# INTERNATIONAL STANDARD

# IEC 60286-3

Fourth edition
2007-06

## Packaging of components for automatic handling –

## Part 3: Packaging of surface mount components on continuous tapes



Reference number
IEC 60286-3:2007(E)

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Commission Electrotechnique Internationale
International Electrotechnical Commission
Международная Электротехническая Комиссия

PRICE CODE U

*For price, see current catalogue*

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

# PACKAGING OF COMPONENTS FOR AUTOMATIC HANDLING –

## Part 3: Packaging of surface mount components on continuous tapes

## FOREWORD

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International Standard IEC 60286-3 has been prepared by IEC technical committee 40: Capacitors and resistors for electronic equipment.

This fourth edition cancels and replaces the third edition issued in 1997. It constitutes a technical revision.

This edition contains the following significant technical changes with respect to the previous edition:

a) implementation of Type IV (adhesive-backed punched plastic carrier tape for singulated bare die and other surface mount components);
b) minor revisions related to tables, figures and references.

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

| FDIS | Report on voting |
|---|---|
| 40/1838/FDIS | 40/1847/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.

The list of all the parts of the IEC 60286 series, under the general title *Packaging of components for automatic handling*, can be found on the IEC website.

The committee has decided that the contents of this publication will remain unchanged until the maintenance result date indicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

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- withdrawn,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

A bilingual version of this publication may be issued at a later date

# PACKAGING OF COMPONENTS FOR AUTOMATIC HANDLING –

## Part 3: Packaging of surface mount components on continuous tapes

## INTRODUCTION

Tape packaging meets the requirements of automatic component placement machines and also covers the use of tape packaging for components for test purposes and other operations.

## 1 General

### 1.1 Scope

This part of IEC 60286 is applicable to the tape packaging of electronic components without leads or with lead stumps which are intended to be connected to electronic circuits. It includes only those dimensions that are essential for the taping of components intended for the above-mentioned purposes.

This standard also includes requirements related to the packaging of singulated die products including bare die and bumped die (flip chips).

### 1.2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60191-2:1966, *Mechanical standardization of semiconductor devices – Part 2: Dimensions*

IEC 61340-5-1:1998, *Electrostatics – Part 5-1: Protection of electronic devices from electrostatic phenomena – General requirements*

IEC 61340-5-2:1999, *Electrostatics – Part 5-2: Protection of electronic devices from electrostatic phenomena – User guide*

IEC 62258-3:2005, *Semiconductor die products – Part 3: Recommendations for good practice in handling, packing and storage*

ISO/IEC 16388:1999, *Information technology – Automatic identification and data capture techniques – Bar code symbology specifications – Code 39*

ISO 11469:2000, *Plastics – Generic identification and marking of plastics products*

## 2 Terms and definitions

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

**2.1**
**packaging**
product made of any material of any nature to be used for the containment, protection, structured alignment for automatic assembly, handling and delivery

## 3 Structure of the specification

The various types of tapes are as follows.

Type I - Punched carrier tape, with top and bottom cover tape (8 mm and 12 mm)

Type II - Blister carrier tape, with single sprocket holes (8 mm, 12 mm, 16 mm and 24 mm)

Type III - Blister carrier tape, with double sprocket holes (32 mm to 200 mm)

Type IV - Adhesive-backed punched plastic carrier tape for singulated bare die and other surface mount components

Type V - Continuous pressed carrier tapes (in development)

Type VI - Blister carrier tapes 4 mm in width (in development)

All dimensions in the tables are in millimetres.

### 3.1 Type I – Punched carrier tape, with top and bottom cover tape (8 mm and 12 mm)

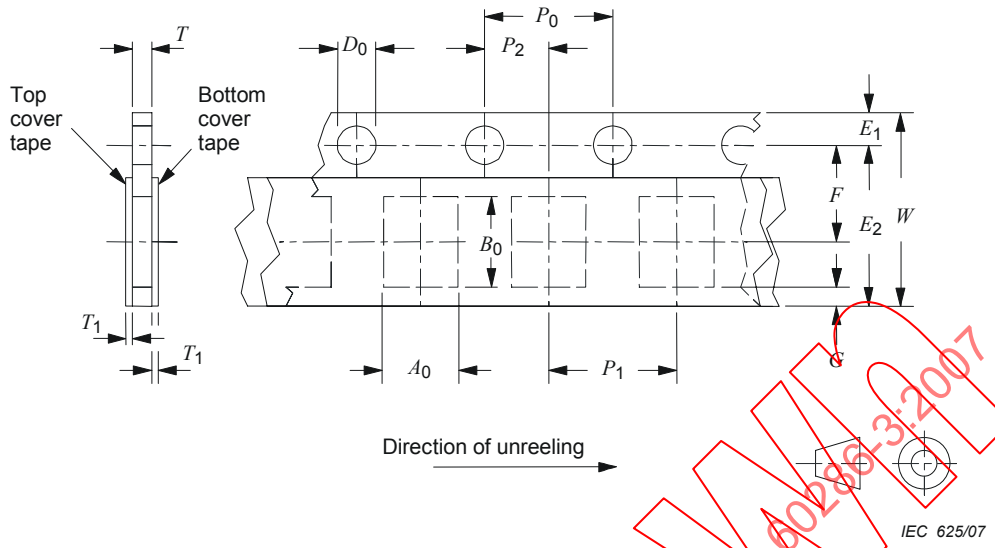


**Figure 1 – 8 mm and 12 mm punched carrier-tape dimensions**

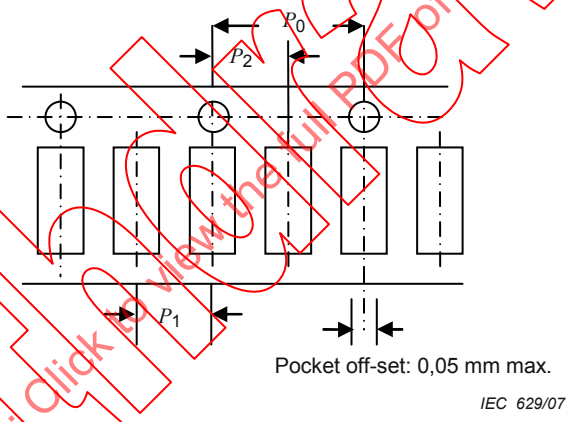


**Figure 2 – Illustration of 2 mm cavity pitch**

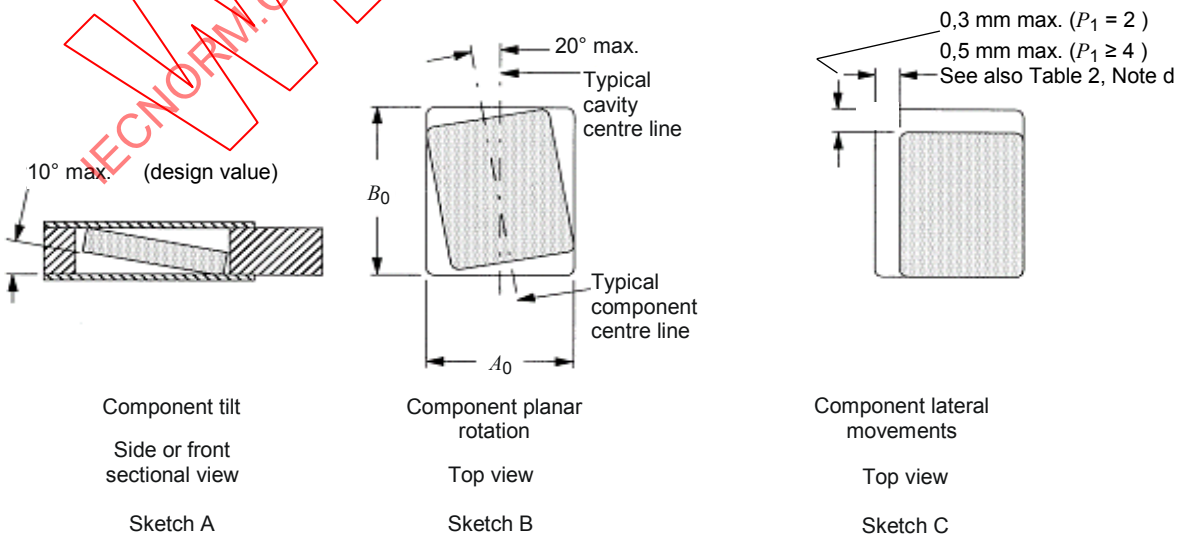


**Figure 3 – Maximum component tilt, rotation and lateral movement**

**Table 1 – Constant dimensions of 8 mm and 12 mm punched carrier tape**

| Tape size | $D_0$ | $E_1$ | $P_0$ | $P_2$ | $G_{min}$ | $T_{max}$ | $T_{1max}$ | Cumulative pitch (over 10 pitches) |
|---|---|---|---|---|---|---|---|---|
| **8 and 12** | $1{,}5\ ^{+0{,}1}_{0}$ | 1,75 ± 0,1 | 4,0 ± 0,1 ($P_1 \geq 4$)<br>4,0 ± 0,05 ($P_1 = 2$) | 2,0 ± 0,05 | 0,75 | 1,1 paper<br>1,6 non-paper | 0,1 | ± 0,2 |

**Table 2 – Variable dimensions of 8 mm and 12 mm punched carrier tape**

| Tape size | $E_{2\,min}$ | $F$ | $P_1$ | $W$ | $A_0$, $B_0$, $T$ |
|---|---|---|---|---|---|
| **8** | 6,25 | 3,5 ± 0,05 | 4,0 ± 0,1 ($P_1 \geq 4$)<br>2,0 ± 0,05 ($P_1 = 2$) | $8{,}0\ ^{+0{,}3}_{-0{,}1}$ | See note |
| **12** | 10,25 | 5,5 ± 0,05 | 4,0 ± 0,1 ($P_1 \geq 4$)<br>2,0 ± 0,05 ($P_1 = 2$) | $12{,}0\ ^{+0{,}3}_{-0{,}1}$ | |

NOTE The nominal dimensions of the component compartment should be derived from the relevant component specification. The tolerances on the nominal dimensions of the compartment should be chosen so that the components cannot change their orientation within the tape and can be easily removed from the tape, with the following characteristics.

There shall be sufficient clearance surrounding the component so that

a) the component does not protrude beyond either surface of the carrier tape;

b) the component can be removed from the cavity in a vertical direction without mechanical restriction after the top cover tape has been removed;

c) the rotation of the component is limited to a 10° max. tilt (see Figure 3, sketch A) and a 20° max. planar rotation (see Figure 3, sketch B);

d) the lateral movement of the component is restricted to 0,5 mm max.($P_1 \geq 4$), 0,3 mm max.($P_1 = 2$) (see Figure 3, sketch C).

For components with either length or width dimensions of less than 1,2 mm, market trends are towards a planar rotation limit of 10° max. and a lateral movement of 0,2 mm max. and a component rotation depends on the agreement between suppliers and users. See also Clause 6 for die products.

For defined component positioning, the pocket positions should be defined to an origin point; in this case, the index hole. Pockets should be positioned relative to this hole.

Preferred dimensions for components should be taken from the relevant IEC specifications.

Dimensions $A_0 \leqq B_0$.

### 3.2 Type II – Blister carrier tape, with single sprocket holes (8 mm, 12 mm, 16 mm and 24 mm)

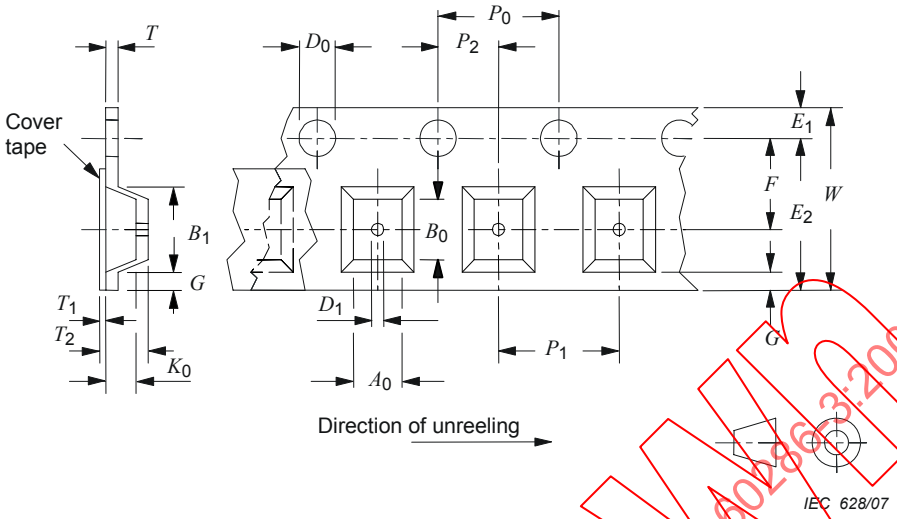


**Figure 4 – Blister carrier tape dimensions (8 mm, 12 mm, 16 mm and 24 mm)**

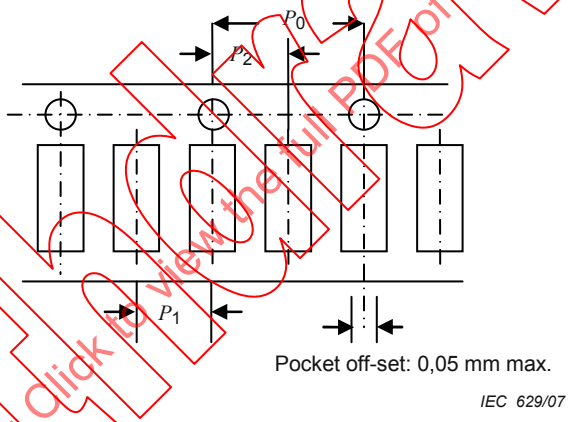


**Figure 5 – Illustration of 2 mm cavity pitch**

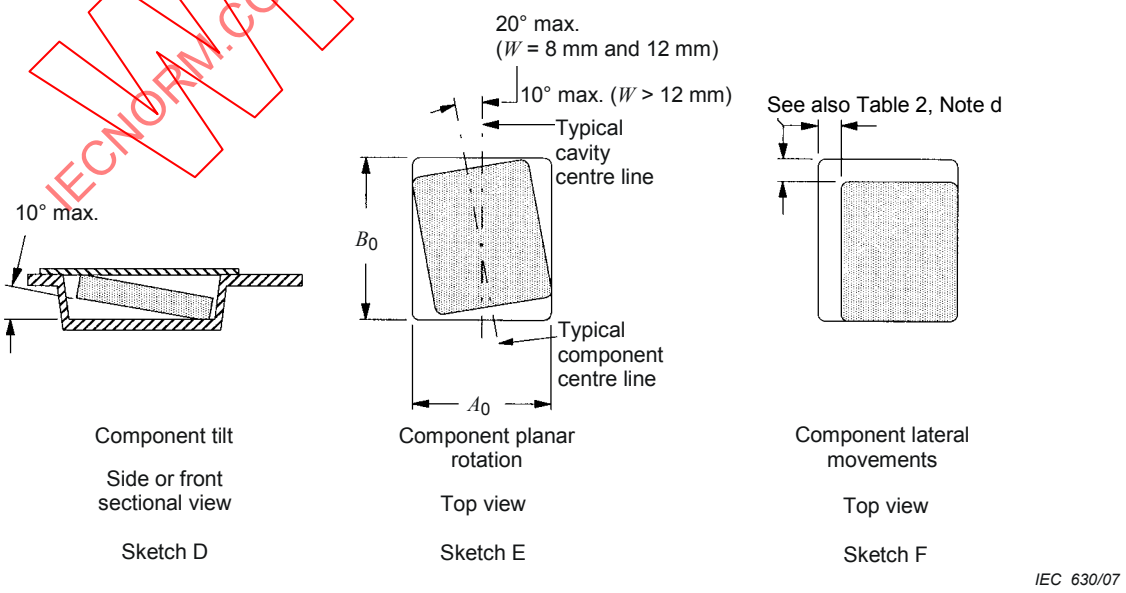


**Figure 6 – Maximum component tilt, rotation and lateral movement**

**Table 3 – Constant dimensions of 8 mm to 24 mm blister carrier tape**

| Tape size | $D_0$ | $E_1$ | $G_{min}$ | $P_0$ | $T_{max}$ | $T_{1max}$ | Cumulative pitch (over 10 pitches) |
|---|---|---|---|---|---|---|---|
| 8 to 24 | $1{,}5\ ^{+0,1}_{0}$ | 1,75 ± 0,1 | 0,75 | 4,0 ± 0,1 ($P_1 \geq 4$)<br>4,0 ± 0,05 ($P_1 = 2$) | 0,6 | 0,1 | ±0,2 |

**Table 4 – Variable dimensions of 8 mm to 24 mm blister carrier tape**

| Tape size | $B_{1max.}$ | $D_{1\ min}$ [a] | $E_{2\ min}$ | $F$ | $P_1$ | $P_2$ | $T_{2\ max}$ | $W$ | $A_0$, $B_0$, $K_0$ |
|---|---|---|---|---|---|---|---|---|---|
| **8** | 4,35 | 0,3 | 6,25 | 3,5 ± 0,05 | 2,0 ± 0,05<br>4,0 ± 0,1 | 2,0 ± 0,05 | 3,5 | $8{,}0\ ^{+0,3}_{-0,1}$ | see Note |
| **12** | 8,2 | 1,5 | 10,25 | 5,5 ± 0,05 | 2,0 ± 0,05<br>4,0 ± 0,1 or<br>12,0 ± 0,1 in<br>4,0 increments | 2,0 ± 0,05 | 6,5 | $12{,}0\ ^{+0,3}_{-0,1}$ | |
| **16** | 12,1 | 1,5 | 14,25 | 7,5 ± 0,1 | 4,0 ± 0,1 to<br>16,0 ± 0,1 in<br>4,0 increments | 2,0 ± 0,1 | 9,5 | $16{,}0\ ^{+0,3}_{-0,1}$ | |
| **24** | 20,1 | 1,5 | 22,25 | 11,5 ± 0,1 | 4,0 ± 0,1 to<br>24,0 ± 0,1 in<br>4,0 increments | 2,0 ± 0,1 | 12,5 | $24{,}0\ ^{+0,3}_{-0,1}$ | |

NOTE The nominal dimensions of the component compartment should be derived from the relevant component specification. The tolerances on the nominal sizes of the compartment should be selected so that the components cannot change their orientation within the tape and can be easily removed from the tape, with the following characteristics.

There shall be sufficient clearance surrounding the component so that

a) the component does not protrude above the top surface of the carrier tape;

b) the component can be removed from the cavity in a vertical direction without mechanical restriction after the top cover tape has been removed;

c) the rotation of the component is limited to a 10° max. tilt (see Figure 6, sketch D), a 20° max. planar rotation for $W$ = 8 mm and 12 mm and a 10° max. planar rotation for $W$ = 16 mm and 24 mm (see Figure 6, sketch E);

d) the lateral movement of the component is restricted to 0,5 mm max. (see Figure 6, sketch F).

For components with either length or width dimensions of less than 1,2 mm, market trends are towards a planar rotation limit of 10° max. and lateral movements of 0,2 mm max. See also Clause 6 for die products.

The centre of the component compartment is defined by $P_2$ and $F$, relative to the sprocket holes, as shown in Figure 4 with tolerances given in the table above. The centre of the index hole is defined by $P_2$ and $F$, relative to the sprocket holes, as shown in Figure 4 with the tolerances given in the table above.

Preferred dimensions for components shall be taken from the relevant IEC specifications.

Dimensions $A_0 \leq B_0$.

Dimension $K_0$ should comply with the component tilt in Sketch D.

In the case of $P_1$ = 2 mm, the off-set between the centre of the component compartment and the centre of the sprocket hole should not be more than 0,05 mm (see Figure 5).

[a] Optionally, for easy and reliable removal of the component, or for component inspection or for any applicable application, the cavity may have a hole in the centre of the bottom.

### 3.3 Type III – Blister carrier tape, with double sprocket holes (32 mm to 200 mm)

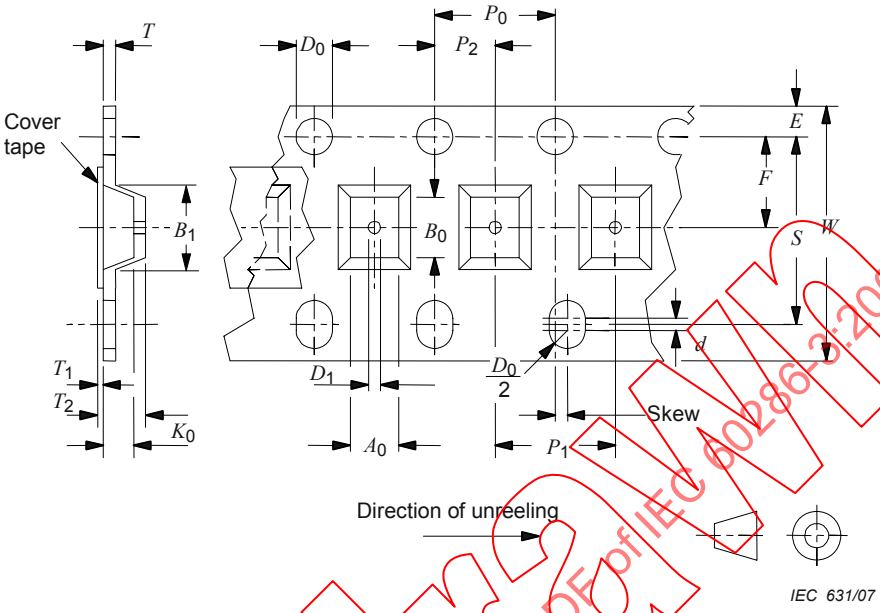


**Figure 7 – Blister carrier tape**

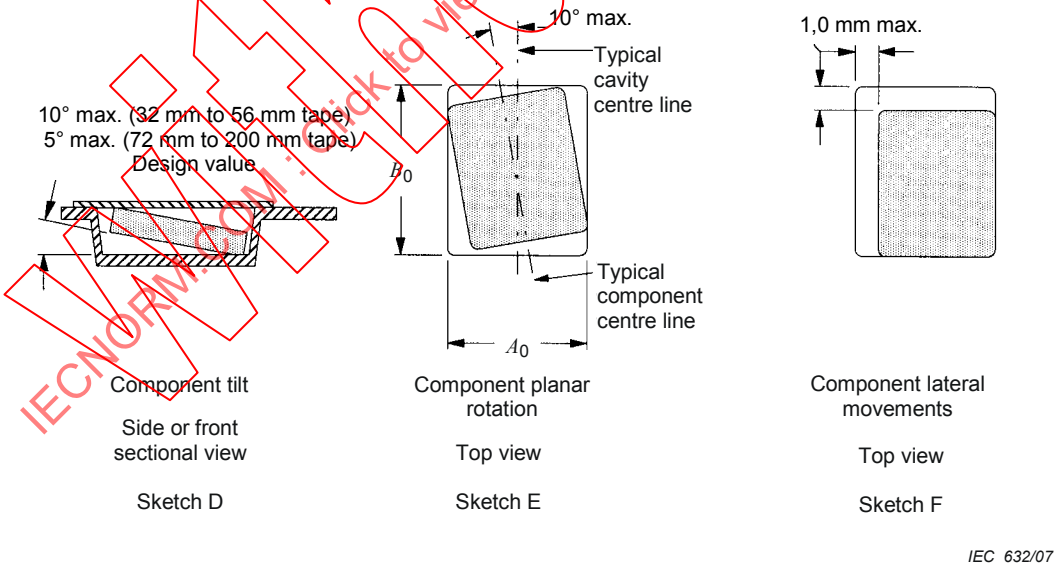


**Figure 8 – Maximum component tilt, rotation and lateral movement**

**Table 5 – Constant dimensions of 32 mm to 200 mm blister carrier tape**

| Tape size | $D_0$ | $D_{1\ min}$ [a] | $d$ | $E$ | $P_0$ | $T_{max}$ | $T_{1\ max}$ | Cumulative pitch (over 10 pitches) |
|---|---|---|---|---|---|---|---|---|
| 32 to 200 | $1{,}5\ ^{+0{,}1}_{0}$ | 2,0 | 0,2 ± 0,05 | 1,75 ± 0,1 | 4,0 ± 0,1 | 1,0 | 0,1 | ±0,2 |

[a] Optionally, for easy and reliable removal of the component from the compartment of the tape by automatic pick-up equipment, the cavity may have a hole in the centre of the bottom.

**Table 6 – Variable dimensions of 32 mm to 200 mm blister carrier tape**

| Tape size | $B_{1\ max}$ | $F$ | $P_1$ | $P_2$ | $S$ | Skew max. | $T_{2\ max}$ | $W$ | $A_0$, $B_0$, $K_0$ |
|---|---|---|---|---|---|---|---|---|---|
| **32** | 23,0 | 14,2 ± 0,1 | 4,0 ± 0,1 to 32,0 ± 0,1 in 4,0 increments | 2,0 ± 0,1 | 28,4 ± 0,1 | 0,05 | 12,5 | 32,0 ± 0,3 | see note |
| **44** | 35,0 | 20,2 ± 0,1 | 4,0 ± 0,1 to 44,0 ± 0,1 in 4,0 increments | 2,0 ± 0,15 | 40,4 ± 0,1 | | 16,0 | 44,0 ± 0,3 | |
| **56** | 46,0 | 26,2 ± 0,1 | 4,0 ± 0,1 to 56,0 ± 0,1 in 4,0 increments | 2,0 ± 0,15 | 52,4 ± 0,1 | | 20,0 | 56,0 ± 0,3 | |
| **72** | 60,0 | 34,2 ± 0,30 | 4,0 ± 0,15 to 72.0 ± 0,15 in 4,0 increments | 2,0 ± 0,2 | 68,4 ± 0,1 | 0,1 | 30,0 | 72,0 - 0,3/ +0,4 | |
| **88** | 76,0 | 42,2 ± 0,30 | | | 84,4 ± 0,1 | | | 88,0 - 0,3/ +0,4 | |
| **104** | 91,0 | 50,2 ± 0,35 | 4,0 ± 0,20 to 72.0 ± 0,20 in 4,0 increments | 2,0 ± 0,25 | 100,4 ± 0,2 | 0,15 | 35,0 | 104,0 - 0,3/ +0,5 | |
| **120** | 107,0 | 58,2 ± 0,35 | | | 116,4 ± 0,2 | | 40,0 | 120,0 - 0,3/ +0,5 | |
| **136** | 123,0 | 66,2 ± 0,40 | 4,0 ± 0,25 to 72.0 ± 0,25 in 4,0 increments | 2,0 ± 0,3 | 132,4 ± 0,2 | | | 136,0 - 0,3/ +0,5 | |
| **152** | 139,0 | 74,2 ± 0,40 | | | 148,4 ± 0,3 | | | 152,0 - 0,3/ +0,6 | |
| **168** | 153,0 | 82,2 ± 0,45 | 4,0 ± 0,30 to 72.0 ± 0,30 in 4,0 increments | 2,0 ± 0,35 | 164,4 ± 0,3 | 0,2 | | 168,0 - 0,3/ +0,6 | |
| **184** | 169,0 | 90,2 ± 0,45 | | | 180,4 ± 0,3 | | | 184,0 - 0,3/ +0,6 | |
| **200** | 185,0 | 98,2 ± 0,50 | 4,0 ± 0,35 to 72.0 ± 0,35 in 4,0 increments | 2,0 ± 0,4 | 196,4 ± 0,3 | | | 200,0 - 0,3/ +0,6 | |

NOTE The nominal dimension of the component compartment should be derived from the relevant component specification. The tolerances on the nominal sizes of the compartment should be selected so that the components cannot change their orientation within the tape and can be easily removed from the tape, with the following characteristics.

There shall be sufficient clearance surrounding the component so that

a) the component does not protrude above the top surface of the carrier tape;

b) the component can be removed from the cavity in a vertical direction without mechanical restriction after the top cover tape has been removed;

c) the rotation of the component is limited to 10° max. (see Figure 8, sketches D and E);

d) the lateral movement of the component is restricted to 1,0 mm max. (see Figure 8, sketch F).

Preferred dimensions for components shall be taken from the relevant IEC specifications.

Dimensions $A_0 \leq B_0$.

Dimension $K_0$ should comply with the component tilt in Sketch D.

$R_{min}$ for 72 mm to 200 mm tape: 75.

The centre of the component compartment is defined by $P_2$ and $F$, relative to the sprocket holes, as shown in Figure 6 with the tolerances given in the table above. The centre of the index hole is defined by $P_2$ and $F$, relative to the sprocket holes, as shown in Figure 6 with the tolerances given in the table above.

### 3.4 Type IV – Adhesive-backed punched plastic carrier tape for singulated bare die and other surface mount components (8 mm, 12 mm, 16 mm and 24 mm)

Type IV requires some explanation of the coordinate system and tape parameters. It is similar to Type I, but, whereas Type I has cavities sized to the component dimensions, Type IV uses a standard compartment size much larger than the component, the orientation and displacement of which is fixed by being placed on a backing of adhesive film.

Component placement accuracy is determined during component taping, when the component is placed into the tape. Therefore, parameters $P_{2A}$ and $F_A$ are absolute when determining the displacement of the component in the tape relative to the drive sprocket hole (see 3.4.1 and Table 9).

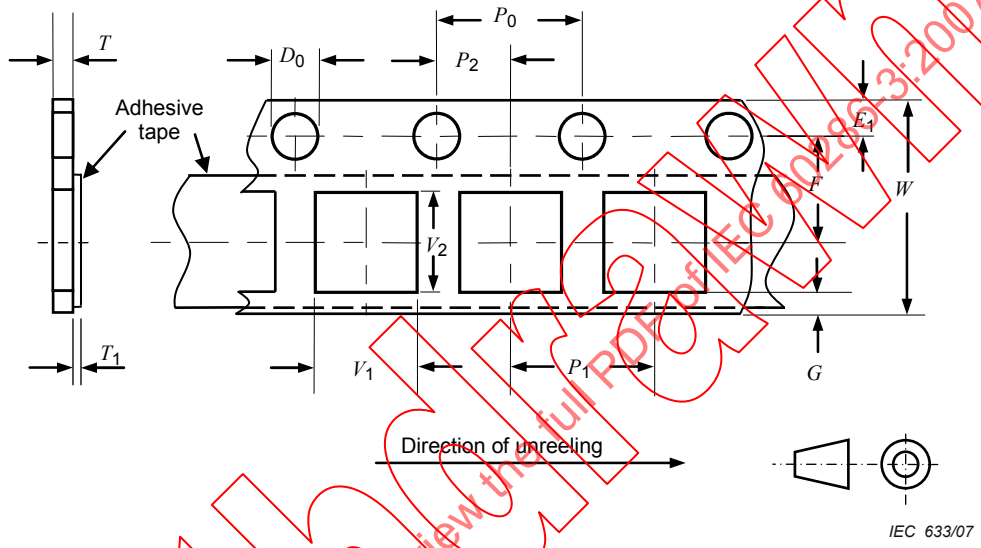


**Figure 9 – Adhesive-backed punched carrier-tape dimensions (4 mm compartment pitch)**

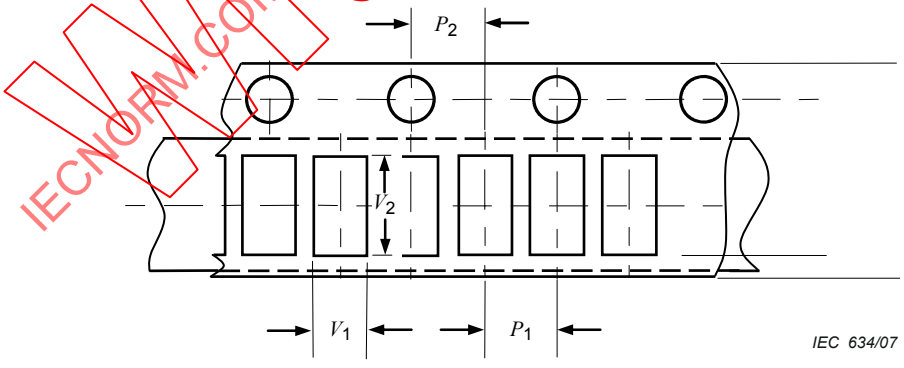


**Figure 10 – Illustration of 2 mm compartment pitch**

**Table 7 – Constant dimensions of adhesive backed punched carrier tape**

| Tape size | $D_o$ | $E_1$ | $P_o$ | $P_2$ | $T_{1\ max}$ | $G_{\ min}$ | $T_{\ max}$ |
|---|---|---|---|---|---|---|---|
| 8 to24 | $1{,}5\ ^{+0{,}05}_{0}$ | 1,75 ± 0.05 | 4,0 ± 0,025 | 2,0 ± 0,05 ($W$ = 8 and 12)<br>2,0 ± 0,1 ($W$ = 16 and 24) | 0,1 | 0,75 | 1,1 |

**Table 8 – Variable dimensions of adhesive-backed punched carrier tape**

| Tape size | $F$ | $P_1$ | $V_1$ | $V_2$ | $W$ |
|---|---|---|---|---|---|
| 8 | 3,50 ± 0,05 | 2,0 ± 0,05<br>4,0 ± 0,1 | 1,5 | 3,1 | 8,1 ± 0,1 |
| | | | 3,1 | 3,1 | |
| 12 | 5,50 ± 0,05 | 2,0 ± 0,05<br>4,0 ± 0,1 to 12,0 ± 0,1 in 4,0 increments | 1,5 | 6,35 | 12,1 ± 0,1 |
| | | | 3,1 | 6,35 | |
| | | | 6,35 | 6,35 | |
| 16 | 7,50 ± 0,05 | 4,0 ± 0,1 to 16,0 ± 0,1 in 4,0 increments | 6,35 | 10,2 | 16,1 ± 0,1 |
| | | | 10,2 | 10,2 | |
| 24 | 11,50 ± 0,05 | 4,0 ± 0,1 to 24,0 ± 0,1 in 4,0 increments | 10,2 | 17,3 | 24,1 ± 0,1 |
| | | | 14,0 | 17,3 | |

NOTE 1 The virtual boundary (comprising an area of maximum size, irrespective of component size) is defined by $V_1$, $V_2$, and $T$. These dimensions should be selected to provide sufficient clearance surrounding the component so that

a) the component does not protrude beyond the top of the carrier tape;

b) the component can be removed from the compartment in a vertical direction by vacuum pick-up or by non-surface contact means;

c) the component may be precisely positioned laterally and rotationally at the target coordinates and remain immobilized when affixed to the adhesive backing.

NOTE 2 The minimum bending radius for the tape with components is proportional to the component dimension in the $V_1$ direction of the carrier tape compartment. A minimum bending radius of 100 mm is recommended for 24 mm tapes containing singulated bare die when the component/compartment pitch $P_1$ (Figure 9) is 16 mm. When required, a length of carrier tape trailer can be spooled on the reel to increase effective reel hub diameter (N, Figure 18).

NOTE 3 Dimension $E_2$, as defined in 3.1, is for Type IV tape minimum value only but can be derived as a reference dimension by subtracting $E_1$ from $W_{max}$.

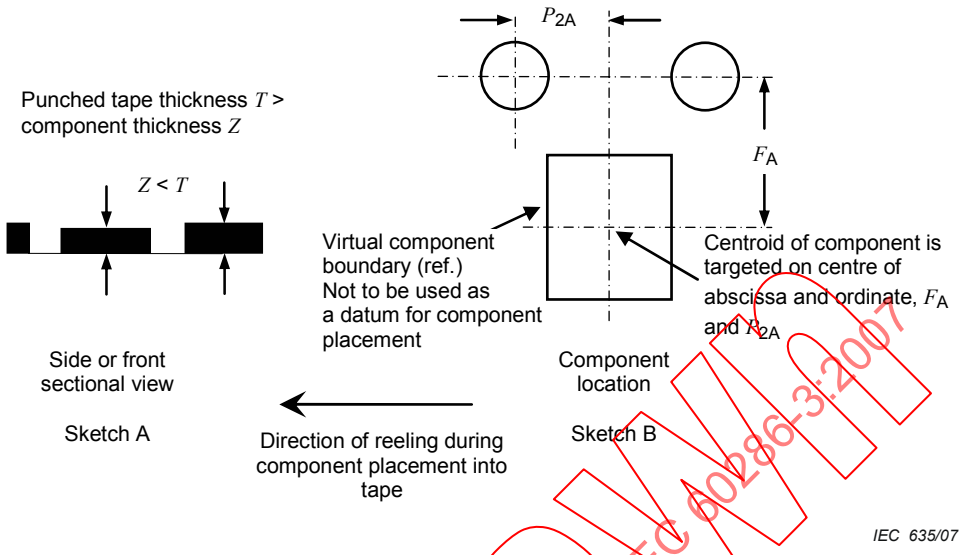


**Figure 11 – Component clearance and positioning method**

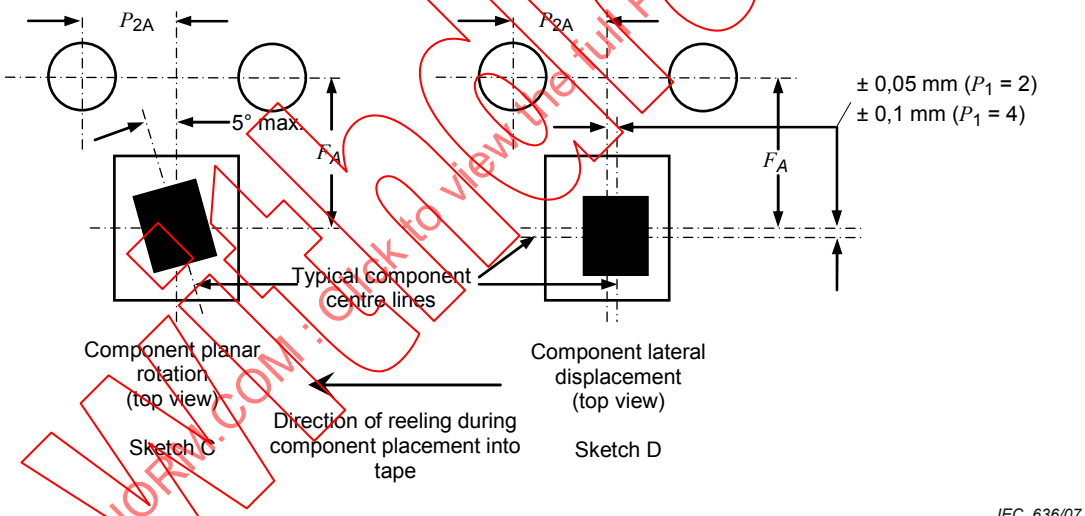


**Figure 12 – Maximum component tilt and lateral displacement**



### 3.4.1 Component positioning and lateral displacement (see Figures 11 and 12)

The component position in Type IV tape is not measured with respect to the compartment, as in Types I, II and III, but relative to a virtual target point at an absolute position given by $P_{2A}$ and $F_A$. Table 9 gives the absolute position of this target point relative to the sprocket-hole centroid for different tape sizes.

The maximum displacement of the actual component position from this target location is shown in sketch D of Figure 12 and may be negative or positive. This displacement is a function of the accuracy of the component placement system and not the tape.

It is normal for the user drawing to specify the maximum component rotational and lateral displacement of the component when delivered in Type IV, which may have a tighter tolerance

than that shown in sketches C and D, where the repeatability of the component position at the pick point is critical.

**Table 9 – Absolute referencing data for component target position**

| Tape size | $F_A$ | $P_{2A}$ |
|---|---|---|
| 8 | 3,5 | 2,0 |
| 12 | 5,5 | 2,0 |
| 16 | 7,5 | 2,0 |
| 24 | 11,5 | 2,0 |

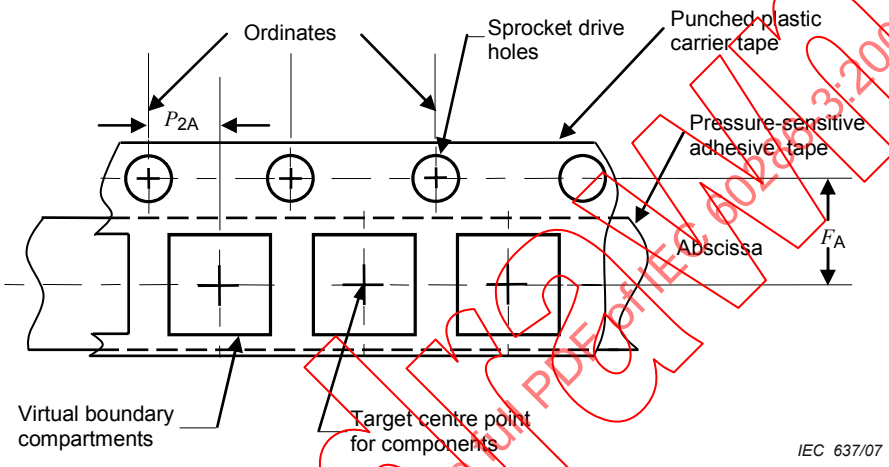


**Figure 13 – Type IV coordinate system**

### 3.4.2 Coordinate system

**3.4.2.1** The coordinate system shown in Figure 13 is established to define carrier tape dimensioning together with components placements on adhesive-backed punched plastic carrier tapes.

**3.4.2.2** The abscissa is a 0-0 datum straight line of infinite length to align the centres of a plurality of sprocket drive holes throughout the entire length of the continuous tapes.

**3.4.2.3** Ordinates are lines at right angles to the abscissa and uniformly spaced along its length to position the centre of each sprocket drive hole aligned along the abscissa.

**3.4.2.4** Compartments within the punched plastic carrier tape comprise virtual boundaries for the placement of components at predetermined pitch intervals throughout the length of the carrier tape.

**3.4.2.5** Horizontal and vertical coordinates dimensioned from the abscissa and ordinates establish target location centre points for the planar centroids of the components placed within each virtual boundary. See 3.4.2.6 and 3.4.2.7.

**3.4.2.6** The centre of the components shall be located within a 0.2 mm diameter of the target centerpoints within the virtual boundaries. See Figures 11 and 13.

**3.4.2.7** Component rotation shall be limited to 5° from the abscissa axis centre line of the sprocket drive holes (see Figure 12).

**3.4.2.8** Adherence to the tolerances defined in Figure 9 and Table 8 ensures that the following critical criteria are maintained:

a) precise alignment of all sprocket drive hole centres along abscissa;

b) consistent pitch of sprocket holes throughout the entire length of the tape;

c) uniform diameters of all sprocket drive holes;

d) polarity and orientation of components in the tape.

## 4 Polarity and orientation of components in the tape

### 4.1 All tapes

All polarized components shall be oriented in one direction. For components with two terminations, the cathode side shall be either adjacent to the sprocket hole or the last one to leave the package, unless otherwise specified in the detail specification.

For components in flat packages (for example, chip carriers and SO-packages) with more than two terminations, termination No. 1 shall be adjacent to the round sprocket hole, unless otherwise specified in the detail specification.

For die products (bare die or bumped die) with more than two pads or terminations, pad No. 1 shall be located on the side adjacent to the round sprocket hole, unless otherwise specified in the detail specification.

For components with a lead configuration corresponding to IEC 60191-2, the component side from which one single termination emerges shall be at the compartment side closest to the sprocket holes in the tape and the mounting side shall face the bottom of the component compartment.

For quartz-crystal units with two terminations located on one side of the package, the terminations shall be located at the sprocket hole side.

The polarity or orientation of components with other shapes or termination configurations shall be stated in the detail specification.

### 4.2 Tape reeling

#### 4.2.1 All types

Tape with components ready for assembly placement shall be spooled in such a way that the sprocket drive holes shall be on the left-hand side as the tape enters the feeder as viewed from the back of the feeder looking towards the bed of the assembly machine.

#### 4.2.2 Type I

Type I has effectively a cover tape on either side. Therefore, components may be placed with the mounting side orientated to the bottom or the top side of the tape. If the mounting side needs to be reversed (as is the case for some surface mounted components), then the tape is re-spooled and the alternate cover tape removed, effectively inverting the component.

#### 4.2.3 Types I, II and III only

The mounting side of the components shall be oriented to the bottom side of the tape. The bottom side is defined as the invisible side of the tape when reeled (see Figure 14).

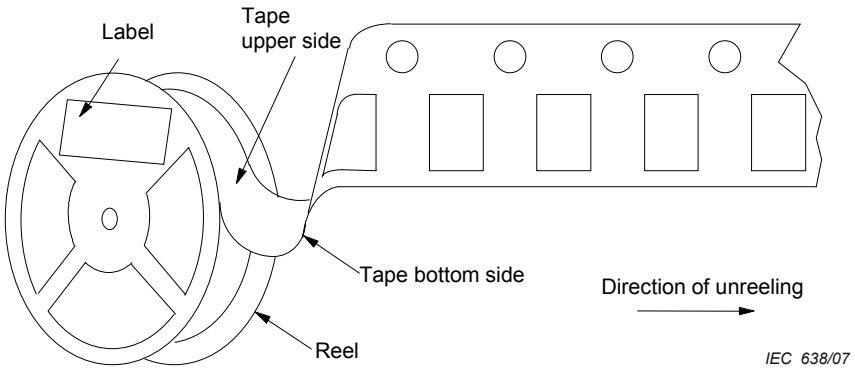


**Figure 14 – Tape reeling and label area on the reel**

### 4.2.4 Type IV only

The non-active side of the component is always placed to the bottom side of the tape, i.e. affixed to the adhesive layer. In the case of flip-chips, the component is placed 'bumps up' on the tape, the reel is then re-spooled and the tape fed into the assembly placement feeder with the component on the bottom side of the tape, now effectively in the 'bumps down' orientation.

## 5 Fixing of components and additional tape requirements

### 5.1 All types

**5.1.1** Components shall be prevented from falling out of the component window of the tape. This is normally done by cover tapes on one (blister-tape) or both (punched-tape) sides of the carrier tape. Requirements for Types I, II and III, which use cover tapes, are listed in 5.2. Type IV does not require a cover tape, because components are affixed to the adhesive backing when taped and are held in position.

**5.1.2** Tapes in adjacent layers shall not stick together, when wound on the reel.

**5.1.3** The tapes shall be suitable to withstand storage of the taped components without danger of migration of the terminations or the giving off of vapours which would make soldering difficult or deteriorate the component properties or terminations by chemical action.

**5.1.4** The carrier tape material shall not age and lose strength so that it breaks on unreeling when the taped components are fed from the package by hand into the assembly machines. Carrier materials shall not delaminate in a manner that would prevent proper delivery of the component in the assembly process.

**5.1.5** The break force of the tape in the direction of unreeling shall be at least 10 N. Properties of the splice tape should be such that it can be attached to the surface of the carrier tape and cover tape and will not hamper the transport of the carrier tape and cover tape. When splicing is applied, the misalignment of the holes on each side of the splice shall not be greater than ± 0,15 mm in any direction.

**5.1.6** To minimize the effect of losing components by electrostatic discharge, it is recommended that the packaging materials, component placement equipment, and controlled environmental conditions be optimized to effectively dissipate any charge build-up. This charge, commonly referred to as tribo-electric charge, should be controlled according to the guidelines in IEC 61340-5-1 and IEC 61340-5-2.

### 5.2 Requirements for Types I, II and III where cover tape is used

**5.2.1** The cover tapes shall not cover the sprocket holes.

**5.2.2** The adhesive of the cover tape shall not adversely affect the mechanical and electrical characteristics and the marking of the components.

**5.2.3** Components shall not stick to the carrier tape or to the cover tape.

**5.2.4** The cover tape shall not become detached.

**5.2.5** The cover tape shall not protrude beyond the edge of the tape.

**5.2.6** The cover tape shall not be attached to the carrier tape on the surface between two adjacent component pocket**s**.

### 5.3 Specific requirements for Type IV tapes

**5.3.1** Components shall be prevented from falling off the adhesive backing of the carrier tape and shall remain in fixed position for automatic handling. Components shall be firmly affixed to the adhesive backing. No lateral or rotational movement of the component is allowed after placement on the adhesive backing.

**5.3.2** During unreeling, components shall be capable of clean release from the carrier tape, without damage or adhesive residue.

**5.3.3** The adhesive backing shall remain in position and not become detached.

### 5.4 Peel force of the cover tape (for Types I, II and III only)

The angle between the cover tape during peel-off and the direction of unreeling shall be 165° to 180°. The cover tape shall adhere uniformly to the carrier tape along both sides in the direction of unreeling.

The peel force with a peel speed of 300 mm/min ± 10 mm/min shall be as indicated in Table 10.

**Table 10 – Peel force**

| Tape width<br>*W* | Peel force |
|---|---|
| 8 mm | 0,1 N to 1,0 N |
| 12 mm to 56 mm | 0,1 N to 1,3 N |
| 72 mm to 200 mm | 0,1 N to 1,5 N |

### 5.5 Minimum bending radius (for all types)

When the tape is bent with the minimum radius (measured at the bottom side of the tape) given for a particular tape width as indicated in Table 11, the tape shall not be damaged and the components shall maintain their position and orientation in the tape.

NOTE Tape material should have such properties that without additional assistance the material can easily bend to the radius specified in Table 11. Otherwise, the tape cannot be handled any more.

**Table 11 – Minimum bending radius**

| $W$ | $P_1$ | $R_{min}$ (Types I, II and III) | $R_{min}$ (Type IV only) |
|---|---|---|---|
| 8 | 2/4 | 25 | 25 |
| 12 | 2/4/ 8 | 30[a] | 50 |
| 16 | 4/8/12/16 | 30 | 50 |
| 24 | 4/8/12 | 30 | 50 |
| 24 | 16/24 | 30 | 89 |
| 32 | 4–32 | 40 | n/a |
| 44 | 4–44 | 40 | n/a |
| 56 | 4–56 | 50 | n/a |
| 72 to 200 | 4–72[b] | 75 | n/a |

[a] For punched tapes the minimum bending radius shall be 25 mm.

[b] See Table 6.

Tape with components shall pass around radius $R_{min}$ without damage.

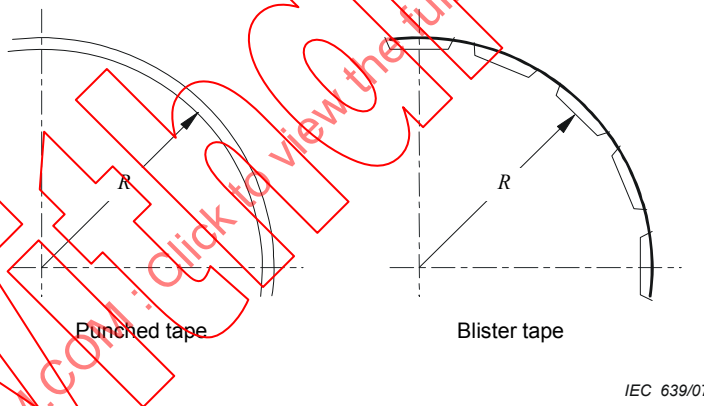


**Figure 15 – Bending radius**



### 5.6 Break force of the cover tapes (for Types I, II and III only)

The break force of the cover tape shall be 10 N min.

### 5.7 Taping materials

Taping materials and techniques shall be selected to avoid damage to electrostatic-sensitive components.

### 5.8 Camber

The camber shall be measured without tension applied to the tape according to Figure 16. The camber shall not exceed 1 mm over 250 mm in either direction.

NOTE This point is only applicable for planetary reels.

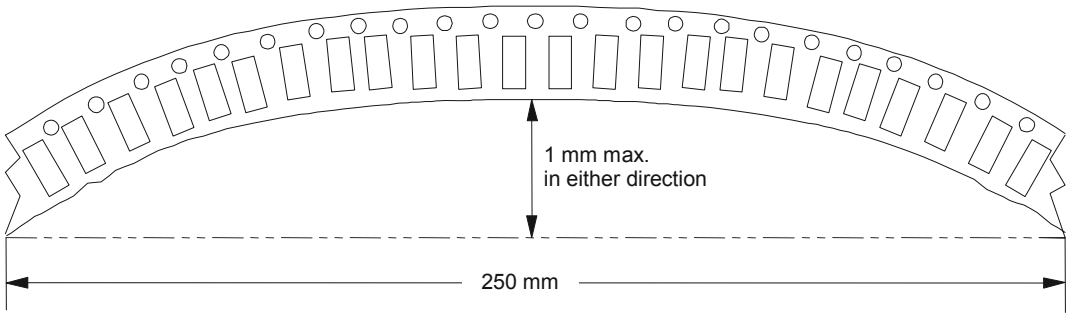


**Figure 16 – Camber** (top view)

## 6 Specific requirements for tapes containing die products

Die products such as bare die and bumped die (flip-chip) require special handling to ensure the dies are not damaged during tape loading, transportation, storage and unloading. Tapes designed for these types of product normally contain certain design features to protect the die and prevent edge or corner chipping from occurring and, in the case of bumped die, to protect the bumps from damage. Particular care should be taken to prevent very thin die from sliding under the cover tape between adjacent pockets.

For further guidance on recommended handling of die products, refer to IEC/TR 62258-3.

The following items should be considered where the tape is used for die products.

### 6.1 Tape design for tapes containing die products

Types I and II should have special design features to ensure the corners of the die do not contact the corners of the pocket. A square or circular relief may be used.

Type II should include special features in the base of the cavity to protect bumped die, where the die are placed in the pocket 'bumps down'.

Type III is not suitable for use with die products.

Type IV does not require special features since it is inherently designed for die products.

### 6.2 Cleanliness

Tapes that are to be used for storing die products shall be in compliance with clean room class requirements. The sealed bags containing the tape shall only be opened in a suitable environment such as a clean room.

Tapes must also be free from any burrs or particles that may dislodge during handling or storage, which may stick to the surface of the die and cause damage.

Precautions should also be taken to ensure that no fibres or residue are released that could adhere to, or damage, the die product when the cover tape is removed.

### 6.3 Component lateral movement (Types I and II)

The edges of die products are fragile and the design of the pocket in the tape should provide for minimal lateral movement of the die within the pocket during loading, unloading and transportation. Special punching or forming may be required to achieve the necessary tolerances to minimize lateral movement.