

JIS

JAPANESE INDUSTRIAL STANDARD

**Mechanical presses — Methods of
measurement of A-weighted
sound pressure level**

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Mechanical presses - Methods of measurement
of A-weighted sound pressure level

B 6406-1991

1. Scope

This Japanese Industrial Standard specifies the measuring methods of A-weighted sound pressure levels of the sounds emitted from presses to be used for the blanking, bending, forming, deep drawing processes, etc. of metal plates, among the mechanical presses of nominal capacity 2500 kN or under, hereinafter referred to as the "presses". However, this is not applicable to the presses of special construction⁽¹⁾.

Note (¹) The powder molding presses, hot and warm forging presses, and presses specially for bending of other presses than for metal plate processing to be used ordinarily.

Remarks: The applicable standards to this Standard are as given in the following:

JIS C 1502-Sound level meters

JIS C 1505-Precision sound level meters

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

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

JIS Z 8106-Glossary of acoustical terms (General)

JIS Z 8732-Precision methods for the measurement of sound power level in anechoic and hemi-anechoic rooms

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

IEC 651 Sound level meters

IEC 942 Sound calibrators

2. Definitions

For the purposes of this Standard, the following definitions apply, and others are in accordance with JIS Z 8106.

- (1) A-weighted sound pressure level (L_A or L_{pA}) Ten times the common logarithm of the value of the square of the effect value (p_A) of the sound pressure which has been frequency weighted in accordance with the A-characteristic specified in JIS C 1505 and has been time weighted⁽²⁾, hereinafter referred to as the "A-weighted sound pressure", divided by the square of the reference sound pressure (p_0) ($20\mu\text{Pa}$). Unit in decibel and unit symbol by dB.

Note ⁽²⁾ The time weighting means an operation to average a square sound pressure by a mean circuit satisfying any one of the dynamic characteristics of the indicating mechanism specified in JIS C 1505 [fast dynamic characteristic (FAST) and slow dynamic characteristic (SLOW)] and the dynamic characteristic (IMPULSE) specified in IEC 651.

- (2) equivalent continuous A-weighted sound pressure level ($L_{Aeq,T}$)⁽³⁾ In the case where the A-weighted sound pressure level varies with time, the A-weighted sound pressure level of a continuous stationary sound which imparts the equal mean square sound pressure to this within the measurement time interval⁽⁴⁾. Unit in decibel and unit symbol by dB.

$$L_{Aeq,T} = 10 \log_{10} \left[\frac{1}{t_2 - t_1} \int_{t_1}^{t_2} \frac{p_A^2(t)}{p_0^2} dt \right] \dots\dots\dots (1)$$

where $L_{Aeq,T}$: equivalent continuous A-weighted sound pressure level (dB)

$p_A(t)$: A-characteristic sound pressure (dB)

p_0 : reference sound pressure ($20\mu\text{Pa}$)

Furthermore, the suffix T means the measurement time interval starting from a time t_1 and ending at a time t_2 .

Notes ⁽³⁾ In the case where it is not liable to cause confusion, L_{Aeq} may also be used.

⁽⁴⁾ Even though the measurement time interval shall generally indicate the time (referred to as the actually measured time.) during which a continuous measurement is to be conducted, however, as in the case of obtaining the representative value of a long time interval by intermittent actual measurements, it may also indicate a total time length (referred to as the observation time.) which is considered to be the object of observation.

- (3) A 1-weighted sound pressure level (L_{A1}) The A-weighted sound pressure level to be measured by using the dynamic characteristic (IMPULSE) of the sound level meter specified in IEC 651. Unit in decibel, and unit symbol by dB.
- (4) peak value of instantaneous sound pressure level ($L_{p,peak}$) The sound pressure level by using the function which measures the peak value of instantaneous sound pressure level (the level of the peak value of sound pressure wave shape without frequency characteristic weighting) specified in IEC 651. Or the sound pressure level to be obtained from the peak value of the recorded sound pressure wave shape by an oscillograph or the like. Unit in decibel, and unit symbol by dB.

- (5) stationary noise When an A-weighted sound pressure level has been measured in accordance with the slow dynamic characteristic (SLOW) of a sound level meter, the noise which fluctuates 5 dB or under during an actual measurement time interval (including the case where no fluctuation is present).
- (6) fluctuating noise When an A-weighted sound pressure level has been measured in accordance with the slow dynamic characteristic of a sound level meter, the noise which fluctuates larger than 5 dB during the interval of an actual measurement time.
- (7) impulsive noise A noise including one or more of noises which stands up rapidly and goes down within a period of duration of one second.
- (8) background noise The noise at a certain location where the objective sound of a press is absent.
- (9) reflection sound That sound which is received by a microphone, when the sound emitted from a press is reflected by other substances, floors, walls, etc. than the objective press.
- (10) reference rectangular parallelopiped A rectangular parallelopiped to be established for representing the shape and dimensions of a press. It circumscribes the press, and its bottom face coincides with the floor. All of the body and projections which are considered to be the sound sources are included in its interior.
- (11) free sound field A sound field in an isotropic and homogeneous medium in which the influence of boundary is negligible.
- (12) hemi-free sound field Above the plane of perfect reflectivity acoustically and having an infinite area, the sound field filled with an isotropic and homogeneous medium in which the influence of the boundary other than this plane can be neglected.
- (13) operational period When a press repeats the specific process, the period of its single process.

3. Measuring items

Under the specified conditions, A-weighted sound pressure levels (generally, equivalent continuous A-weighted sound pressure levels) at the position of the operator of the press and at the position in the circumference of the press where the maximum noise is detected.

Furthermore, if the measurement of an acoustic power level is required, it is preferable to measure in accordance with the method specified in Annex 1.

4. Measurement conditions

4.1 Measurement environment

4.1.1 Measurement location Measurements shall be carried out at the location above a reflection plane providing the free sound field.

Practically, a sound field which can be considered to be a hemi-free sound field, such as in a large room or out doors with little sound, may be applicable. Even in a room where the influence of reflected sound is fairly larger, it may be allowable provided that the selection of measuring points can be conducted in accordance with the principle of the hemi-free sound field.

Furthermore, acoustical conditions of the room used in the measurements shall be clearly stated in the test results.

When the operator is positioned in the specific position as in the exclusive operating room, measurements shall be made in that room, considering this to be a part of the machine.

4.1.2 Background noise It should preferably be that the background noise is lower by 10 dB or over than the noise of the objective press (It shall be at least 6 dB or lower), however in the case where the difference of indications is 4 to 9 dB due to unavoidable circumstances, it shall be corrected in accordance with Table 1.

Table 1. Correction values for background noise

Difference of indications between the presence and the absence of the objective sound, dB	4, 5	6, 7, 8, 9
Correction value to be added to the indication in the presence of the objective sound, dB	-2	-1

4.2 Operational conditions As regards the operational conditions, the A-weighted sound pressure levels during the continuous or intermittent operation at no load⁽⁵⁾ and continuous or intermittent operation at load⁽⁶⁾ on the same press which has been installed under the installing conditions specified by the manufacturer shall be measured.

Notes ⁽⁵⁾ Irrespective of the presence or not of a metal mould, that condition where a material to be processed is not being processed, operating at the nominal maximum slide speed.

Furthermore, in the no load operation, the equipment other than the slide drive and the equipment to be driven in continuity with this (feeding equipment and the like), such as die cushion, air equipment for blowing off products, etc. shall not be actuated.

⁽⁶⁾ The blanking process of 75 % the nominal capacity at the nominal maximum slide speed. However, for the hydraulic press, pressurizing to the block may also be substituted for the blanking process.

5. Measuring instruments

5.1 Sound level meter The sound level meter to be used in the measurements shall be the precision sound level meter in accordance with JIS C 1505 (or the ordinary sound level meter in accordance with JIS C 1502), and it shall be that which has been approved in the inspection in accordance with the Law of Measurements or a measuring instrument having the performances equal to or superior to this, hereafter referred to as the "sound level meter".

In the case where it is required to measure the A 1-weighted sound pressure or peak value of instantaneous sound pressure level, the sound level meter provided with the measuring performances for these specified in IEC 651 shall be used.

Remarks: The sound level meter having the functions of integrating and averaging (it is called as the integral sound level meter) for measuring the equivalent continuous A-weighted sound pressure level specified in JIS C 1505 or JIS C 1502 may be used effectively.

5.2 Level recorder The level recorder used shall be the level recorder specified in JIS C 1512 or the measuring instrument having the performances equal to or superior to this.

5.3 Recording machine In the case where the output signals of the sound level are to be recorded into the data recorder or tape recorder of magnetic recording system, attention shall be paid to the fluctuation range of the sound pressure level of the press noises, dynamic range of the record and reproduction of recording machine, and the range of measuring frequency.

5.4 Checking methods of measuring instruments In the measurements, check the sensitivities of sound level meter, frequency analyzer, etc. to be used in the measurements at the frequencies of one or more in the objective frequency range⁽⁷⁾.

Note (7) Apart from this, for the periodical calibration on a sound level meter, it is necessary to be subjected to approval or inspection by the public inspection organization.

6. Measurements

6.1 Measurement position

6.1.1 Measurement position in the case of the press which requires an operator In the case where the operator is standing, measurement shall be made at the position 0.2 ± 0.02 m apart from the position of the ear of the operator (the ear of the larger side face of A-weighted sound pressure level). In this case, if no operator is present, measurement shall be made at the position of 1.5 ± 0.025 m above floor from the central point where the operator is standing always.

In the case where the operator is sitting, measurement shall be made at the position of 0.2 ± 0.02 m from the position (the ear of the larger side face of A-weighted sound pressure level) of the ear of the operator, adjusting the height of the seat so that the operator can operate comfortably. In this case, if no operator is present, measure at the position 0.8 ± 0.02 m from the center of the face of seat.

In the case where the operator takes one or more positions in order to operate the press, noise shall be measured at the position of 1.5 ± 0.025 m above the floor in the operating position where the noise which holds the essential part of operating time of the operator is the largest.

6.1.2 Measurement position in the case of the press which does not require an operator In the case of the press which always does not require an operator, measurement shall be made at the position (1.5 m above floor in height) 1 m apart from the center of the front face (approaching side of an operator) of the reference rectangular parallelepiped specified in JIS Z 8733.

6.1.3 Measurement position of the largest noise in periphery of press The measurement position of the largest noise in the periphery of the press shall be as follows:

- (1) As to the reference for determining the A-weighted sound pressure level, at first a reference rectangular parallelepiped circumscribing the press shall be established. In this case, projected part or the like which does not constitute the main sound-source radiating body may be neglected.
- (2) Measurement shall be made at the position where the A-weighted sound pressure level becomes the maximum value on the circumference of the press at the height of 1 m from the face of the reference rectangular parallelepiped and 1.5 m above the floor.

6.2 Direction of microphone The microphone shall be directed horizontally to that direction from which the operator receives principal noise, as well as to which the operator is facing when carrying out the principal operation.

6.3 Procedure of measurement

6.3.1 When the noise of the press is of stationary noise, measure an equivalent continuous A-weighted sound pressure level or read out the mean value of the indications of the slow dynamic characteristic (SLOW) of the sound level meter.

6.3.2 When the noise of the press is of fluctuating noise, measure an equivalent continuous A-weighted sound pressure level. The actual period of measurement, in this case, is to be determined considering the change in level of the noise, however, for the minimum actual period of measurement, any one of the longer period of 10 seconds or the operational period of the press (for example, one cycle) if the noise generates periodically, shall be taken. However, in the case where the actual period of measurement is specified by the number of times of stroke, measure the equivalent A-weighted sound pressure level over 7 times of stroke.

Even though the equivalent A-weighted sound pressure level can be measured directly with an integral sound level meter, in the case where it is to be obtained from the indicated values of the slow dynamic characteristic (SLOW) of the sound level meter, the following formula shall apply:

$$L_{Aeq,T} = \log_{10} \left[\frac{1}{n} (10^{L_{A1}} + 10^{L_{A2}} + \dots + 10^{L_{An}}) \right] \text{ dB} \dots\dots\dots (2)$$

where $L_{Aeq,T}$: equivalent A-weighted sound pressure level (dB)

$L_{A1}, L_{A2}, \dots, L_{An}$: measured values of A-weighted sound pressure level (dB)

n : total number of measured values

Furthermore, the time interval Δt of sampling is selected according to the degree of fluctuation of A-weighted sound pressure level, but in the case where the slow dynamic characteristic (SLOW) of the sound level meter is used, it should preferably be 2 s or under. However, where the fluctuation of A-weighted sound levels is slow and the actual measuring time extends to several minutes, Δt may be expanded to about 5 s.

6.3.3 When the noise of the press is of an impulsive noise, an equivalent A-weighted sound pressure level shall generally be measured. If required, the maximum indication shall be read out using the indicating function of the fast dynamic characteristic (FAST) of a sound level meter, the dynamic characteristic (IMPULSE) specified in IEC 651 or peak value of instantaneous sound pressure level. In this case, read out the maximum indicated values several times, and obtain the mean value when there are any differences in the values thereof.

7. Items to be appended to test results

The following items shall be appended to the test results, as required.

(1) Press to be tested

- (a) Descriptions of press (name, form, nominal capacity, dimensions of bolster, manufacturer's name, type, serial number, etc.)
- (b) Installation conditions

Remarks: In the case where the auxiliary equipment to allow the press to run is required, its details, the connecting relation with the press, etc. shall be clearly stated.

- (c) Operational conditions at time of noise measurement (set load, slide speed, metal mould, material, plate thickness, etc.)

(2) Test location

- (a) Measurement location (measurement positions, measurement height, etc.)
- (b) Surrounding conditions (noise absorbing treatment in room, position of press and distances to reflection planes such as walls and ceiling)

(3) Measurements

- (a) Descriptions on measuring instrument (Name, type, manufacturer's name, type, serial number, etc.)
- (b) Measuring positions and equivalent A-weighted sound pressure level or A-weighted sound pressure level
- (c) A-weighted sound pressure level of background noise level at each measurement position, and equivalent correction value, if corrected
- (d) A 1-weighted sound pressure level, peak value of instantaneous sound pressure level, etc., if obtained
- (e) Characteristics on sense of hearing of emitted sounds
(Presence of pure sound, presence of impulsive component, time functional fluctuation property, etc.)
- (f) Date of measurement, name of measurement organization, names of person attended on measurements, etc.
- (g) Ambient temperature, relative humidity, etc. at time of measurement.

Annex 1 Measuring methods for sound power levels of mechanical presses

1. Scope

This Annex specifies the simple measuring methods for obtaining the A-weighted sound power levels from the octave band sound power levels in the general sound fields of the open air and ordinary interior of a room relating to the noises of the mechanical presses mainly to be used for metal workings. The applicable frequency range is defined as 125 Hz to 8000 Hz in central frequency of octave band.

Remarks: The applicable standards to this Annex are as given in the following:

JIS C 1505-Precision sound level meters

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

JIS Z 8106-Glossary of acoustical terms (General)

JIS Z 8732-Precision methods for the measurement of sound power level in anechoic and hemi-anechoic rooms

IEC 942-Sound calibrators

2. Definitions

For the purposes of this Annex, the following definitions apply, and others are in accordance with JIS Z 8106.

- (1) sound pressure level Particularly in the case where the sound pressure weighted by the A-characteristic specified in JIS C 1505 is taken as an object, it is termed as an A-weighted sound pressure level, and in the case where the sound pressure of each octave band specified in JIS C 1513 is taken as an object, it is termed as an octave band sound pressure level.
- (2) sound power level Particularly in the case where the sound power level weighted by the A-characteristic specified in JIS C 1505 is taken as an object, it is termed as an A-weighted sound power level, and in the case where the sound power level of each octave band specified in JIS C 1513 is taken as an object, it is termed as an octave band sound power level.
- (3) reference sound source The small sized wide band noise property sound source having sufficient and stable output, flat frequency characteristic and excellent whole-directionality in a measuring frequency range, and of which sound power level has been calibrated, when it has been installed on the reflection plane in accordance with JIS Z 8732.

Remarks: This sound power level shall mean the calibrated acoustic power level of the reference sound source.

- (4) equivalent sound absorbing area in a room That value which has multiplied the sound absorption rate of a certain plane in the measurement room to the area of its plane. It is also called the sound absorption power. Unit in square meter, and unit symbol by m^2 .
- (5) reference rectangular parallelopiped A parallelopiped to be established for representing the shape and dimension of a press. Its base plane shall coincide with a floor plane.
- (6) measuring rectangular parallelopiped A parallelopiped surrounding the sound source to be established for the purposes of the setting of measurement positions and the calculation of sound power levels.
- (7) Measurement rectangular parallelopiped planes An area of the measurement rectangular parallelopiped excluding the bottom area. Unit in square meter, and unit symbol by m^2 .
- (8) stationary sound When the A-weighted sound pressure level has been measured by using the slow dynamic characteristic (SLOW) specified in JIS C 1505, the smaller sound than 3 dB in fluctuation of indicated values.
- (9) non-stationary sound When the A-weighted sound pressure level has been measured by using the slow dynamic characteristic (SLOW) specified in JIS C 1505, the sound of 3 dB or over in fluctuation of indicated values.

3. Types of measuring method

3.1 Simple hemi-free sound field method The simple hemi-free sound field method shall be applicable to the case where the approximate value of sound power level is to be measured simply in a large room of less sounding or in the open air (a place which may be considered to be a hemi-free sound field practically), and the ordinary indoor place (a place in which the influence of reflected sounds are considerably larger, but the arrangement of measuring points can be conducted in accordance with the principle of the hemi-free sound field).

3.2 Simple diffuse sound field method The simple diffuse sound field method shall be applicable to the case where the approximate value of sound power level is to be measured simply in accordance with the principle of the diffuse sound field method, in a room wherein not less than a certain degree of reverberation exists and of which boundary planes (such as walls, floor and ceiling) are capable of being specified.

4. Measuring instruments

4.1 Sound pressure level measuring instrument The sound pressure measuring instrument to be used in measurements shall be that having the performances of equal to or superior to the sound level meter specified in JIS C 1505.

4.2 Frequency analyzer The frequency analyzer to be used in measurements shall be the type II octave band analyzer specified in JIS C 1513.