JEITA

Standard of Japan Electronics and Information Technology Industries Association

EIAJ ED-4701/400

Environmental and endurance test methods for semiconductor devices
(Stress test II)

Established in August, 2001

Prepared by

Technical Standardization Committee on Semiconductor Devices

Published by

Japan Electronics and Information Technology Industries Association

11, Kanda Surugadai 3-chome, Chiyoda-ku, Tokyo 101-0062, Japan

Printed in Japan

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Standard of Japan Electronics and Information Technology Industries Association

ENVIRONMENTAL AND ENDURANCE TEST METHODS FOR SEMICONDUCTOR DEVICES (STRESS TEST II)

1. SCOPE

These standards provide for environmental test methods and endurance test methods (especially stress tests) aimed at evaluating the resistance and the endurance of discrete semiconductor devices and integrated circuits (hereinafter generically called semiconductor devices) used in electronic equipment mainly for general industrial applications and consumer applications, under the various environmental conditions of various kinds that occur during their use, storage and transportation.

2. DEFINITION OF TERMS

The definitions of the technical terms used in these standards and in the relevant specifications are given in **EIAJ ED-4701/001** "Environmental and endurance test methods for semiconductor devices (General)."

3. PRECAUTIONS

The precautions used in these standards and in the relevant specifications are given in **EIAJ ED-4701/001** "Environmental and endurance test methods for semiconductor devices (General)."

4. TEST METHODS

Refer to the Appendix for the test methods.

Remarks:

The various test methods are arranged independently for the sake of more convenient use of these standards.

COMMENTS

1. PURPOSE OF ESTABLISHMENT OF THESE STANDARDS

Before the establishment of these standards, the standardization referring to **EIAJ ED-4701** "Environmental and endurance test methods for semiconductor devices" established on Feb., 1992, and EIAJ has issued amendments, whenever the revision and also new test method establish. However, it is recondite where the latest test methods are entered, it was resulting the confusion of users. So establishment of new numbering system that is easy to use both users and manufacturers was decided, and reached to the issuance in this time.

Electronic Industries Association of Japan (EIAJ) and The Japan Electronic Industry Development Association (JEIDA) have merged effective November 1,2 000, the Japan Electronics and Information Technology Industries Association (JEITA).

2. EVOLUTION OF THE DELIBERATIONS

The revision of the standards and new numbering system have been deliberated by "Sub-Committee on Semiconductor Devices Reliability" of the Technical Standardization Committee on Semiconductor Devices/Semiconductor Devices Reliability Group from Apr., 2000. Though to issue as a separate standard every each test method was considered, it made to issue with the system like the following.

(a) EIAJ ED-4701/001 Environmental and endurance test methods for semiconductor devices (General)

(b) EIAJ ED-4701/100 Environmental and endurance test methods for semiconductor devices (Life test I)

- **101** Steady state operating life
- **102** Temperature humidity bias (THB)
- **103** Temperature humidity storage
- **104** Moisture soaking and soldering heat stress series test
- **105** Temperature cycle
- **106** Intermittent operating life

(c) EIAJ ED-4701/200 Environmental and endurance test methods for semiconductor devices (Life test II)

- **201** High temperature storage
- **202** Low temperature storage
- **203** Moisture resistance (Cyclic)
- **204** Salt mist

(d) EIAJ ED-4701/300 Environmental and endurance test methods for semiconductor devices (Stress test I)

- **301** Resistance to soldering heat for surface mounting devices (SMD)
- **302** Resistance to soldering heat (excluding surface mounting devices)
- **303** Solderability
- **304** Human body model electrostatic discharge (HBM/ESD)

305 Charged device model electrostatic discharge (CDM/ESD)
306 Latch-up
307 Thermal shock

(e) EIAJ ED-4701/400 Environmental and endurance test methods for semiconductor devices (Stress test II)

401 Terminal strength
402 Mounting strength
403 Vibration (Sinusoidal)
404 Shock
405 Acceleration (Steady state)

(f) EIAJ ED-4701/500 Environmental and endurance test methods for semiconductor devices (Miscellaneous)

501 Permanence of marking
502 Flammability tests of plastic-encapsulated devices (Externally induced)
503 Seal
504 Low air pressure

Both life and stress tests are divided into two standards as "I" and "II". "I" is including test method that is thought that revision occurs comparatively from now on.

3. DELIBERATING MEMBERS

Deliberation of this standard has been made by "Sub-Committee on Semiconductor Devices Reliability" of the Technical Standardization Committee on Semiconductor Devices/Semiconductor Devices Reliability Group.

Below are listed the members of deliberation of this standard.

<Technical Standardization Committee on Semiconductor Devices/Semiconductor Devices Reliability Group>

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<Semiconductor Devices Reliability Group>

Chairman	Kazutoshi Miyamoto	Mitsubishi Electric Corp.

<Sub-Committee on Semiconductor Devices Reliability>

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Special Members	Yasuhiro Fukuda	Oki Electric Industry Co., Ltd.
	Kouji Obinata	Sony Corp.
	Takeshi Watanabe	NEC Corp.

APPENDIX

TEST METHOD 401
TERMINAL STRENGTH

1. SCOPE

This standard provides for the method to evaluate the resistance of terminals of semiconductor devices against forces applied during their handling and/or normal assembly work.

Remark:

It is recommended to apply the Method I (pull test), Method II (torsion test), Method III (bending test), Method IV (torque test of screw terminal) to the various terminals according to **TABLE 1**.

TABLE 1 TEST METHODS FOR THE TERMINAL STRENGTH IN TERMINAL SHAPE

Terminal shape	Test Method			
	Method I (Pull test)	Method II (Torsion test)	Method III (Bending test)	Method IV (Torque/test)
Lead wire terminal (can type, etc.)	○	○	○	
Plate terminal I (DIP, SIP, etc.)	○		○	
Plate terminal II (SOP, QFP, TSOP, QFI, etc.)	○			
Plate terminal III (SOJ, QFJ, etc.)	Not applicable			
Stud terminal (power diode, etc.)				○
Pin terminal [PGA (pin grid array), etc.]	○			

Remark:

A circle mark (○) indicates that the method is applied.

2. TEST EQUIPMENT

The equipment to be used in these tests consist of appropriate jigs, vices, etc., to apply the specified load.

Care should be taken not to cause scratches and deformations that could exert influence on the results of the tests.

3. PROCEDURE

3.1 Preliminary treatment

Whenever necessary, relevant specifications provide for the pre-treatment.

3.2 Initial measurement

Carry out the initial measurements in conformity with the items and conditions specified in the relevant specifications.

3.3 Test

There are 4 test methods, I, II, III and IV.

Select the most appropriate method according to the shape of the specimen (Refer to **TABLE 1**). The relevant specifications provide for one or more method. The terminals to be tested should be 1/4 or more of the total number of terminals or 3 or more terminals, except when otherwise specified. All terminals should be tested, however, when there are less than 3 terminals.

(1) Method I (Pull test)

Fix the component body of the specimen and apply the pull forces shown in **TABLE 1**, in the regular outlet direction in the case of lead wire terminals and in the terminal end direction shown in **TABLE 2** in the case of other kinds of terminals, and keep it unchanged for 10s±1s. The test method is specified in the relevant specifications, however, when the cross-sectional area of the terminal is sized less than $0.03mm^2$.

Remarks:

1. Component body is the part of the specimen excluding the terminals.
2. Since SMD with J-lead can not be pulled in the terminal direction, it was decided not to apply this test.

TABLE 2 METHOD I PULL TEST CONDITIONS

Nominal cross-sectional area (S) mm^2	Nominal lead wire diameter (d) (In the case of circular cross section) mm	Pull force N
$0.03 < S \leq 0.05$	$0.2 < d \leq 0.25$	1
$0.05 < S \leq 0.07$	$0.25 < d \leq 0.3$	2.5
$0.07 < S \leq 0.2$	$0.3 < d \leq 0.5$	5
$0.2 < S \leq 0.5$	$0.5 < d \leq 0.8$	10
$0.5 < S \leq 1.2$	$0.8 < d \leq 1.25$	20
$1.2 < S$	$1.25 < d$	40

Reference test:

The conditions in **TABLE 3**, prepared from the hypothetical curve of **FIGURE 1** obtained from the existing conditions, are recommended to method I (Pull Test) of minute terminals with nominal cross-sectional area sized less than $0.03mm^2$.

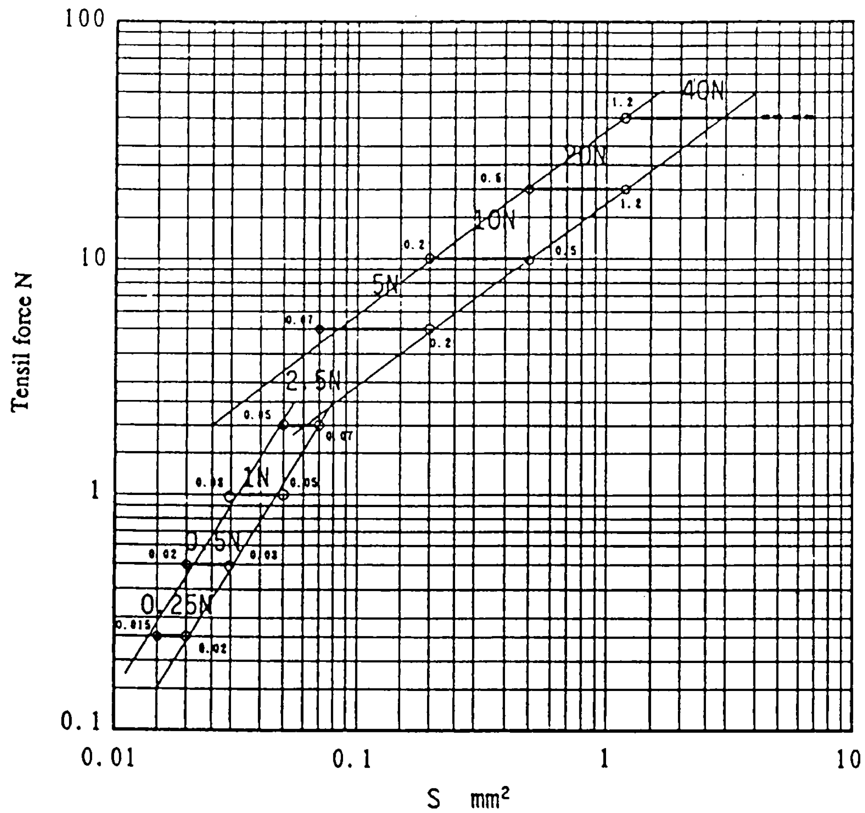
Stipulations for $S \leq 0.015$ ($d \leq 0.14$) are given in the relevant specifications.

The gradient of the nominal cross-sectional area versus pull force log-log graph of **FIGURE 1**, drawn based on the existing conditions, changes in smaller than $0.07mm^2$ of the nominal cross-sectional area. Thus, the conditions for cross-sectional areas smaller than $0.03mm^2$ were determined on the same gradient corresponding to cross-sectional areas smaller than $0.07mm^2$.

TABLE 3 METHOD I PULL TEST

Nominal cross-sectional area (S) mm^2	Nominal lead wire diameter (d) (In the case of circular cross section) mm	Pull force N
$0.015 < S \leq 0.02$	$0.14 < d \leq 0.16$	0.25
$0.02 < S \leq 0.03$	$0.16 < d \leq 0.2$	0.5

FIGURE 1 LOG-LOG GRAPH OF THE NOMINAL CROSS-SECTIONAL AREA VERSUS PULL FORCE RELATION



(2) Method II (Torsion test):

Put a jig sized 6.0 mm to 6.5mm in thickness and 0.75 mm to 0.8mm in radius of curvature on the base of the lead wire, and bend the lead wire 90 degrees by the jig. Next, fix the lead wire at a point distant 1.2mm±0.4mm from the place where it is bent, and rotate, according to the specified angle, the lead wire by the plane perpendicular to the normal extension axis of the lead wires of the specimen, which functions as rotation axis. This is one torsion. Next, rotate in the opposite direction according to the specified angle. This is the second torsion. The duration for one torsion test is about 5 seconds. Either the specimen holder or the lead wire holder can be rotated when carrying out this test, except when otherwise specified in the relevant specifications. This method is applicable only to lead wire terminals. (Refer to **FIGURE 2** and **FIGURE 3**).

TABLE 4 METHOD II TORSION TEST CONDITIONS

Test condition code	Torsion angle (degrees)	Number of torsions (times)
A	360	3
B	180	2

FIGURE 2 EXAMPLE OF JIG FOR LEAD WIRE TERMINAL TORSION TEST

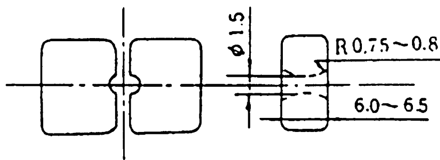
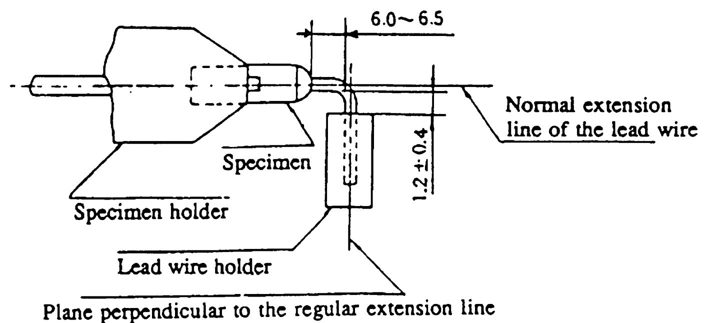


FIGURE 3 TORSION TEST METHOD OF LEAD WIRE TERMINAL



(3) Method III (Bending test):

Hold the specimen in such a way that the normal extension axis of the lead wire terminals, or the terminal direction in the case of plate terminals, become vertical, hang the load specified in **TABLE 5** to the extremity of the terminal, bend the terminal body by 90 degrees, and then return it to the original state. Carry out this operation within 2 to 3 seconds, and count this operation as 1 time. Next, bend the lead wire by 90 degrees and with the same speed in the opposite direction, or in the same direction in the case of plate terminal, and then return in to the original state once again. Count this operation as 2 times, and carry out the test 2 times except when otherwise specified. As for terminals with cross-sectional area sized less than 0.03mm^2, the applicable test procedures are specified in the relevant specifications.

The bending directions should be in conformity with the relevant specifications, and special care should be taken not to twist.

Remark

1. In plate terminals, carry out the bending at the part with wider surface.
2. Application of bending test to SMD: It was decided not to apply the bending test to SMD, because it can not be mounted when the terminals are bent at the time of the actual use, and further more the leads can not be bent according to the specified angle because they have special shape.
3. **IEC 60749** have specified test method for 2 times bending to the same direction, but this specifications decided not to apply.

TABLE 5 METHOD III BENDING TEST LOAD

Nominal cross-sectional area (S) mm^2	Nominal lead wire diameter (d) (In the case of circular cross section) mm	Load N
$0.03 < S \leq 0.05$	$0.2 < d \leq 0.25$	0.5
$0.05 < S \leq 0.07$	$0.25 < d \leq 0.3$	1.25
$0.07 < S \leq 0.2$	$0.3 < d \leq 0.5$	2.5
$0.2 < S \leq 0.5$	$0.5 < d \leq 0.8$	5
$0.5 < S \leq 1.2$	$0.8 < d \leq 1.25$	10
$1.2 < S$	$1.25 < d$	20

(4) Method IV (Torque test of screw terminal):

Apply the torque specified in Condition A or Condition B of **TABLE 6** on the screw terminal, in the plane perpendicular to the axis of the terminal during 10s±1s.

Remark

IEC 60749 have specified time to add torque, 10-15 seconds, that is longer than JEITA specifications.

TABLE 6 METHOD IV TORQUE TEST CONDITIONS

Nominal Diameter of the screw (mm)	Test condition	
	A N · m	B N · m
2	0.3	-
2.6	0.4	0.2
3	0.5	0.25
3.5	0.8	0.4
4	1.2	0.6
5	2	1
6	2.5	1.25

3.4 Post treatment

Specified in the relevant specifications, when necessary.

3.5 End-point measurement

After finishing the tests, inspect the external visual with magnification of 10 to 20 times, and make sure that there is no cut, breakage and looseness. When there are specified items in the relevant specifications, carry out the measurements in conformity with the specified items and conditions.

4. INFORMATION TO BE GIVEN IN THE RELEVANT SPECIFICATION

(1) Preliminary treatment (when required) [Refer to **3.1**]

(2) Items and conditions of the initial measurements(when required) [Refer to **3.2**]

(3) Types of test methods [Refer to **3.3**]

(4) Pull force of the pull test (cases other than the specified ones) [Refer to **3.3(1)**]

(5) Duration applied the pull force in the pull test (cases other than the specified ones) [Refer to **3.3(1)**]

(6) Test condition symbol of torsion test [Refer to **3.3(2)**]

(7) Number of cycles of the torsion test (cases other than the specified ones) [Refer to **3.3(2)**]

(8) Bending direction, load and number of cycles of the bending test (cases other than the specified ones) [Refer to **3.3(3)**]

(9) Test condition symbol of the torque test of the screw terminal [Refer to **3.3(4)**]

10) Duration applied torque for the screw terminal (cases other than the specified ones) [Refer to **3.3(4)**]

(11) Post treatment (when required) [Refer to **3.4**]

(12) Items and conditions of the end-point measurement (when required) [Refer to **3.5**]

REFERENCE 1. SUPPLEMENTARY INFORMATION ON THE TEST METHOD

1. REMARKS

Application to TCP (Tape carrier package): It is difficult to apply this standard to the lead terminals of TCP with extremely small cross-sectional areas comparing with conventional packages. Also, about BGA (Ball grid array) did not specify because a terminal shape is special. Thus, it was decided to make no specification, and to leave the matter as an issue to be discussed futurely.

In general, distinction must be made between the terminal strength test and the lead wire fatigue test, but as things now stand both tests are carried out simultaneously in view of the package construction and the lead shape. Thus, no distinction is made in these test conditions.

The test loads smaller than 1N will be requied, because the terminal cross-section of the package of surface mounting devices will become further smaller.

2. FOR DIFFERENCE WITH ANOTHER STANDARD

There is the following standard as another standard. However, in this standard do not included to consider coordination.

(1) For difference with JIS C 0051 (IEC 60068-2-21)

In JIS standard (or **IEC 60068-2-21**) that this standard is not given the terminal strength pushing test method are specified. There were not a proof of data and were as a future theme regarding about this test method. Also, there are standard to applied to semiconductor suface mounting devices on board. It is specified as **EIAJ ED-4702** "Mechanical stress test methods for semiconductor surface mounting devices" in JEITA.

(2) For difference with JEDEC JESD 22 B 105-B

The test item in JEDEC standard is the same as this standard but, the test conditions is very different.

The test conditions have almost same content and, it supposed to refer from "**MIL-STD-883E**".

TEST METHOD 402
MOUNTING STRENGTH

1. SCOPE

This standard provides for the methods to evaluate the resistance and the endurance, against forces applied during the mounting, wiring and/or use, of stud type, flat type, pressure-fitting type and other kinds of discrete semiconductor devices, as well integrated circuits that are mounted by screws and other mechanical means, which **EIAJ ED-4701/401** (terminal strength test) is not applicable to.

2. TEST EQUIPMENT

Equipment to be used in these tests should be appropriate mounting and/or pressure jigs aimed at applying the specified load, radiator, etc.

By the way, test equipment should be properly engineered not to cause scratches, deformations and other effects on the specimen, that could exert influence on the test results.

3. PROCEDURE

3.1 Pre-treatment

When required, the pre-treatments should be provided for in the relevant specifications.

3.2 Initial measurement

The initial measurements should be carried out in conformity with the items and conditions specified in the relevant specifications.

3.3 Test

There are 4 test methods, I, II, III and IV. The most appropriate test method should be selected according to the outer shape and construction of the specimen. The relevant specification provide for one or more test methods that are regarded as necessary.

Moreover, the types of screws, nuts, washers, etc., as well as the use of grease, compound, etc., are also mentioned in the relevant specification.

(1) Method I (Mounting torque test): (Applicable to specimens provided with screw on the body: e.g. Stud type)

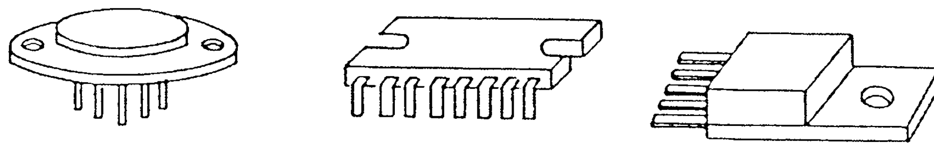
The specimen is mouted on the radiator according to the specified value of the mounting torque, is hold for 10s±1s, and then is removed it from the radiator. In this method the mounting force should work on the base of the specimen unless otherwise specified, and the mounting torque should be applied in the direction perpendicular to the mounting direction of the device, mounting it gradually so as to prevent the application of any shock. Tightening test from the nut side should be in conformity with stipulations of the relevant specifications.

(2) Method II (Mounting torque test): (Applicable to specimens that are mounted at 1 or more places, and are not provided with screw, Example: **FIGURE 1**)

The mounted specimen on the radiator according to the specified value of the mounting torque, is kept for 10s±1s, and then is removed from the radiator. When the specimen is to be mounted at 2 or more places, take care not to mount only 1 place up to the specified torque with the other mounting places kept opened. Carry out a light preliminary mounting of all mounting places in

the first place, and then mount up to the specified torque value.

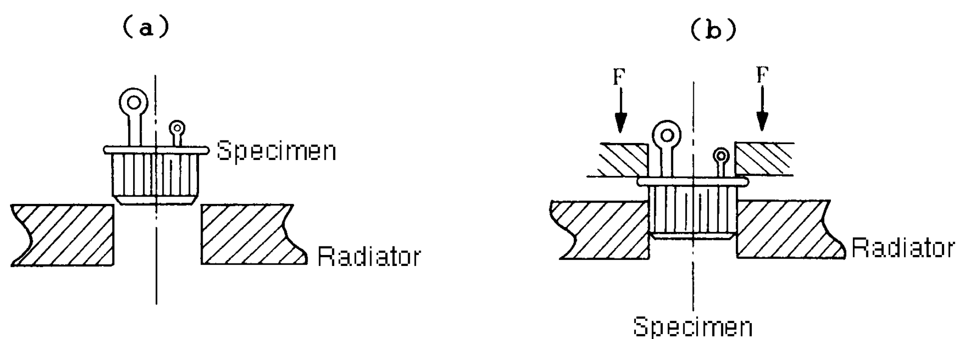
FIGURE 1 SCREW TYPE PACKAGES



(3) Method III (Pressure-bonding force test): (Example: Flat type)
Apply the specified pressure-bonding force evenly on the pressure bonding face of the specimen, leave it for 10s±1s, and then remove it.

(4) Method IV (Pressure-fitting force test): (Example: pressure-fitting type)
Place the specimen on the radiator made of the specified material and having the specified thickness and the specified hole diameter, as shown in **FIGURE 2(a)**, and fit the specimen into the hole by applying evenly the specified fitting pressure on its upper side. During this test, the specimen is kept mounting on the radiator.

FIGURE 2 PRESSURE-FITTING METHOD



3.4 Post treatment

When necessary, the post treatment should be specified in the relevant specifications.

3.5 End-point measurement

When specified in the relevant specifications, the end-point measurements should be carried out in conformity with the specified items and conditions. When they are not provided for, the outer view, the other shape, the sealing and other relevant aspects should be examined after the completion of the tests.

4. INFORMATION TO BE GIVEN IN THE RELEVANT SPECIFICATION

(1) Preliminary treatment (when required) [Refer to **3.1**]
(2) Items and conditions of the initial measurements (when required) [Refer to **3.2**]
(3) Types of test methods [Refer to **3.3**]
(4) Mounting torque value, pressure-initial measurements or pressure-fitting force [Refer to **3.3**]

(5) Materials and dimensions of the mounting jig, pressure jig and radiator [Refer to **2.**]

(6) Necessity of mounting accessories [Refer to **3.3**]

(7) Necessity of grease, compound, etc. [Refer to **3.3**]

(8) Post treatment (when necessary) [Refer to **3.4**]

(9) Items and conditions of the end-point measurements [Refer to **3.5**]

TEST METHOD 403
VIBRATION (SINUSOIDAL)

1. SCOPE

This standard provides for the methods to evaluate the resistance and endurance of semiconductor devices against vibrations that work during their transportation and field use.

Remarks

1. These tests are specified by assuming the evaluation of the breakage of the bonding wires and other kinds of troubles cased by vibration during the transportation and/or use of semiconductor devices consisting mostly of hollow seal packages.
2. These tests are not intended to evaluate the strength and endurance of the leads against vibration when the leads are fixed.

2. TEST EQUIPMENT

The vibration equipment should be satisfied the following conditions.

2.1 Vibration waveform and strain

The waveform of the vibration applied on the specimen should be a sinusoidal wave, and the harmonics contained in the vibration waveform should be less than 25%.

2.2 Vibration amplitude tolerance

The tolerance the amplitude, in the specified vibration directions and within the specified frequency range should be within ±15% of the specified value.

2.3 Vibrations in the directions perpendicular to the specified vibration direction

The maximum amplitudes in all directions perpendicular to the specified vibration direction, at the mounting position of the specimen, should be within 25% of the amplitude in the specified direction.

2.4 Vibration frequency tolerance

The tolerance should be ±2%.

2.5 Sweeping method

Sweeping should be continuous, and symmetric unless otherwise specified, but uniform sweeping is also acceptable. One sweep means doing one round trip within the specified frequency range (e.g.100Hz-2 000Hz-100Hz).

Remarks

When the equipment generates magnetism, and the specimen is sensitive to magnetism, the maximum permissible value of the magnetism should be specified in the relevant specification.

3. PROCEDURE

3.1 Initial measurement

The initial measurements should be carried out in conformity with the items and conditions specified in the relevant specification.

3.2 Mounting the specimen

The specimen should be firmly mounted, from the mechanical standpoint, on the vibrating stand, either directly or by using a mounting jig, in conformity with the method specified in the relevant specifications. The mounting tools should be capable to secure the precision specified in section **2**,

and moreover they should secure the applicarion of vibrations in the directions specified in section **3.3.** Sufficient strength, tight fixing and no resonance are required in fixing by mounting tools. The specimen should be mounted by fixing its body, unless otherwise specified. The lead wires can be fixed, however, when the specimen has such a shape that its body can be fixed by fixing its lead wires. In such a case, the method and the position to fix the lead wires should be specified in the relevant specification.

3.3 Tests

The test conditions should be specified in **TABLE 1**. The vibration should be applied in three directions, X, Y and Z. The duration of the test period should be even in the three directions.

TABLE 1 VIBRATION TEST CONDITIONS

Type of vibration	Variable frequency
Frequency range	100Hz-2 000Hz
Overall amplitude or acceleration	200m/s^2
Sweeping rate	100Hz-2 000Hz-100Hz, Approximately 4 minutes
Sweeping method	Logarithmic or uniform
Sweeping direction	4 cycles of each X,Y,Z
Test time	48 minutes

3.4 End-point measurement

The end-point measurements should be carried out in comformity with the items and conditions specified in the relevant specifications.

4. INFORMATION TO BE GIVEN IN THE RELEVANT SPECIFICATION

(1) Existence of magnetic influence and permissible maximum value (when required) [Refer to **2.** Remarks]

(2) Items and conditions of the initial measurements [Refer to **3.1**]

(3) Mounting method of the specimen (When required) [Refer to **3.2**]

(4) The contents of the test conditions when they are different from those ones of **TABLE 1** [Refer to **3.3**]

(5) Items and conditions of the end-point measurements [Refer to **3.4**]

REFERENCE 1. SUPPLEMENTARY INFORMATION ON THE TEST METHOD

1. REMARKS

A test condition of the vibration test was specified for conditions of 5 kind. The condition A, B, C, and E is the condition that it do not to applied in **IEC 60749** standard. Up to now, the each test conditions could select about vibration frequency and acceleration. And, this standard left the same condition as **IEC 60749** and deleted about other conditions because about to see endurance for an acceleration do not to apllied in generally and, in **IEC 60749** do not to applied to semiconductor devices.

VIBRATION TEST CONDITIONS

Test condition code	A	B	C	D	E
Type of vibration	Variable frequency	Variable frequency	Variable frequency	Variable frequency	Fixed frequency
Frequency range	10 Hz - 55 Hz	10 Hz - 500 Hz	100 Hz – 2 000 Hz	100 Hz – 2 000 Hz	60 Hz ± 20 Hz
Overall amplitude or acceleration	1.5 mm	1.5 mm or 100 m/s^2	100 m/s^2	200 m/s^2	200 m/s^2
Sweeping rate	10 Hz - 55 Hz - 10 Hz Approximately 1 minute	10 Hz - 500 Hz - 10 Hz Approximately 15 minutes	100 Hz – 2 000 Hz – 100 Hz Approximately 20 minutes	100 Hz – 2 000 Hz - 100 Hz Approximately 4 minutes	–
Sweeping method	Logarithmic or uniform				–
Test time	6 hours	6 hours	6 hours	48 minutes	96 hours

2. FOR DIFFERENCE WITH ANOTHER STANDARD

There is the following standard as another standard. However, in this standard do not included to consider coordination.

(1) For difference with JEDEC JESD 22 B 103-A

Start vibration frequency in JEDEC standard are 20Hz. However, it did not apply because it do not to get clear for difference with JEITA and IEC standard.

(2) For difference with MIL-STD-883E

For method 2 007.2 is the same with JEDEC standard the vibration frequency in method 2 005.2 specified as certain with 60Hz±20Hz and, it specified different JEITA and IEC standard because it specified on 96 hours for test time, it did not apply because do not useful in generally.

TEST METHOD 404
SHOCK

1. SCOPE

This standard provides for the methods to evaluate the structural and mechanical resistance and endurance of the semiconductor devices against strong shocks that work on them due to rough handling, as well as during transportation and/or use.

Remark

1. This test is mainly applied to hollow seal packages.

2. TEST EQUIPMENT

The shock test equipment are aimed at applying the maximum accelerations and the pulse cycles that are presumed to work on the specimens, and the maximum acceleration should be the half - sine pulse within ±20% of the specified maximum acceleration. In the case of the test conditions A, however, it must be the half - sine pulse within ±10% of the maximum acceleration.

3. PROCEDURE

3.1 Initial measurement

The initial measurements should be carried out in conformity with the items and conditions specified in the relevant specifications.

3.2 Mounting the specimen

The specimen should be mounted by giving the external leads proper protection, and by holding and fixing the case. Utmost care must be taken to prevent the application of excessive force from the jig on the case when mounting the specimen, and to prevent the case from being damaged due to deformation of the mounting jig and vibration during the application of the shock.

3.3 Tests

Mount the shock test equipment on a solid test bench or an equivalent base, place it at horizontal position before using it, raise the mounting bench up to a height where the specified acceleration can be obtained, and then drop it. At that time, it is desirable to take measures to prevent the repetition of the shock due to rebound and the like.

The test conditions should be selected out of those ones of **TABLE 1**, unless otherwise specified. The directions enclosed within parentheses in the "DIRECTION" column of **TABLE 1** can be omitted in conformity with the relevant specifications.

TABLE 1 SHOCK TEST CONDITIONS

Test condition code	Maximum acceleration (m/s^2)	Pulse width (ms)	Direction	Times
A	1 000	6	X1,(X2),Y1,Y2,Z1,(Z2)	3times/direction
B	5 000	1	X1,(X2),Y1,Y2,Z1,(Z2)	3times/direction
D	15 000	0.5	X1,(X2),Y1,Y2,Z1,(Z2)	3times/direction

Reference,

Test condition C of 10 000 m/s^2 and 0.5 ms is deleted in accordance with **IEC 60749**.

3.4 End-point measurement

The end-point measurements should be carried out in conformity with the items and conditions of the relevant specifications.

4. INFORMATION TO BE GIVEN IN THE RELEVANT SPECIFICATION

(1) Shock waveform (when required) [Refer to **2.**]

(2) Items and conditions of the initial measurements [Refer to **3.1**]

(3) Code of the test conditions, or the contents of the test conditions when they are different from those ones of **TABLE 1** [Refer to **3.3**]

(4) Directions [Refer to **3.3**]

(5) Items and conditions of the end-point measurements [Refer to **3.4**]

TEST METHOD 405
ACCELERATION (STEADY STATE)

1. SCOPE

This standard provides for the method to evaluate the endurance and the resistance of semiconductor devices against steady state acceleration.

Remarks

1. These tests are specified by assuming the evaluation of the breakage of the bonding wires and other kinds of failures caused by vibration during the transportation and/or use of semiconductor devices consisting mostly of hollow packages.
2. These tests are designed in such a way to detect structural and mechanical defects that can not necessarily be detected by shock tests and vibration tests.
3. Depending on the construction and the materials of the specimen, failure modes that are impossible on the market may occur in these tests. In particular, special attention is required in the case of gold wire bonding, because failure modes that are impossible in the field use may occur due to wire displacement under the condition D, 300 000 m/s^2.

2. TEST EQUIPMENT

The steady state acceleration test equipment should be able to apply the accelerations shown in **TABLE 1** on the specimen, by means of centrifugal force.

3. PROCEDURE

3.1 Initial measurement

The initial measurements should be carried out in conformity with the items and conditions of the relevant specifications.

3.2 Mounting

The specimen should be fixed by means of jigs or normal mounting methods. The lead wires can be fixed, however, when the specimen has such a shape that its body can be fixed by fixing its lead wires. In such a case, the method and the position to fix the lead wires should be specified in the relevant specifications.

3.3 Tests

The specified accelerations (m/s^2) should be applied in the directions X_1, X_2, Y_1, Y_2, Z_1 and Z_2 during 1 minute, unless otherwise specified. The tolerance of the acceleration should be within ±15 % of the specified acceleration. Unless otherwise specified, the centrifugal force to be applied should be selected out of those ones shown in **TABLE 1**, depending on the shape and construction of the specimen.

TABLE 1 ACCELERATION CONDITIONS

Test condition code	Acceleration(m/s^2)
A	50 000
B	100 000
C	200 000
D	300 000

The centrifugal force should be applied gradually, for the acceleration to increase up to the specified value and to decrease to zero again, in 20 seconds or more, respectively.

Reference

IEC 60749 recommends condition D for the severity of tests.

IEC 60749 also describes 500 000 m/s^2 as condition E

3.4 End-point measurement

The end-point measurements should be carried out in conformity with the items and conditions specified in the relevant specifications.

4. INFORMATION TO BE GIVEN IN THE RELEVANT SPECIFICATION

(1) Items and conditions of the initial measurements [Refer to **3.1**]

(2) Mounting method of the specimen [Refer to **3.2**]

(3) Code of the test conditions, or the contents of the test conditions when they are different from those ones of **TABLE 1** [Refer to **3.3**]

(4) Method of application of the accelerations (When they are different from the specified ones) [Refer to **3.3**]

(5) Items and conditions of the end-point measurements [Refer to **3.4**]