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Semiconductor devices - Mechanical and climatic test methods - Part 19: Die shear strength (IEC 60749-19:2003)

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EUROPEAN STANDARD

**EN 60749-19**

NORME EUROPÉENNE

EUROPÄISCHE NORM

April 2003

ICS 31.080.01

English version

**Semiconductor devices –  
Mechanical and climatic test methods  
Part 19: Die shear strength  
(IEC 60749-19:2002)**

Dispositifs à semiconducteurs –  
Méthodes d'essais mécaniques  
et climatiques  
Partie 19: Résistance de la pastille  
au cisaillement  
(CEI 60749-19:2002)

Halbleiterbauelemente –  
Mechanische und klimatische  
Prüfverfahren  
Teil 19: Prüfung der Chip-Bondfestigkeit  
(IEC 60749-19:2002)

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This European Standard was approved by CENELEC on 2003-04-01. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CENELEC member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the Central Secretariat has the same status as the official versions.

CENELEC members are the national electrotechnical committees of Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Luxembourg, Malta, Netherlands, Norway, Portugal, Slovakia, Spain, Sweden, Switzerland and United Kingdom.

**CENELEC**

European Committee for Electrotechnical Standardization  
Comité Européen de Normalisation Electrotechnique  
Europäisches Komitee für Elektrotechnische Normung

**Central Secretariat: rue de Stassart 35, B - 1050 Brussels**

## Foreword

The text of document 47/1664/FDIS, future edition 1 of IEC 60749-19, prepared by IEC TC 47, Semiconductor devices, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as EN 60749-19 on 2003-04-01.

This mechanical and climatic test method, as it relates to die shear strength, is a complete rewrite of the test contained in Clause 7, Chapter 2 of EN 60749:1999.

The following dates were fixed:

- latest date by which the EN has to be implemented  
at national level by publication of an identical  
national standard or by endorsement (dop) 2004-01-01
- latest date by which the national standards conflicting  
with the EN have to be withdrawn (dow) 2006-04-01

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## Endorsement notice

The text of the International Standard IEC 60749-19:2003 was approved by CENELEC as a European Standard without any modification.

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SIST EN 60749-19:2004

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NORME  
INTERNATIONALE  
INTERNATIONAL  
STANDARD

CEI  
IEC

60749-19

Première édition  
First edition  
2003-02

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**Dispositifs à semiconducteurs –  
Méthodes d'essais mécaniques et climatiques –**

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**Part 19:  
Die shear strength**

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## INTERNATIONAL ELECTROTECHNICAL COMMISSION

SEMICONDUCTOR DEVICES –  
MECHANICAL AND CLIMATIC TEST METHODS –

**Part 19: Die shear strength**

FOREWORD

- 1) The IEC (International Electrotechnical Commission) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of the IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, the IEC publishes International Standards. Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. The IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
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- 3) The documents produced have the form of recommendations for international use and are published in the form of standards, technical specifications, technical reports or guides and they are accepted by the National Committees in that sense.
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- 6) Attention is drawn to the possibility that some of the elements of this International Standard may be the subject of patent rights. The IEC shall not be held responsible for identifying any or all such patent rights.

International Standard IEC 60749-19 has been prepared by IEC technical committee 47: Semiconductor devices.

The text of this standard is based on the following documents:

FDIS	Report on voting
47/1664/FDIS	47/1684/RVD

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

This mechanical and climatic test method, as it relates to die shear strength, is a rewrite of the test method contained in Clause 7, Chapter 2 of IEC 60749.

The committee has decided that the contents of this publication will remain unchanged until 2007. At this date, the publication will be

- reconfirmed;
- withdrawn;
- replaced by a revised edition, or
- amended.

# SEMICONDUCTOR DEVICES – MECHANICAL AND CLIMATIC TEST METHODS –

## Part 19: Die shear strength

### 1 Scope

This part of IEC 60749 determines (see note) the integrity of materials and procedures used to attach semiconductor die to package headers or other substrates (for the purpose of this test method, the term “semiconductor die” should be taken to include passive elements).

This test method is generally only applicable to cavity packages or as a process monitor. It is not applicable for die areas greater than 10 mm<sup>2</sup>. It is also not applicable to flip chip technology or to flexible substrates.

NOTE This determination is based on a measure of the force applied to the die or to the element, and, if a failure occurs, the type of failure resulting from the application of force and the visual appearance of the residual die attach medium and the header/substrate metallization.

### 2 Description of the test apparatus

The apparatus for this test shall consist of a load applying instrument in the form of a linear motion force-applying instrument or a circular dynamometer with a lever arm. In addition it shall have the following:

- a) a contact tool which applies a uniform load to the edge of the die, perpendicular to the die mounting plane of the package or substrate (see Figure 3). A compliant material on the contact tool may be used to ensure that the load is applied uniformly (see Figure 1);
- b) an accuracy of 5 % of full scale or  $\pm 0,5$  N, whichever is the greater tolerance;
- c) a means of indicating the load applied;
- d) a facility, fitted with suitable light source, to allow visual observation (e.g. at 10 $\times$  magnification) of the die and contact tool during testing;
- e) a fixture with rotational capability relative to the die contact tool and package/substrate holding fixture to allow line contact of the tool along the whole edge of the die from end to end (see Figure 2).

NOTE Many measuring equipments are graduated in kilogram-force (kgf) (1 kgf = 9,8 N).

### 3 Test method

A force sufficient to shear the die from its mounting, or equal to twice the minimum specified shear strength (see Clause 4), whichever is the smaller, shall be applied to the die using the apparatus of Clause 2, with the following provisions.

- a) When a linear motion force-applying instrument is used, the direction of the applied force shall be parallel with the plane of the header or substrate and perpendicular to the die being tested.
- b) When a circular dynamometer with a lever arm is employed to apply the force required for testing, it shall be pivoted about the lever arm axis and the motion shall be parallel with the plane of the header or substrate and perpendicular to the edge of the die being tested. The contact tooling attached to the lever arm shall be at a proper distance to ensure an accurate value of applied force.
- c) The die contact tool shall load against an edge of the die which most closely approximates a 90° angle with the base of the header or substrate to which it is bonded (see Figure 3).
- d) After initial contact with the die edge and during the application of force, the contact tool shall not move vertically with respect to the die such that contact is made with the header/substrate or die attach medium. If the tool rides over the die, a new die may be substituted or the die may be repositioned, provided that the requirements of item c) of Clause 3 are met.

### 4 Failure criteria

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The strength of attachment of a die shall be considered to have failed the test if any of the following criteria exists:

- a) Unless otherwise specified in the relevant specification, die separation at a force not greater than the following:
  - 1)  $4,1 \text{ mm}^2 \leq \text{die area} \leq 10 \text{ mm}^2$ : 25 N,
  - 2) die area < 4,1 mm<sup>2</sup>: 6,1 N per mm<sup>2</sup> of die area,
  - 3) die area > 10 mm<sup>2</sup>: not applicable (see clause 1);
- b) die separation at a force less than 1,25 times that in item a) above and evidence of less than 50 % adhesion of the die attach medium to the die (as determined by visual inspection);
- c) die separation at a force less than 2 times that in item a) above and evidence of less than 10 % adhesion of the die attach medium to the die (as determined by visual inspection).

NOTE Residual die material attached in discrete areas of the die attach medium should be considered as evidence of such adhesion.

### 5 Requirements

When specified, the force required to achieve separation and the category of the separation shall be recorded.



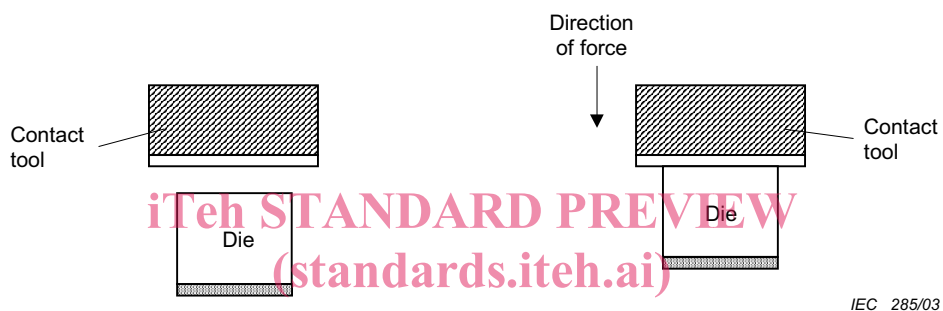
## 6 Categories of separation

- Shearing of die with residual die material remaining.
- Separation of die from die attach medium.
- Separation of die and die attach medium from package.

## 7 Summary

When this test is required in the relevant specification, the following details shall be given:

- Minimum die attach strength if other than that given by the expressions in item a) of Clause 4.
- The number of devices to be tested and acceptance criteria.
- Requirements for data recording, when applicable (see Clauses 5 and 6).



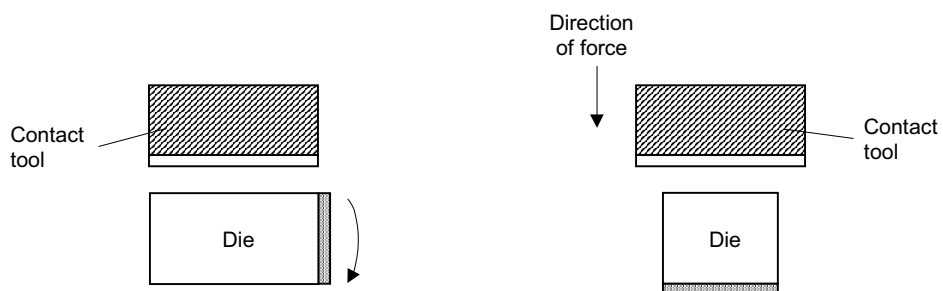
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NOTE A compliant interface on the contact tool distributes the load to the irregular edge of the die.

**Figure 1 – Compliant interface on contact tool (plane view)**



IEC 286/03

NOTE The die contact tool or the device may be rotated to ensure parallel alignment.

**Figure 2 – Alignment of tool with die (plane view)**