

**SLOVENSKI STANDARD**  
**oSIST prEN IEC 60749-22-2:2025**  
**01-februar-2025**

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**Polprevodniški elementi - Metode za mehansko in klimatsko preskušanje - 22-2.  
del: Moč vezi - Preskusne metode za strižno vezavo žice**

Semiconductor devices - Mechanical and climatic test methods - Part 22-2: Bond strength - Wire bond shear test methods

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**Ta slovenski standard je istoveten z: prEN IEC 60749-22-2:2024**

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**ICS:**

31.080.01	Polprevodniški elementi (naprave) na splošno	Semiconductor devices in general
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<b>SECRETARIAT:</b> Korea, Republic of	<b>SECRETARY:</b> Mr Cheolung Cha
<b>OF INTEREST TO THE FOLLOWING COMMITTEES:</b>	<b>HORIZONTAL FUNCTION(S):</b>
<b>ASPECTS CONCERNED:</b>	
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<b>TITLE:</b> <b>Semiconductor devices - Mechanical and climatic test methods - Part 22-2: Bond strength - Wire bond shear test methods</b>
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<b>PROPOSED STABILITY DATE:</b> 2031
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<b>NOTE FROM TC/SC OFFICERS:</b>
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## 89 INTERNATIONAL ELECTROTECHNICAL COMMISSION

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92 SEMICONDUCTOR DEVICES –  
93 MECHANICAL AND CLIMATIC TEST METHODS –  
94

## 95 Part 22-2: Bond strength - wire bond shear test methods

96

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133 This first edition together with the first edition of IEC 60749-22-1, cancels and replaces IEC  
134 60749-22 published in 2002 and is based on JEDEC document JESD22-B116B. It is used with  
135 permission of the copyright holder, JEDEC Solid State Technology Association.

136 This edition includes the following significant technical changes with respect to the previous  
137 edition:

138 Major update, including new techniques and use of new materials (e.g. copper wire) involving  
139 a complete rewrite as two separate subparts (this document and IEC 60749-22-1)

141 The text of this International Standard is based on the following documents:

Draft	Report on voting
XX/XX/FDIS	XX/XX/RVD

142

143 Full information on the voting for its approval can be found in the report on voting indicated in  
144 the above table.

145 The language used for the development of this International Standard is English

146 This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in  
147 accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available  
148 at [www.iec.ch/members\\_experts/refdocs](http://www.iec.ch/members_experts/refdocs). The main document types developed by IEC are  
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150 The committee has decided that the contents of this document will remain unchanged until the  
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152 specific document. At this date, the document will be

- 153 • reconfirmed,
- 154 • withdrawn,
- 155 • replaced by a revised edition, or
- 156 • amended.

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158

## SEMICONDUCTOR DEVICES – MECHANICAL AND CLIMATIC TEST METHODS –

### PART 22-2: BOND STRENGTH - WIRE BOND SHEAR TEST METHODS

163

164

#### 165 1 Scope

166 This test method establishes a means for determining the strength of a ball bond to a die or  
167 package bonding surface and may be performed on pre-encapsulation or post-encapsulation  
168 devices. This measure of bond strength is extremely important in determining two features:

169 the integrity of the metallurgical bond which has been formed, and

170 the quality of ball bonds to die or package bonding surfaces.

171 This test method covers thermosonic (ball) bonds made with small diameter wire from 15 µm to  
172 76 µm (0,000 6 "to 0,003").

173 This test method can only be used when the bonds are large enough to allow for proper contact  
174 with the shear test chisel and when there are no adjacent interfering structures that would hinder  
175 the movement of the chisel. For consistent shear results the ball height must be at least 4,0 µm  
176 (0,000 6 ") for ball bonds, which is the current state of the art for bond shear test equipment at  
177 the time of this revision.

178 This test method can also be used on ball bonds that have had their wire removed and on to  
179 which a 2nd bond wire (typically a stitch bond) is placed. This may be known as "stitch on ball"  
180 and "reverse bonding". See Annex A for additional information.<sup>25</sup>

181 The wire bond shear test is destructive. It is appropriate for use in process development,  
182 process control, and/or quality assurance.

183 This test method may be used on ultrasonic (wedge) bonds, however its use has not been  
184 shown to be a consistent indicator of bond integrity. See Annex B for information on performing  
185 shear testing on wedge bonds.

186 This test method does not include bond strength testing using wire bond pull testing. Wire bond  
187 pull testing is described in IEC 60749-22-1, Bond strength testing – Wire bond pull test methods.

188

#### 189 2 Normative references

190 The following documents are referred to in the text in such a way that some or all of their content  
191 constitutes requirements of this document. For dated references, only the edition cited applies.

192 IEC 60749-22-1, *Semiconductor devices – Mechanical and climatic test methods – Part 22-1:*  
193 *Bond strength testing – Wire bond pull test methods.*

194 For undated references, the latest edition of the referenced document (including any  
195 amendments) applies.

196 Also see Bibliography (informative) references.

197 **3 Terms and definitions**

198 For the purposes of this document, the following terms and definitions apply.

199 ISO and IEC maintain terminology databases for use in standardization at the following  
200 addresses:

- 201 • IEC Electropedia: available at <https://www.electropedia.org/>
- 202 • ISO Online browsing platform: available at <https://www.iso.org/obp>

203 **3.1**

204 **ball bond**

205 adhesion or welding of a small diameter wire, typically gold or copper, to a bonding surface  
206 metallization, usually an aluminium alloy, using a thermosonic wire bond process

207 Note 1 to entry: The ball bond includes the enlarged spherical, or nail-head, portion of the wire (provided by the  
208 flame-off and first bonding operation), the underlying bonding surface and the ball bond-bonding surface metallurgical  
209 weld interface.

210 Note 2 to entry: Gold wire implies a gold alloy in which the gold content is likely 99% or greater. Copper wire  
211 implies a copper alloy of similarly high copper content and also includes copper wire with a very thin coating of  
212 palladium]

213 Note 3 to entry: At the time of this revision, other wire materials and wire coatings are being evaluated, but there is  
214 not enough information collected to confirm that the fail modes listed in this test method are valid for any of the new  
215 wire types.

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216 **3.2**

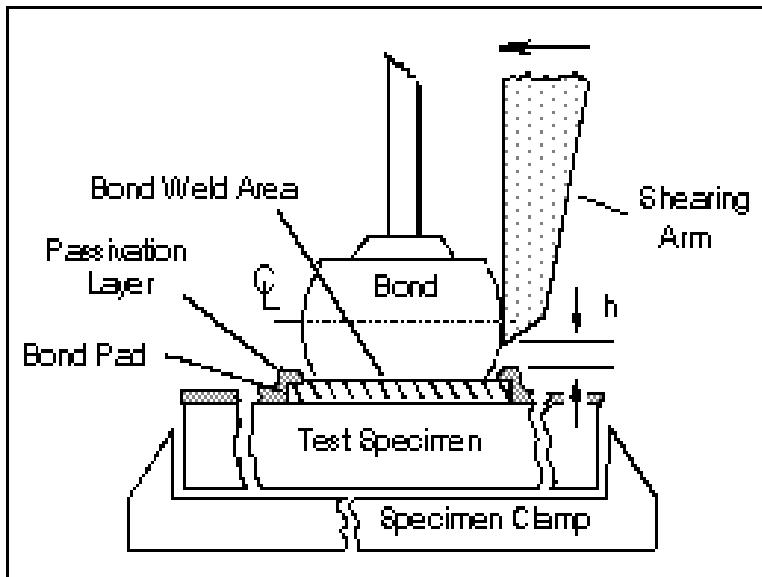
217 **bonding surface**

218 either 1) die pad metallization or 2) package surface metallization to which the wire is ball  
219 bonded

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220 **3.3** <https://standards.iteh.ai/catalog/standards/sist/ce4d154e-be77-4b25-90c5-de84bd7a232f/osit-pr-en-iec-60749-22-2-2025>  
221 **bond shear**  
222 process in which an instrument uses a chisel-shaped tool to shear or push a ball bond off the  
223 bonding surface (see Figure 1)

224 NOTE The force required to cause this separation is recorded and is referred to as the bond shear force. The bond  
225 shear force of a ball bond, when correlated to the diameter of the ball bond, is an indicator of the quality of the  
226 metallurgical bond between the ball bond and the bonding surface metallization.



227

228 **Figure 1 — Bond shear set-up for bond on die bonding pad**  
 229 **(Similar setup for bonds on other bonding surfaces, such as package**  
 230 **substrate/leadframe)**

231 **3.4**  
 232 **shear tool; shear arm**  
 233 chisel (made of tungsten carbide or an equivalent material with similar mechanical properties)  
 234 with specific angles on the bottom and back of the tool to ensure a shearing action

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235 **3.5**  
 236 **stitch bond**  
 237 second bond during the ball (thermosonic) bonding process, in which the wire is typically  
 238 bonded to the package bonding surface.

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239 Note 1 to entry: A stitch bond may also be referred to as a crescent bond.

240 Note 2 to entry: For some unique constructions (e.g., "stitch on ball"), the second bond may be formed on top of  
 241 another ball bond, from which the wire has been removed.

242 **3.6**  
 243 **wedge bond**  
 244 adhesion or weld of a thin wire, typically aluminium, copper, or gold to a die pad metallization  
 245 or the package bonding surface, usually a plated leadframe post or finger, using an ultrasonic  
 246 wire bonding process

247 Note to entry: See Annex B for information on performing shear testing on wedge bonds.

## 4 Apparatus and material required

### 4.1 Inspection equipment

250 An optical microscope system or scanning electron microscope providing a minimum of 70X  
 251 magnification. A higher magnification may be necessary for 15 µm (0,000 6") diameter wire.

### 4.2 Measurement equipment

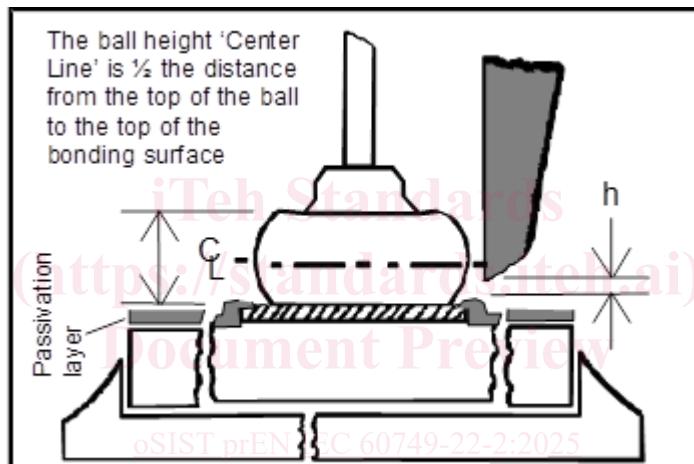
253 An optical microscope/measurement system capable of measuring the bond diameter to within  
 254  $\pm 2,54 \mu\text{m}$  (0,000 1").

### 255 4.3 Workholder

256 Fixture used to hold the part being tested parallel to the shearing plane and perpendicular to  
 257 the shear tool. The fixture shall also eliminate part movement during bond shear testing. If using  
 258 a calliper controlled workholder, place the holder so that the shear motion is against the positive  
 259 stop of the calliper. This is to ensure that the recoil movement of the calliper controlled  
 260 workholder does not influence the bond shear test.

### 261 4.4 Bond shear equipment

262 The bond shear equipment must be capable of repeatable, precision placement of the shearing  
 263 tool with respect to the ball height and the bonding surface. The specified distance (h) above  
 264 the topmost part of the bonding surface (e.g., passivation layer on IC, solder mask on organic  
 265 substrate) shall ensure the shear tool does not contact the bonding surface (e.g., top  
 266 passivation or polyimide layer, solder mask) and shall be less than the distance from the  
 267 topmost part of the bonding surface to the centre line (CL) of the ball bond (see Figure 2). See  
 268 Annex C for guidance when the passivation, or other structures on the die surface and  
 269 excessive Al splash prevent the shear tool from contacting the ball below the centre line.



270 **Figure 2 — Proper height placement of shear tool with respect to ball centre line**

### 271 4.5 Bond shear chisel tool setup

272 When choosing the proper chisel for the bond being sheared items to consider include but are  
 273 not limited to flat shear face, sharp shearing edge, shearing width of a minimum of 1,2X the  
 274 bond diameter, and bond length. The sample and chisel face should be clean and free of chips  
 275 or other defects that will interfere with the shearing test.

276 Bonds should also be examined to determine if adjacent interfering structures are far enough  
 277 away to allow suitable placement and clearance (above the bonding surface and between  
 278 adjacent bonds) for the shear test tool.

## 280 5 Procedure

### 281 5.1 Calibration

282 Before performing the bond shear test, it must be determined that the equipment has been  
 283 calibrated in accordance with manufacturer's specifications and is presently in calibration.  
 284 Recalibration is required if the equipment is moved to another location.