JEITA

Standard of Japan Electronics and Information Technology Industries Association

EIAJ ED-4701/500

Environmental and endurance test methods for semiconductor devices
(Miscellaneous)

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Standard of Japan Electronics and Information Technology Industries Association

ENVIRONMENTAL AND ENDURANCE TEST METHODS FOR SEMICONDUCTOR DEVICES (MISCELLANEOUS)

1. SCOPE

These standards provide for environmental test methods and endurance test methods (especially tests that do not belong to which of life and 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 detail 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 detail 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>

Chairman	Mitsutoshi Ito	NEC Corp.

<Semiconductor Devices Reliability Group>

Chairman	Kazutoshi Miyamoto	Mitsubishi Electric Corp.

<Sub-Committee on Semiconductor Devices Reliability>

Chairman	Tetsuaki Wada	Matsushita Electronics Co., Ltd.
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Special Members	Yasuhiro Fukuda	Oki Electric Industry Co., Ltd.
	Kouji Obinata	Sony Corp.
	Takeshi Watanabe	NEC Corp.

APPENDIX

TEST METHOD 501
PERMANENCE OF MARKING

1. SCOPE

This standard provides for the method to evaluate the permanence of the marking against solvents used to remove flux stuck on the semiconductor device.

Remarks:

This test is designed with the major object of evaluating the permanence of the paint for marking against solvents, represented by that one used to remove flux.

Therefore, it does not apply to the laser marking.

2. TEST EQUIPMENT

Container to be used in this test should be made of nonreactive material, and should be sufficient size to permit complete immersion of the specimen.

The required protective facilities and apparatuses should be provided, and the work should be performed with sufficient care when using organic solvents.

3. SOLVENT

TABLE 1 shows the solvents and the immersion time which are used unless otherwise specified.

TABLE 1 TYPES OF SOLVENT

Type of the solvent	Specification of the solvent	Temperature of the solvent [°C]	Immersion time [min]
Isopropyl alcohol	**JIS K 1522**(1)	23±5	5±0.5
Distilled water or deionized water	Transmission rate less than 2mS/m Resistance rate more than 500Ωm	55±5	5±0.5

Attention(1):

It may use the solvent at **JIS K 8839**, because it is equal to the solvent at **JIS K 1522**.

4. PROCEDURE

4.1 Initial measurement

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

4.2 Tests

The specimen immerse in solvent completely at the condition to be shown in **TABLE 1**.

After taking the specimen out of the solvent, dry it more than 5 minutes.

Rub the marking on the surface of the specimen 5 strokes in both directions with absorbent cotton or the pale leaf paper at a speed of stroke in both directions per second.

The rubbing pressure is $5.0N/cm^2 \pm 0.5N/cm^2$.

Remarks:

Material of the absorbent cotton or the pale leaf paper specified in the detail specification.

4.3 Final treatment

If the final treatment specified in the relevant specifications, wash the rubbed specimen with clean and same solvent, and dry it at standard condition.

4.4 End-point measurement

Carry out visual inspection of the specimen, and reject it when the markings are illegible. The magnification power of the optical device used in the inspection should not exceed 3 to 5 times, and the inspection should be carried out under the same conditions as the initial measurements.

Remarks:

Changes in the characteristics of the specimen due to the test are not object of evaluation, unless otherwise specified.

5. INFORMATION TO BE GIVEN IN THE RELEVANT SPECIFICATION

(1) Items and conditions of the initial measurement [Refer to **4.1**]

(2) Type of solvent [Refer to **3.**]

(3) Immersion condition (When the immersion period is other than the specified ones) [Refer to **3.**]

(4) Material of the absorbent cotton or the pale leaf paper [Refer to **4.2**]

(5) Final treatment (If it is necessary) [Refer to **4.3**]

(6) Items and conditions of the end-point measurements [Refer to **4.4**]

TEST METHOD 502
FLAMMABILITY TESTS OF PLASTIC-ENCAPSULATED DEVICES (EXTERNALLY INDUCED)

I. SCOPE

This standard shall provides for the test methods to simulate the effect of small flames which may result from fault condition within the equipment.

Remark:

This standard has been established based on **JIS C 0061**, Fire Hazard Testing Part 2: Test Methods **Section 2** Needle Flame Test (injection needle burner) (**IEC 60695-2-2**: 1991), and it has been specifically prepared for the plastic-encapsulated devices while taking the requirements of **IEC 60749** into consideration; Flammability (externally induced) under the item 2 of **section 1**, Flammability Tests of Plastic-Encapsulated Devices, Chapter IV, the Semiconductor Devices, the Mechanical and Climatic Test Methods.

2. TEST EQUIPMENT

The burner to produce the test flame consists of a tube, which is at least 35mm long and has a bore of 0.5mm±0.1mm and an outer diameter not exceeding 0.9mm. A hypodermic needle, the tapered end of which is cut off, may be used for the test.

The burner is supplied with butane gas having a purity of at least 95%; there must be no air admitted to the burner tube.

Remark:

Propane gas may be used to supply the burner, butane gas being however the standard reference.

To evaluate the possibility of spread of fire , for example by burning or glowing particles falling from the specimen, a layer of the material or components normally surrounding or situated underneath the specimen is placed underneath the specimen at a distance equal to the distance between the specimen and the surrounding material or components when the specimen is mounted as in normal use.

Unless otherwise specified in the relevant specifications, a piece of flat smooth white pinewood board, approximately l0mm thick covered in close contact with a single layer of wrapping tissue, is positioned at the distance of 200mm±5mm below the place where the needle flame is applied to the specimen, unless otherwise specified in the relevant specification. The strobe pinewood board or wrapping tissue may be replaced by other materials if they have been verified as equally suitable for the purpose.

Remarks:

(1) Wrapping tissue as specified in 6.86 of **ISO 4046**: A soft and strong, lightweight wrapping paper of grammage generally between 12g/m^2 and 30g/m^2, primarily intended for protective packaging of delicate articles and for gift wrapping.

(2) Tue term "strobe pine" used herein shall be a kind of pine that is produced in the north America, of which leaves are somewhat whiter than those of ordinary pines. The pine is called the white pine in English.

3. PROCEDURE

Precautions must be taken to safeguard the health of the personnel conducting tests against:

(1) the risks of explosion or fire;

(2) the inhalation of smoke and/or toxic products;

(3) toxic residues.

3.1 Initial Measurement

The measurements shall be taken by the items and conditions specified in the relevant specifications. The visual inspection shall also be carried out on the appearance of the tested device.

3.2 Test

(1) Unless otherwise specified in the relevant specification, the specimen is arranged in its most specimen shall be oriented so that it will unfavorable position of normal use.

(2) With the axis of the burner in the vertical position, the gas supply is adjusted so that without artificial air supply the length of the flame is 12mm ± 1mm. (See **FIGURE 1(a)**.)

(3) Place the flame underneath the test specimen, hold it in position for 10s $^{+0}_{-1}$ and then remove it. An example of the flame placement is shown in **FIGURE 1(b)**.

Remarks:

(1) The room or compartment in which the test is made shall have adequate dimensions to ensure that the test is carried out in a substantially draught-free atmosphere and with an adequate supply of air.

(2) The means to fix the specimen shall not influence the effect of the test flame or the propagation of flames in a way other than that occurring under normal conditions of use.

(3) During the adjustment of the test flame, any influence of heat on the specimen shall be avoided.

(4) The test flame is applied to that part of the surface of the specimen which is likely to be affected by flames resulting from normal use or from fault conditions, or from any source of ignition accidentally applied.

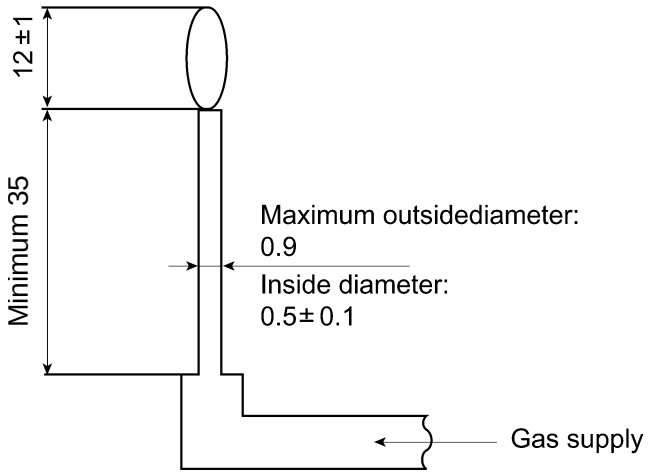
In order that the test flame may be applied in the most unfavorable way, the tube of the burner may be bent.

Once the test flame has been positioned so that at least the tip of the flame is in contact with the surface of the specimen, the burner must not be moved. The test flame is removed after the specified time. For examples of test positions, see **FIGURE 1(b)**.

(5) When required by the relevant specification, the test is made at more than one point on the same specimen, in which case care must be taken to ensure that any deterioration caused by previous tests will not affect the result of the test to be made .

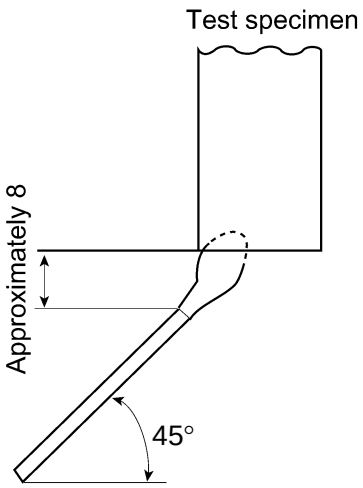
FIGURE 1 Examples of the needle flame and test position

(a) Flame adjustment



(b) An example of test position

Unit: mm



3.3 Number of Test Specimens

Unless otherwise specified in the relevant specification, the test is made on three specimens.

3.4 Observation and Measurement

(1) During the test, the specimen, the parts surrounding the specimen and the layer placed below it shall be observed.

(2) In the case of ignition of the specimen or of the parts surrounding it or of the layer placed below it, the duration of burning is measured and recorded.

Duration of burning denotes the time interval from the moment the test flame is removed until the flames have extinguished or the glowing of the specimen or of parts in its vicinity or of the layer used for the test is no longer visible.

(3) If specified in the relevant specification, the extent of burning is measured after the specimen has been allowed to cool down to approximately room temperature and has been cleaned by mean of a clean dry cloth.

Extent of burning denotes the distance measured between the center of the area where the test flame is applied and the most distant trace of burning.

When determining the trace of burning, changes in color, soot formation, distortion of shape due to heat, melting and scorching of the surface are ignored.

(4) The specimen shall be examined visually for physical damage and the mechanical/electrical parameters measured as specified in the relevant specification.

3.5 Judgment Criteria for the Test Results

Unless otherwise prescribed in the relevant specification, the specimen is considered to have satisfactorily withstood the needle-flame test if one of the following situations applies:

(1) There is no flame and no glowing of the specimen and no ignition of the wrapping tissue of scorching of the pinewood board when these are used.

(2) Flames or glowing of the specimen, the surroundings and the layer below extinguish within 30s after the removal of the needle-flame, the surrounding parts and the layer below have not burnt away completely and there has been no ignition of the wrapping tissue nor scorching of the

pinewood board.

4. INFORMATION TO BE GIVEN IN THE RELEVANT SPECIFICATION

(1) Objects to be placed underneath the test specimen (If an unspecified object is to be used) [Refer to **2**]

(2) Initial measurement items (If required) [Refer to **3.1**]

(3) Position of the test specimen [Refer to **3.2.(1)**]

(4) Number of the test specimen (If not three) [Refer to **3.3**]

(5) Extent of burning (If required) [Refer to **3.4(3)**]

(6) Physical and electrical parameters (If required) [Refer to **3.4(4)**]

(7) Judgment criteria (If others than those specified are to be used) [Refer to **3.5**]

5. REMARKS

(1) Requirements that need to be considered in the relevant specification

Whether the criteria specified are sufficient to check compliance with the safety requirements, or whether further criteria should be introduced.

REFERENCE 1. SUPPLEMENTARY INFORMATION ON THE TEST METHOD

1. PROBLEMS DELIBERATED

(1) Positioning of the flammability tests (internally Induced), and fixing of the conditions to apply the stresses and judgment criteria thereof:

The test methods specified in the IEC were ambiguous and there were problems with regard to the product liability. Although there was an opinion to establish it as a reference standard, it was concluded that it was too early to establish it as an JEITA standard.

(2) Positioning of the flammability tests (externally induced):

The relationship between the flammability tests of devices and flammability tests of the materials (such as the UL standard) is not clear, which needs to be clarified as the future assignment.

TEST METHOD 503
SEAL

1. SCOPE

This standard provides for the method to evaluate the air tightness of airtight package semiconductor devices.

1.1 DEFINITION

(1) Calculated leakage rate

Volume of dry air, expressed in units of cubic centimeters, that leaks through during l second at 25°C temperature when the high-pressure side is at $l \times 10^5$ Pa and the low-pressure side is at less than 1.33x $l0^2$Pa. The unit is $Pa \cdot cm^3/s$.

(2) Measured leakage rate

Leakage rate of the specimen measured under the specified conditions. The unit is $Pa \cdot cm^3/s$.

The measured leakage rate is converted to the calculated leakage rate for the sake of comparison.[See section **3.3 (2)(c)**].

2. TEST EQUIPMENT

2.1 Method I (fine leakage test using radioisotopes)

The test equipment consists of the pressure vessel, which has the function of pressurizing the mixture of krypton 85 and dry nitrogen gas to the specified pressure and during the specified time, the scintillation counter , as well as the mass-spectrometric leakage detector with the specified detecting precision.

2.2 Method II (fine leakage test using helium gas)

The test equipment consists of the pressure vessel, which has the function of pressurizing helium gas to the specified pressure and during the specified time, as well as the mass-spectrometric leakage detector with the specified detecting precision.

2.3 Method III (gross leakage test by means of detecting bubbles)

The test equipment consists of an appropriate lighting equipment and magnifying glasses, that have the function of keeping the specified low-viscosity fluid at the specified temperature and allowing accurate observation of the bubbles.

3. PROCEDURE

3.1 Preliminary treatment

When required, the preliminary treatment is specified in the relevant specifications.

3.2 Initial measurement

Whenever provided in the detail specifications, the initial measurements should be performed in conformity with the specified items and conditions.

3.3 Tests

There are 3 methods to perform these tests. One or more of these methods are specified in the relevant specifications, in conformity with the required items.

When performing both the fine leakage test and the gross leakage test, the fine leakage test should be carried out before the gross leakage test.

(1) Method I (Fine leakage by means of radioisotope)

(a) Place the specimen in a sealed container, and pressurize it with a mixture of krypton85 and dry nitrogen gas according to the time and pressure specified in the detail specifications. When required, the radioactivity of the pressurized gas (concentration of krypton 85) should be specified in the detail specifications.

(b) After pressuring during the specified time ,measure the leakage rate of the specimen by means of the scintillation counter. The measurement should be carried out within 4 hours after finishing the pressurization.

(c) The relation between the measured count (R) and the leakage rate (Q) is given by the following equation .

$$Q_S = \frac{R_0 \cdot P*}{S \cdot K \cdot T \cdot P \cdot t}$$

where:

Qs : Specified maximum permissible leak rate ($Pa \cdot cm^3/s$)

Ro : Maximum permissible count specified for the device (count/min.)

S : Relative radioactivity of the pressurized gas ($\mu Ci/Pa \cdot cm^3$)

K : Overall counting efficiency of the scintillation counter (count/min/μCi)

T : Pressurization time (h)

P : $Pe^2 - Pi^2$: Pe is the pressurizing pressure (Pa), Pi is the internal pressure of the specimen (Pa)

t : Time count converted to seconds (3 600s/h)

P* : $Po^2 - (\Delta P)^2$: Po is the pressure at the sea level (Pa)expressed in terms of absolute pressure.

ΔP is the difference between the actual pressure at the test site and the pressure at the sea level (Pa).

$$Q = \frac{R}{R_0} \cdot Q_S$$

where:

Q : Leak rate of the specimen ($Pa \cdot cm^3/s$)

R : Count of the specimen (count/min.)

(d) The judgment should be done in conformity with the detail specifications

Remarks:

l. Since the little error occurring in the form of ΔP=0 is small compared with the basic precision of this test method, the correction coefficient (P*)corresponding to the altitude above the sea level used to be omitted in conventional cases, but it was decided to add it in this case with the object of adjusting the dimensions.

2. This test method is applicable exclusively to specimens that can endure the test pressure.

3. This test method is effective for specimens with air leakage rate below l $Pa \cdot cm^3/s$. In general, the pressure vessel is evacuated with the objective of recovering the gas. It is impracticable to detect large leakage's, because gas is lost from the leak

4. Method I is not popular because it is difficult to perform or it needs sea level calibration before judgment.

(2) Method II (Fine leakage test using helium gas)

(a) Place the specimen in a sealed vessel, and pressurize helium gas (95%or more purity) in conformity with the time and pressure specified in the detail specifications.

(b) After finishing the pressurization with helium gas during the specified time, measure the leakage of the specimen using a mass-spectrometric leakage detector.

When helium gas adsorbed on the specimen causes errors in the measurements, the specimen can in principle be left standing for 30minutes.

When required, the precision of the mass-spectrometric leakage detector should be specified in the detail specifications.

(c) The measured leakage rate (R) is converted to the calculated leakage rate(L)using the following equation.

$$R = \frac{LP_E}{P_0}\left(\frac{M_A}{M}\right)^{\frac{1}{2}}\left\{1-\exp-\left(\frac{Lt_1}{VP_0}\left(\frac{M_A}{M}\right)^{\frac{1}{2}}\right)\right\}\exp-\left(\frac{Lt_2}{VP_0}\left(\frac{M_A}{M}\right)^{\frac{1}{2}}\right)$$

Where:

R : Measured leakage rate ($Pa \cdot cm^3/s$)

L : Calculated leakage rate ($Pa \cdot cm^3/s$)

P_E : Pressure during pressurization (Pa)

P_0 : Atmospheric pressure (Pa)

M_A : Average molecular weight of the atmosphere

M : Molecular weight of helium

t_1 : Pressurization time (s)

t_2 : Standing time(s) from the end of the pressurization to the measurement. (Maximum 30minutes unless otherwise specified).

(d) No Pressurization is needed, and the measurement can be performed immediately with the mass-spectrometric leakage detector when the sealing of the specimen is carried out in helium gas ambient. It must be remembered, however, that the equation above can not be used for converting the measured leakage rate into calculated leakage rate.

(e) The measurement criteria should be in conformity with the detail specification.

(f) The mass-spectrometric leakage detector should be calibrated using a diffusion-type leakage standard instrument.

Remarks:

1. This test method is applicable only to specimens capable of enduring the test pressure.

2. This test method is effective for specimens that have air leak rate below approximately 1 $Pa \cdot cm^3/s$. In general the pressure vessel is evacuated after the pressurization with the object of recovering the gas. When the leakage is large, it is impossible to detect it because gas is lost through the leak.

(3) Method III (Large leakage tests using bubbles)

(a) Heat the fluid specified in the detail specifications to 125°C±5°C, unless when otherwise specified, and immerse the specimen during the time specified in the detail specifications.

(b) In this test use fluid with viscosity below 22mm^2/s under normal conditions. In general, it is recommendable to use fluorocarbon (FC-43,FC-48), silicone oil, #1 electrical insulation oil (JIS C 2320), ethylene glycol, etc.

(c) The immersion depth(from the uppermost part of the specimen to the fluid surface)should be 5.0cm or more, unless otherwise specified.

(d) Gas contained in the inner space of the device is expanded and bubbles can be observed from the leak point when there is any leakage in the immersed specimen, and an appropriate lighting and magnifying glass can be used for the sake of accurate observation of these bubbles.

(e) The specimen should be rejected when bubbles are observed during the specified time or before it.

(f) Large leakage can be detected using this test, but fine leakage can not. It is recommendable to use this method in combination with the Test Method I and II.

Remarks:

When there is any substance with boiling point below l25°C, such as water and the like, stuck on the surface of the specimen, it can be mistaken for leakage, and in such a case it is necessary to wash it or to carry out some appropriate preliminary treatment, or to carry out appropriate preliminary treatment in the detail specifications. Moreover, gas contained in fine cavities existing on the surface of the specimen and not linked with its inner space may generate bubbles. Since these bubbles stop within short time, care must be taken not to mistake them for leakage.

3.4 Post treatment

When required, the post treatment should be specified in the detail 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.

4. INFORMATION TO BE GIVEN IN THE RELEVANT SPECIFICATION

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

(2) Initial measurements (When required) [Refer to **3.2**]

(3) Test method [Refer to **3.3**]

(4) Information related to Method I

(a) Minimum pressurization pressure, minimum pressurization time and minimum relative radioactivity (when required) [Refer to **3.3(l)(a)**]

(b) Judgment criteria

(5) Information related to Method II

(a) Pressurization pressure and pressurization time of helium (When required) [Refer to **3.3(2)(a)**]

(b) Time during which the specimen is to be left standing until the measurements, after the helium gas pressurization (When required) [Refer to **3.3(2)(b)**]

(c) Minimum detecting sensitivity of the mass-spectrometric leakage detector (When required) [Refer to **3.3(2)(b)**]

(d) Judgment criteria (Including when the specimen is sealed in helium gas) [Refer to **3.3(2)(e)**]

(6) Information related to Method III
Immersion fluid, fluid temperature and immersion time
[Refer to **3.3.(3)(a)** and **3.3.(3)(b)**]

(7) Post treatment (When required) [Refer to **3.4**]

(8) End-point measurements (When required) [Refer to **3.5**]

TEST METHOD 504
LOW AIR PRESSURE

1. SCOPE

This standard provides for the methods to evaluate the characteristics of semiconductor devices and the performance of their component materials with the object of preventing dielectric strength accidents due to the reduction of dielectric strength of the air and other parts, mainly when the air pressure is lowered.

This test is applied only for the devices whose operating voltage is over 1000V.

2. TEST EQUIPMENT

The test equipment to be used in this test should consist of an appropriate airtight chamber equipped with vacuum pump, allowing the measurement and observation of the specimen during the tests, as well as a manometer and a micrometer or an oscilloscope capable of detecting currents from DC to high frequency (approximately 30MHz).The test chamber should be capable to maintain the air pressures of **TABLE 1** within the largest one of the limits given by$\pm l \times l0^2$Pa or±5%.

3. PROCEDURE

3.1 Pre-treatment

When required, the pre-treatment are specified in the relevant specifications.

3.2 Initial measurement

Carry out the initial measurements including the observation of the outer view, in conformity with the items and conditions specified in the relevant specifications.

3.3 Tests

The test conditions are specified in the relevant specifications, in correspondence to the test condition codes shown in **TABLE 1**. Test conditions other than those ones of **TABLE 1** are specified in the detail specifications. Apply the specified voltage on the specimen, and monitor the functional deterioration of the device while the pressure in the test chamber is lowered from the atmospheric pressure to the specified value and is returned again to the atmospheric pressure. When there are component parts with generation of arc and noxious corona, and/ or other defects or deterioration that obstruct the operation of the component part, they should be rejected.

Moreover, carry out the measurements and the inspection of the outer view (within the visible extent), as needed, under decompressed conditions.

By the way, when decompressing the specimen under low-temperature and high-temperature conditions, make sure of decompressing the interior of the test chamber after reaching the specified temperature value. Use dry air when returning the pressure and the temperature to the normal temperature and pressure conditions.

3.4 Post treatment

At the end of test period, take the specimen out of the test chamber, and leave it standing under norma1 conditions from 2 hours to 24hours.When there is frost or water drops stuck on the specimen, remove them beforehand

3.5 End-point measurement

Carry out the end-point measurements, including the observation of the outer view, in conformity with the items and conditions specified in the relevant specifications.

TABLE 1 LOW AIR PRESSURE TEST CONDITIONS

Test condition code	Air pressure (Pa)	Approximate altitude (Reference) (m)
A(1)	8.40×10^4	-
B	7.00×10^4	3 000
C	5.50×10^4	4 850
D	4.00×10^4	7 200
E	2.50×10^4	10 400
F	1.50×10^4	13 600
G	8.0×10^3	17 600
H	4.0×10^3	22 100
I	2.0×10^3	26 600
J	1.0×10^3	31 200

NOTE(1) Applicable when test under the lower limit of the normal conditions is required.

Reference:

It is specified that the pressure conditions should be chosen among 1kPa, 4.4kPa, or 60kPa , in **IEC 60749**.

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 [Refer to **3.2**]
(3) Test conditions (When performing the tests under conditions other than those ones of **TABLE 1**) [Refer to **3.3**]
(4) Test condition codes [Refer to **3.3**]
(5) Test temperature and time [Refer to **3.3**]
(6) Loading conditions (Load application conditions) [Refer to **3.3**]
(7) Measurement items, methods and times during the test. (When required) [Refer to **3.3**]
(8) Post treatment (When required) [Refer to **3.4**]
(9) Items and conditions of the end-point measurements [Refer to **3.5**]

5. REFERENCE

As for space applications and high altitude applications, in which semiconductor devices are used at places where the air pressure is lowered below the values specified in there standards, the matter will be dealt with by means of detail specifications specified in correspondence to each specific case of application.