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# Developments in the standardization of methods for the measurement and evaluation ofnoise in Japan

Masaru Koyasu

Acoustical Engineering Laboratory,
2-13-11-806, Shinjuku-ku, Tokyo, 160 japan

Developments and future trends in the standardization of methods for the measurement and evaluation of noise in Japan are reviewed in this paper. They are divided mainly into three parts; (1)standards on measuring instruments, (2)standards on methods for the measurement of environmental noise, and (3)standards on methods for the measurement of noise emitted by machinery, equipment and other sound sources. The last parts are further subdivided into two groups, that is general standards and specific standards which specify test procedures to be adopted for specific sound sources. For the developments of these standards, it is the important principles that the key specifications shall hace the sufficient conformities to the corresponding international standards, such as ISO and IEC standards. It is also considered to introduce some amendments and/or supplements based on the recent techinical developments and experiences.

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## 1. INTRODUCTION

Accurate measurements of noises in various kinds of environment and of noises emitted by noise sources are the important basis for the evaluation of noise and the development of noise control technology. From the 1950s, the environmental impacts of industrial noise, construction noise, traffic noise and another kinds of noise have been one of the important social problems in Japan. National and prepared hurriedly. Corresponding to the development of these refulations, it has been strongly required to standardize the method for the measurement of noise and to specify instruments for the measurement of noise. So far, the standardization on the methods for noise measurements in Japan has been mainly aimed at the general environmental noise, sonsistent with the regualtory requirements.

In recent years it has been rather usual that the specifications of noise emitted by various kinds of machinery and equipment have been included in the order form for the machinery or equipment. Hence, it has become necessary to standardize methods for noise measurements.

Corresponding to these two different requirements,several kinds of standard, such as Japanese Industrial Standards, have been established in Japan. Here, it has been strongly reequired thatthe national standards should have sufficient conformity to the international standards, such as those published by the ISO, IEC and so on.In this paper, the outlines of the exsiting Japanese Industrial Standards concerning noise measurement and envaluation and future trends are reviewed.

## 2. STANDARDS ON MEASURING INSTRUMENTS

### 2.1 Sound Level Meters

Sound level meters are widely used as the basic instruments for noise measurements. Sound level meters are used primarily for the measurement of A-weighted sound pressure levels which are used as the standard values in various kinds of noise regulations. They are also used as measuring amplifiers for the frequency analysis of noise. Moreover, in Japan sound level meters are specified in the

Measurement Las as the legal measuring instruments for the measurement of A-weighted sound pressure level and subject to the official approval system.

2.1.1 The existing Japanese Industrial Standards

Three standareds on sound level meters are published as japanese Industrial Standards. These standards originated from JIS B 7201 (Sound level meters) published in 1952 and have been revised or newly published to conform with technical progress. The conformity to IEC standards had been considered carefully at each stage of standards development. However, there still remain some inconformities to the existing IEC standards, IEC 651-1979 "Sound level meter," which was published in 1979 as the overall revision of the previous IEC standards, IEC 123 and IEC 179.

(1) JIS C 1502-1977 Sound level meters

Some parts of this standardconform to IEC 651 Type 2 and the other parts ot IEC 651 Type 3, respectively. The sound level meters which conform to this standard have been widely used in Japan, especially for the large scale field survey of various kinds of environmental noise.

(2) JIS C 1503-1960 Sound level meters (Simple type)

Sound level meters that conform to this standard should only be used for preliminary survey measurements of approximate A-weighted sound pressure level. They are seldom used nose and will be abandoned in the near future.

(3) JIS C 1505-1977 Precision sound level meters

Precision sound level meters are used not only for the measurement of noise, but also for the general measurement of sound. That is, precision sound level meters are often used as the so-called precision measuring amplifiers. This standard was originally established by requiring the conformity to the previous IEC standard on precision sound level meters, IEC 179. So, the existing JIS C 1505 has the essential conformity to IEC 651 Type 1. However, there still remain some minor inconformities.

2.1.2 Revision of JIS series

IEC 651 is regarded as reflecting the recent technology for manufacturing sound level meters. It places strict specifications on various characteristics and test methods.

In 1986, the Institute of Noise Control Engineering of Japan established a technical committee (Chairman, Dr. H. Miura) for preparing the recised draft standard on sound level meters. In March 1987, the revision of JIS C 1505 was completed and submitted for approval to the Agency of Industrial Science & Technology, Ministry of International Trade & Industry. Now, the technical committee is working to prepare the revised draft of JIS C 1502.

In these drafting works, the basic principle has been adopted that the revised standards should have the essential conformity to IEC 651. Hence, revised draft standards JIS C 1505 (Precision sound level meters) conforms to IEC 651 Type 1, and revised draft standard JIS C 1502 (Sound level meters) will conform to IEC 651 Type 2.

Moreover, each of these draft standards has an Annex titled "Functions necessary to determine the equivalent continuous A-weighted sound pressure level and the single event sound exposure level." Specifications in the Annex correspond to those of IEC 804-1985 "Integrating-averaaging sound level meters" and the measuring instruments having these functions are appied for the measurement and evaluation of environmental noise, as will be discussed later in JIS Z 8731 "Methods of measurement and description of A-weighted sound pressure level."

As was already mentioned, draft standards have been prepared by considering the sufficient conformity to the specifications for corresponding types in IEC 651. However, it was required to introduce some amendments based on the recent developments and experiences. It was also necessary to have due conformities to the style of Japanese Industrial Standards as specified in JIS Z 8301, and so it was inadequate to preoare the revised draft standards as simple translations of the corresponding parts of IEC 651.

The important specifications in draft JIS C 1505 are summarized in Table 1 and compared with those corresponding to IEC 651 Type 1.

2.2 Frequency Analyzers

Frequency analysis is important for the evaluation and control of noise. Various kinds of frequency analyzer have been developed and used. They are roughly divided into two types, that is, constant percentage bandwidth analyzers and constant bandwidth analyzers. Rapid advances in digital signal processing have contributed significantly for the design of frequency analyzers. FFT analyzer and various kinds of digital filters are increasingly

**Table 1** The important specifications in draft. JIS C 1505 compared with corresponding IEC 651 Type 1.

| | Standard | |
|---|---|---|
| | IEC 651 Type 1 | Draft JIS C 1505 |
| Frequency weighting | One or more characteristics designated A,B,C. Option:Lin,D | A, C and/or Flat |
| Time weighting | One or more characteristics designated S,F,I. Option:Peak | F and S |
| Accuracy of readings | ±0.7(dB) | 0.7(dB) |
| Toperance on level range control accuracy | | |
| 31.5～8,000Hz | ±0.5(dB) | ±0.5(dB) |
| 20～12,500Hz | ±1.0(dB) | ±0.5(dB) |
| Self noise | at least 5dB below | at least 8dB below |
| Respomse to tone burst | | |
| F:200ms | -1.0±1(dB) | -1.0+0.5(dB) -1.0 |
| S:500ms | -4.1±1(dB) | -4 ±1 (dB) |
| Macimum overshoot | | |
| F | 1.1(dB) | 1(dB) |
| S | 1.6(dB) | 1(dB) |
| Range of the indicator | at least 15dB | at least 15dB |
| Scale(analogue) | at least 1mn/1dB | at least 1mn/1dB |
| Scale(digital) | Resolution of 0.1dB or more | |

important in the field of noise measurement.

Still, the most widely used frequency analyzers for noise measurements are octave-band and 1/3 octave-band frequency analyzers. Now, the following Japanese Industrial Standard is applied to frequency analyzers which are principally used for noise measurements:

JIS C 1513-1983 Octave and third-octave band analyzers for sounds and vibrations.

Typical standards related with JIS C 1513 are the following two standards:

**Table 2** Filter characteristics specified in JIS C 1513.

| | Band width | |
|---|---|---|
| | Octave band | 1/3 octave band |
| I | ANSI Class I | - |
| II | IEC<br>ANSI Class II | IEC<br>ANSI Class II |
| III | - | ANSI Class III |

Note: IEC 225 and ANSI S1.11 are under revisions. Above specifications correspond to the existing versions.

IEC 225-1966 Octave, half-octave and third-octave band filters intended for the analysis of sounds and vibrations.

ANSIS 1.11 American national standard specifications for octave, half-octave and third octave filter sets.

The important specifications of JIS C 1513 were established by considering the due conformity to these standards. The correspondence of the filter characteristics specified in JIS C 1513 with those of IEC and ANSI standards is summarized in Table2.

Another special feature of JIS C 1513 is that it specifies the characteristics of analyzers in addition to those of filters. This means that the specifications for indicating devices are also included in JIS C 1513, corresponding to the specifications in standards for sound level meters (JIS C 1502 and JIS C 1505).

The existing IEC and ANSI standards are now under revision, considering the recent developments of filter design technology. Especially, the important changes habve been made to place more strict specifications of filter characteristics and to introduce the digital filter technology.

In the near future, it will become necessary to revise the existing JIS C 1513 to take the conformity to the revised IEC standard/

## 2.3 Level Recorders

In Japan, for field surveys environmental noise and for related noise measurements, it has been usual to take the continuous recordings of A-weighted sound pressure levels over the measurement time periods. For these noise measurements, the indicating characteristics of the level recorders are standardized in conformity with those of sound

level meters.

The following Japanese Industrial Standard is applied to level recorders used for noise measurements:

JIS C 1512-1983 Level recorders for recording sound level and/or vibration level.

The important specification in this standard is that the recording characteristic shall have the exponential time weighting just like those of sound level meters. The recording characteristics of existing level recorders are divided into two types: those with the constant speed response and those having the exponentially variable speed response. The level recorders with exponentially variable speed response which have basically the same dynamic characteristics as sound level meters, are specified in this standard to record the AC output signals of sound level meters. The level recorders with constant speed response are specified to record either the DC (rms) output signals of sound level meters or the DC (rms) outout of sound level meters. The details of this circuit are specified in the Annex to this standard.

## 3. GENERAL STANDARDS ON THE METHODS FOR MEASUREMENTS OF NOISE

Standards on methods of measurements of noise are roughly divided into two groups, that is general/basic standards and specific standards. Here, the outlines of general/bacsic standards are reviewed.

### 3.1 The Basic Standard on the Method of Measurement of Envieonmental Noise

As the basic standard for the measurement of A-weighted soudn pressure level, the following standard is used in Japan:

JIS Z 8731-1983 Methods of measurement and description of A-weighted sound pressure level.

This standard was first published in 1957 and it has been widely used as the basic standard on the method for the measurement of noise in Japan. Especially, most of the measurements of noise required by the Noise Regulation Law and the Environmental Quality Standards for Noise in Japan refer to this standard.

When first published, this standard had the specifications on the method for the measurement of noise emitted by various kinds of noise source such as machinery and vehicles, in addition to the method for measurement of environmental noise. In this sense, this standard was the most important basic standard for the measurement of all noise sources.

In relation with the publication of the international basic standard on the method for the measurement and description of environmental noise, ISO 1996/1, the overall recision of JIS Z 8731 was undertaken and the revised standard was published in 1983.

The important specifications in the revised JIS Z 8731 are summarized in the following paragraphs.

(1) Scope: This standard specifies the method

**Table 3** Evaluation of noise in various kinds of regulation and standard in Japan.

| Type of noise | Descriptors | Measurement positions | Remarks |
|---|---|---|---|
| General envieonmental noise | $L_{50}$ | Locations in question Standard for Noise | Environmental Quality |
| Industrial noise | $L_5$ , Average of peak levels | Boundary line of a site | Noise Regulation Law |
| Construction noise | ditto | 30m from the boundary line of working site | ditto |
| Railway noise (Shinkansen) | Power average of peak levels | 1m from the facade of building in question | Environmental Quality Standard for Noise |
| Road traffic noise | $L_{50}$ | ditto | ditto |
| Road vehicle | Peak level | 7.5m from the center Noise Regulation Law lineof track | |
| Aircraft noise (around airport) | WECPNL | Locations in question | Environmental Quality Standard for Noise |

for the measurement and description of noise in general environments and at the working environments. The method for measurement of noise emitted by machinery and other noise sources specified in the older standard was deleted.

(2) Descriptions for the environemental noise: In the older JIS Z 8731, percentile levels $L_{50}$, $L_5$ and $L_{95}$ were specified as the descriptors of fluctuating noise. These quantities have been used for the evaluation of environmental noises in various kinds of regulation and standard in Japan. Typical examples of the application of these quantities for national and local regulations and standards are summarized in Table 3. Corresponding to these situations, percentile levels $L_x$ are still used as the descriptors for environmental noise in the revised JIS Z 8731.

As in ISO 1996/1, equivalent continuous A-weighted sound pressure level $L_{Aeq,T}$ was introduced in the revised JIS Z 8731 as on of the descriptors of environmental noise. Also, single event sound exposure level $L_{AE}$ was introduced as the basic quantity for the description of intermittent and impulsive noises.

Thus, this standard specifies two different kinds of descriptor for enbvironmental noise, that is the energy-based rating quantities $L_{Aeq,T}$ and $L_{AE}$, and the statistical rating quantities $L_{50}$ and so on. This standard specifies the method for measurement of these quantities in the case of various kinds of environment. The application of these quantities for the evaluation of environmental noise lies outside the scope of this standard.

(3) Measurement positions: The specifications for the measurement positions in JIS Z 8731 are completely in conformance with ISO 1996/1.

### 3.2 The Basic Standards for the Determination of Sound Power Levels

#### 3.2.1 Background for the standardization

So far, A-weighted sound pressure levels or band pressure levels have been mainly used in Japan for the description and evaluation of noise emitted by various kinds of noise source. In the older version of JIS Z 8731 and most of the standards on the methods for measurement of noise emitted by individual machinery, A-weighted sound pressure levels have been used. As is well known, A-weighted sound pressure levels or band pressure levels depend on the conditions of the measurement environment and the relative positions between the source and microphon position. It is necessary to take care of the measuring conditions for the practical applications of the measured data on the noise sources.

In Europe and America, the applications of the sound power level for the description of noise emitted from noise sources have been fixed for a long time. Already, in 1972 a "Sound power level measurement symposium" was held in the U.S.A.[1)]

More than 15 years ago, ISO/TC 43/SC 1 started work on the preparation of basic standards for the determination of sound power level of noise sources and until now, most of the basic standard series, the so-called ISO 3740 series, has been published. Now, the standards for the determination of sound power level of specific noise sources are in progress. Also, a basic standard for the determination of sound power level based on the sound intensity technique is being drafted by an ISO working group.

Under the background of these situations, the importance of sound power levels has been gradually understood in Japan and the standardization of methods for the determination of sound power levels have been strongly demanded by the industry.

#### 3.2.2 Standards for the determination of sound power levels of sound sources in various measurement environments

(1) Outline

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

These standards have been prepared as general standards based on the conventional p-squared methods and prepared by considering the corresponding standards of the ISO 3740 series. However, during the drafting of these standards, it was required to introduce some amendments and additions to account for recent developments and experiences involved. Also, from th epractical point of view, it was necessary to reexamine the classification on the accuracy grades, especially to up-grade the survey methods of the ISO 3740 series.

(2) Classification of the methods for determination of sound power levels of sound sources

Table 4 shows the methods for the determination of the sound power levels of sound sources classified by the principle of measurement. As is well known, the ISO 3740 series is based on the

**Table 4** Methods for the determination of sound power level classified by the principles of measurements.

| | Methods | Measurement field or test rom | ISO | JIS | Principle** |
|---|---|---|---|---|---|
| -method I | Free field method | Anechoic room | 3745 | Z8732 | $I = p^2/\rho c$ |
| | Hemi-free field method | Hemi-anechoic room | | | $P = \int I\, dS$ |
| | Approximately hemi-free field method | Large (dead) room<br>Outdoors | 3744<br>3746 | Z8733<br>A&B | |
| -method II | Diffuse field method | Reverberation room | 3741<br>3742 | Z8734 | $E = \overline{p}^2/\rho c^2$ |
| | Approximately diffuse fieild method | Ordinary (live) room | | Z8733<br>C | $P = cEA/4$ |
| Sound intensity method (direct method) | | Anechoic room<br>Hemi-anechoic room<br>Ordinary room | 9614* | - | $P = \int I\, dS$ |

Note: *At present at the stage of draft
** $p$ : Sound pressure (Pa)
$\rho$ : Density of air ($kg/m^3$)
$c$ : Speed of sound in air (m/s)
$I$ : Sound intensity ($W/m^2$)
$P$ : Sound power of a source (W)
$E$ : Average sound energy density ($J/m^3$)
$A$ : Equivalent absorption area ($m^2$)

conventional p-squared method. Recently, the application of the sound intensity technique for the determination of sound power level has attracted much attention. In the near future, the basic standard series is ecpected to be reqritten by the combination of the p-squared method and the sound intensity (direct) method. At the present stage of development, it was decided to limit the scope of the Japanese Industrial Standard series to the conventional p-squared methods.

(3) Details of the Japanese Industrial Standard series

Titles of the JIS series of standards for the determination of the sound power levels of sound sources and the correspondence with ISO 3740 series are summarized in Table 5. Because of the annual publication schedule for Japanese Industrial Standards, sic standards of ISO 3740 series have been integrated into three standards. The important requirements of each standard are shown in the followings:

**JIS Z 8732-1986** (Precision method for the determination of sound power level of sound source in anechoic and hemi-anechoic rooms). This srandard has the essential conformity to the corresponding ISO standard 3745. Several important amendments and additions are as follows:

a) Procedures for checking the sound fields in anechoic and hemi-anechoic rooms are specified in more detail. Setting up the loudspeaker in the room to be testedm the test signal is emitted and the sound pressure levels are measure dalong lines directed in specified directions from the acoustic center of the loudspeaker. From the measured sound pressure levels, the functional relationship between sound pressure level and distance is estimated. By using these functional relations, the deviations from the inverse square law drop-off of sound pressure at each measurement position are obtained. The applicability of the room for the determination of sound power levels is checked by using the same qualification requirements specified in ISO 3745.

b) The limitation on the maximum volume of the source to be tested has been deleted. The reason for this deletion is that if the above mentioned sound field condition is fulfilled at the measurement surface, it is unnecessary to specify th emaximum volume of the source explicity.

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

**Table 5** JIS series for the determination of sound power level of noise source.

| | Title | Date of publication | Corresponding 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 soun dsource in general sound fields | 1987-02-01 | 3744<br>3746<br>3741*<br>3742*<br>3743* |
| JIS Z 8734 | Precision method for the determination of sound power level of soun dsource in reverberation room | Submitted as draft standard 1987-03-15 | 3741<br>3742 |

Note: *Reference standards

**Table 6** Synopses of three methods A, B and C in JIS Z 8733.

| Method | Accuracy | Measuring site | Measurement surface | Correction | Quantities to be determined | ISO |
|---|---|---|---|---|---|---|
| A:<br>Hemi-free field method | Engineering | Hemi-anechoic room<br>Large room<br>Outdoors | Hemi-spherical surface<br>Rectangular parallelepiped surface<br>Conformal surface | Environmental correction<br>Background noise correction | 1/3 octave band PWL<br>Octave band PWL<br>A-weighted PWL*<br>Directivity | 3744 |
| B:<br>Hemi-free field method | Survey | ditto | Rectangular parallelepiped surface | ditto | Octave band PWL<br>A-weighteds PWL* | 3746 |
| C:<br>Diffuse field method | Survey | Reverberation room<br>Ordinary room | Diffuse field region in room | Random incidence correction | ditto | 3741**<br>3742**<br>3743** |

Note: * A-weighted sound power level should be calculated from octabe or 1/3 octave band sound power level.
** Reference standards

sound fields). The expression " general sound fields " refers to the wide variety of sound fields, such as the sound fields outdoors, in large factory rooms, in machinery rooms in buildings and so on. These are the sound fields encountered in practice, in addition to laboratory situations, such as the free sound field (anechoic room), the hemi-free field (hemi-anechoic room) and the diffuse sound field (reverberation room). From the view point of practical applications, this standard is the most important one of the JIS series.

This standard specifies three different methods coresponding to different measurement environments and accuracy frades, as shown in Table 6. Flow charts of the measurement procedures in these methods are shown in Figs.1, 2 and 3, respectively.

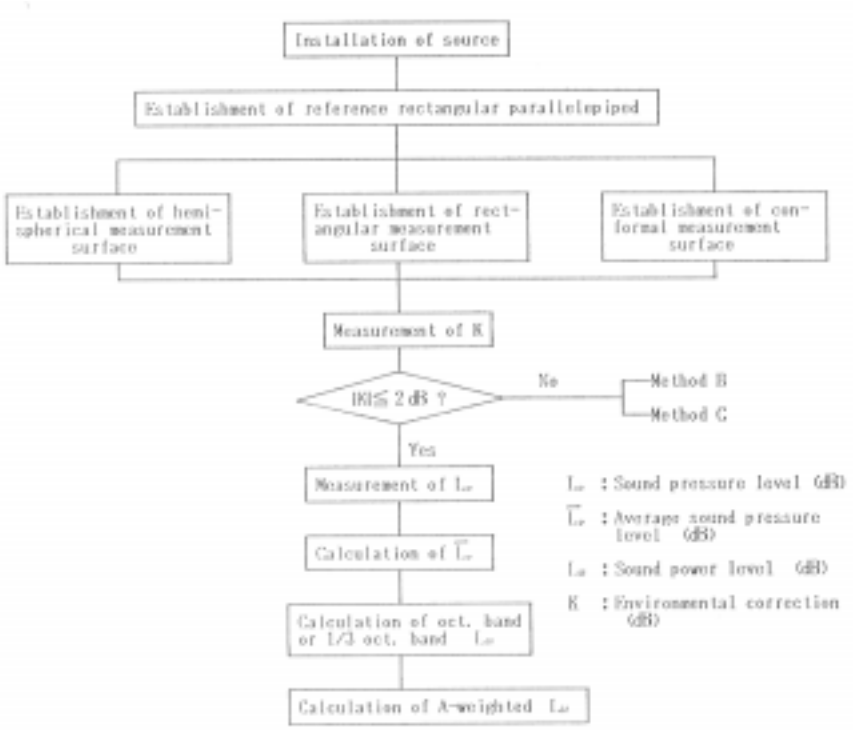


**Fig.1** Measurement procedure for the engineering hemi-free field method (JIS Z 8733 Method A).

Important requirements of this standard are summarized as follows:

a) Survey method in approximately diffuse sound field (Method C). This method is neqwly introduced for the determination of the sound power levels of sound sources located in relatively reverberant ordinary rooms. This standard has no counterpart in the ISO 3740 series. Here, procedures to set up the source and microphone position sand to determine the sound power level are referred to ISO 3741, 3742 and 3743, with some simplication. The accuracy frade for this method is classified as "survey", however this is up-graded compared to the accuracy of the survey method in ISO 3740 series.

b) Determination of octave band sound power levels by th esurvey method. In the survey methods specified in the ISO 3740 series, the quantity to be power level. However, octave band sound power levels are frequently necessary for the prediction and control of noise in various practical situations. Hence, in this standard octave band sound power levels are included in the quantities to be determined for two kinds of survey methods (Methods B and C), by up-grading the measurement accuracy.

c) 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, the A-weighted environmental correction or the A-weighted equivalent sound absorption area appears to be meaningless. In this standard, it is specified that the A-weighted sound power level should be determined from the octave band (Methods A, B and C) or 1/3 octave band (Method A) sound power level.

JIS Z 8734 (draft) (Precision method for the determination of sound power level of sound source in reverberation room). The flow chart of the measurement procedres is shown in Fig.4. Important requirements in this draft standard has the due conformity to those of ISO 3741 and 3742, except for the following modifications and additions.

a) In addition to the usual space averaging of sound pressure in the reverberation room, the surface sound pressure method[2] is given in the Annex.

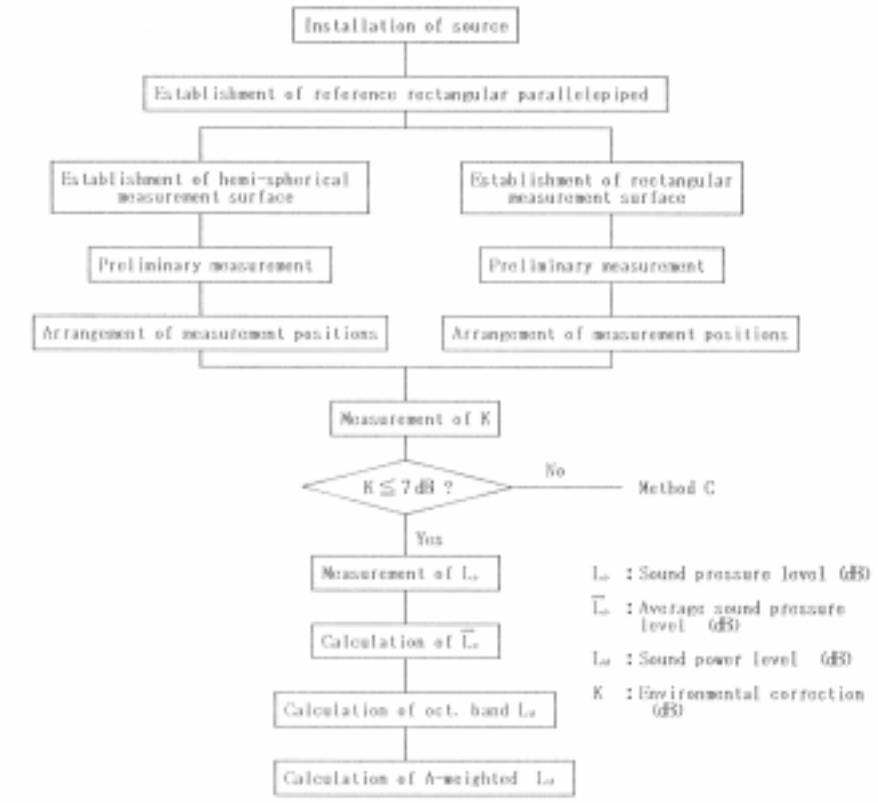


**Fig.2** Measurement procedure for the survey hemi-free field method (JIS Z 8733 Method B).

b) The maximum allowable deviations of tempreture and relative humidity of air in the room during the measurement of reverberation time and sound pressure level are specified in this standard with some modifications. If the change of temperature and/or relative humidity exceeds these limits, corrections for the change of the sound attenuation constant in air should be adopted.[3] The method for making these corrections is given in the Annex.

3.3 Standards on the Methods for Measurement of the Noise Emitted by Individual Noise Sources

The noise emitted by machinery and equipment are described by either its sound power level or its sound pressure level. The methods for the measurement of these quantities should be specified in the measurement standards. The basic standards mentioned above (the former JIS Z 8731, JIS Z 8732, JIS Z 8733 and JIS Z 8734) describe the general requirement on the methods for measurement without reference to any specific kinds of machinery and equipment. If the installation conditions and/or the operating conditions of the source to be tested influence the generation of noise, these conditions are to be specified in individual standards.

This is a large number of Japanese Industrial Standards which describe methods for the measurement of noise emitted by individual machinery and equipment. Most of them specify methods for measurements of sound pressure levels, especially A-weighted sound pressure levels. Recently, there appears to be an increasing tendency to adopt the sound power level for the evaluation of noise emitted by individual machinery and equipment. Reflecting this trend, it has been required to establish the standards on the method for determination of sound power level of noise emitted by individual noise sources. Existing standards and the draft standard are listed below.

JIS A 1708-1976* Method of test for noise of equipment units for dqellings.

JIS A 4003-1977+ Warm air furnaces.


**Fig.3** Measurement procedure for the survey diffuse field method (JIS Z 8733 Method C).

JIS A XXXX-198X+ Method for the measurement of airborne noise emitted by construction equipment intended for outdoor use (draft).
JIS B 1548-1976 Measuring method of sound pressure levels of ball and roller bearings.
JIS B 1753-1976 Measuring method of noise of gears.
JIS B 6004-1980 Method of sound pressure level measurement for machine tools.
JIS B 6521-1978** Method of measurement for noise emitted by wood working machinery.
JIS B 8005-1975** measuring method of noise emitted by internal combustion engines.
JIS B 8310-1985++ Methods of A-weighted sound pressure level measurement for pumps.
JIS B 8346-1985++ Methods of A-weighted sound pressure level measurement for fnas, blowers and compressors.

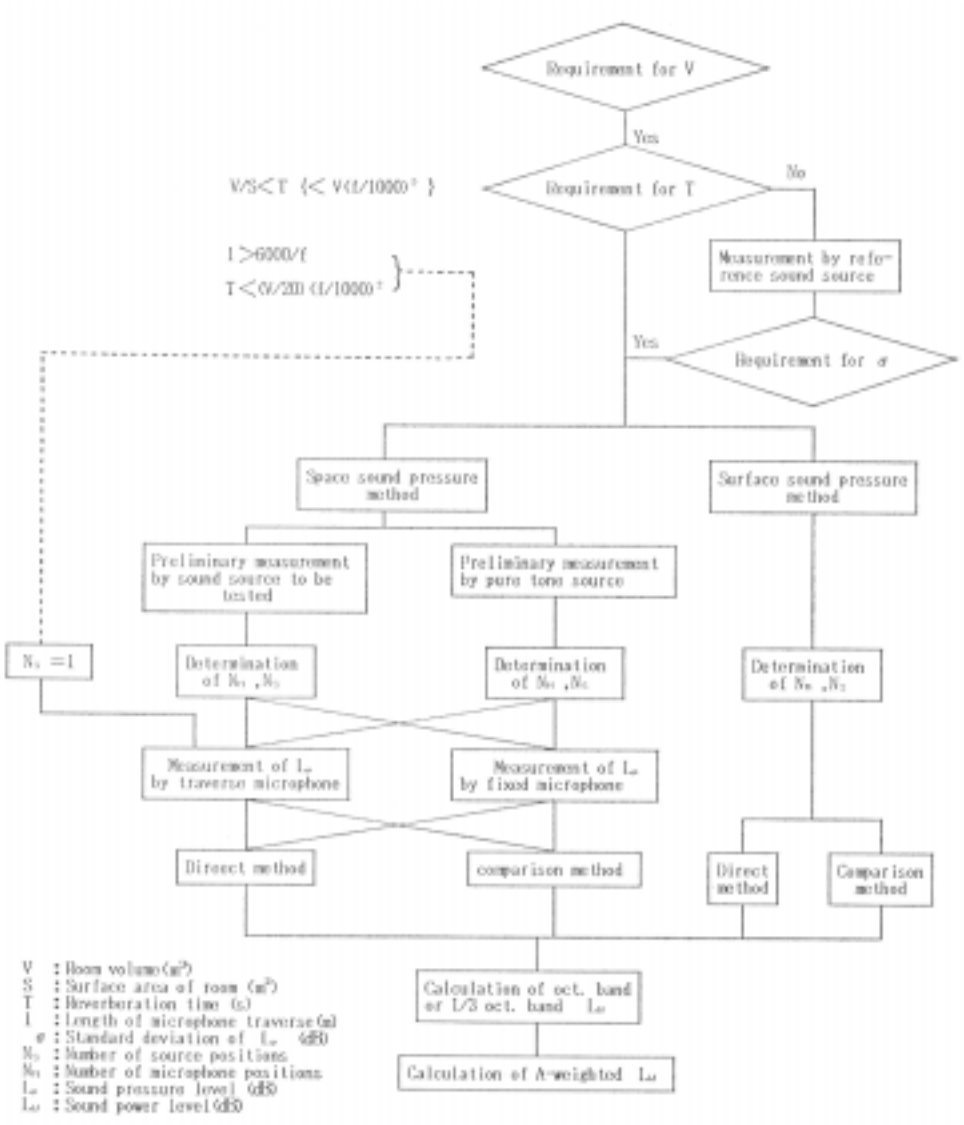


**Fig.4** Mearurement procedure for the precision diffuse gieldese difffuse method (JIS Z 8734.

JIS B 8350-1984++ Methods of noise level measurement for oil hydralic pumps and morots.
JIS B 9064-1981 Method of sound level measurement for industrial sewing machine.
JIS C 8106-1983 Luminaires for fluorescent lamps.
JIS C 8108-1983 Ballasts for fluorescent lamps.
JIS C 8112-1985 Table study lamps for fluorecent lamps.
JIS C 8115-1985 Domestic pendant luminaires for fluorescent lamps.
JIS C 9108-1976 Electric vacuum cleaners.
JIS C 9603-1976 Ventilating fans.
JIS C 9606-1979 Electric washing machine.
JIS C 9609-1977 Electric blenders and electric juicers for household use.
JIS C 9610-1976 Portable electric grinders.
JIS C 9611-1976 Electric disc grinders.
JIS C 9612-1983 Room air conditioners.
JIS C 9614-1979 Electric shavers.
JIS C 9615-1976+ Air cleaners.
JIS C 9625-1976 Portable electric planers.

JIS C 9626-1981 Portable electric circular saws.
JIS D 1024-1982 Measurements of noise emitted by automobiles.
JIS D 1038-1975 Method of noise test for motor cycles.
JIS D 6502-1986 Testing methods of motor graders.
JIS D 6503-1982 Testing methods of crawler tractors.
JIS F 0904-1981 Measurement of noise level on board cessels (Machinery part).
JIS F 0905-1981 Measurement of noise level on board cessels (Accomodation part).
JIS S 3026-1982 Kerosene feeders for kerosene combustion appliances.
JIS S 3031-1982* General rules for test methods or oil burning appliances.

Note:
* Sound power level and (A-weighted) sound pressure level are specified.
\+ Sound power level is specified.
** A method for determination of th eapprocimate sound power level is given in explanatory notes which do not form integral parts of the standard.
++ A method for determination of the sound power level is described in the reference.

## 4. FUTURE TRENDS

As has already been shown above, standards for the measurement and evaluation of noise are well advanced in Japan. These standards have been widely adopted for the regulation and control of various kinds of noise.

The important items to be considered in the future more sufficient arrangements of standards in this field are summarized as floows:

(1) To support the basic standards for the determination of the sound power levels of noise sources, it is necessary to establish the standard to specify the characteristics of reference sound sources as soon as possible.

(2) Sound intensity techniques should play an important role in the determination of the sound power level of noise sources, especially in field/*in situ* measurements. The method for the determination of sound power levels of noise sources using intensity measurements should be standardized, consistent with the trends in ISO, ANSI and other national standards development bodies.

(3) In the future, it would be desirable to rearrange the basic standard system for the determination of sound power level, covering both the psquared method and the intensity method. Here, conditions in measurement environments and accuracy rezuirements should be considered carefully.

(4) It is also necessary to standardize the basic standard for the measurement of the sound pressure level of noise emitted by machinery and equipment. In this case, conformity to the recently published ISO 6081 (Noise emitted by machinery and equipment-Guidelines for the preparation of test codes of engineering grade requiring noise measurements at the operator's or bystander's position) should be considered.

(5) Concerning the standards o the methods for measurement of noise emitted by individual noise sources, revisions of the existing standards should first be prepared. Here, it is necessary that the revised standards conform to the corresponding basic standards or international standards specified for specific machinery and euipment.

In many cases, the should insulation characteristics of buildings play an important role for the control of noise. Hence, standards relevant to the methods for measurement of sound insulation characteristics have been standardized in Japan. The details of these standards will be discussed elsewhere.

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