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**Acoustics—Laboratory measurements
of the reduction of transmitted impact
sound by floor coverings on a solid
standard floor—Part 1 : Method using
standard light impact source**

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Foreword

This translation has been made based on the original Japanese Industrial Standard established by the Minister of Land, Infrastructure and Transport through deliberations at the Japanese Industrial Standards Committee as the result of proposal for establishing a Japanese Industrial Standard submitted by Japan Testing Center for Construction Materials (JTCCM)/Japanese Standards Association (JSA) with the draft being attached, based on the provision of Article 12 Clause 1 of the Industrial Standardization Law.

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JIS A 1440 consists of the following 2 parts under the general title “*Acoustics—Laboratory measurements of the reduction of transmitted impact sound by floor coverings on a solid standard floor*”:

Part 1: Method using standard light impact source

Part 2: Method using standard heavy impact sources

Acoustics—Laboratory measurements of the reduction of transmitted impact sound by floor coverings on a solid standard floor—Part 1 : Method using standard light impact source

Introduction

This Japanese Industrial Standard has been prepared based on the second edition of **ISO 140-8** published in 1997, with some modifications of the technical contents which are to reflect the actual conditions in Japan.

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

1 Scope

This part of **JIS A 1440** specifies the laboratory measurement method of the reduction of light impact sound pressure level of the floor covering installed directly on the concrete slabs in buildings (hereafter referred to as “specimens”). Specimens supported only by the periphery of floor slabs or specimens supported by walls and beams are excluded.

NOTE 1 In this part of **JIS A 1440**, floor coverings refer to the multi-layered products or the single-layered products such as the floor structures prepared for finishing on the upper part of a concrete floor and the floor covering installed directly on the upper part of a concrete floor.

NOTE 2 The International Standard corresponding to this part of **JIS A 1440** and the symbol which denotes the degree of correspondence shall be as follows.

ISO 140-8:1997 *Acoustics—Measurement of sound insulation in buildings and of building elements—Part 8: Laboratory measurements of the reduction of transmitted impact noise by floor coverings on a heavyweight standard floor* (MOD)

The symbols of degree of correspondence between **JIS** and the relevant International Standard are IDT (identical), MOD (modified), and NEQ (not equivalent) according to **ISO/IEC Guide 21**.

NOTE 3 The method of measuring the impact sound insulation performance of buildings using standard light impact source is specified in **JIS A 1418-1**.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this part of **JIS A 1440**. For standards with the indication of the year, the edition of the indicated year shall be applied so that any revision (including amendments) made thereafter is not applied, and for those without, the most recent edition (including amendments) shall be applied.

JIS A 1409 *Method for measurement of sound absorption coefficients in a reverberation room*

NOTE : Corresponding International Standard: **ISO 354**:1985 *Acoustics—Measurement of sound absorption in a reverberation room* (IDT)

JIS A 1418-1 *Acoustics—Measurement of floor impact sound insulation of buildings—Part 1: Method using standard light impact source*

NOTE : Corresponding International Standard: **ISO 140-7**:1998 *Acoustics—Measurement of sound insulation in buildings and of building elements—Part 7: Field measurements of impact sound insulation of floors* (MOD)

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

JIS C 1514 *Electroacoustics—Octave-band and fractional-octave-band filters*

NOTE : Corresponding International Standard: **IEC 61260**:1995 *Electroacoustics—Octave-band and fractional-octave-band filters* (IDT)

JIS C 1515 *Electroacoustics—Sound calibrators*

NOTE : Corresponding International Standard: **IEC 60942**:2003 *Electroacoustics—Sound calibrators* (IDT)

JIS Z 1528 *Pressure sensitive adhesive double coated tapes*

JIS Z 8401 *Guide to the rounding of numbers*

ISO 140-2:1991 *Acoustics—Measurement of sound insulation in buildings and of building elements—Part 2: Determination, verification and application of precision data*

NOTE : At the present, there is no **JIS** standard corresponding to **ISO 140-2**.

3 Terms and definitions

For the purpose of this part of **JIS A 1440**, the following terms and definitions apply.

3.1 average sound pressure level in a room, L

ten times the common logarithm of the ratio of the space and time average of the sound pressure squared to the square of the reference sound pressure

It is expressed in decibels. The space average being taken over the entire room with the exception of those parts where the direct radiation of a sound source or the near field of the boundaries (wall, etc.) is of significant influence.

3.2 impact sound pressure level, L_i

the average sound pressure level in a one-third-octave band in the receiving room when the floor under test is excited by the standard light impact source (also referred to as “tapping machine”) specified in Annex 1 of **JIS A 1418-1**

It is expressed in decibels.

3.3 normalized impact sound pressure level, L_n

the impact sound pressure level L_i increased by a correction term which is given in decibels, being ten times the common logarithm of the ratio between the measured

equivalent absorption area (A) of the receiving room and the reference equivalent absorption area (A_0), obtained by formula (1)

It is expressed in decibels.

$$L_n = L_i + 10 \log_{10} \frac{A}{A_0} \dots\dots\dots (1)$$

where, $A_0 = 10 \text{ m}^2$

3.4 reduction of impact sound pressure level; improvement of impact sound insulation, ΔL

value obtained by subtracting the normalized impact sound pressure level of the standard concrete floor with the installed floor covering (L_{n0}), from the normalized impact sound pressure level of the standard concrete floor of the plain surface (L_n), obtained by formula (2)

It is expressed in decibels.

$$\Delta L = L_{n0} - L_n \dots\dots\dots (2)$$

NOTE : If no difference of the equivalent sound absorption area in the receiving room absorption is found between testing under the state in which the test covering is not yet installed (hereafter referred to as “bare-surface state”) and under the state in which the specimen is installed (hereafter referred to as “specimen-installed state”), L_{n0} may be L'_0 and L_n may be L' , where, L'_0 is the impact sound pressure level of the concrete standard floor under bare-surface state, and L' , the impact sound pressure level of the concrete standard floor under specimen-installed state.

4 Measuring equipment

The measuring equipment shall have sufficient precision to perform the test in clause 7 and shall be as follows.

- a) For impact source, the standard light impact source meeting the requirements given in Annex 1 of **JIS A 1418-1** shall be used.
- b) For sound level measurement, a sound level meter of an accuracy equivalent or superior to the requirements of accuracy Class 1 defined in **JIS C 1509-1** shall be used.

For sound level meters calibrated for measurements in sound fields of progressive plane waves corrections for the diffuse sound field shall be applied.

- c) The complete measuring system including the microphone shall be adjusted before each measurement using a sound calibrator specified in **JIS C 1515**.
- d) For the frequency measurement, one-third-octave band filters or octave band filters specified in **JIS C 1514** shall be used.

NOTE : The real-time frequency analyzer which complies with the requirements specified in **JIS C 1509-1** and **JIS C 1514** may be used.

- e) The reverberation time measurement equipment shall comply with the requirements given in **JIS A 1409**.

5 Test arrangement

5.1 General arrangement

Two vertically adjacent rooms are used [the upper one being designated the “source room” and the lower one the “receiving room”], which are separated by the standard concrete floor.

In addition, it is necessary to make the airborne sound insulation performance between source room and receiving room sufficiently high so that the sound pressure level measured in the receiving room is not determined by the acoustic energy transmitted from source room to receiving room as airborne sound generated in the source room in each measurement frequency band specified in 7.6.

NOTE : The difference of sound pressure level between source room and receiving room should be measured in accordance with **JIS A 1417** beforehand, and then the sound pressure level in the source room should be measured at the time of measurement of the impact sound pressure level under bare-surface state and specimen-installed state, so that the sound pressure level of airborne sound in the receiving room is predicted and is verified to be smaller than the impact sound pressure level measured in the receiving room by 15 dB or more.

5.2 Source room

There are no specific requirements for the size and shape of the source room. However, in the case of using the test arrangement specified in Annex JC, the requirements given therein shall apply.

NOTE : It is preferable that the sound pressure level of air sound generated in the source room is restrained by installing a sound absorbing material, but with cares not to interfere with the measurement.

5.3 Receiving room

The receiving room shall be as follows.

- a) The volume of the receiving room shall be 50 m³ or more.
- b) Set up the dimensional ratio of the receiving room so that the natural frequency in the low frequency band is distributed as uniformly as possible.
- c) The large space variation of a sound pressure level indicates that the eminently strong stationary wave exists. In such a case, the diffuser etc. should be installed.
- d) As the normal test condition, the reverberation time should not be made extremely long or short. When the reverberation time in the low frequency band is 2 s or more or 1 s or less, the room equivalent absorption area shall be adjusted so that the reverberation time (T) in the low frequency band satisfies formula (3).

$$1 \leq T \leq 2(V/50)^{2/3} \dots\dots\dots (3)$$

where, V : volume of receiving room (m³)

5.4 Standard concrete floor

The standard concrete floor shall be as follows.

- a) The standard concrete floor on which the specimen is installed shall be the reinforced concrete plate 120 mm to 210 mm in thickness, of which the plane shape is a rectangle. In the case of using the test apparatus specified in Annex JC, the requirements in Annex JC shall be applied.
- b) The surface area of the standard concrete plate, viewed from the receiving room, shall be approximately 10 m² to 20 m², and the length of each of both sides shall be 2.3 m or more.

NOTE : The natural frequencies in the long side direction and short side direction shall be made apart from each other as much as possible.

- c) Prepare the standard concrete plate by pouring concrete once in a densely packed manner. The concrete to pour shall be the plain concrete of which the design strength is 18 N/mm² to 36 N/mm².
- d) The standard concrete floor shall be the flat plate in shape which is hard to generate deflection, torsion, crack, etc. and of which the thickness variation according to the location is small.
- e) The surface of the standard concrete floor shall be flat (to ± 1 mm in a horizontal distance of 200 mm), and, with reinforcement procedure performed if necessary, sufficient hardness to endure the impacts of the standard light impact source without any breakage shall be ensured.

6 Test specimen

6.1 General

The floor coverings used as specimens shall be classified into Category I to Category III. According to the defined characteristics of each category, whether the specimen slightly larger than the standard light impact source can be used or it has to be installed over the whole surface of the standard concrete floor can be known.

6.2 Classification of specimen

The classification of specimens shall be as follows.

- a) **Category I (small specimens)** This category refers to the specimen which has no anisotropy in plane, and of which the material is homogeneous. Deformation that can be caused on it by the standard light impact source at the time of impact is limited to the impact point and its vicinities. Therefore, when using the specimen under this category, the test is sufficiently practicable with a small-sized specimen, i.e., one that is slightly larger than the standard light impact source given in Annex JA.

Example : Matting, carpet (partial covering), cork, plastics, rubber, etc.

- b) **Category II (large specimens)** This category refers to the specimen which is the multi-layer floor coverings having material with comparatively high flexural rigidity and in which the planar broadening of deformation of the finishing material cannot be disregarded with respect to the impact of standard light impact source.

Example : Floating floor structure, single-framed floor structure, dry-type double floor structure, foamed-plastics system floor structure, direct covering wood flooring, tatami mat, etc.

- c) **Category III (stretched materials)** This category refers to the specimen which is the flexible floor coverings to be finished by using tension to cover the whole floor surface.

Example : Carpet installed using tension etc.

A specimen of which the category is uncertain shall be treated as Category II.

6.3 Installation of test specimen

The installation of test specimen shall be as follows.

- a) The specimen shall be installed over the whole surface of the standard concrete floor in accordance with the standard installation specification. When the test of the specimen included in Category II is performed, the test shall be performed in accordance with Annex JC, and the specimen shall be installed as specified in Annex JC. However, in the case of using a specimen under Category I, or that under other categories whose size, it is decided, is permitted to be small for the test results to be equally reliable as when it is installed all over the surface, may be the small-sized specimen as shown in Annex JA, and the test performed in accordance with the procedure specified in Annex JA.
- b) In the case of the specimen which is installed using adhesives on the upper part of the standard concrete floor, the installation shall be performed in accordance with the installation method in an actual site. The amount used, method of application, and curing period, etc. of adhesives shall be described in the report. However, in order to protect the upper surface of concrete, the pressure sensitive adhesive double coated tape of Class 3 less than 0.2 mm in thickness specified in **JIS Z 1528** may be used for the lower part of adhesives.
- c) Among the specimens which are to be installed using adhesives, those clearly judged to bring about equivalent results when installed by means of the pressure sensitive adhesive double coated tape of Class 3 less than 0.2 mm in thickness specified in **JIS Z 1528** may be installed using the said adhesive double coated tape without using the adhesives.
- d) For the floating slab floor, the test shall not be performed until the normal curing period of the floating floor layer has elapsed.

7 Test method

7.1 Test conditions

The test conditions shall be as follows.

- a) The measurement of the impact sound pressure level by the standard light impact source shall be performed under two conditions: with the standard concrete floor under bare-surface state and specimen-installed state.

- b) The tests in both states shall be performed under no load. However, for testing Category II specimens, a uniformly distributed load of 20 kg/m² to 25 kg/m² should be applied on the installed specimen. The distributed load should be arranged with at least one weight per square metre of the flooring area.

7.2 Influence of temperature and humidity of the source room

In the case of measuring a specimen the material of which has acoustic properties that are likely to depend on either temperature or humidity, prior to acoustic measurement, measure the temperature at the centre of the upper floor surface and the temperature and humidity of the air in the source room.

The temperature of the floor surface observed at its centre should preferably be in the range 18 °C to 25 °C.

7.3 Installing positions of standard light impact source

The installing positions of standard light impact source shall be set as follows.

- a) For both cases of testing of the standard concrete floors under bare-surface state and specimen-installed state, four or more ¹⁾ points by which the average impact sound pressure level can be obtained shall be set as the installing positions of the standard light impact source. In the case of the specimen of Category II, the setting shall be in accordance with Annex JC.

Note ¹⁾ Five or more points are preferable.

- b) Except the case where the specimen of Category I is measured in accordance with Annex JA, the number of installing positions of standard light impact source in the measurement of the standard concrete floor under bare-surface state shall be the same as those in the measurement of the standard concrete floor under specimen-installed state. Furthermore, the installing position of the standard light impact source should also be the same for bare surface-state and specimen-installed state.
- c) Each hammer of the standard light impact source shall be separated by a distance of 10 cm or more from the end of the specimen, and by a distance of 50 cm or more from the end of the standard concrete floor.

NOTE : The line which connects the hammers of the standard light impact source should be at an angle of approximately 45° with respect to the side of the perimeter of the standard concrete floor as shown in figure 1.