking the sound field in the anechoic and hemi-anechoic rooms are specified in details. From the loudspeaker set in the room, test sound is emitted and the sound pressure levels are measured along the line directed to the specified direction from the acoustic center of the loudspeaker. From the measured sound pressure levels, the functional relations between the sound pressure level versus distance are estimated. By using these functional relations, the deviations from the inverse square characteristics of sound pressure level at each measuring position are obtained.

(2) The limitation on the maximum volume of the source to be tested is delated. The reason for this deletion is that if the above-mentioned sound field condition is fulfilled at the measurement surface, it would be unnecessary to specify the maximum volume of the source explicitly.

JIS Z 8733-1987 Engineering and survey methods for the determination of sound power level of sound source in general sound fields

The term "general sound fields" means the wide variety of sound fields, such as the sound field in outdoors, large factory rooms, machine rooms in buildings and so on met in practice, in addition to the free field (anechoic room), hemi-free field (hemi-anechoic room) and diffuse field (reverberation room). From the view point of practical applications, this standard corresponding to these general sound fields would play the most important role.

This standard specifies three different methods corresponding to different measurement environments and accuracy grades, as shown in Table 3.

Table 3. Synopses of three methods A, B, and C in JIS Z 8733

method	accuracy	measuring site	measurement surface	correction	quantities to be determined	ISO
hemi-free field method (A)	engineering	hemi-anechoic room, large room, outdoor	hemi-spherical surface, rectangular parallelepiped surface, conformal surface	environ-mental correction, background noise correction	1/3 octave band PWL, octave band PWL, A-weighted PWL *, directivity	3744
hemi-free field method (B)	survey	ditto	rectangular parallelepiped surface	ditto	octave band PWL, A-weighted PWL *	3746
diffuse field method (C)	survey	reverberation room, usual room	diffuse field region in room	random incidence correction	ditto	3743**

NOTE: * calculated from octave or 1/3 octave band PWL
** reference standard

Important specifications in this standard are briefly reviewed in the following:

(1) Survey method in approximately diffuse sound field (Method C).

This method is newly introduced without direct corresponcence with

ISO 3740 series, for the determination of sound power levels of sound sources situated in the relatively reverberant ordinary rooms. Here, procedures for the installation of the source and microphones are refered to ISO 3743, with some simplifications.

(2) Determination of octave band sound power level in survey method.

Octave band sound power level would be necessary for the prediction and control of noise environments in various sound field situations. So, it is included in the quantities to be determined for two kinds of survey methods, by considering some degrees of the up-grade of measurement accuracy.

(3) Determination of A-weighted sound power level.

In general, environmental corrections in Methods A and B and the reverberation time in Method C depend on the frequency of sound. In these cases, A-weighted environmental correction or A-weighted equivalent sound absorption area seems to be meaningless.

This standard specifies that the A-weighted sound power level should be determined from the octave or 1/3 octave band sound power level.

JIS Z 8734 (draft) Precision method for the determination of sound power level of sound source in reverberation room.

Important specifications in this draft standard correspond to ISO 3741 and 3742, except for the following modification and supplement:

(1) In addition to the usual space averaging of sound pressure in the reverberation room, surface sound pressure method is specified in Annex.

(2) the maximum allowable deviations of temperature and humidity during the measurements of reverberation time and sound pressure level are specified in this standard. If the change of temperature or humidity exceeds this limit, corrections for the change of sound attenuation constant in air should be adopted [2]. The method of correction is specified in Annex.

REFERENCES

[1] M.Koyasu *et al*., Proc. of Inter-Noise 86, 1091

[2] ANSI S 1.26, *Method for the calculation of the absorption of sound by the atmosphere.*