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Replacing GB/T 13310-1991

Electrodynamic vibration generator systems

电动振动台

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Table of Contents

Foreword.....	3
1 Scope	5
2 Normative references	5
3 Terms and definitions	5
4 Vibration-generator-systems' composition.....	6
5 Basic parameters and parameter series.....	7
6 Technical conditions	7
7 Inspection rules	11
8 Inspection rules	21
9 Mark and packaging	21
10 Accompanying technical documents	22

Foreword

This Standard is a revision to GB/T 13310-1991 *Specification for electrodynamic vibration generator systems*.

This Standard non-equivalently adopts the requirements for test equipment in IEC 60068-2-6:1995 *Environment test - Part 2: Test method - Test Fc: Vibration (sinusoidal)*.

The electrodynamic vibration generator systems that are manufactured according to this Standard shall also meet the requirements for vibration test equipment in MIL-STD-810F *Environmental engineering consideration and laboratory test*.

This Standard replaces GB/T 13310-1991 *Specification for electrodynamic vibration generator systems*. Compared with GB/T 13310-1991, the main differences of this Standard are as follows:

- Change the Standard name to be electrodynamic vibration generator systems;
- Compile the Standard according to the requirements of structure and format in GB/T 1.1-2000 *Directives for Standardization - Part 1: Rules for the structure and drafting of Standards*; adjust the structure;
- Add an foreword;
- The applicable scope of this Standard is changed to be “apply to vibration generator systems for test with rated excitation force under sinusoidal conditions or random excitation force being not more than 200 kN.” (Chapter 1 in version 1991; Chapter 2 in this version) from “apply to vibration generator systems for test with rated excitation force under sinusoidal conditions being 50 kN or less than 50 kN”;
- Add terms and definitions (see Chapter 3);
- Add rated random excitation forces in basic parameters [see 5.1 b)];
- Add parameter series for vibration generator systems in basic parameters [see 5.2)];
- Technical requirements are divided into sinusoidal vibration and random vibration for vibration generator systems; in sinusoidal vibration, the table-surface transverse movement ratio, acceleration distortion and table-surface acceleration amplitude uniformity are all increased with vibration generator system indicators being more than 50 kN. Add technical requirements to random vibration for vibration generator systems (see 6.2 and 6.3);
- Add requirements to electrical safety, safety protection and auxiliary cooling devices of vibration generator systems (see 6.4);

Electrodynamic vibration generator systems

1 Scope

This Standard specifies the general requirements, basic parameters, technical requirements, inspection methods, inspection rules and others of electrodynamic vibration generator systems (hereinafter referred to as vibration-generator-systems).

This Standard applies to vibration-generator-systems for test with rated excitation force under sinusoidal conditions or random excitation force being not more than 200 kN.

For vibration-generator-systems with excitation force being more than 200 kN, an agreement shall be made by the user and manufacturer or the supplier through negotiation according to this Standard.

2 Normative references

The articles contained in the following documents have become part of this document when they are quoted herein. For the dated documents so quoted, all subsequent modifications (including all corrections) or revisions made thereafter do not apply to this Standard. However, the parties who reach an agreement according to this Standard are encouraged to study whether the latest versions of these documents may be used. For the undated documents so quoted, the latest versions (including all modification sheets) apply to this document.

GB/T 2298 Mechanical vibration and shock - Terminology (GB/T 2298-1991, neq ISO 2041:1990)

GB/T 2611-2007 General requirements for testing machines

JB/T 6147-2007 Requirements for the packaging marking and handling of testing machine products

3 Terms and definitions

For the purpose of this document, the terms and definitions established in GB/T 2298 shall apply.

3.1

Rated mass

The maximum test mass specified in relevant technical documents.

3.2

Rated excitation force under sinusoidal conditions

The minimum value in all maximum excitation force under sinusoidal conditions under different test masses.

3.3

Rated sinusoidal acceleration

The maximum acceleration allowed by the table-surface under normal work.

3.4

Limit characteristic

The limit value of the displacement-speed-acceleration that changes along with different test masses; it is usually expressed by limit curve.

3.5

Rated frequency range

Limit characteristic curve range from the minimum frequency to the maximum frequency.

3.6

Rated random excitation force

The minimum value of random excitation force under any test mass. This force corresponds to the power spectral density of constant acceleration between the upper frequency limit and the lower frequency limit.

4 Vibration-generator-systems' composition

One vibration-generator-systems is composed by the following parts:

- a) vibration-generator-systems body;
- b) Power amplifier;
- c) Vibration control instrument (can be configured according to requirements of the user);
- d) Cooling fan or heat exchanger and other auxiliary equipment.

- c) The change of power supply voltage is within $\pm 10\%$ of the rated voltage.

6.2 Sinusoidal vibration

6.2.1 Frequency indication error

Within the specified frequency range, the frequency of the vibration-generator-systems can be adjusted continuously and the frequency indication error is:

- When $5 \text{ Hz} \leq f \leq 50 \text{ Hz}$, the maximum allowable value is $\pm 1 \text{ Hz}$;
- When $f > 50 \text{ Hz}$, the maximum allowable value is $\pm 2\% f$.

f is the actual vibration frequency of vibration-generator-systems.

6.2.2 Indication errors of acceleration, speed and displacement

Within the specified frequency range, the acceleration of vibration-generator-systems can be adjusted. The maximum allowable error of acceleration indication is $\pm 10\%$ and the maximum allowable error of speed and displacement indications is $\pm 15\%$.

6.2.3 Table-surface transverse movement ratio

When one vibration-generator-systems works, its table-surface transverse movement ratio shall meet requirements in Table 2.

Note: Transverse movement ratio is the ratio between transverse acceleration and axial acceleration.

Table 2 Table-surface transverse movement ratio

Excitation force is not more than 50 kN		Excitation force is more than 50 kN	
Frequency range Hz	Transverse movement ratio %	Frequency range Hz	Transverse movement ratio %
$5 \leq f < 500$	≤ 15	$5 \leq f < 500$	≤ 15
$500 \leq f \leq 2\,000$	≤ 25	$500 \leq f \leq 1\,500$	≤ 25
Within the specified frequency range, it is allowed to have 1~2 frequency bands with large transverse movement. Within this frequency band, the maximum transverse movement ratio is not more than 50%; the maximum transverse movement ratio of one vibration-generator-systems with excitation force being more than 50 kN within this frequency band is not more than 100%, and the frequency bandwidth does not exceed $\pm 10\%$ of corresponding frequency of transverse movement ratio.			

6.2.4 Acceleration waveform distortion

When the vibration-generator-systems works normally, the waveform distortion of the table-surface acceleration shall meet requirements of Table 3.

The signal-to-noise ratio of the table-surface acceleration of vibration-generator-systems shall be more than 60 dB.

6.2.8 Frequency sweep rate and frequency sweep accuracy

The vibration-generator-systems sweeps the frequency back and forth to data or displacement at certain speed and certain acceleration within specified frequency range; the frequency-sweep rate can be adjusted. The maximum allowable error of the frequency-sweep rate is $\pm 10\%$; the accuracy of frequency sweep to determine the vibration is less than 2 dB.

6.3 Random vibration

6.3.1 Dynamic range of acceleration control spectrum for random vibration

The dynamic range of random acceleration power spectrum control for vibration-generator-systems (set the spectrum dynamic range 40 dB) shall not be less than 35 dB.

6.3.2 Root mean square value of acceleration indication error

The maximum allowable error of the root mean square value of random acceleration indication of vibration-generator-systems is $\pm 10\%$.

6.3.3 The ratio R between the root mean square value of acceleration outside the work frequency range and that within the work frequency range

The ratio R between the root mean square value of acceleration outside the work frequency range and that within the work frequency range for the random vibration of vibration-generator-systems shall not be more than 10%.

6.3.4 Acceleration power spectral density indication error

The maximum allowable error of the acceleration power spectral density indication for the random vibration of vibration-generator-systems is $\pm 20\%$.

6.3.5 Control accuracy of root mean square value of acceleration and acceleration power spectrum density

Under 90% of confidence level, the control of the root mean square value of acceleration for random vibration of vibration-generator-systems shall accurate to ± 1.5 dB; the control of acceleration power spectrum density shall accurate to ± 2 dB.

6.4 Other requirements

6.4.1 Continuous working hours: each function of one vibration-generator-systems shall be normal when the vibration-generator-systems works for 6 hours continuously under normal working conditions.

6.4.2 The table-surface leakage flux of one vibration-generator-systems shall be less than 5mT when it works.

6.4.3 Vibration-generator-systems shall be equipment with safety equipment and protection functions to protect the safe of vibration-generator-systems.

6.4.4 The manufacturer shall give the maximum working noise of vibration-generator-systems.

6.4.5 The appearance of vibration-generator-systems shall comply with provisions of Chapter 10 in GB/T 2611-2007.

6.4.6 The electric safety of vibration-generator-systems shall comply with provisions of 7.2 in GB/T 2611-2007. The insulation resistance of vibration-generator-systems shall not be less than 2 MΩ and the voltage withstand is 1500 V in 1 minute.

6.4.7 When one vibration-generator-systems works, the cooling fan or heat exchanger and other auxiliary equipment shall work normally and each pipeline interface shall be reliable without cooling air or liquid leakage.

6.4.8 Transport test shall be done to vibration-generator-systems under packaging conditions. Vibration-generator-systems shall be able to boot normally after the test and shall still comply with each item of requirements of this Standard.

7 Inspection rules

7.1 Inspection items and inspection instruments

The items for exit-factory inspection and type inspection of vibration-generator-systems are shown in Table 5; the instruments for inspection are shown in Table 6.

Table 5 Inspection items

SN	Inspection items	Type inspection	Exit-factory inspection	Clause or sub-clause number of requirements	Clause or sub-clause number of inspection methods
1	Basic parameters	√	√	5	7.3.1
Sinusoidal vibration				6.2	
2	Frequency indication error	√	√	6.2.1	7.3.2
3	Indication error of acceleration, speed and displacement	√	√	6.2.2	7.3.3
4	Table-surface transverse movement ratio	√	√	6.2.3	7.3.4
5	Acceleration waveform distortion	√	√	6.2.4	7.3.5
6	Amplitude uniformity of the table-surface	√	√	6.2.5	7.3.6

Where:

F_{omt} - Excitation force, the unit is Newton (N);

m_e - Equivalent mass of moving parts, the unit is kilogram (kg);

m_t - Weight of the inspection mass, the unit is kilogram (kg);

a - Acceleration of the central point, the unit is meter per square second (m/s^2).

7.2 Frequency indication error

Select 10 frequency values uniformly or according to the octave at output end of the signal generator connected with the digital frequency meter within the specified frequency range to measure (include the upper limit and the lower limit of the working frequency); use frequency meter to measure the frequency value; record the frequency indication of vibration-generator-systems and the measured value of digital frequency meter respectively. The difference between the two shall comply with provisions of 6.2.1.

7.3.3 Indication errors of acceleration, speed and displacement

Connect the accelerator meter with the table-surface center of the vibration-generator-systems rigidly; connect the output with a vibration meter. Corresponding to specified frequency range, select one frequency value in high frequency band, middle frequency band and low frequency band respectively; and select 3 big, medium, small values of acceleration, speed and displacement respectively; use vibration meter to measure the table-surface center's acceleration, speed and displacement values; compare them with indication values of the acceleration, speed and displacement of the vibration-generator-systems. The result shall comply with provision of 6.2.2.

7.3.4 Table-surface transverse movement ratio

Connect the three-axial acceleration meter with the table-surface center rigidly; connect the three outputs of the acceleration meter with multi-channel vibration meter, vibration meter and recorder. Within the specified frequency range, the axial of vibration-generator-systems conducts frequency sweep vibration with 80% of the maximum vibration amplitude; respectively record the frequency function curve at the direction of vibration direction of the table-surface AND two mutually perpendicular frequency curves that are perpendicular to the vibration direction and perpendicular to the trunnion axial; then determine the maximum transverse movement ratio and corresponding frequency width. The result shall comply with provisions of 6.2.3.

7.3.5 Acceleration waveform distortion

Connect the acceleration meter with the table-surface center rigidly; connect the output with the distortion meter through the vibration meter.

excitation force being not less than 50% and 1 000 Hz of working frequency for 6 hours continuously; check each item of functions; it shall comply with provisions of 6.4.1. The continuous working hours can be assessed according to conditions negotiated and agreed by the supplier and the demander.

7.3.15 Table-surface leakage flux

When the vibration-generator-systems excitation device works normally, use a Teslameter to measure the magnetic flux density on the whole plane of which the height is 1/4 of the maximum distributed circle diameter of installation screw-hole on the table-surface, and parallel to the table-surface. The result shall comply with provisions of 6.4.2.

7.3.16 Safety equipment and protection functions of vibration-generator-systems

Visually inspect the vibration-generator-systems when it works beyond the set normal working state's parameters (such as over-current, over-voltage, over-displacement, over-heat, cooling equipment in low liquid level, pressure loss, water leakage, etc.); the protection function and safety equipment of the vibration-generator-systems shall be able to take effective-reliable protection or automatic shutdown. The inspection result shall comply with provisions of 6.4.3.

7.3.17 The maximum working noise of vibration-generator-systems

The vibration-generator-systems is unloaded; within the rated frequency range, conduct frequency sweep vibration at rated acceleration amplitude; select at least 6 measurement points, 1.0 m away from the vibration-generator-systems body and 1.5 m away from the ground; use sound level meter (A-weighting) to measure the noise of the vibration-generator-systems in working. The maximum measured value in the six measured values is the maximum working noise of the vibration-generator-systems; provide the noise value according to requirements of 6.4.4.

7.3.18 Appearance

Check the appearance and external marks of each part of the vibration-generator-systems in visual; it shall comply with provisions of 6.4.5.

7.3.19 Electric safety

Use insulation resistance tester and voltage tester to measure the live parts and non-grounding parts of the body. The measurement conditions: withstand-voltage 1500 V, 20 mA and 1 minute. The result shall comply with provisions of 6.4.6.

7.3.20 Cooling fan, heat exchanger and other auxiliary equipment

When the vibration-generator-systems is working, check the cooling fan, heat exchanger and other auxiliary equipment in visual. The working pressure and flow of the pipeline

AND the interface of each pipeline shall comply with provisions of 6.4.7.

7.3.21 Transport test

It shall conduct simulation vehicle transport test or field-test to the packaging of packed vibration-generator-systems. the selected test conditions are:

- a) Pavement: the middle pavement of class three road, roads with irregular stones and mud-roads;
- b) Mileage: 200 km;
- c) Vehicle speed: 30 km/h~40 km/h.

The test result shall comply with provisions of 6.4.8.

8 Inspection rules

8.1 Inspection classification

The inspection to vibration-generator-systems is divided into exit-factory inspection and type inspection.

8.2 Exit-factory inspection

The inspection items of exit-factory inspection shall be done to vibration-generator-systems one-by-one according to Table 5; vibration-generator-systems can leave the factory only after passing the inspection and being accompanied with product qualification certificate.

8.3 Type inspection

Type inspection items are stipulated in Table 5. During inspection, select one vibration-generator-systems among those of the same type randomly and conduct the inspection. When all inspection items are qualified, the sample system is qualified in inspection and vibration-generator-systems of this type shall be determined as a qualified batch.

9 Mark and packaging

9.1 Mark

9.1.1 The nameplate shall be fixed at an appropriate place on the vibration-generator-systems.

9.1.2 The nameplate shall include the following contents:

- a) Product model and name;
- b) Main technical parameters;
- c) Manufacturing number and manufacturing date;
- d) Name of mark of the manufacturer.

9.1.3 The marks on the packaging box shall include the following contents:

- a) Product model, name, specification and quantity;
- b) The maximum shape size of the box (Length× width× height);
- c) Net weight and rough weigh, kg;
- d) Shipping unit and address;
- e) The manufacturer's name.

9.1.4 The pictorial markings for handling of packages shall comply with provisions of Chapter 6 in JB/T 6147-2007.

9.2 Packaging

9.2.1 The packaging of the vibration-generator-systems shall be moisture-proof, rust-proof, and dust-proof combined protective packaging.

9.2.2 The packaging of the vibration-generator-systems shall comply with provisions of 5.1, 5.4, 5.6.2, 5.6.4 and 5.6.6 in JB/T 6147-2007.

10 Accompanying technical documents

Vibration-generator-systems shall be provided with the following technical documents:

- a) Packing list;
- b) Conformance certificate;
- c) Instructions for use (for products that execute this Standard, it shall indicate the number and name of this Standard), etc.

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