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**Building construction machinery
and equipment—External vibrators
for concrete**

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Foreword

This translation has been made based on the original Japanese Industrial Standard 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 Japan Construction Mechanization Association (JCMA)/Japanese Standards Association (JSA) with the draft being attached, based on the provision of Article 12 Clause 1 of the Industrial Standardization Law applicable to the case of revision by the provision of Article 14. Consequently **JIS A 8611 : 1993** is replaced with this Standard.

This revision has been made based on **ISO/DIS 18652 : 2002** *Building construction machinery and equipment—External vibrators for concrete* for the purposes of making it easier to compare this Standard with International Standard; to prepare Japanese Industrial Standard conforming with International Standard; and to propose a draft of an International Standard which is based on Japanese Industrial Standard.

Attention is drawn to the possibility that some parts of this Standard may conflict with a patent right, application for a patent after opening to the public, utility model right or application for registration of utility model after opening to the public which have technical properties. The relevant Minister and the Japanese Industrial Standards Committee are not responsible for identifying the patent right, application for a patent after opening to the public, utility model right or application for registration of utility model after opening to the public which have the said technical properties.

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the original JIS is to be the final authority.

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Building construction machinery and equipment—External vibrators for concrete

Introduction This Japanese Industrial Standard has been prepared based on **ISO/DIS 18652 : 2002** *Building construction machinery and equipment—External vibrators for concrete* with some modifications of the technical contents.

Portions given sidelines or dotted underlines are the matters modified from the original Draft International Standard. A list of modifications with the explanations is given in annex 1 (informative).

1 Scope This Standard specifies external vibrators for concrete (hereafter referred to as “vibrators”) for compacting concrete mix from outside the forms.

It is applicable to only the power-driven vibrators for compacting concrete by applying vibration from outside. The use of the vibrators consists in their attachment to vibration stands, vibration tables, surface vibrators, vibrating beams, etc. in order to make concrete mix compaction.

This Standard does not apply to portable external vibrators to be pressed to the vibrating object by hand.

NOTE : The International Standard corresponding to this Standard is as follows.

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**.

ISO/DIS 18652 : 2002 *Building construction machinery and equipment—External vibrators for concrete* (**MOD**)

2 Normative references The following standards contain provisions which, through reference in this Standard, constitute provisions of this Standard. If the indication of the year of publication is given to these referred standards, only the edition of the indicated year constitutes the provision of this Standard but the revision and amendment made thereafter do not apply. The normative references without the indication of the year of coming into effect apply only to the most recent edition (including amendments).

JIS B 9960-1 *Safety of machinery—Electrical equipment of machines—Part 1 : General requirements*

NOTE : **IEC 60204-1 : 1997** *Safety of machinery—Electrical equipment of machines—Part 1 : General requirements* is equivalent to the said standard.

JIS C 4034-1 *Rotating electrical machines Part 1 : Rating and performance*

NOTE : **IEC 60034-1 : 1996** *Rotating electrical machines—Part 1 : Rating and performance* is equivalent to the said standard.

JIS C 4034-5 *Rotating electrical machines—Part 5 : Classification of degrees of protection provided by enclosures of rotating electrical machines (IP code)*

NOTE : **IEC 60034-5** : 1991 *Rotating electrical machines—Part 5 : Degrees of protection provided by the integral design of rotating electrical machines (IP code)—Classification* is identical with the said standard.

JIS K 6332 *Rubber hose, textile-reinforced, for compressed air—Specification*

NOTE : **ISO 2398** : 1995 *Industrial rubber hose for compressed air (up to 2.5 MPa)* is equivalent to the said standard.

ISO 6150 : 1988 *Pneumatic fluid power—Cylindrical quick-action couplings for maximum working pressures of 10 bar, 16 bar and 25 bar (1 MPa, 1.6 MPa and 2.5 MPa)—Plug connecting dimensions, specifications, application guidelines and testing*

ISO 7241-1 : 1987 *Hydraulic fluid power—Quick-action couplings—Part 1 : Dimensions and requirements*

ISO 8041 : 1990 *Human response to vibration—Measuring instrumentation*

ISO 8331 : 1991 *Rubber and plastics hoses and hose assemblies—Guide to selection, storage, use and maintenance*

ISO 11375 : 1998 *Building construction machinery and equipment—Terms and definitions*

ISO 12100-2 : 2002 *Safety of machinery—Basic concepts, general principles for design—Part 2 : Technical principles*

3 Definitions For the purposes of this Standard, the definitions given in **ISO 11375** and the following definitions apply.

3.1 external vibrator vibrator using an eccentric mass or pendulum working principle and which is attachable to external elements of building construction equipment (e.g. wall of form) to cause compaction of the concrete mix (see **ISO 11375** : 1998, 2.3.1.2)

NOTE : It is powered mostly by electric, pneumatic or hydraulic drive.

3.2 electric external vibrator unit in which the prime mover is an electric motor

NOTE : The electric external vibrator is moved by a single or three-phase induction motor on shaft ends of which eccentric out of balance masses are fixed (see annex A figures 1 and 8).

3.3 pneumatic external vibrator unit operating on the principle of bearingless turbine or reciprocation with pneumatic drive (see annex A figures 2, 3, 9 and 10)

NOTE : The pneumatic external vibrator has typically a rotary vibration generator in form of a bushing or ball located in housing, which rolls on a fixed axle. The set of vibrator is composed of the vibrator itself, supplying hose with on/off stopcock and various fixings for use with metal and wooden type shuttering. On/off stopcock makes possible the change of the vibration parameters.

3.4 hydraulic external vibrator unit comprising a rotating eccentric mass directly coupled to a specially designed hydraulic motor (see annex A figure 4)

NOTE : The hydraulic external vibrator is supplied by a feeder containing hydraulic pump, pressure and flow controls, with the aim of the precise regulation of vibration frequency to suit requirements.

3.5 high frequency external vibrator (HF) unit of a vibration frequency equal or above 70 Hz

NOTE : High frequency external vibrators are typically integrated with cage induction motors fed from converters.

3.6 normal frequency external vibrator (NF) unit of a vibration frequency from 20 Hz to 69 Hz

NOTE : Normal frequency external vibrators are typically integrated with cage induction motors supplied with the current of a network frequency.

3.7 external vibrator of directed vibration unit for generation of directed vibrations (see annex A figures 11 to 13)

3.8 single external vibrator of directed vibration unit for generation of linear, vertical vibrations by special fixing on the hinge (see annex A figures 11 B and 12)

3.9 double external vibrator of directed vibration unit for generation of the liner directed vibrations and composed of two external vibrators rotating in opposite directions and joined by a gear (see annex A figures 11 A and 13)

NOTE : These vibrators may be driven by two external motors or consist of two induction motors geared together and enclosed in common housing.

3.10 fixed external vibrator unit fixed to the vibrating object directly by means of treads (see annex A figures 1, 2, 4 and 6)

3.11 removable external vibrator unit fixed to the vibrating object indirectly by means of quick-action clamping and releasing device (see annex A figures 3, 7 and 10)

3.12 portable external vibrator (The specification in the corresponding draft International Standard is not adopted.)

3.13 external vibrator with external motor unit driven by external electric or internal combustion motor

3.14 frequency and voltage converter for external vibrator unit used for electric supply of the vibrator with frequency higher than in power network and safety voltage

4 Classification The external vibrators are classified into four categories according to frequency, power source and structure as given in table 1.

Table 1 Classification of the external vibrator

Class code	Frequency	Power source	Structure	Power (W)
NF	Normal frequency	Electric motor	• Fixed type • Removable type • Directed vibration type	25, 35, 50, 75, 100, 150, 200, 250, 400, 550, 750, 1 100, 1 500, 1 700, 2 200, 3 000
HF	High frequency			30, 50, 100, 150, 200, 300, 400, 550, 750, 1 000
A	—	Pneumatic	• Fixed type • Removable type	—
H	—	Hydraulic	• Fixed type • Removable type	—

5 Structure The vibrator's structure depends on the type of its drive (electric, pneumatic, hydraulic), and the method of fixing to the vibrating object. Examples of the vibrator's structures are shown in annex A figures 1 to 4.

6 Performance requirements

6.1 Frequency Vibrators shall be divided according to the frequency obtained in the load test specified in 7.2 as shown in table 2. The vibrator's frequency shall comply with the data declared by its manufacturer.

Table 2 Frequency of vibrators

Designation	Frequency
NF	20 Hz to 69 Hz
HF	70 Hz or more

6.2 Centrifugal force External vibrators' prime mover shall be sufficient to drive device, in order to maintain the declared centrifugal force constant under maximum load of intended use.

6.3 Acceleration The acceleration of the vibrators shall be more than 30 m/s², when subjected to the load test specified in 7.2.

6.4 Rating time Rating time of the power unit shall be continuous. For electric motors, short time rating of 30 min shall be permissible.

6.5 Current and power consumption The current and power consumption of the electric vibrators, when subjected to the load specified in 7.6 should comply with data declared by manufacturer.

6.6 Safety requirements

6.6.1 Recommendation for vibrators design It is recommended to use the content of ISO 12100-2 for vibrators design in respect to their safety.

6.6.2 Requirements for fixed and removable electric vibrators

6.6.2.1 General Subject vibrators shall comply with the requirements of JIS B 9960-1 and JIS C 4034-1. The designer shall design item as far as possible in accordance with internationally accepted best design practice, appropriate to the application.

6.6.2.2 Degree of protection The housing of vibrators should be protected to at least IP 55 according to JIS C 4034-5 due to their exposure to water jet cleaning and fine dust when tested by 7.7.1.1.

6.6.2.3 Overload protection Each unit of vibrators rated at 0.5 kW or more shall be provided with overload protection. When the test of 7.7.1.2 is carried out for the overload protection, the protective switch shall function. For the recommendations on overload protection, 7.3 of JIS B 9960-1 shall apply.

6.6.2.4 Thermal performance The temperature rise of properly mounted vibrators related to the cooling, when tested by 7.7.1.3, should remain within the limits of the insulation class defined in 7.3 of JIS C 4034-1.

6.6.2.5 Vibrator earthing Vibrators shall be provided with means for connecting a protective conductor or an earthing system. These means, when tested by 7.7.1.4, shall have a cable sectional area as defined in 10.1 of JIS C 4034-1.

6.6.2.6 Insulation resistance The insulation resistance measured at 500 V d.c. between the power circuit conductors and the vibrator housing body, when tested by 7.7.1.5, shall not be less than 1 MΩ, according to 19.3 of JIS B 9960-1.

6.6.2.7 Withstand voltage The electric vibrator shall withstand a test voltage applied for a period of 1 s between the conductors of all circuits and the protective bonding circuit. The test voltage shall be as follows:

- Twice the rated supply voltage of the vibrator or 1 000 V, whichever is greater.
- At a frequency of 50 Hz.
- Being supplied from a transformer with a minimum rating of 500 VA (see JIS C 4034-1, 8.1 or JIS B 9960-1, 19.4).

6.6.3 Requirements for electric portable vibrators (The specification in the corresponding draft International Standard is not adopted.)

6.6.4 Requirements for pneumatic and hydraulic vibrators Pneumatic and hydraulic vibrators, when tested by 7.7.3, shall comply with the following requirements:

- to prove the correct operation in operational test,
- to pass pressure test at the maximum working pressure under all conditions of intended use,

- leakage and damage of a vibrators component should not cause a hazard of a fluid ejection.

Special attention should be given to flexible hoses and quick action couplings the vibrators may be equipped with. The hoses should comply with **JIS K 6332** and **ISO 8331** and the couplings **ISO 6150** and **ISO 7241-1**.

6.6.5 Requirements for vibrator no-load test For no-load test when carried out in conditions laid down in **7.1**, during 2 min work, the vibrator shall prove the correct operation. All parts should be securely held in their positions and prevented against loosening.

6.6.6 Requirements for vibrator load test Load test shall be conducted according to **7.2**. The vibrator should prove correct operation in 3 min test.

7 Method of performance tests

7.0A Placing of vibrator The vibrator shall be placed horizontally on a buffer material in dependence on total mass of the vibrator and payload (for the case of load test).

NOTE : Buffer materials are described in annex B.

7.1 No-load test For the no-load test, the vibrator shall be placed according to **7.0A** to operate for a period of 2 min.

7.2 Load test With the vibrator placed according to **7.0A**, the load test shall be accomplished as follows:

Perform the test for a period of 3 min, during which the frequency, acceleration (or double amplitude), current and power consumption shall be measured.

These may be measured simultaneously. The payload applied for the test shall be as given in **7.2.1** to **7.2.3**.

7.2.1 A cubic mass made of steel or cast iron should be used as a payload.

7.2.2 The vibrator should be firmly connected to the payload. The masses of the payload for particular vibrators are specified in table 3.

Table 3 Mass of the payload fixed for vibrator load test

Class and motor output (W)	Payload mass (kg) ⁽¹⁾	Class and motor output (W)	Payload mass (kg) ⁽¹⁾
NF 25	5	NF 2 200	500
NF 35	5	NF 3 000	700
NF 50	10	NF 4 000	950
NF 75	15	HF 30	10
NF 100	20	HF 50	15
NF 150	30	HF 100	25
NF 200	50	HF 150	40
NF 250	60	HF 200	50
NF 400	100	HF 300	80
NF 550	120	HF 400	100
NF 750	200	HF 550	150
NF 1 100	250	HF 750	200
NF 1 500	350	HF 1 000	280
NF 1 700	400		

Note ⁽¹⁾ Mass tolerance: $\pm 2.5 \%$

7.2.3 For the pneumatic and hydraulic drive vibrators, the mass of the payload should be selected basing on calculated power consumption.

7.3 Frequency measurement Vibrator's frequency should be measured by vibration meter or stroboscope, etc. under condition of load test. Tachometer can be used for measurement of the motor revolutions.

7.4 Centrifugal force evaluation The specifications in 7.4 and 7.5 of the corresponding draft International Standard are not adopted. Instead, 7A is newly added which includes the organized contents of them.

7.5 Acceleration measurement or calculation The specifications in 7.4 and 7.5 of the corresponding draft International Standard are not adopted. Instead, 7A is newly added which includes the organized contents of them.

7.6 Current and power consumption measurement The current and power consumption measurement shall be measured by means of general use ammeters and wattmeters.

7.7 Tests on verification of safety requirements

7.7.1 Fixed and removable electrical vibrators

7.7.1.1 Degree of protection Test for characteristic numerals of IP code carry out according to the method laid down in JIS C 4034-5.

7.7.1.2 Test of protection against overload Effectiveness of operation of the vibrator's protection against overload is verified by its overloading and checking of switching off action. Overloading may be realized by any method e.g. by supplying of the protection device with current above rated making value.

7.7.1.3 Thermal performance test Thermal performance test shall carry out according to the method laid down in **JIS C 4034-1**, clause 7.

7.7.1.4 Test of earthing Check visually protective terminal regarding to its location, designation and measure its cross-sectional area according to the requirements of **JIS C 4034-1**, 10.1.

7.7.1.5 Insulation value measurement Insulation value measurement shall carry out according to the method laid down in **JIS C 4034-1**, 8.1.

7.7.2 Portable electric vibrations (Not adopting the specifications in the corresponding draft International Standard.)

7.7.3 Pneumatic and hydraulic vibrators The test of pneumatic and hydraulic vibrators shall carry out by their fixing to payload. To check the vibrators correct operation in operational pressure and maximum working pressure. Check also the conditions of the hoses and quick action coupling (if any) meeting the requirements in **6.6.4**.

7A Evaluation of centrifugal force and acceleration

7A.1 Methods of centrifugal force evaluation Centrifugal force can be evaluated by either of the following methods.

- measurement method
- measure—calculation method

7A.2 Evaluation of centrifugal force Centrifugal force is calculated from the following formula.

$$F = 4 \times m \times e \times \pi^2 \times n^2 / 1\,000$$

where, F : centrifugal force (N)
 m : unbalanced mass (kg)
 e : value of eccentric (mm)
 n : frequency (Hz)

Unbalanced mass is the mass only of the part being out of balance to the axis.

The unbalanced mass and value of eccentric are presented by the vibrator manufacturer as required.

7A.3 Evaluation of acceleration The acceleration shall be measured by a vibration meter (see **ISO 8041**) directly, or calculated from the measured values of amplitude and frequency. The formula is as follows. The acceleration shall be at least 30 m/s².

$$\alpha_{\max} = (2 \times \pi^2 \times A \times n^2) / 1\,000$$

where, $\alpha_{\max}$: maximum acceleration (m/s²)

A : full amplitude (mm) $A = 2a$

a : amplitude (mm)

n : frequency (Hz)

8 Inspection The vibrators shall be inspected by carrying out the tests specified in clause 7 and the results shall satisfy the requirements in clause 6.

9 Designation Vibrators shall be designated by the frequency, power source, nominal output, etc.

The following letter codes may be used for the designation.

- NF : driven by normal frequency electric motor
- HF : driven by high frequency electric motor
- A : with pneumatic drive (driven by air pressure)
- H : with hydraulic drive

Example : “NF 750” designates a vibrator driven by normal frequency electric motor of 750 W output.

10 Indication of type plate The type plate of vibrators shall indicate the following information.

- manufacturer’s name and address
- name and type of product and serial number (if any)
- year of production
- frequency Hz
- mass kg
- indication relating to the power source and structure
 - electric vibrators
 - designation: e.g. “NF 750” for a case driven by normal frequency motor
 - voltage (V), frequency (Hz), rated output (kW), rated current (A), division of single-/three-phase
 - rating time: continuous or intermittent
 - other electrical data according to JIS C 4034-1, clause 9
 - pneumatic vibrators
 - designation: e.g. Pneumatic external vibrator “A 750”
 - maximum working pressure MPa
 - rated air consumption L/min

- hydraulic vibrators
 - designation: e.g. Hydraulic external vibrator “H 750”
 - maximum working pressure MPa
 - pump output L/min

11 Commercial specifications The commercial specification shall generally contain the following information.

- manufacturer's name and address
- name and type of product and serial number (if any)
- year of production
- frequency Hz
- mass kg
- indication relating to the power source and structure
 - electric vibrators
 - designation: e.g. “NF 750” for a case driven by normal frequency motor
 - voltage (V), frequency (Hz), rated output (kW), rated current (A), division of single-/three-phase
 - rating time: continuous or intermittent
 - other electrical data according to clause 9 of **JIS C 4034-1**
 - centrifugal forces on particular graduation positions daN
 - overall and mounting dimensions (see annex A figures 8, 12 and 13)
 - admissible position of the eccentric mass shaft
 - ambient temperature °C
 - height of use above sea level m
 - class of electric insulation (acc. **JIS C 4034-1**)
 - special execution for tropical or marine climate
 - accessories (if any): fixing bracket, quick-action clamping device, frequency and voltage converter, feeder box, motor switch with built-in cut-out, starter box with built-in overload cut-out, connecting plug, cable coupler socket connector plug and fixing device for generation of directed vibration
 - pneumatic vibrators
 - designation: e.g. Pneumatic external vibrator “A 750”
 - maximum working pressure MPa
 - rated air consumption L/min
 - year of production
 - overall and mounting dimensions (see annex A figures 9 and 10)