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COMMENTED VERSION

INTERNATIONAL STANDARD

colour
inside

Packaging of components for automatic handling –
Part 3: Packaging of surface mount components on continuous tapes

IEC 60286-3:2022-11 CMV(en)

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PACKAGING OF COMPONENTS FOR AUTOMATIC HANDLING –

Part 3: Packaging of surface mount components on continuous tapes

FOREWORD

1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of 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, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). 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. 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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This commented version (CMV) of the official standard IEC 60286-3:2022 edition 7.0 allows the user to identify the changes made to the previous IEC 60286-3:2019 edition 6.0. Furthermore, comments from IEC TC 40 experts are provided to explain the reasons of the most relevant changes, or to clarify any part of the content.

A vertical bar appears in the margin wherever a change has been made. Additions are in green text, deletions are in strikethrough red text. Experts' comments are identified by a blue-background number. Mouse over a number to display a pop-up note with the comment.

This publication contains the CMV and the official standard. The full list of comments is available at the end of the CMV.

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

This seventh edition cancels and replaces the sixth edition published in 2019. This edition constitutes a technical revision.

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

a) addition terms and definitions.
b) addition of a table of the classification to symbols concerning drive hole diameter and distance between the reel hole centre and the drive hole centre;
c) addition of drive hole to the reel (optional);
d) revision of reel hole diameter tolerances;
e) revision of 72 mm tape size carrier tape width dimension tolerances;
f) addition of Annex B (informative);
g) addition of component size 0201M.

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

Draft	Report on voting
40/2972/FDIS	40/2984/RVD

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

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

A list of all parts in the IEC 60268 series, published under the general title *Packaging of components for automatic handling*, can be found on the IEC website.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/publications.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under webstore.iec.ch in the data related to the specific document. At this date, the document will be

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

IMPORTANT – The "colour inside" logo on the cover page of this document indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

INTRODUCTION

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

PACKAGING OF COMPONENTS FOR AUTOMATIC HANDLING –

Part 3: Packaging of surface mount components on continuous tapes

1 Scope

This part of IEC 60286 is applicable to the tape packaging of electronic components without leads or with lead stumps, 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 document also includes requirements related to the packaging of singulated die products including bare die and bumped die (flip chips).

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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, *Mechanical standardization of semiconductor devices – Part 2: Dimensions*

IEC 61340-4-5, *Electrostatics – Part 4-5: Standard test methods for specific applications – Methods for characterizing the electrostatic protection of footwear and flooring in combination with a person*

IEC 61340-4-6, *Electrostatics – Part 4-6: Standard test methods for specific applications – Wrist straps*

IEC 61340-4-7, *Electrostatics – Part 4-7: Standard test methods for specific applications – Ionization*

IEC 61340-4-9, *Electrostatics – Part 4-9: Standard test methods for specific applications – Garments* **1**

3 Terms, definitions and symbols

3.1 Terms and definitions

For the purposes of this document, the following terms and definitions apply. Definitions apply to all tape types, unless specifically mentioned.

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

- IEC Electropedia: available at https://www.electropedia.org/
- ISO Online browsing platform: available at https://www.iso.org/obp

3.1.1

component

electronic part of a product that cannot be physically divided into smaller parts without losing its particular function

Note 1 to entry: This includes singulated die product.

Note 2 to entry: This is applied to all packaging-types for bare die products unless specifically mentioned otherwise.

3.1.2

component size

size of component that is identified with its metric size code

Note 1 to entry: This size code is followed by a capital M.

Note 2 to entry: To avoid possible confusion with inch-based size codes, an equivalency table is shown in Table 1.

Table 1 – Component size codes

Metric size code	Inch size code
0201M	008004 2
0402M	01005
0603M	0201
1005M	0402
1608M	0603
2012M	0805

3.1.3

packaging

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

3.1.4

pressed carrier tape

<type 1b> carrier tape with concave cavities formed by compression of the base material

3.1.5

fluff

<type 1b> fibre from the base material attached inside the cavity

Note 1 to entry: See Figure 1.

3.1.6

burr

<type 1b> surface projection of tape unintentionally produced when cavity is formed

Note 1 to entry: See Figure 1.

3.1.7

deformation

<type 1b> bulge on the inner wall of the cavity

Note 1 to entry: See Figure 1.

3.1.8
puff

<type 1b> bulge on the reverse side of the cavity

Note 1 to entry: See Figure 1.

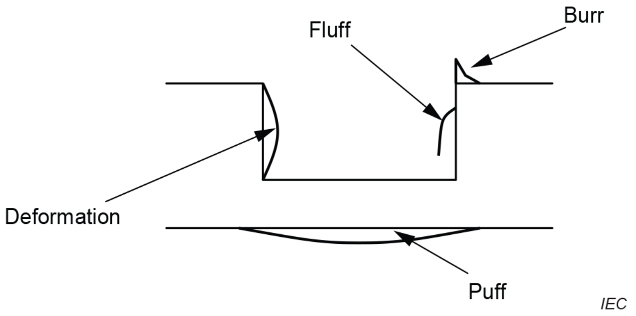


Figure 1 – Sectional view of component cavity (type 1b)

3.1.9
blister carrier tape
embossed carrier tape

carrier tape which is identified as tape belonging to type 2a, type 2b and type3

~~Note 1 to entry These types of carriers are also known as "embossed" carrier types.~~

3.1.10
punched carrier tape

<type 1a> carrier tape on which the concave cavities are formed by punching a hole on the base material and covering up the bottom by the cover tape

3.2 Symbols

The symbols used in this document are listed in Table 2.

Table 2 – Classification to symbols concerning tape, reel and common symbols

Symbols	Definitions	Figure references
A	Reel diameter	26
A_0	Cavity's bottom dimension in direction of unreeling	2, 4, 5, 7, 8, 10, 11, 13, 14, 16, 20 and A.2
B	Reel hole key's groove width	27
B_0	Cavity's bottom dimension in direction of tape width	2, 4, 5, 7, 8, 10, 11, 13, 14, 16, 20 and A.2
B_1	Cavity's rim in direction of tape width	8, 11 and 14
C	Reel hole diameter	26 and 27
C_T	Distance of puff under cavity in direction of tape width	5
d	Difference of diameter between sprocket hole and round foramen	14
D	Reel slot diameter	27
D_0	Sprocket hole diameter	2, 5, 8, 11, 14 and 17
D_1	Cavity's bottom hole diameter	8 and 14
D_{DH}	Drive hole diameter	28
E_1	Shorter distance in direction of width between the origin point of round sprocket hole and the edge of a side of tape	2, 5, 8, 11, 14 and 17

Symbols	Definitions	Figure references
E_2	Longer distance in direction of width between the origin point of round sprocket hole and the edge of a side of tape	2, 5, 8 and 11
F	Distance in direction of width between the origin point of round sprocket hole and the centre of cavity	2, 5, 8, 11 and 14
F_{A}	Distance in direction of width between the origin point of round sprocket hole and the centre of compartment	17, 19, 24 and 25
G	Shorter distance in direction of width between the cavity and the edge of a side of tape	2, 5, 8, 11 and 17
K_0	Cavity depth	2, 5, 8 ,11, 14 and A.3
M	Distance between the reel hole centre and the drive hole centre	28
N	Hub diameter	26
P_0	Pitch of the sprocket holes	2, 3, 5, 6, 8, 9, 11, 14 and 17
P_1	Cavity pitch	2, 3, 5, 6, 8, 9, 11, 14, 17 and 18
P_2	Pitch between the centre of a cavity on the same line with the origin point of round sprocket hole and the centre of the next cavity in direction of unreeling	2, 3, 5, 6, 8, 9, 11 and 14
$P_{2\mathrm{A}}$	Pitch between the centre line of the origin point of round sprocket hole and the centre line of compartment in direction of unreeling	17, 18, 19, 24 and 25
P_3	Pitch between the centre of a cavity on the same line with the origin point of round sprocket hole and the centre of the second next cavity in direction of unreeling	3 and 6
P_4	Pitch between the centre of a cavity on the same line with the origin point of round sprocket hole and the centre of the third next cavity in direction of unreeling	3 and 6
S	Sprocket hole pitch in direction of width	14
R	Bending radius of carrier tape	21
r	Curvature radius of reel hole key's groove	27
T	Carrier tape thickness without cover tape	2, 5, 8, 11, 14, 17, 25 and A.1
T_1	Top cover tape thickness ~~or bottom cover tape thickness~~	2, 5, 8, 11~~,~~ and 14~~ and 17~~
T_2	Sum of outer cavity height and top cover tape thickness	8, 11 and 14
T_3	Thickenss of pressed carrier tape including bulge	5 and A.1
T_4	Bottom cover tape thickness or Adhesive tape thickness	2 and 17
V_1	Compartment dimension in direcion of unreeling	17 and 18
V_2	Compartment dimension in direction of width	17 and 18
W	Carrier tape width	2, 5, 8, 11, 14 and 17
W_{P}	Distance between adhesive tapes	17
W_1	Reel inner width (measured at hub)	26
W_2	Reel overall width	26
W_3	Reel inner width in the rim	26
Z	Component thickness	25

4 Structure of the specification

The various types of tapes are as follows.

Type 1 – Punched and pressed carrier tape

Type 1a: Punched carrier tape, with top and bottom cover tape (tape widths: 8 mm and 12 mm)

Type 1b: Pressed carrier tape, with top cover tape (tape width: 8 mm)

Type 2 – Blister carrier tape, with single round sprocket holes

Type 2a: Blister carrier tape, with single round sprocket holes, with top cover tape and tape pitches down to 2 mm (tape widths: 8 mm, 12 mm, 16 mm and 24 mm)

Type 2b: Blister carrier tape, with single round sprocket holes, with top cover tape and with 1mm tape pitch (tape widths: 4 mm)

Type 3 – Blister carrier tape, with double sprocket holes (tape widths: 32 mm to 200 mm)

Type 4 – Adhesive-backed punched plastic carrier tape for singulated bare die and other surface mount components (tape widths: 8 mm, 12 mm, 16 mm, and 24 mm)

5 Dimensional requirements for taping

5.1 Component cavity positioning requirements

5.1.1 Requirements for type 1a, type 1b, type 2a, type 2b and type 3

For defined component positioning, the cavity shall be defined to an origin point. The origin is the centre of the round sprocket hole, defined by the crosshair of the dimension E_1 and dimension P_0. The centre of the compartment shall be defined by P_2 and F, relative to the round sprocket hole (see Figure 2, Figure 5, Figure 8, Figure 11 and Figure 14). When dimension P_1 is smaller or equal to 2 mm, the maximum allowed pocket offset, relative to the centre of the round sprocket hole, shall be applied (see Figure 3, Figure 6, Figure 9 and Figure 12).

5.1.2 Requirements for type 4

For defined component positioning, the component placement and location shall be defined to an origin. The origin is the centre of the sprocket hole, defined by the crosshair of the dimension E_1 and dimension P_0. The centre of the component location shall be defined by P_{2A} and F_A, relative to the sprocket hole (see Figure 17). Type 4 does not have cavities that are used to position components. Therefore, all position measurements should be made according to the principle defined here and not to the compartments or 'pockets', which are virtual boundaries for component protection only. The term 'pocket offset' does not apply to type 4. The following applies to ~~tape~~ type 4:

a) rotation and lateral movement of the component is defined by the accuracy to which it has been placed in the compartment, with reference to the target;

a) the component shall not protrude above the top surface of the carrier tape (see Figure 25a);

b) the components shall not change their orientation within the tape;

c) the component shall be able to be removed from the cavity or compartment in a vertical direction, without mechanical restriction.

5.2 Component cavity dimension requirements (~~tape~~ type 1a, type 1b, type 2a, type 2b and type 3)

The size of the component cavity, including applicable tolerances, is governed by the dimensions of the component for which the packaging applies, to ensure that the component is adequately protected and that tilt, rotation and lateral movement of the component complies with the requirements detailed for each type of tape. The following applies to ~~tape~~ type 1a, type 1b, type 2a, type 2b and type 3:

a) dimension A_0 ≤ dimension B_0, unless otherwise specified in the component detail specification;

b) maximum and minimum dimensions of the component shall be taken from the component detail specification;

c) the component shall not protrude above the top surface of the carrier tape, except for type 1a where the component shall not protrude beyond either surface of the carrier tape;

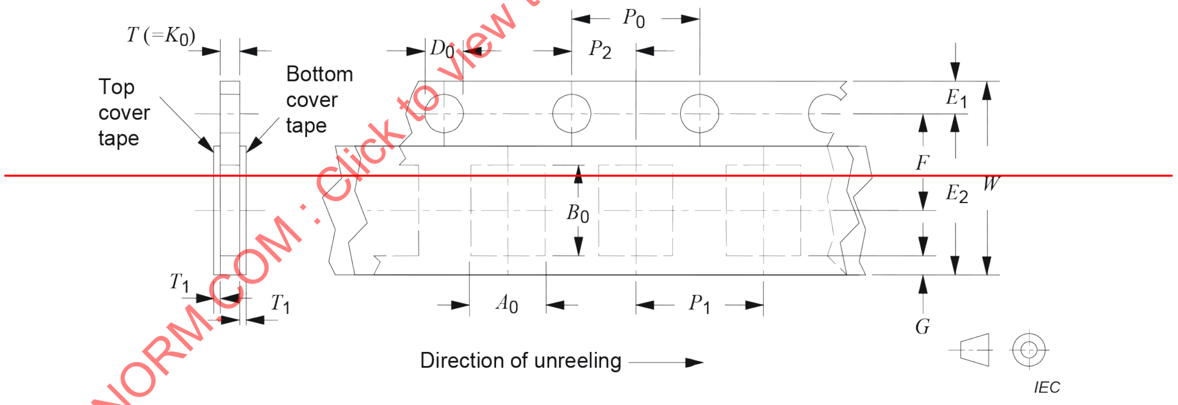
d) the components shall not change their orientation within the tape;

e) the component shall be able to be removed from the cavity or compartment in a vertical direction, without mechanical restriction, after the top cover has been removed, where a cover tape is used.

f) Unless otherwise defined in the detail specification, for punched carrier tapes, K_0 shall be equivalent to T. For pressed and embossed tapes K_0 shall be defined in each detail specification. 3

5.3 Type 1a – Punched carrier tape, with top and bottom cover tape (tape widths: 8 mm and 12 mm)

For respective dimensional codes, see Figure 2 to Figure 4 and Table 3 to Table 5.



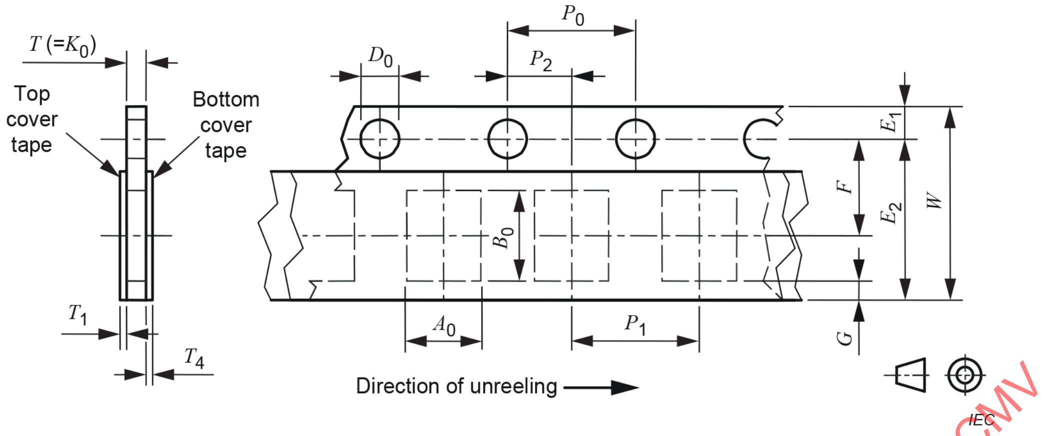
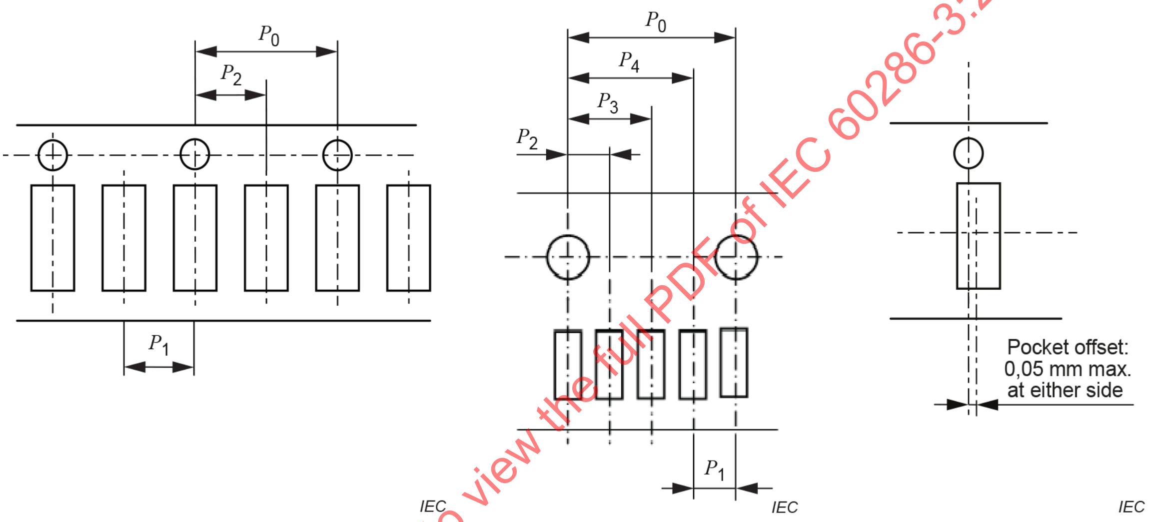


Figure 2 – 8 mm and 12 mm punched carrier-tape dimensions (4 mm cavity pitch)

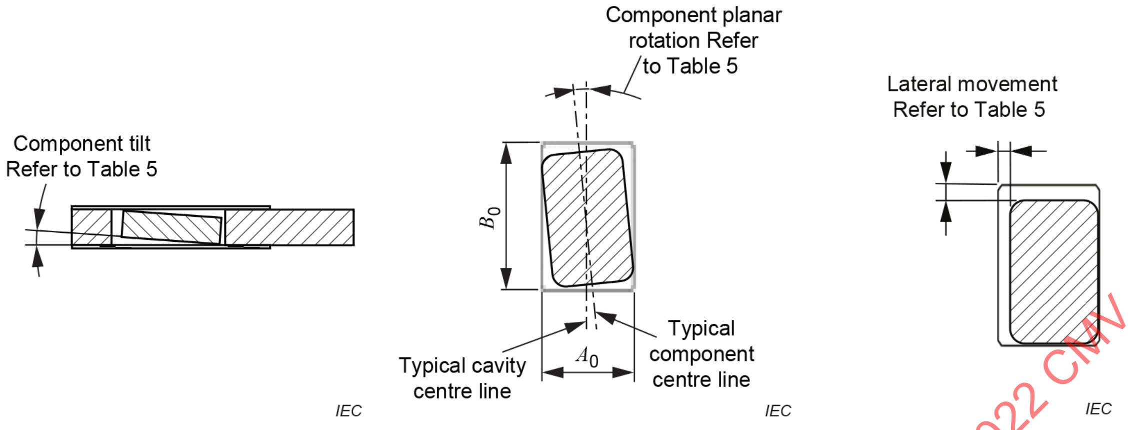


a) **2 mm cavity pitch**

b) **1 mm cavity pitch**

c) **Pocket offset**

Figure 3 – Illustration of 2 mm and 1 mm cavity pitch and maximum pocket offset



a) Sketch A
Component tilt
Side view

b) Sketch B
Component planar rotation
Top view

c) Sketch C
Lateral movement
Top view

Figure 4 – Maximum component tilt, rotation and lateral movement

Table 3 – Constant dimensions of 8 mm and 12 mm punched carrier tape

Dimensions in millimetres

Tape size	D_0	E_1	P_0	G min.	T max.	T_1 ~~(each T_1)~~ max.	T_4 max.	**P_0 pitch cumulative tolerance**
8 and 12	$1{,}5^{+0{,}1}_{0}$	1,75 ± 0,1	4,0 ± 0,1 ($P_1 \geq 4$)	0,75	1,1 paper[a]	0,1	0,1	± 0,2 / 10 pitches
			4,0 ± 0,05 ($P_1 = 2$, $P_1 = 1$)		1,6 non-paper			

For respective dimensional codes, see Figure 2.

[a] The paper is the material of the punched carrier tape.

Table 4 – Variable dimensions of 8 mm and 12 mm punched carrier tape

Dimensions in millimetres

Tape size	E_2 min.	F	P_1	P_2	P_3	P_4	W	A_0, B_0, and K_0
8	6,25	3,5 ± 0,05	1,0 ± 0,05 (P_1 = 1)	1,0 ± 0,05 (P_1 = 1)	2,0 ± 0,05 (P_1 = 1)	3,0 ± 0,05 (P_1 = 1)	$8{,}0\ ^{+0{,}3}_{-0{,}1}$	See 5.2
			2,0 ± 0,05 (P_1 = 2)	2,0 ± 0,05 (P_1 = 2)				
			4,0 ± 0,1 (P_1 = 4)	2,0 ± 0,05 (P_1 = 4)				
12	10,25	5,5 ± 0,05	2,0 ± 0,05 (P_1 = 2)	2,0 ± 0,05	–	–	$12{,}0\ ^{+0{,}3}_{-0{,}1}$	
			4,0 ± 0,1 (P_1 ≥ 4)					
For respective dimensional codes, see Figure 2 to Figure 4.								

Table 5 – Component tilt, planar rotation and lateral movement

Tape size mm	Component tilt (design value) [a]	Component planar rotation (design value) [a]	Lateral movement mm
8 and 12	10° maximum	20° maximum	0,3 maximum (P_1 = 1, P_1 = 2)
			0,5 maximum (P_1 ≥ 4)

For respective dimensional codes, see Figure 4.

The trend for allowed component planar rotation of components with either length or width less than 1,2 mm is 10° maximum.

For components with either length or width dimensions of less than 1,2 mm, market trends are towards a lateral movement of 0,2 mm maximum.

When handling bare die products in tape size 8 mm, the lateral movement of 0,1 mm maximum for either cavity dimension should be allowed.

When handling bare die products in tape size 12 mm, the lateral movement of 0,15 mm maximum for either cavity dimension should be allowed.

[a] A design value is a calculated value for design purposes only. For example, component tilt is not intended to be measured, but is intended to be the calculated value for the pocket design of a carrier tape.

5.4 Type 1b – Pressed carrier tape, with top cover tape (tape width: 8 mm)

For respective dimensional codes, see Figure 5 to Figure 7 and Table 6 to Table 8.

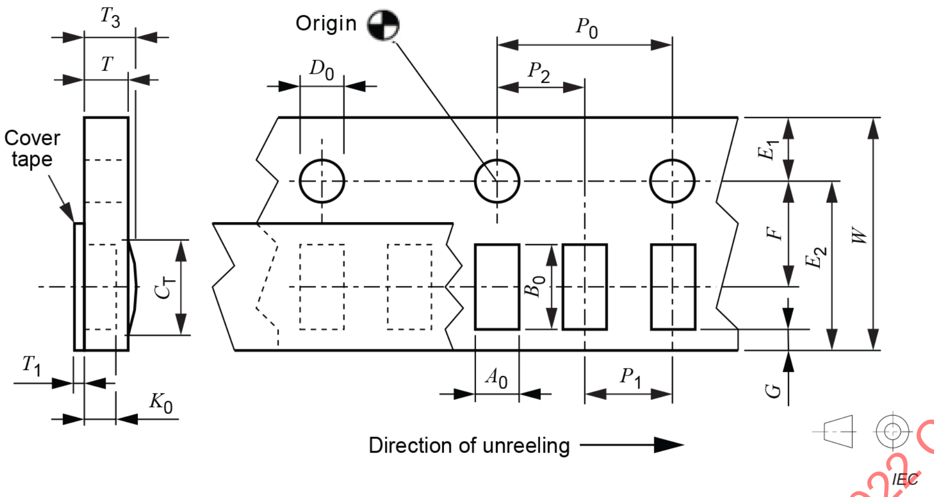
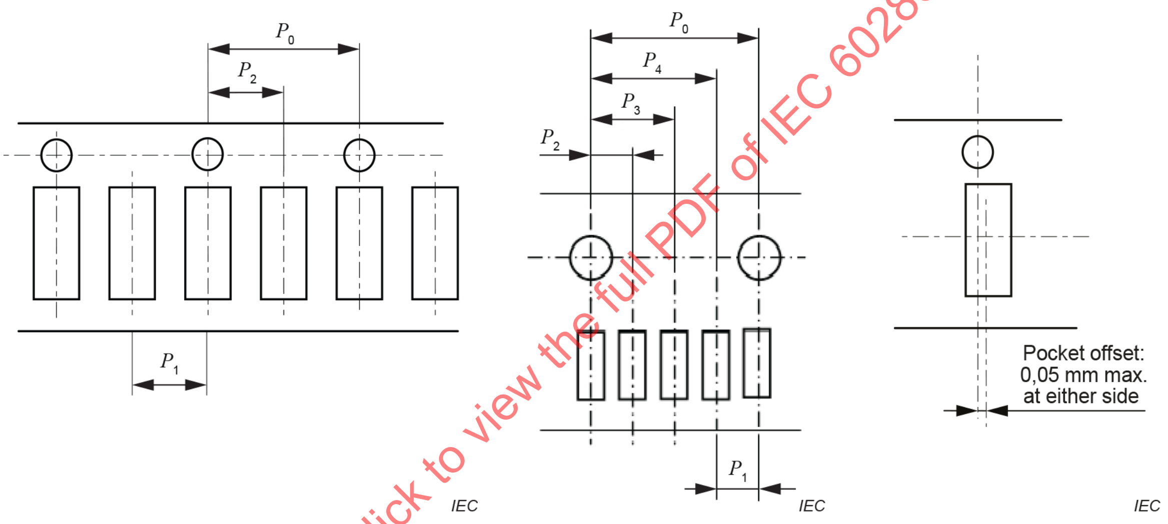
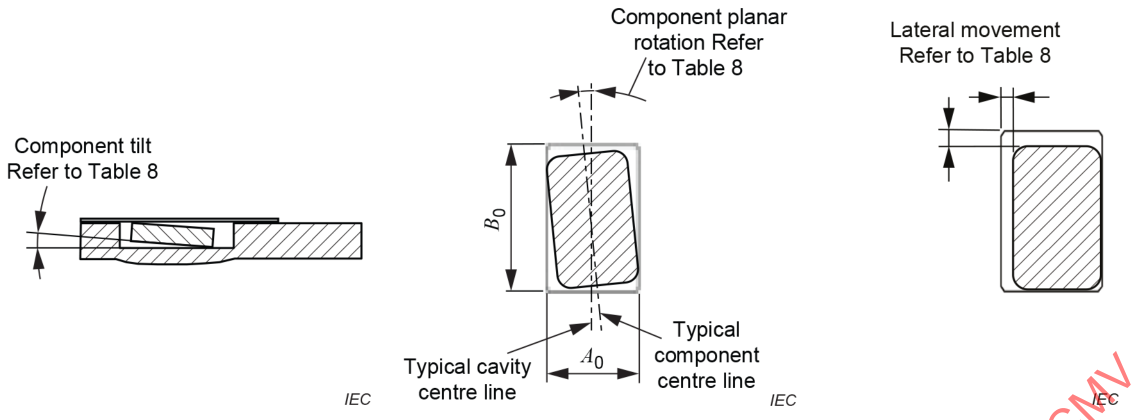


Figure 5 – Dimensions (P_0 = 4 mm/P_1 = 2 mm) and (P_0 = 4 mm/P_1 = 1 mm)



a) 2 mm cavity pitch b) 1 mm cavity pitch c) Pocket offset

Figure 6 – Illustration of 2 mm and 1 mm cavity pitch and maximum pocket offset



a) Sketch D
Component tilt
Side or front sectional view

b) Sketch E
Component planar rotation
Top view

c) Sketch F
Lateral movement
Top view

Figure 7 – Maximum component tilt, rotation and lateral movement

Table 6 – Constant dimensions of 8 mm pressed carrier tape

Dimensions in millimetres

Tape size	D_0 [a]	E_1	G min.	P_0	T max.	T_1 max.	T_3-T [b] max.	**P_0 pitch cumulative tolerance**
8	$1{,}5^{+0{,}1}_{0}$	1,75 ± 0,1	0,75	4,0 ± 0,1	1,1	0,1	0,1	± 0,1 / 10 pitches

For respective dimensional codes, see Figure 5 and Figure 6.

[a] If positioning precision is required, for example when components ≤ size 1005M are mounted in a narrow space, then the tolerance on D_0 should be +0,05 / −0,00 mm.

[b] For components with size designation of 1005M or smaller, the puff (T_3 − T) should be limited to 0,05 mm maximum.

Table 7 – Variable dimensions of 8 mm pressed carrier tape

Dimensions in millimetres

Tape size	C_T max.	E_2 min.	F	P_1	P_2	P_3	P_4	W	A_0, B_0 and K_0
8	4,35	6,25	3,5 ± 0,05	1,0 ± 0,05 (P_1 = 1)	1,0 ± 0,05 (P_1 = 1)	2,0 ± 0,05 (P_1 = 1)	3,0 ± 0,05 (P_1 = 1)	$8{,}0^{+0{,}3}_{-0{,}1}$	See 5.2
				2,0 ± 0,05 (P_1 = 2)	2,0 ± 0,05 (P_1 = 2)				
				4,0 ± 0,1 (P_1 = 4)	2,0 ± 0,05 (P_1 = 4)				

For respective dimensional codes, see Figure 5 to Figure 7.

Table 8 – Component tilt, planar rotation and lateral movement

Tape size mm	Component tilt (design value) [a]	Component planar rotation (design value) [a]	Lateral movement mm
8	20° maximum	20° maximum	0,12 maximum (Component size ≤ 0603M)
			0,20 maximum (Component size 1005M)
			0,30 maximum (Component size ≥ 1608M)

For respective ~~dimensional codes~~ illustration, see Figure 7.

[a] A design value is a calculated value for design purposes only. For example, component tilt is not intended to be measured, but is intended to be the calculated value for the pocket design of a carrier tape.

5.5 Type 2a – Blister carrier tape, with single round sprocket holes and tape pitches down to 2 mm (tape widths: 8 mm, 12 mm, 16 mm and 24 mm)

For respective dimensional codes, see Figure 8 to Figure 10 and Table 9 to Table 11.

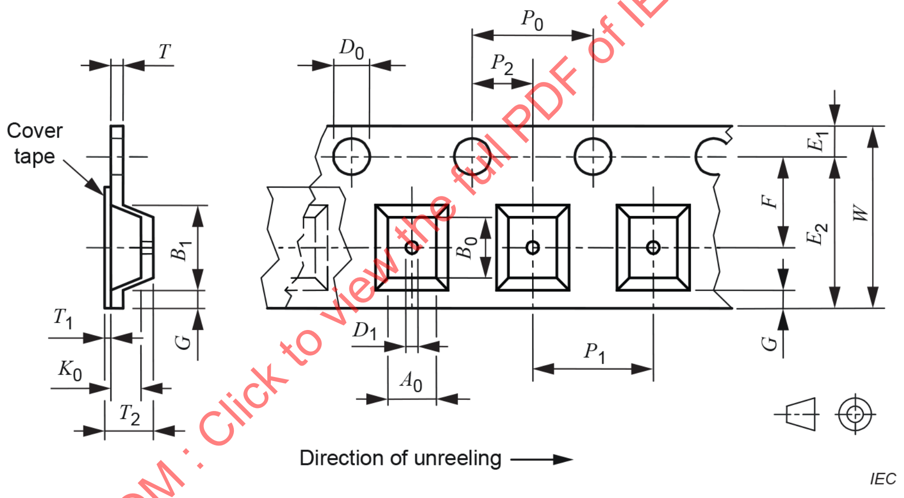
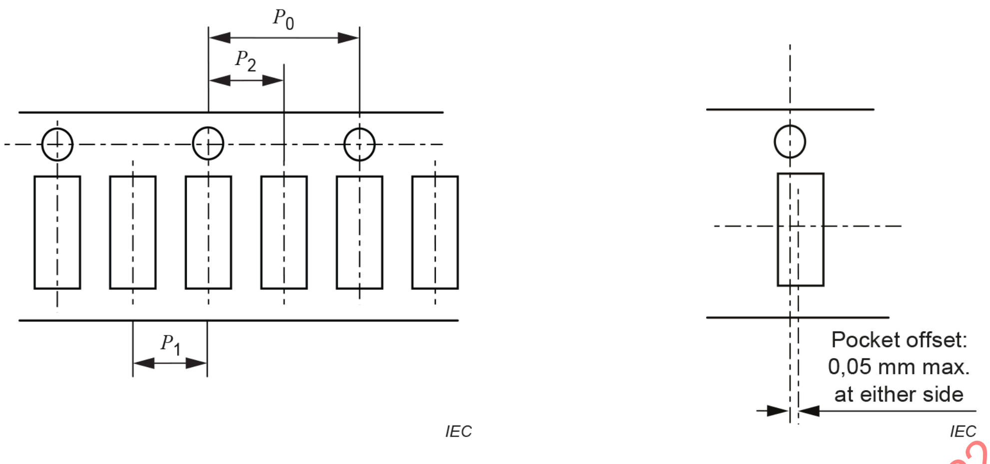
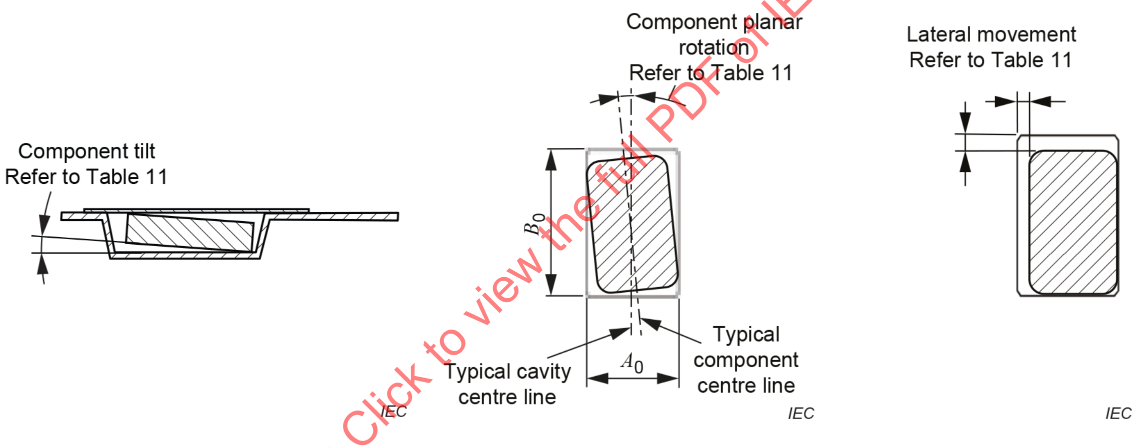


Figure 8 – Blister carrier tape dimensions (8 mm, 12 mm, 16 mm and 24 mm)



a) 2 mm cavity pitch **b) Pocket offset**

Figure 9 – Illustration of 2 mm cavity pitch and pocket offset



a) Sketch G
Component tilt
Side or front sectional view

b) Sketch H
Component planar rotation
Top view

c) Sketch I
Lateral movement
Top view

Figure 10 – Maximum component tilt, rotation and lateral movement

Table 9 – Constant dimensions of 8 mm to 24 mm blister carrier tape

Dimensions in millimetres

Tape size	D_0	E_1	G min.	P_0	T max.	T_1 max.	P_0 pitch cumulative tolerance
8 to 24	$1{,}5^{+0{,}1}_{0}$	1,75 ± 0,1	0,75	4,0 ± 0,1 (P_1 ≥ 4)	0,6	0,1	±0,2 / 10 pitches
				4,0 ± 0,05 (P_1 = 2)			
For respective dimensional codes, see Figure 8 and Figure 9.							

Table 10 – Variable dimensions of 8 mm to 24 mm blister carrier tape

Dimensions in millimetres

Tape size	B_1 max.	D_1 [a] min.	E_2 min.	F	P_1	P_2	T_2 max.	W	A_0, B_0 and K_0
8	4,35	0,3	6,25	3,5 ± 0,05	2,0 ± 0,05 4,0 ± 0,1	2,0 ± 0,05	3,5	$8{,}0^{+0{,}3}_{-0{,}1}$	See 5.2
12	8,2	1,5	10,25	5,5 ± 0,05	2,0 ± 0,05 4,0 ± 0,1 to 12,0 ± 0,1 in 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 16,0 ± 0,1 in 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 24,0 ± 0,1 in 4,0 increments	2,0 ± 0,1	12,5	$24{,}0^{+0{,}3}_{-0{,}1}$	

For respective dimensional codes, see Figure 8 to Figure 10.

[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.

Table 11 – Component tilt, rotation and lateral movement

Tape size mm	Component tilt (design value) [a]	Component planar rotation (design value) [a]	Lateral movement mm
8 and 12	10° maximum	20° maximum	0,5 maximum
16 and 24	10° maximum	10° maximum	0,5 maximum

For respective ~~dimensional codes~~ illustration, see Figure 10.

The trend for allowed component planar rotation of components with either length or width less than 1,2 mm is 10° maximum.

For components with either length or width dimensions of less than 1,2 mm, market trends are towards a lateral movement of 0,2 mm maximum.

When handling bare die products in tape size 8 mm, the lateral movement of 0,1 mm maximum for either cavity dimension should be allowed.

When handling bare die products in tape size 12 mm, the lateral movement of 0,15 mm maximum for either cavity dimension should be allowed.

[a] A design value is a calculated value for design purposes only. For example, component tilt is not intended to be measured, but is intended to be the calculated value for the pocket design of a carrier tape.

5.6 Type 2b – Blister carrier tape, with single round sprocket holes and with 1mm tape pitch (tape widths: 4 mm)

For respective dimensional codes, see Figure 11 to Figure 13 and Table 12 to Table 14.

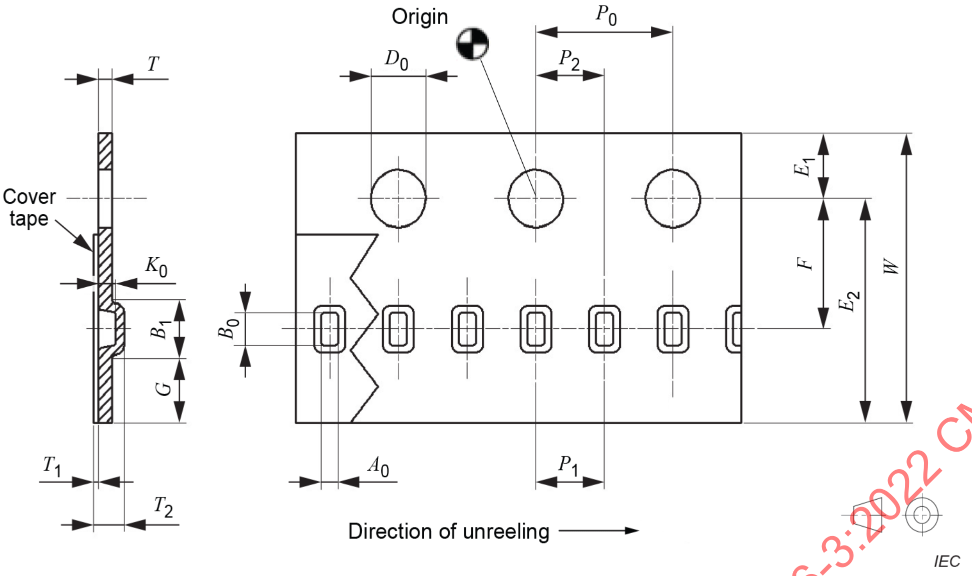


Figure 11 – Type 2b carrier tape

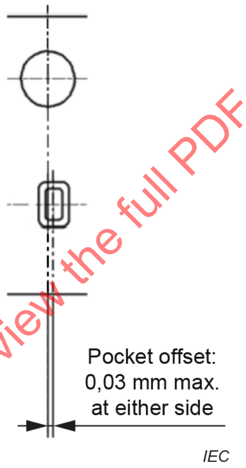
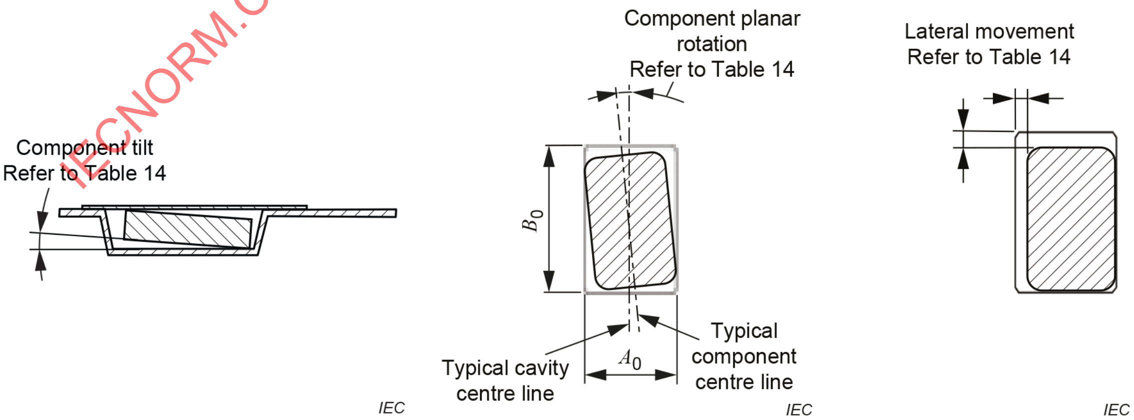


Figure 12 – Maximum pocket offset



a) Sketch J
Component tilt
Side or front sectional view

b) Sketch K
Component planar rotation
Top view

c) Sketch L
Lateral movement
Top view

Figure 13 – Maximum component tilt, rotation and lateral movement

Table 12 – Constant dimensions of 4 mm carrier tape

Dimensions in millimetres

Tape size	D_0	E_1	G min.	P_0	T min.	T max.	T_1 max.	P_0 pitch cumulative tolerance
4	0,80 ± 0,04	0,90 ± 0,05	0,50	2,00 ± 0,04	0,15	0,40	0,08	±0,1 / 20 pitches

For respective dimensional codes, see Figure 11.

Table 13 – Variable dimensions of 4 mm carrier tape

Dimensions in millimetres

Tape size	B_1 max.	E_2 min.	F	P_1	P_2	T_2 max.	W	A_0, B_0 and K_0
4	1,48 [a]	3,07	1,8 ± 0,03	1,0 ± 0,03	1,0 ± 0,03	1,1	4,0 ± 0,08	See 5.2

For respective dimensional codes, see Figure 11 and Figure 13.

[a] Reference dimension.

Table 14 – Component tilt, planar rotation and lateral movements

Tape size mm	Component tilt (design value) [a]	Component planar rotation (design value) [a]	Lateral movement mm
4	20° maximum	20° maximum	0,08 maximum (Component size 0201M)
			0,10 maximum (Component size 0402M)
			0,12 maximum (Component size 0603M)
			0,20 maximum (Component size > 0603M)

For respective ~~dimensional codes~~ illustration, see Figure 13.

[a] A design value is a calculated value for design purposes only. For example, component tilt is not intended to be measured, but is intended to be the calculated value for the pocket design of a carrier tape.

5.7 Type 3 – Blister carrier tape, with double sprocket holes (32 mm to 200 mm)

For respective dimensional codes, see Figure 14 to Figure 16 and Table 15 to Table 17.

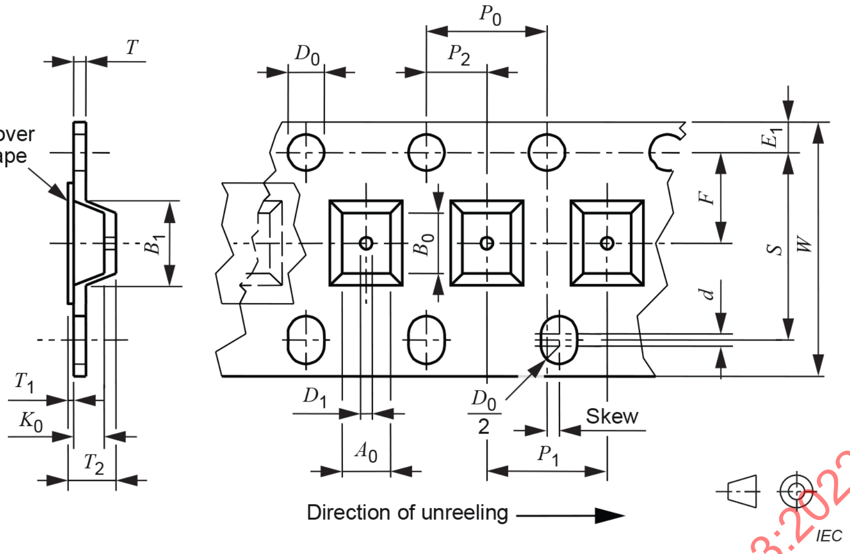


Figure 14 – Blister carrier tape

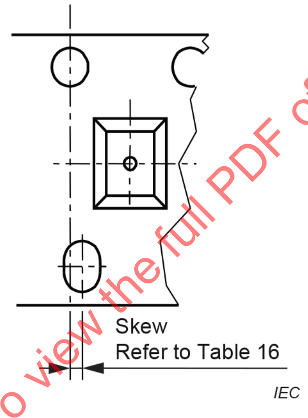
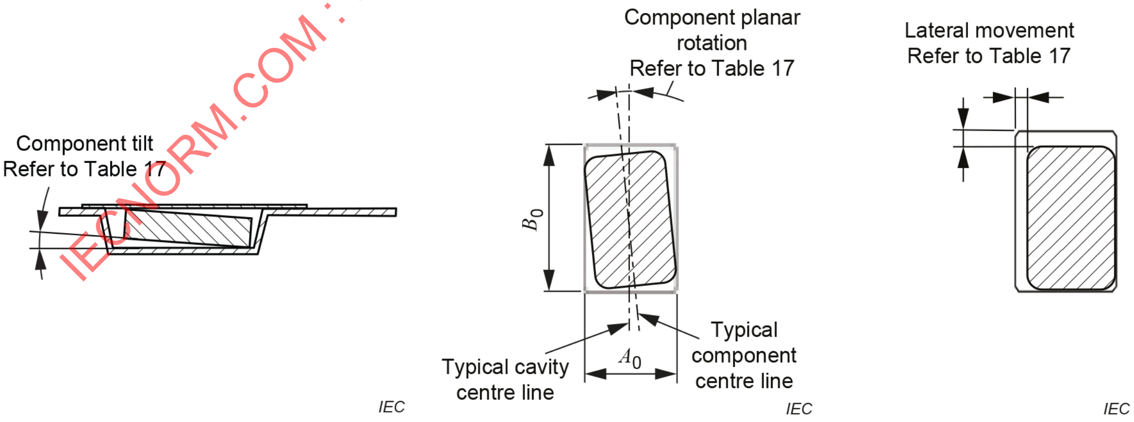


Figure 15 – Elongated sprocket hole skew



a) Sketch M
Component tilt
Side or front sectional view

b) Sketch N
Component planar rotation
Top view

c) Sketch O
Lateral movement
Top view

Figure 16 – Maximum component tilt, rotation and lateral movement

Table 15 – Constant dimensions of 32 mm to 200 mm blister carrier tape

Dimensions in millimetres

Tape size	D_0	D_1[a] min.	d	E_1	P_0	T max.	T_1 max.	P_0 pitch cumulative tolerance
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 / 10 pitches

For respective dimensional codes, see Figure 14.

[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 16 – Variable dimensions of 32 mm to 200 mm blister carrier tape

Dimensions in millimetres

Tape size	B_1 max.	F	P_1	P_2	S	Skew max.	T_2 max.	W	A_0, B_0 and 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 5.2
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~~ ± 0,3	
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	

For respective dimensional codes, see Figure 14 and Figure 15.

Table 17 – Component tilt, planar rotation and lateral movements

Tape size mm	**Component tilt** **(design value)** [a]	**Component planar rotation** **(design value)** [a]	**Lateral movement** mm
32, 44 and 56	10° maximum	10° maximum	1,0 maximum
72 to 200	5° maximum	10° maximum	1,0 maximum

For respective ~~dimensional codes~~ illustration, see Figure 16.

[a] A design value is a calculated value for design purposes only. For example, component tilt is not intended to be measured, but is intended to be the calculated value for the pocket design of a carrier tape.

5.8 Type 4 – Adhesive-backed punched plastic carrier tape for ~~singulated~~ singled bare die and other surface mount components (8 mm, 12 mm, 16 mm and 24 mm)

For respective dimensional codes, see Figure 17 to Figure 19 and Table 18 to Table 20. Type 4 carrier is designed specifically for automated handling of components, such as ~~singulated~~ singled bare die. Components are placed on an adhesive film in compartments. The compartment is defined by dimensions V_1 and V_2, which are virtual boundaries of maximum practical sizes that enable use of a multiple of component footprints. The boundaries shall not be used as fiducials for component placement during taping. Refer to 9.4.2 for component positioning and lateral placement.

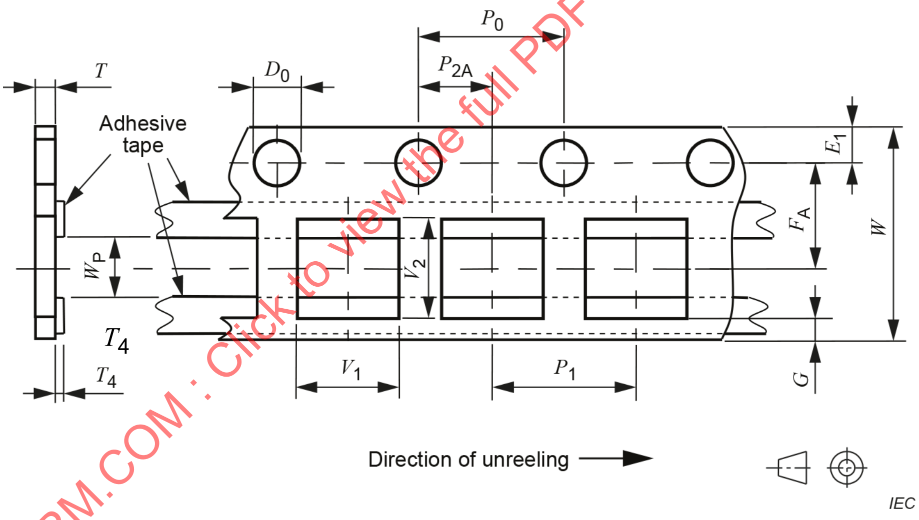


Figure 17 – Adhesive-backed punched carrier-tape dimensions (4 mm compartment pitch)

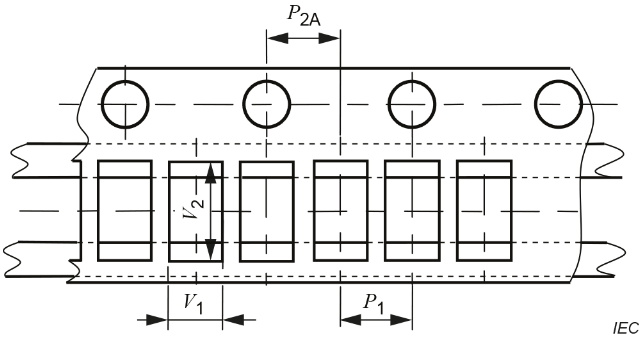
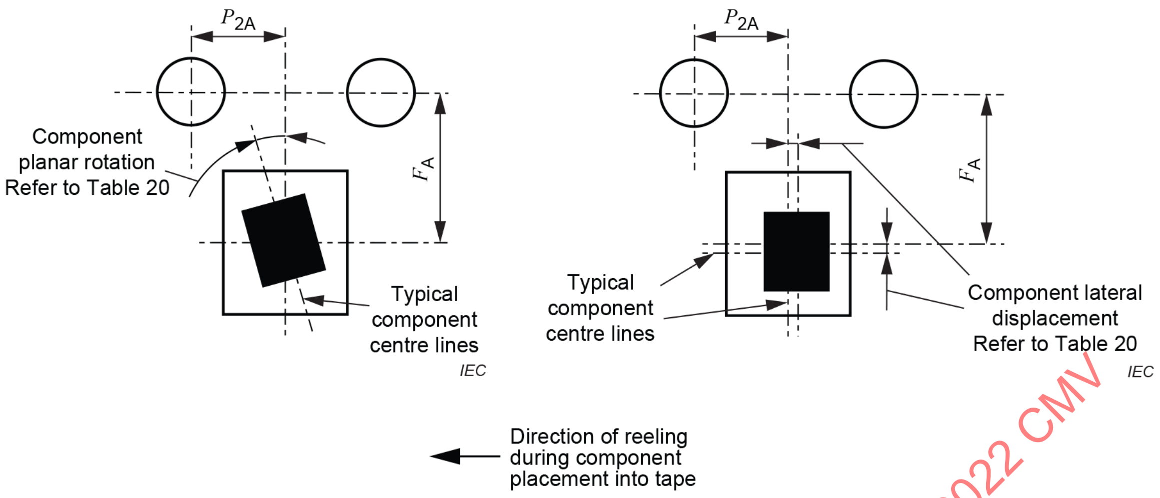


Figure 18 – Illustration of 2 mm compartment pitch



a) Sketch P
Component planar rotation
Top view

b) Sketch Q
Typical component centre lines
Top view

Figure 19 – Maximum component planar rotation and lateral displacement

Table 18 – Dimensions of adhesive backed punched carrier tape

Dimensions in millimetres

Tape size	D_0	E_1	P_0	P_{2A}	~~T_1~~ T_4 max.	G min.	T max.	W_P	**P_0 pitch cumulative tolerance**
8, 12, 16 and 24	$1{,}5^{+0{,}05}_{0}$	1,75 ± 0.1	4,0 ± 0,025	2,0 ± 0,05 (W = 8 and 12)	0,1	0,75	1,1	a, b, c	± 0,2 / 10 pitches
				2,0 ± 0,1 (W = 16 and 24)					

For respective dimensional codes, see Figure 17 to Figure 19.

[a] Gap W_P is optional and is defined together with the end-user. W_P is determined from the component specifications (dimension B and surface terrain). Its purpose is to

a) minimize adhesion of the component to optimize consistent retrieval at the pick point. This is especially important with components having a surface contact area of 10 mm^2 or greater with the adhesive film;

b) secure retention of component in compartment during reeling/unreeling.

[b] Gap W_P is typically ≤ (0,5 × component dimension in the direction of V_2), see Figure 17.

[c] Gap W_P is centred along the F_A centreline.

Table 19 – Variable dimensions of adhesive-backed punched carrier tape

Dimensions in millimetres

Tape size	F_A	P_1	V_1	V_2	W
8	3,50 ± 0,05	2,0 ± 0,05 4,0 ± 0,1	1,5	3,1	$8{,}0\ ^{+0{,}2}_{-0{,}1}$
			3,1	3,1	
12	5,50 ± 0,05	2,0 ± 0,05 4,0 ± 0,1 to 12,0 ± 0,1 in 4,0 increments	1,5	6,35	$12{,}0\ ^{+0{,}2}_{-0{,}1}$
			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	$16{,}0\ ^{+0{,}2}_{-0{,}1}$
			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	$24{,}0\ ^{+0{,}2}_{-0{,}1}$
			14,0	17,3	
For respective dimensional codes, see Figure 17 to Figure 19. NOTE Dimension E_2, as defined in ~~tape~~ type 1a, type 1b, type 2a and type 2b, is for type 4 tape minimum value only, but can be derived as a reference dimension by subtracting E_1 from W (maximum).					

Table 20 – Component planar rotation and lateral displacement

Tape size mm	Component planar rotation	Component lateral displacement mm
8, 12, 16 and 24	5° maximum	0,05 maximum (P_1 = 2)
		0,1 maximum (P_1 = 4)
For respective dimensional codes, see Figure 19.		

6 Polarity and orientation requirements of components in the tape

6.1 Requirements for all ~~tape~~ types

For all tape types, the following requirements apply.

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

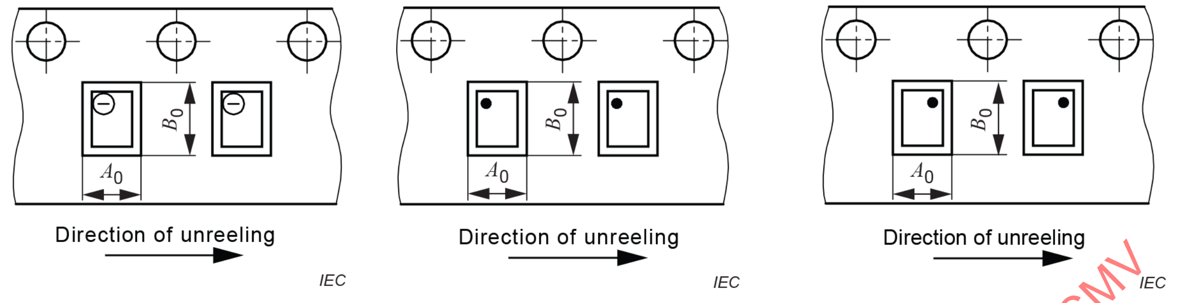
b) For components in flat packages (for example, chip carriers and SO-packages) with more than two terminations, termination No. 1 shall be adjacent to the round sprocket hole, unless otherwise specified in the detail specification;

c) 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;

d) 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 round sprocket holes in the tape and the mounting side shall face the bottom of the component compartment;

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

f) The polarity or orientation of components with other shapes or termination configurations shall be stated in the detail specification (see Figure 20).



a) Cathode is in the upper left

b) Termination No.1 is in the upper left

c) Termination No.1 is in the upper right

The graphical symbol "-", which stands for the position of the cathode side, is shown in a). The mark "•", which stands for the position of termination No.1, is shown in b). Another position of termination No.1 is shown in c), where the position cannot be settled as in b).

Figure 20 – Example of polarity and orientation

6.2 Specific requirements for type 1a

Type 1a has ~~effectively~~ a top cover tape and a bottom cover tape on ~~either side~~ both sides of the carrier tape. Therefore, components may be placed with the mounting side orientated to the bottom or the top side of the tape (for the bottom side of the tape, see 11.1). 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.~~, the tape is re-spooled. Then, the bottom cover tape is removed to invert the components.

6.3 Specific requirements for type 4

The non-active side of the component is generally placed at the bottom side of the tape, i.e. affixed to the adhesive layer. This orientation enables additional visual inspection and probe testing 'in-situ', within an open compartment, since a cover tape is not required for component retention. In the case of flip-chips or WLCSP, the component may be placed 'bumps down' on a special adhesive layer designed for that purpose. Bumps down orientation, on adhesive tape, protects the bumps from damage attributable to abrasion or mechanical handling.

7 Carrier tape requirements

7.1 Taping materials

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

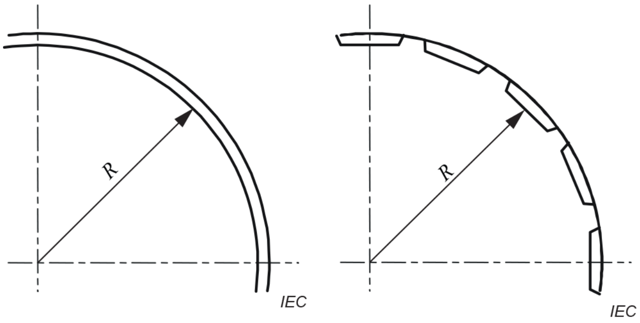
Components shall not stick to the carrier tape. 4

7.2 Minimum bending radius (for all types)

When the tape is bent with the minimum radius (measured at the bottom side of the tape, see Figure 21) given for a particular tape width as indicated in Table 21, the tape shall not be damaged and the components shall maintain their position and orientation in the tape.

Tape material should have such properties that without additional assistance the material can easily bend to the radius specified in Table 21. Otherwise, the tape cannot be handled anymore.

Tape with components shall pass around the radius R specified in Table 21 without damage.



a) Punched tape **b) Blister tape**

Figure 21 – Bending radius

Table 21 – Minimum bending radius

Dimensions in millimetres

W	P_1	R min.	
		Type 1a, type 1b, type 2a, type 2b and type 3	**Type 4 only [b]**
4	1	25	25
8	1,2 and 4	25	25
12	2, 4 and 8	30[a]	50
16	4,8,12 and 16	30	50
24	4, 8 and 12	30	50
24	16 and 24	30	89
32	4 to 32	40	n/a
44	4 to 44	40	n/a
56	4 to 56	50	n/a
72 to 200	4 to 72[b]	75	n/a

n/a Not applicable.

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

[b] 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 17) 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 26).

7.3 Camber

The camber shall be measured with the carrier tape passed between two plates and without tension applied to the tape. To measure camber accurately, both left and right edges of the 250 mm carrier tape shall be in contact with the straight edge. Measure the largest camber between two edges of the tape in accordance with Figure 22. The camber shall not exceed 1 mm over 250 mm in either direction, unless otherwise specified in the relevant specification.

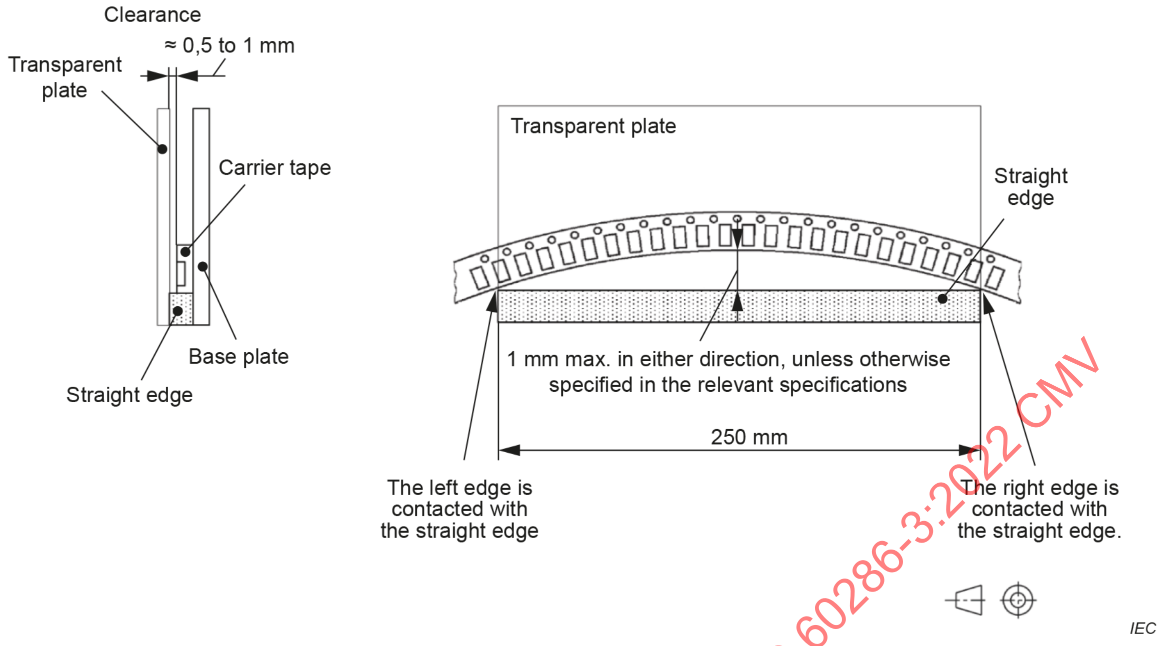


Figure 22 – Measuring method and camber

8 Cover tape requirements (for type 1a, type 1b, type 2a, type 2b and type 3)

For ~~tape~~ type 1a, type 1b, type 2a, type 2b and type 3 the following cover tape requirements apply:

a) the cover tapes shall not cover the round sprocket holes (type 1a, type 1b, type 2a, type 2b and type 3) and elongated sprocket holes (type 3);

b) the adhesive and material of the cover tape shall not adversely affect the mechanical and electrical characteristics and the marking of the components;

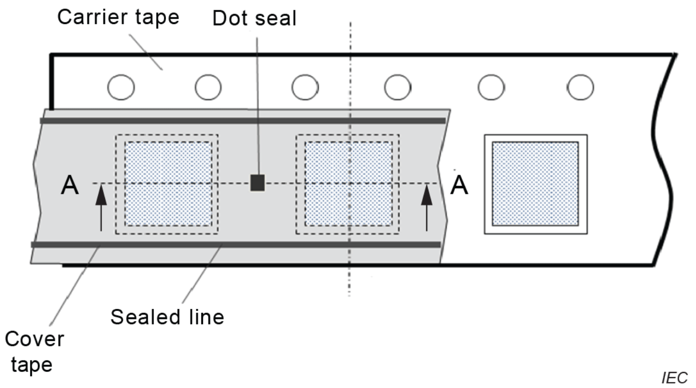
c) components shall not stick to ~~the carrier tape or to~~ the cover tape;

d) the cover tape(s) shall not become detached;

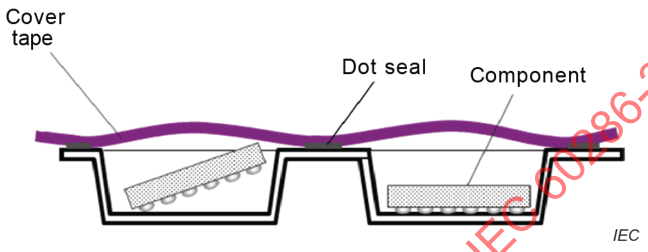
e) the cover tape(s) shall not protrude beyond the edge of the tape;

f) the cover tape shall not be attached to the carrier tape on the surface between two adjacent component pockets.

An exception may apply in those cases where thin components, during reeling or de-reeling, can slide from pocket to pocket. In these cases, the surface between two adjacent pockets may be dot sealed according to the peel force requirements (see Figure 23 and Table 22).



a) **Top view**



b) **Section A-A**

Figure 23 – Dot seals for thin components (as exceptions)

g) The break force of the cover tape shall be at least 10 ~~N min~~.

h) The angle at the peel strength test 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.

i) The peel force with a peel speed of 300 mm/min ± 10 mm/min shall be as indicated in Table 22.

Table 22 – Peel force

Tape width W mm	**Peel force** [a] N
4	0,1 to 0,7
8	0,1 to 1,0
12 to 56	0,1 to 1,3
72 to 200	0,1 to 1,5

~~Tape~~ **Type 1a, type 1b and type 2b**: For ~~ultra~~ very small components 0603M size or smaller, the mass is so light that components may run-off from the component compartment when the cover tape is peeled. For these component sizes it is recommended to use a peel force of 0,2 N ± 0,1 N and, as aging may have an effect on the peel force, this peel force should be valid for at least 7 days after sealing.

Unless specifically requested by the end-user, the ~~sale of~~ sealed tapes shall not be ~~reversed~~ bent in the opposite direction to maintain the appropriate peel force of the cover tapes.

[a] Peel off forces might be higher in case a sealing between adjacent pockets is used, for example dot seal as shown in Figure 23.

9 Component taping and additional tape requirements

9.1 All types

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 type 1a, type 1b, type 2a, type 2b and type 3, which use cover tapes, are listed in Clause 8. Type 4 does not require a cover tape, because components are affixed to the adhesive backing when taped and are held in position.

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

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.

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.

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.

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.

NOTE See IEC 61340-5-1 and IEC TR 61340-5-2 for the guidelines.

In addition, the following measuring methods of electrostatic performance while the cover tape is peeled off the carrier tape in SMD taping with a tape width of 4 mm, 8 mm, 12 mm and 16 mm, are shown in Annex B:

a) electrostatic potential generated;

b) electrostatic charge decay performance acting in the longitudinal direction of the carrier tape. 5

9.2 Specific requirements for type 1b

The presence of burrs, fluff or deformation should be kept to a minimum and shall not affect the removal of components. The presence of fluff shall not affect the mounting of the component.

Recommended measuring methods for carrier tape thickness (T and T_3), cavity (A_0 and B_0) and cavity depth (dimension K_0) shall be in accordance with Annex A.

9.3 Specific tape requirements for type 2b

The carrier tape and cover tape shall be made of a plastic material which does not shed particulates and has antistatic characteristics.

The carrier tape material should be suitable for use in the applicable cleanroom classification for which it is intended.

9.4 Specific requirement for type 4

9.4.1 General

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.

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

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

9.4.2 Coordinate system

For the coordinate system of ~~tape~~ type 4, the following requirements apply.

a) The coordinate system shown in Figure 24 is established to define carrier tape dimensioning together with component placements on adhesive-backed punched plastic carrier tapes.

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

c) Ordinates are lines at right angles to the abscissa and uniformly spaced along its length to position the centre of each round sprocket hole aligned along the abscissa.

d) 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.

e) 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.

f) The centre of the components shall be located within a 0,2 mm diameter of the target centre-points within the virtual boundaries. See Figure 24 and Figure 25.

g) Component rotation shall be limited to 5° from the abscissa axis centre line of the round sprocket holes (see Figure 19).

h) Adherence to the tolerances defined in Table 18 and Table 19 ensures that the following critical criteria are maintained:

   1) precise alignment of all round sprocket hole centres along abscissa;
   2) consistent pitch of the round sprocket holes throughout the entire length of the tape;
   3) uniform diameters of all round sprocket holes;
   4) polarity and orientation of components in the tape.

Table 23 – Absolute referencing data for component target position

Dimensions in millimetres

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

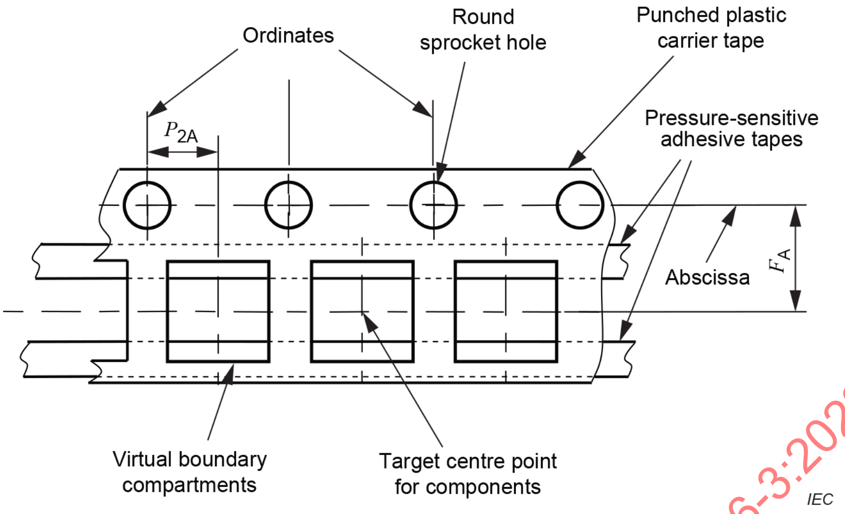


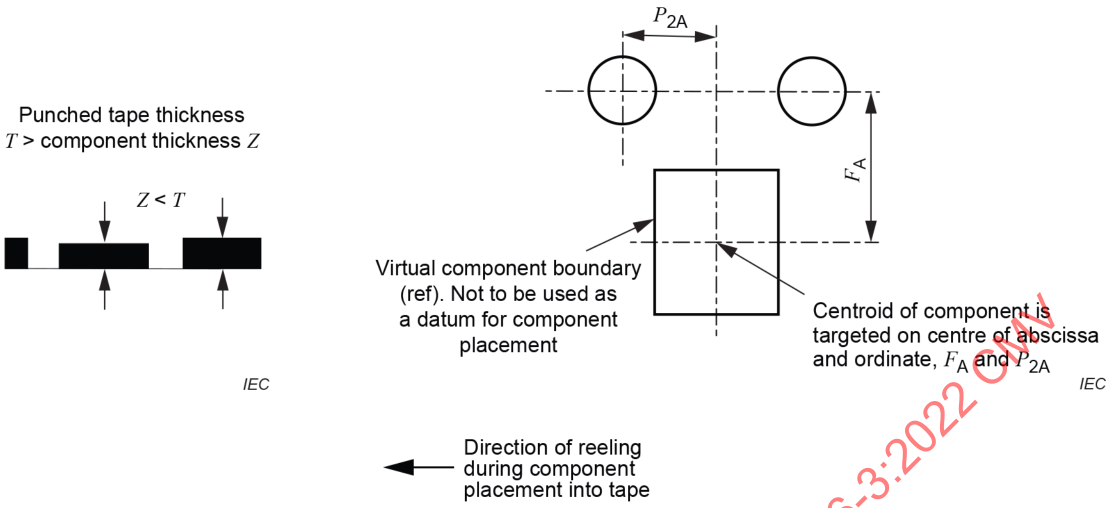
Figure 24 – Type 4 coordinate system

9.4.3 Component positioning and lateral displacement

For the component positioning and lateral displacement, see Figure 19 and Figure 25. The component position in type 4 tape is not measured with respect to the compartment, as in type 1a, type1b, type 2a, type 2b and type 3, but relative to a virtual target point at an absolute position given by P_{2A} and F_A. Table 23 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 Figure 25 b) 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 4, which may have a tighter tolerance than that shown in Table 18 and Table 19 [see Figure 25 b)], where the repeatability of the component position at the pick point is critical. The component should not protrude above the top surface of the carrier tape. This is shown in Figure 25 a) where the component thickness (Z) shall not be more than the punched tape thickness (T).



a) Sketch R
Side or front
Sectional view

b) Sketch S
Component location

Figure 25 – Component clearance and positioning method

9.5 Specific requirements for tapes containing die products

9.5.1 General

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.

NOTE Refer to IEC TR 62258-3 for handling recommendations.

The content of 9.5.2, 9.5.3 and 9.5.4 should be considered where the tape is used for die products.

9.5.2 Tape design for tapes containing die products

Type 1a, type 2a, and type 2b 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 2a and type 2b should include special features in the base of the cavity to protect bumped die, where the die is placed in the pocket 'bumps down'.

Type 4 does not require special features since it is inherently designed for die products.

NOTE Type 1b and type 3 are not suitable for use with die products.

9.5.3 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 shall be free from any burrs or particles that may dislodge during handling or storage; they ~~may~~ can 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.

9.5.4 Die lateral movement (type 1a, type 2a and type 2b)

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.

Die products generally require tighter tape tolerances to minimize lateral movement.

Tapes with a width W of 8 mm and 4 mm should allow for a lateral movement of 0,1 mm maximum. Tapes with a width W of more than 8 mm should allow for a lateral movement of 0,15 mm maximum.

10 Reel requirements

10.1 Dimensions

10.1.1 General

For the reeling of tapes, reels with the essential dimensions listed hereinafter shall be used. The total number of components on the reel shall be such that the components and the final cover do not extend beyond the smallest dimension of the flange (in the radial direction).

10.1.2 Reel dimensions

For the reel dimensions, see Figure 26 and Table 24.

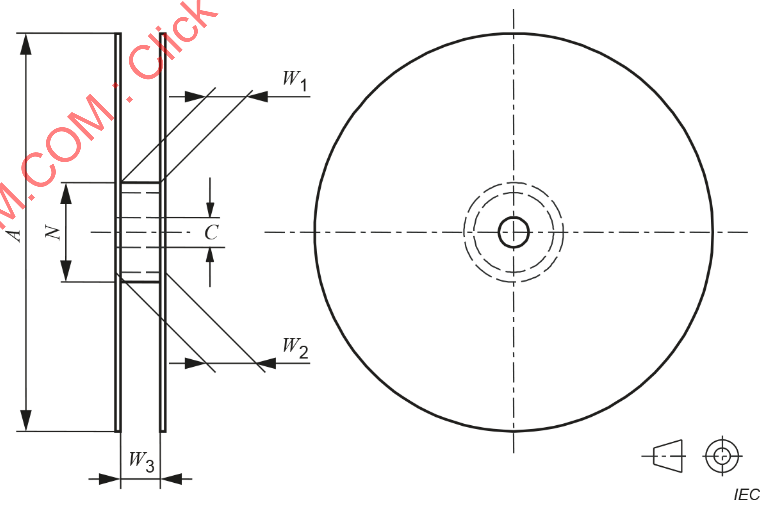


Figure 26 – Reel

Table 24 – Reel dimensions

Dimensions in millimetres

Tape width W	**Reel diameter**[a] A max.	**Hub diameter** N min.	**Reel inner width** W_1[b]	**Reel overall width** W_2 max.	**Reel inner width** W_3 min.	**Reel inner width** W_3 max.
4	180	50	4,2 + 0,75	7,95	3,9	5,95
8	382	50	8,4 + 1,5	14,4	7,9	10,9
12		60 [d]	12,4 + 2	18,4	11,9	15,4
16		60	16,4 + 2	22,4	15,9	19,4
24		60 [c]	24,4 + 2	30,4	23,9	27,4
32		80	32,4 + 2	38,4	31,9	35,4
44		80	44,4 + 2	50,4	43,9	47,4
56		100	56,4 + 2	62,4	55,9	59,4
72	609	150	72,4 min.	89,0	Shall accommodate tape width without interference	
88			88,4 min.	105,0		
104			104,4 min.	121,0		
120			120,4 min.	137,0		
136			136,4 min.	153,0		
152			152,4 min.	169,0		
168			168,4 min.	185,0		
184			184,4 min.	201,0		
200			200,4 min.	217,0		

For the respective dimensional codes, see Figure 26.

[a] Preferred nominal reel diameters, in millimetres, are 180, 254, 284, 330, 360, 382 and 560. ~~Market trend is towards a larger diameter.~~

[b] Measured at the hub.

[c] For type 4: 100 min.

[d] For punched tapes, the minimum diameter shall be 50 mm.

10.1.3 Reel hole dimensions

For the reel hole dimensions, see Figure 27 and Table 25.

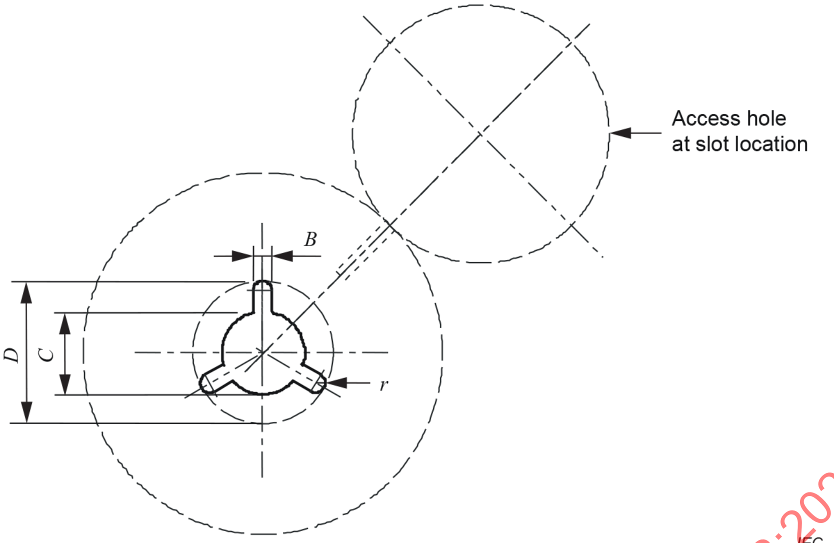


Figure 27 – Reel hole presentation

Table 25 – Reel hole dimensions

Dimensions in millimetres

Symbols	**All types**
B	1,5 minimum
D	20,2 minimum
C	~~12,8 minimum~~ 13,0 +0,5/ −0,2
r	0,5 × *B*
For respective dimensional codes, see Figure 27.	

An adequate tape slot at the hub of the reel may be provided for the trailer. There should then also be a corresponding adequate access hole.

10.1.4 Drive hole dimensions (optional)

For the drive hole dimensions, see Figure 28 and Table 26.

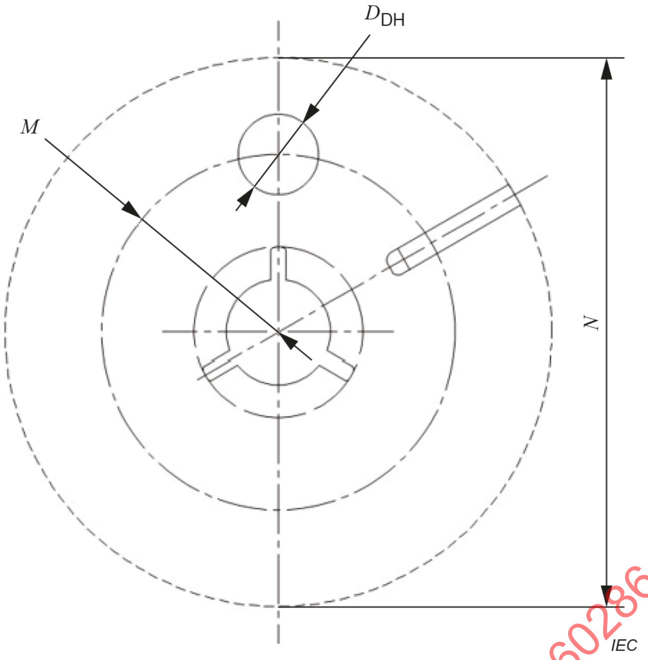


Figure 28 – Drive hole layout

Table 26 – Drive hole dimensions

Dimensions in millimetres

Symbols	All types
D_{DH}	7,6 to 9,5
M	25,4 to 28,55
For respective dimensional codes, see Figure 26 and Figure 28.	

The hub diameter should be chosen appropriately for the following conditions:

a) the drive holes shall be located inside the hub of the reel;

b) the drive hole shall not interfere with the tape slot at the hub of the reel.

10.2 Marking

The reel shall provide space for a label. The label shall be placed on the outside of the flange opposite the round sprocket holes (see Figure 29).

The marking on the reel shall comply with the requirements of the detail specification of the component.

Further information may be given by normal script or in code form for automatic reading, for example, OCR, bar code, and magnetic~~, etc~~.

In the case of bar codes, it is recommended that bar code 39 be used, as specified in ISO/IEC 16388. For optical character recognition (OCR), OCR B should be used.

11 Tape reeling requirements

11.1 All types

Tape with components ready for assembly placement shall be spooled in such a way that the round sprocket holes shall be on the left-hand side as the tape enters the feeder as viewed from the back end of the feeder looking towards the bed of the assembly machine (see Figure 29).

Tape with components shall wrap around the hub (see dimension N in Figure 26) without damage.

Component tapes shall be wound on reels suitable for feeding automatic mounting machines.

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 29).

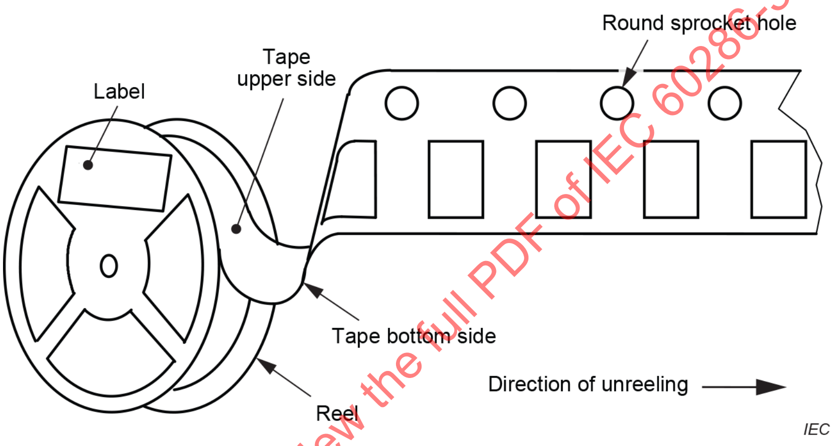


Figure 29 – Tape reeling and label area on the reel

11.2 Specific requirements for type 1a

Type 1a has~~ effectively~~ a top cover tape and a bottom cover tape on~~ either side~~ both sides of the carrier tape. If the mounting side needs to be reversed (~~as is the case~~ for some types of surface-mounted components),~~ then the tape shall be re-spooled and the alternate cover tape removed, to effectively invert the component~~ the tape shall be re-spooled. Then, the bottom cover tape shall be removed to invert the components.

11.3 Specific requirements for type 4

Generally, it is sufficient to wrap a layer of tape around the reel which normally comprises the leader for the tape to protect the components in the tape. However, for additional protection or where the leader is insufficient, a static dissipative wrap may be wound around the completed reel.

11.4 Leader and trailer tape

11.4.1 General

For the leader and trailer, see 11.4.2, 11.4.3 and Figure 30.

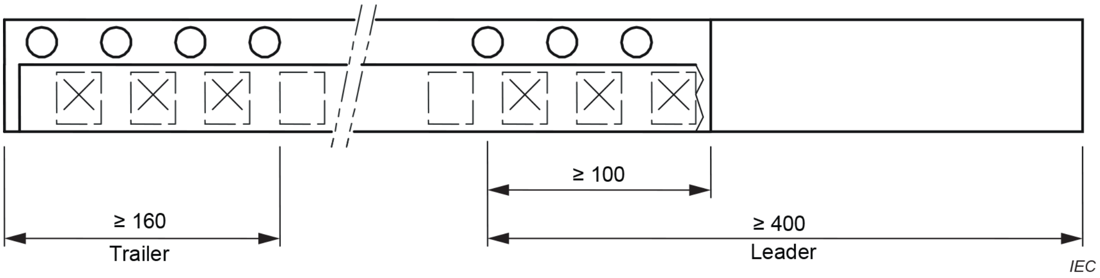


Figure 30 – Leader and trailer

11.4.2 Leader

For type 1a, type 1b, type 2a, type 2b and type 3 tapes, there shall be a leader of 400 mm minimum of cover tape, which includes at least 100 mm of carrier tape with empty compartments. All of leader may consist of the carrier tape with empty compartments sealed by cover tape.

Type 4 tapes, which have no cover tape, shall include at least a leader of 100 mm of carrier tape with empty compartments.

11.4.3 Trailer

There shall be a trailer with a minimum of 160 mm carrier tape with empty compartments and sealed by the cover tape. The carrier tape shall be released from the reel hub as the last portion of the carrier tape unwinds from the reel.

11.5 Recycling

Tape and reels should be made of recyclable material. When such material is used in reels, a recycling symbol shall be marked on the reel.

The requirements of ISO 11469 ~~shall preferably~~ should be ~~used~~ referred to for marking the material.

11.6 Missing components

The maximum number of ~~missing components~~ empty pockets between the leader and the trailer shall be 1 per reel or 0,025 %, whichever is greater.

There shall not be consecutive components missing from any reel for any reason.

Annex A
(normative)

Recommended measuring methods for type 1b

A.1 Measurement method for carrier tape thickness (T and T_3)

The equipment used to conduct these measurements shall be an external micrometer with a measuring pressure of 1,5 N or smaller. To measure the tape thickness at the cavity, including the puff, the probe shall be made of super-hard material with a recommended probe head diameter of 2,0 mm.

The thickness of the carrier tape shall be measured with an accuracy of 0,001 mm. The dimension of the thickness excluding the puff of the bottom of the cavity is T, when the flat side is measured adjacent to the round sprocket holes. The dimension of the thickness including the puff on the bottom of the cavity is T_3.

Measurements shall be made at the points shown in Figure A.1.

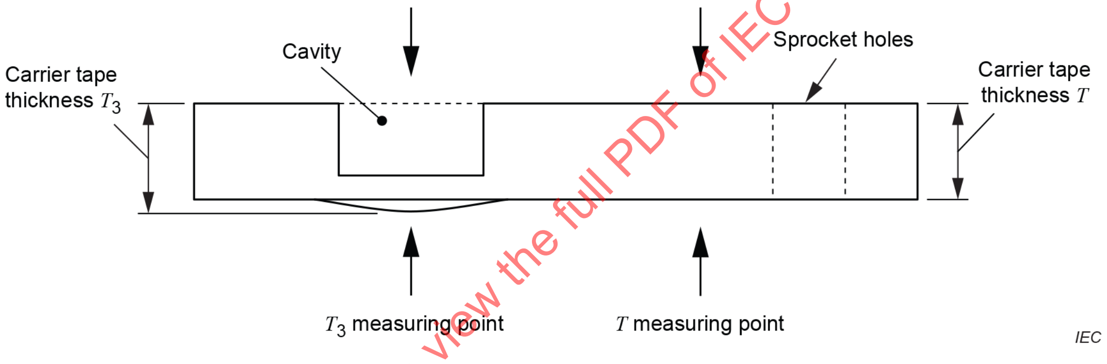
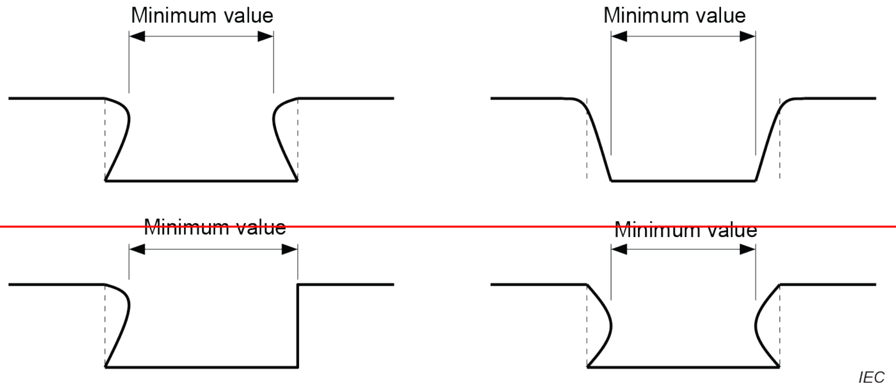


Figure A.1 – Carrier tape thickness measurement points

A.2 Measurement method for cavity (A_0 and B_0)

A measuring viewing scope with 10× magnification or more shall be used.

For dimension A_0 and dimension B_0, the minimum value including deformation of material shall be measured using an adequate light source to illuminate the surface of the tape and allow measurement of the features as shown in Figure A.2. Fluff should be excluded from the dimension.



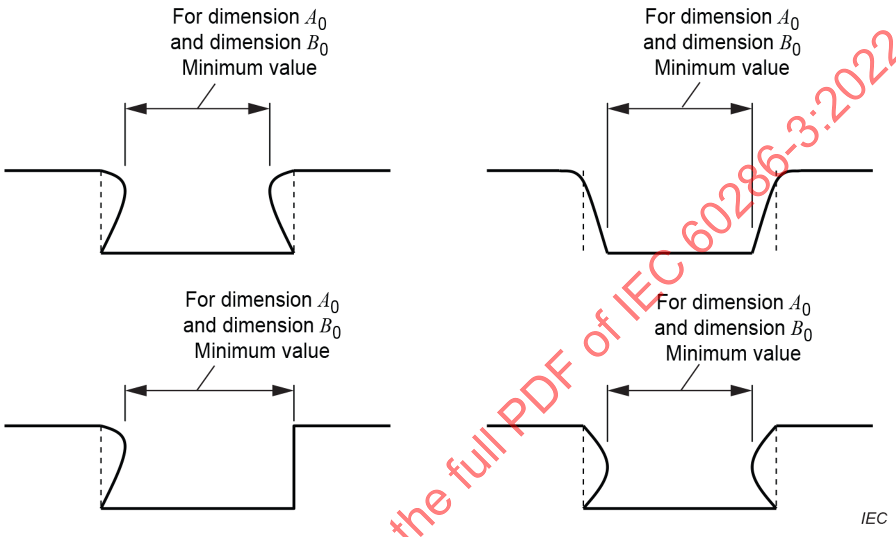


Figure A.2 – Cavity cross-section

A.3 Measurement method for cavity depth (dimension K_0)

The cavity depth K_0 should be the distance between the centre of the bottom of the cavity and the carrier surface at the centre point between the round sprocket hole and the cavity.

An example of a measurement of cavity depth K_0 is to use a non-contact measuring system to perform a measurement in accordance with Figure A.3.

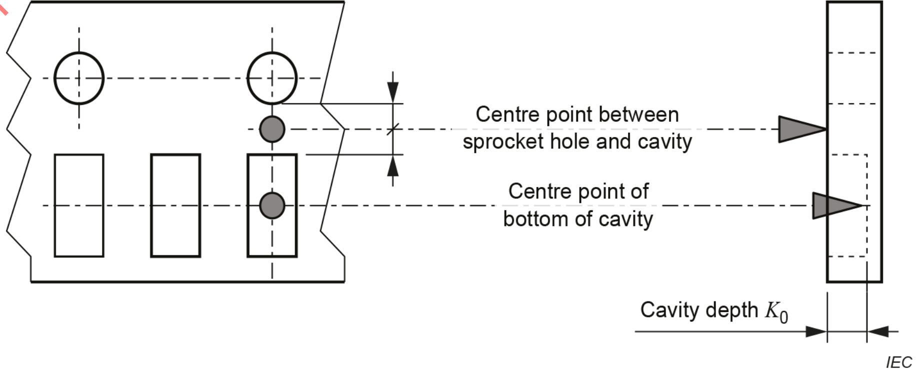


Figure A.3 – Cavity depth dimension

Annex B 6
(informative)

Measuring methods of electrostatic potential and charge decay performance while cover tape is peeled off from carrier tape containing surface mount devices

B.1 General

Surface mount devices (hereinafter referred to as SMDs) are usually packaged in the form of tape and reel. It is necessary to peel off the cover tape from the carrier tape in order to pick up an SMD from the cavity.

When peeling off the cover tape from the carrier tape, electrostatic charges are generated by the separation of materials. These charges can cause the following detrimental effects:

- the SMD is damaged by electrostatic discharge and/or its characteristics are degraded;
- the SMD sticks to the cover tape, and causes an empty cavity;
- the SMD sticks to the inside the cavity of the carrier tape, and the pick and place machine cannot pick it up.

The generated electrostatic potential and its subsequent decay time depend on the following factors:

- packaging materials and sealing methods for SMD taping, environmental conditions before and after peeling off the cover tape and the peeling off conditions;
- type and size of SMD, the reel size;
- the storage conditions.

However, no applicable standard that considers the above factors exists for the measurement of the electrostatic potential generated during peeling off the cover tape from the carrier tape.

NOTE There is a U.S.A. standard for measuring the electrostatic potential when peeling off adhesive tapes (e.g. ESD ADV 11.2:1995) but they are not applicable for non-adhesive tapes.

In addition, no applicable standard that considers the characteristics of the SMD taping exists for the measurement method of the electrostatic charge decay performance.

Therefore, a method for measuring the electrostatic potential and charge decay performance under the actual conditions of peeling off the cover tape needs to be specified in another standard which introduces a new way of thinking.

The data gained by the methods described in this annex are an important tool to develop and evaluate effective countermeasures against the above detrimental electrostatic effects.

This annex describes method for measuring the electrostatic potential generated when the cover tape is peeled off from a carrier tape, and a method for measuring the electrostatic charge decay performance by resistive properties acting in the longitudinal direction of the carrier tape.

This annex applies to SMD tapes with widths of 4 mm, 8 mm, 12 mm and 16 mm.

B.2 Method for measuring electrostatic potential and charge decay performance

B.2.1 General

Electrostatic potential and charge decay performance shall be measured in accordance with B.2.2 to B.2.7.

A configuration diagram of the measurement method using an electrostatic potential measuring instrument is shown in Figure B.1. Figure B.2 shows the measurement method of electrostatic potential generated when cover tape is peeled off the carrier tape. Figure B.3 shows the configuration of the measurement method for electrostatic charge decay performance, and Figure B.4 shows the measurement method:

a) the capacitance of the measuring position (the metal flat plate electrode and non-contact probe) is 10 pF or less;

b) the insulation between the metal flat plate electrode and the electrostatic-potential measuring device itself should be 1 × 10^{14} Ω or more;

c) all measuring instruments should be connected to the ground point.

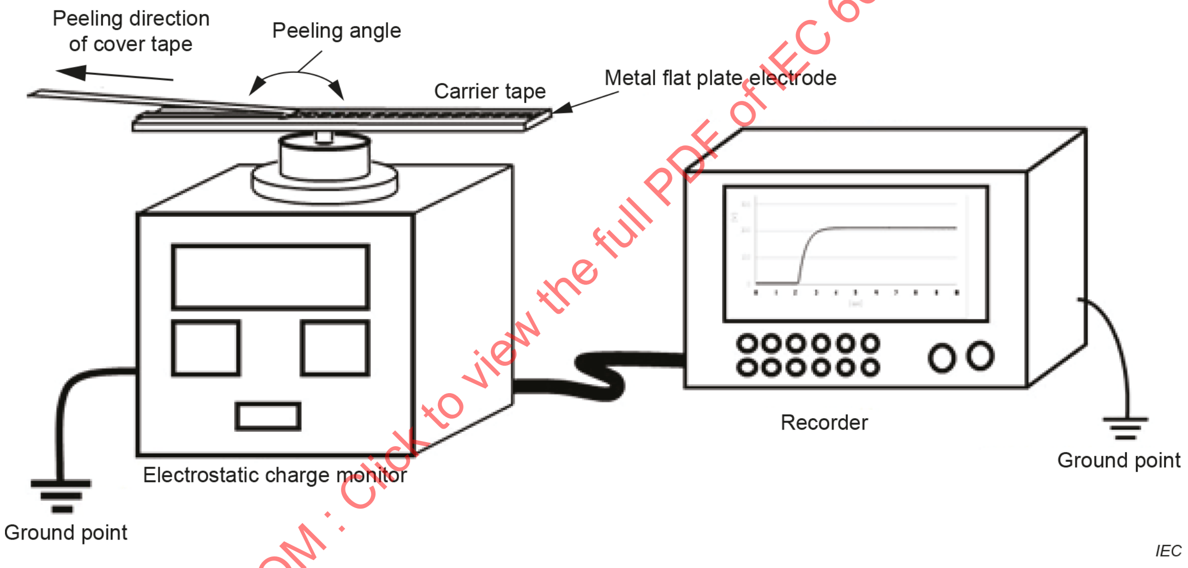


Figure B.1 – Configuration of measurement method using electrostatic potential measuring system

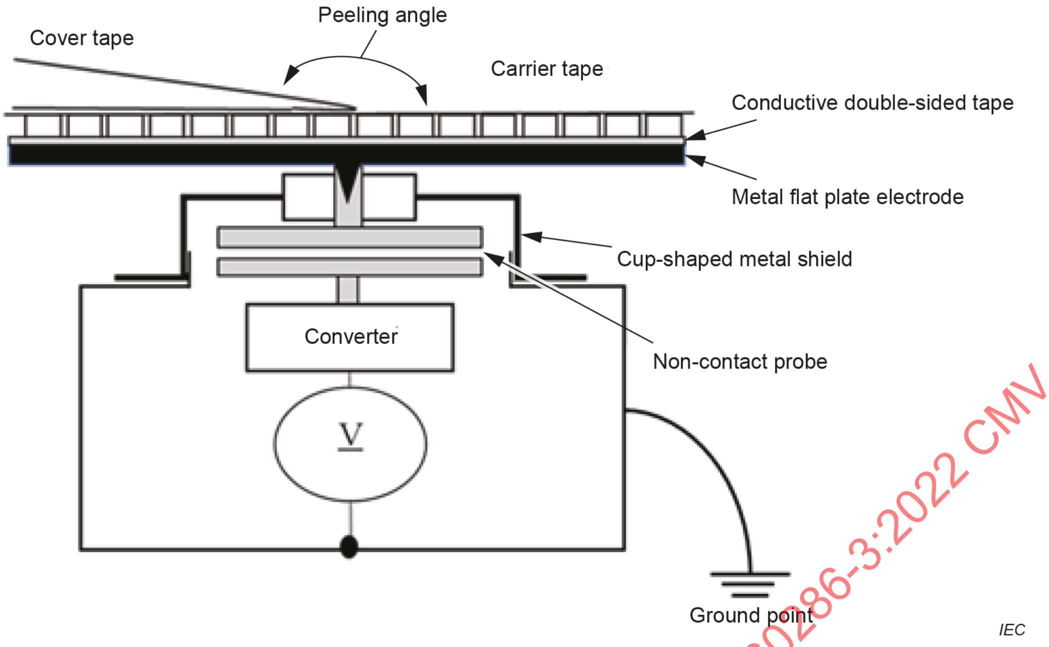
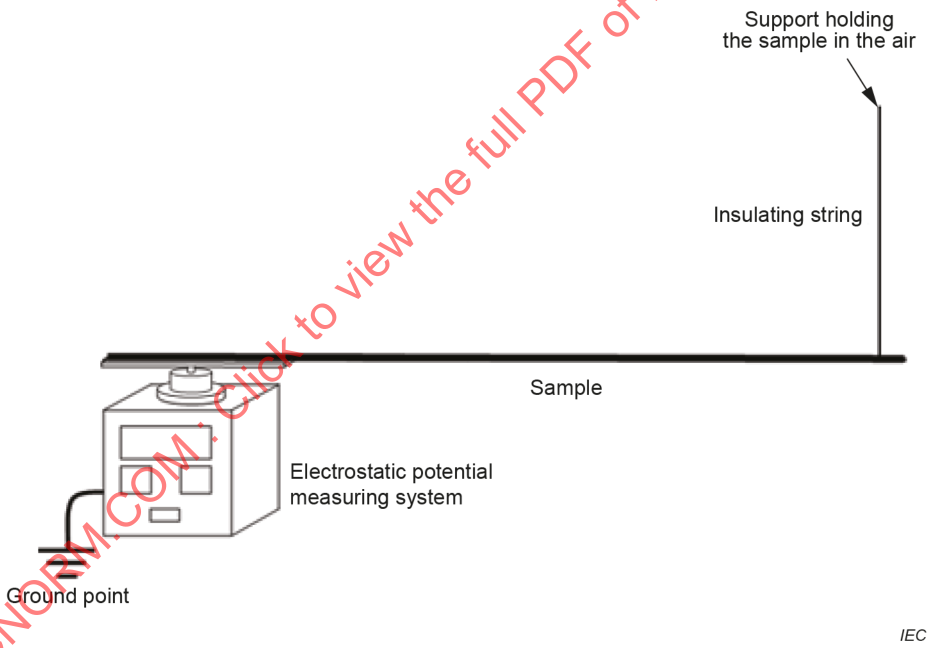


Figure B.2 – Diagram of measure electrostatic potential when peeling cover tape



NOTE Insulating string see B.2.2.11.

Figure B.3 – Configuration of electrostatic charge decay measurement method

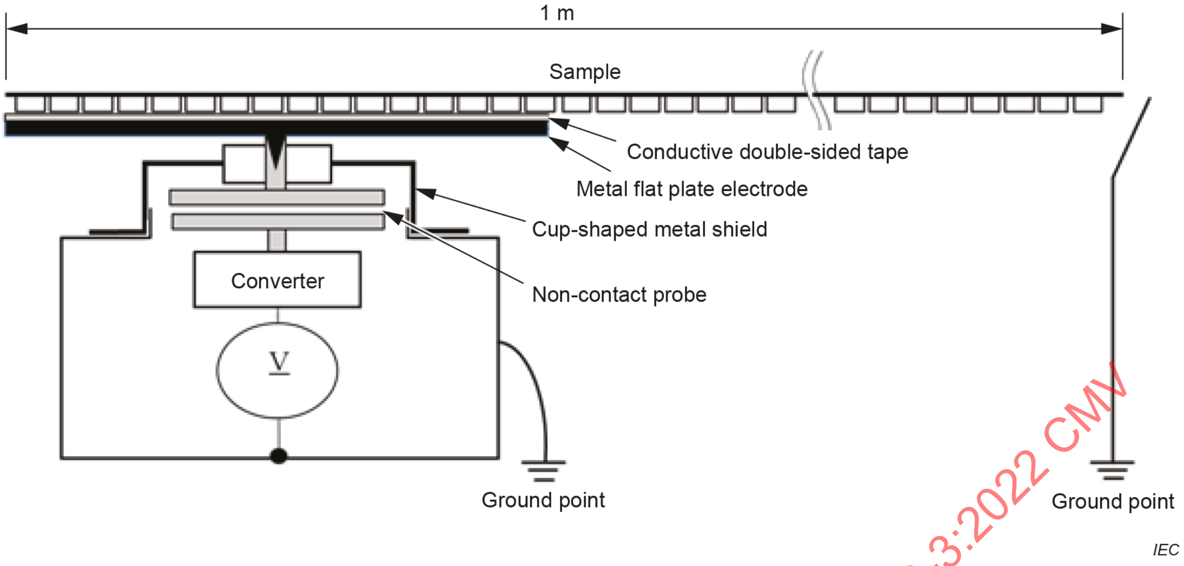


Figure B.4 – Diagram of the measurement of electrostatic charge decay performance

B.2.2 Measurement instrument and device

B.2.2.1 Electrostatic potential measurement instrument

The electrostatic potential measurement instrument used is a noncontact type which can measure electrostatic potential, satisfying the following requirements:

a) measure the electrostatic potential with the range up to ± 5 kV;
b) response time is not more than 100 ms, and preferably as fast as possible.

B.2.2.2 Wrist strap

The wrist strap shall be as specified in IEC 61340-4-6.

B.2.2.3 Metal flat plate electrode

Unless otherwise specified in a related standard, the metal flat plate electrode shall be as follows.

a) Material: stainless steel, specified in ISO 16143-1;
b) Structure: possibility to stick a conductive double-sided tape which fixes the sample at the time of measurement, and to firmly fix the non-contact probe portion of the cup-shaped metal shield without loosening;
c) Dimensions: it should be able to stick the sample and dimensions are as follows:

   length: 200 mm ± 10 mm

   width: 20 mm ± 1 mm

   thickness: 2,0 mm to 3,0 mm

B.2.2.4 Cup-shaped metal shield

The purpose of the cup-shaped metal shield is to cover the measuring portion to prevent the effect of disturbance, such as electrostatic induction.

B.2.2.5 Recording devices (data loggers, etc.)

The recording devices shall be capable of recording the time-course measurement data of the electrostatic potential specified in B.2.6 and the electrostatic discharge performance specified in B.2.7.

B.2.2.6 Ionizer

Ionizers shall comply with the provisions of IEC 61340-4-7.

B.2.2.7 Cleaning solvent

A volatile cleaning solvent shall be used to wash dust, chemicals, finger marks, etc. from the following:

a) metal flat plate electrode;
b) measuring equipment;
c) fingers of the operator, and so on.

For example: isopropyl alcohol.

B.2.2.8 Conductive double-sided tape

The conductive adhesive double-sided tape shall be made of such a material that the adhered test sample does not peel off from the metal flat plate electrode specified in B.2.3.3 while the cover tape of the test sample is peeled off. The surface resistance and volume resistance of the material shall be 100 Ω or less.

B.2.2.9 Electrostatic charger

The charger shall be capable of charging the sample above ±1 000 V to measure the electrostatic charge decay from the sample.

B.2.2.10 Insulating clip

It shall be possible to grasp the insulating clip by hand while the cover tape is peeled off the carrier tape, and the insulating clip is made of insulating material which does not release electrostatic discharge, and its surface resistance and volume resistance are 1×10^{14} Ω or more.

B.2.2.11 Insulating string

The insulating string shall be made of a material having enough strength to hold the sample in the air when measuring the leakage of electrostatic charge, and the surface resistance and the volume resistance of the material shall be 1×10^{14} Ω or more.

B.2.2.12 Crimping jig

The crimping jig shall be capable of uniformly crimping the metal flat plate electrode to the sample.

B.2.2.13 Anti-static shoes and anti-static floors

The combination of antistatic shoes and of the antistatic floor shall comply with IEC 61340-4-5.

As a result, the electrostatic potential of the human body is within ± 20 V.

B.2.2.14 Static control garments

The static control garments shall be as specified in IEC 61340-4-9 and the electrostatic potential shall be within ± 100 V, measured by a surface electrometer.

B.2.2.15 Surface electrometer

The surface electrometer shall be a non-contact type instrument capable of measuring electrostatic potential.

For example, the instrument is preferably a handheld instrument that can measure electrostatic potential in the range of ± 2 kV and has a response time of less than 100 ms.

B.2.3 Sample (test specimen)

B.2.3.1 General

The sample shall be a taped SMD with tape widths of 4 mm, 8 mm, 12 mm, and 16 mm or less, in accordance with B.2.3.2 to B.2.3.3.

The preparation of samples before measurement shall be in accordance with B.2.3.4.

B.2.3.2 Sample used for electrostatic potential measurement

The sample used for the measurement of electrostatic potential is a taped SMD:

a) the length of the carrier tape shall be 200 mm ± 10 mm, unless otherwise specified in the detail specification;

b) the length of the carrier tape is securely sealed by the cover tape, and the end of the cover tape is only about 30 mm in length, which can be gripped by an insulating clip, as shown in Figure B.5.

Dimensions in millimetres

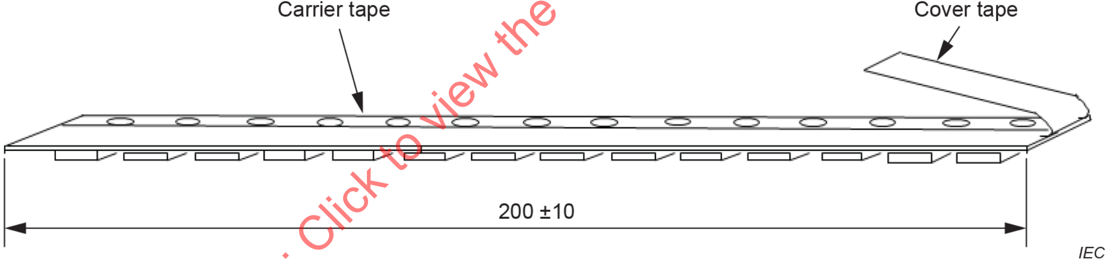


Figure B.5 – Dimensions of the sample

B.2.3.3 Test sample used to measure electrostatic charge decay performance

The length of the test sample used for the measurement of electrostatic charge decay performance shall be 1 m, unless otherwise specified in the detail specification.

B.2.3.4 Preparation of test samples before measurement

In order to improve the efficiency of measurement, the required number of samples shall be prepared before measurement and kept under the environmental conditions listed in Table B.1, in accordance with the related document.

B.2.4 Pre-treatment conditions and measurement environment conditions

The pre-treatment conditions (environmental storage conditions before measurement) and measurement environment conditions shall be in accordance with any of the conditions in Table B.1 specified in detail sepcifications. If there is any doubt about the judgment in Condition 2, the measurement shall be repeated in Condition 1.

Table B.1 – Conditions of the environment in which the samples are kept and the conditions of the measurement test environment before measurement

Condition	Pre-treatment conditions			Measurement environment conditions	
	Temperature °C	Relative humidity %	Standing time h	Temperature °C	Relative humidity %
1	23 ± 2	15 ± 3	48 or more	23 ± 2	15 ± 3
2	23 ± 2	50 ± 3	48 or more	23 ± 2	50 ± 3

NOTE According to the provisions of IEC 61340 series, the relative humidity in condition 1 is 12 %, but in this annex the relative humidity is changed from 12 % to 15 %.

B.2.5 Measurement conditions

B.2.5.1 Peeling speed

The peeling speed shall be measured in the range of 300 mm/min to 12 000 mm/min with higher speed than the peeling speed of the cover tape of the actual pick and place machine, and at the same speed every time, unless otherwise specified in the detail specification.

The peeling speed is confirmed by the rise time of electrostatic potential measurement data recorded in the recording equipment.

B.2.5.2 Peeling angle

The nominal peeling angle shall be between 165° and 180°, unless otherwise specified in the detail specification. However, in the case of a nearly horizontal angle of 180°, the peeled cover tape shall not be allowed to come into contact with measuring instruments such as the carrier tape and the electrostatic potential measuring instrument.

B.2.6 Method for measuring electrostatic potential

The electrostatic potential measurement procedure shall be as follows.

a) The measuring instruments and all samples are left in the environment before the measurement specified in B.2.4.

b) Set the electrostatic potential measurement system. Connect the measuring equipment to the ground point.

c) Turn on the power of the electrostatic potential measuring instrument specified in B.2.2.1 before starting the measurement.

d) The operator wears a wrist strap as specified in B.2.2.2 on the wrist. Connect the grounding conductor from the wrist strap securely to the ground point.

e) Clean the metal flat plate electrode specified in B.2.2.3 with the cleaning solvent specified in B.2.2.7 and dry in air for more than 5 min.

f) Fix the conductive double-sided tape specified in B.2.2.8 uniformly and firmly to the metal flat plate electrode specified in B.2.2.3.

g) Discharge the sample with the ionizer specified in B.2.2.6 by turning it on.

h) Align the end of the test piece of approximately 200 mm specified in B.2.3.2 with the end of the metal flat plate electrode and use a crimping jig specified in B.2.2.12 to fix the bottom of the test sample uniformly and firmly to the conductive double-sided tape fixed to the plate electrode as shown in Figure B.2.

i) Turn on the switch of the recording device specified in B.2.2.5. Turn off the power of the ionizer.

j) The operator shall hold the cover tape of the sample with an insulating clip, peel off the cover tape from the carrier tape under the conditions specified in B.2.5, and record the maximum value of the electrostatic potential measured by the electrostatic potential measuring instrument. The time transition waveform of the electrostatic potential displayed on the recording device is also recorded.

k) If multiple samples are measured, procedures e) to j) are repeated. The sample size is 3 or more.

l) After completion of all measurements, turn off all power switches.

B.2.7 Method for measuring the electrostatic charge decay performance

The measurement procedure of the electrostatic charge decay performance shall be as follows.

a) The measuring instruments and all samples are kept in the environment specified in B.2.4 before measurement.

b) Set the electrostatic potential measurement system. Connect the measuring equipment to the ground point.

c) Turn on the power of the electrostatic potential measuring instrument specified in B.2.2.1 before starting measurement.

d) The operator uses a wrist strap as specified in B.2.2.2 on the wrist. Connect the grounding conductor from the wrist strap securely to the ground point.

e) Clean the metal flat plate electrode specified in B.2.2.3 with the cleaning solvent specified in B.2.2.7 and dry it for more than 5 min.

f) Fix the conductive double-sided tape specified in B.2.2.8 uniformly and firmly to the metal flat plate electrode specified in B.2.2.3.

g) Discharge the sample with the ionizer specified in B.2.2.6 by turning it on.

h) Align the end of the 1 m test piece specified in B.2.2.3 with the end of the metal flat plate electrode as shown in Figure B.4, and fix the test sample uniformly and firmly to a conductive double-sided tape fixed to the plate electrode using a crimping jig specified in B.2.2.12. At this time, as shown in Figure B.3, the part protruding from the metal flat plate electrode is suspended from the top with an insulator, for example insulated string. specified in B.2.2.11, and to confirm the sample is insulated from the ground point (measuring instruments, walls, floors, etc.).

i) Turn on the power of the recording device specified in B.2.2.5. Turn off the power of the ionizer.

j) The operator shall charge the sample to more than 1 000 V with the electrostatic charger specified in B.2.2.9. The position to be charged is the part where the test sample is fixed to the metal flat plate electrode. After charging to more than 1 000 V, release the charger. Then connect the opposite end of the sample to the ground point, read and record the time taken for the electrostatic potential to decay from 1 000 V to 100 V, from the data shown on the equipment. The waveform displayed on the recording device shall also be recorded. Make measurements for both the positive and the negative charging conditions of the electrostatic charger.

k) If multiple samples are measured, procedures e) to j) are repeated. The sample size is 3 or more.

l) After completion of all measurements, turn off all power switches.

B.3 Items to be described in the test report and items to be specified in the related standards

B.3.1 Items to be described in the test report

The items described in the electrostatic potential and charge decay performance test score sheet should be shown as follows.

a) General:
   Test measurement date:
   Test measurement place:
   Measuring instrument name:
   Manufacturer:
   Model:
   Serial No:
   Calibration date:
   Name of measurer:
b) Description and identification of the sample material:
   1) Carrier Tape:
      Manufacturer Name:
      Name Model Number:
      Colour:
      Manufacture Date:
      Lot Number:
   2) Cover tape:
      Manufacturer name:
      Name model number:
      Colour:
      Manufacture date:
      Lot number:
   3) Bonding method of carrier tape and cover tape:
      Sealing machine:
      Setting conditions:
   4) Peeling strength between carrier tape and cover tape:
      Peeling strength measuring instrument:
      Peeling strength: N
   5) Presence or absence of surface mount components (SMD) in the sample:
      SMD item name (With or without):
      Dimension:
      Lot number:
c) Pre-treatment and test environment:
   1) Measurement condition:
      Temperature: °C;
      Humidity: %;
      Test time: h, min or s.
   2) Environment before measurement:
      Temperature: °C;
      Humidity: %;
   3) Standing time:
      From YYYY/MM/DD/TIME to YYYY/MM/DD/TIME, and total time

4) Measurement environment:

Temperature: °C;

Humidity: %;

5) Notes on the standing and measuring environment:

6) Use detergent and standing time after washing:

d) Installation environment of measuring equipment and the status of measures against electrostatic of workers:

1) Instrument grounding and capacitance: Ω, pF;

Ionizer grounding status: Ω;

2) Antistatic status of work bench;

Existence of measures and ESD protection

3) Floor anti-static condition of measurement work place;

4) Combination of anti-static shoes and floor: V (at ground level)* Without wrist strap;

5) Electrostatic potential when wearing the wrist strap of the worker: V (at ground level);

6) Worker's clothes Surface potential: V.

e) Electrostatic measurement test conditions:

1) Retraction speed;

2) Retracting angle;

3) Sample length: m, support material name: insulation resistance value: Ω;

4) Sample number n (minimum 3): .

f) Electrostatic potential and electrostatic charge decay performance results

The measurement chart is attached.

1) Electrostatic potential measurement result:

Maximum electrostatic potential: V, V, V;

Average electrostatic potential: V.

2) Electrostatic charge decay performance measurement results:

The time for the electrostatic potential to decay from 1 000 V to 100 V: s, s, s;

Average value: s.

B.3.2 Items specified in related standards

The matters specified in the relevant standards are as follows:

a) Pre-processing and measurement environment;

b) Measurement conditions (peeling speed and peeling angle);

c) Length of the sample used to measure electrostatic potential or to measure electrostatic charge decay performance;

d) Sample size.

Bibliography

IEC 60068-1, *Environmental testing – Part 1: General and guidance*

IEC 60068-2-45, *Basic environmental testing procedure – Part 2-45: Tests – Test XA and guidance: Immersion in cleaning solvents*

IEC 61340 (all parts), *Electrostatics*

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

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

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

ISO/IEC 16388, *Information technology – Automatic identification and data capture techniques – Code 39 bar code symbology specification*

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

ISO 16143-1:2004*, Stainless steels for general purposes – Part 1: Flat products*

JIS C 0806-301:2020*, Packaging of components for automatic handling – Part 301:Measuring methods of electrostatic potential and charge decay performance while cover tape is peeled off from carrier of SMD taping*

G. Gutman, S. Yau, R. Goetz, S. Koehn and D. Swenson, *A new Technology in Low Tribocharging Adhesives,* EOS/ESD Symposium, 1994, pages 230-236

ESDA ESD ADV 11.2 1995, *(ESDA: Electro Statics Discharge Association) Advisory For the Protection of Electrostatic Discharge Susceptible Items – Triboelectric Charge Accumulation Testing*

List of comments

1 Test methods for electrostatic properties of the package material are added, as they are essential for packing of electrostatically sensitive devices.

2 The currently smallest available component size is added. Pocket dimensions, tolerances and requirements are set to enable smooth automatic handling of the components.

3 This is added for better understanding of the requirement T (= K_0) in Figure 2.

4 This is an important additional requirement for prevention of pick-up errors and machine stops.

Sticking can be caused by various factors, like electrostatic charge, sticky residues, pocket deformations, etc.

5 This is one of the most important addition to the previous edition. An alternative method to determine electrostatic effects due to handling of the tape is described in Annex B, e.g. when the cover tape is peeled off before automatic pick and place operation. The current standards in the IEC 61340 series do not provide methods to determine such effects.

6 The newly added Annex B is one of the most important changes to the previous edition. An alternative method to determine electrostatic effects due to handling of the tape is described in Annex B, e.g. when the cover tape is peeled off before automatic pick and place operation. The current standards in the IEC 61340 series do not provide methods to determine such effects. See also IEC TR 61340-5-5:2018, Clause 10 for further information.

IEC 60286-3

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INTERNATIONAL STANDARD

NORME INTERNATIONALE

colour inside

Packaging of components for automatic handling – Part 3: Packaging of surface mount components on continuous tapes

Emballage de composants pour opérations automatisées – Partie 3: Emballage des composants pour montage en surface en bandes continues

CONTENTS

INTERNATIONAL ELECTROTECHNICAL COMMISSION

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PACKAGING OF COMPONENTS FOR AUTOMATIC HANDLING –

Part 3: Packaging of surface mount components on continuous tapes

FOREWORD

1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of 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, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). 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. 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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IEC 60286-3 has been prepared by IEC technical committee 40: Capacitors and resistors for electronic equipment. It is an International Standard.

This seventh edition cancels and replaces the sixth edition published in 2019. This edition constitutes a technical revision.

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

a) addition terms and definitions.
b) addition of a table of the classification to symbols concerning drive hole diameter and distance between the reel hole centre and the drive hole centre;
c) addition of drive hole to the reel (optional);
d) revision of reel hole diameter tolerances;
e) revision of 72 mm tape size carrier tape width dimension tolerances;

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f) addition of Annex B (informative);

g) addition of component size 0201M.

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

Draft	Report on voting
40/2972/FDIS	40/2984/RVD

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

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

A list of all parts in the IEC 60268 series, published under the general title *Packaging of components for automatic handling*, can be found on the IEC website.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/publications.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under webstore.iec.ch in the data related to the specific document. At this date, the document will be

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

IMPORTANT – The "colour inside" logo on the cover page of this document indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

INTRODUCTION

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

PACKAGING OF COMPONENTS FOR AUTOMATIC HANDLING –

Part 3: Packaging of surface mount components on continuous tapes

1 Scope

This part of IEC 60286 is applicable to the tape packaging of electronic components without leads or with lead stumps, 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 document also includes requirements related to the packaging of singulated die products including bare die and bumped die (flip chips).

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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, *Mechanical standardization of semiconductor devices – Part 2: Dimensions*

IEC 61340-4-5, *Electrostatics – Part 4-5: Standard test methods for specific applications – Methods for characterizing the electrostatic protection of footwear and flooring in combination with a person*

IEC 61340-4-6, *Electrostatics – Part 4-6: Standard test methods for specific applications – Wrist straps*

IEC 61340-4-7, *Electrostatics – Part 4-7: Standard test methods for specific applications – Ionization*

IEC 61340-4-9, *Electrostatics – Part 4-9: Standard test methods for specific applications – Garments*

3 Terms, definitions and symbols

3.1 Terms and definitions

For the purposes of this document, the following terms and definitions apply. Definitions apply to all tape types, unless specifically mentioned.

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

- IEC Electropedia: available at https://www.electropedia.org/
- ISO Online browsing platform: available at https://www.iso.org/obp

3.1.1
component

electronic part of a product that cannot be physically divided into smaller parts without losing its particular function

Note 1 to entry: This includes singulated die product.

Note 2 to entry: This is applied to all packaging-types for bare die products unless specifically mentioned otherwise.

3.1.2
component size

size of component that is identified with its metric size code

Note 1 to entry: This size code is followed by a capital M.

Note 2 to entry: To avoid possible confusion with inch-based size codes, an equivalency table is shown in Table 1.

Table 1 – Component size codes

Metric size code	Inch size code
0201M	008004
0402M	01005
0603M	0201
1005M	0402
1608M	0603
2012M	0805

3.1.3
packaging

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

3.1.4
pressed carrier tape

<type 1b> carrier tape with concave cavities formed by compression of the base material

3.1.5
fluff

<type 1b> fibre from the base material attached inside the cavity

Note 1 to entry: See Figure 1.

3.1.6
burr

<type 1b> surface projection of tape unintentionally produced when cavity is formed

Note 1 to entry: See Figure 1.

3.1.7
deformation

<type 1b> bulge on the inner wall of the cavity

Note 1 to entry: See Figure 1.

3.1.8
puff

<type 1b> bulge on the reverse side of the cavity

Note 1 to entry: See Figure 1.

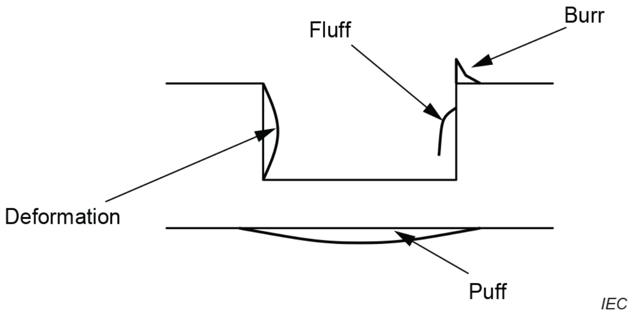


Figure 1 – Sectional view of component cavity (type 1b)

3.1.9
blister carrier tape
embossed carrier tape

carrier tape which is identified as tape belonging to type 2a, type 2b and type3

3.1.10
punched carrier tape

<type 1a> carrier tape on which the concave cavities are formed by punching a hole on the base material and covering up the bottom by the cover tape

3.2 Symbols

The symbols used in this document are listed in Table 2.

Table 2 – Classification to symbols concerning tape, reel and common symbols

Symbols	Definitions	Figure references
A	Reel diameter	26
A_0	Cavity's bottom dimension in direction of unreeling	2, 4, 5, 7, 8, 10, 11, 13, 14, 16, 20 and A.2
B	Reel hole key's groove width	27
B_0	Cavity's bottom dimension in direction of tape width	2, 4, 5, 7, 8, 10, 11, 13, 14, 16, 20 and A.2
B_1	Cavity's rim in direction of tape width	8, 11 and 14
C	Reel hole diameter	26 and 27
C_T	Distance of puff under cavity in direction of tape width	5
d	Difference of diameter between sprocket hole and round foramen	14
D	Reel slot diameter	27
D_0	Sprocket hole diameter	2, 5, 8, 11, 14 and 17
D_1	Cavity's bottom hole diameter	8 and 14
D_{DH}	Drive hole diameter	28
E_1	Shorter distance in direction of width between the origin point of round sprocket hole and the edge of a side of tape	2, 5, 8, 11, 14 and 17

Symbols	Definitions	Figure references
E_2	Longer distance in direction of width between the origin point of round sprocket hole and the edge of a side of tape	2, 5, 8 and 11
F	Distance in direction of width between the origin point of round sprocket hole and the centre of cavity	2, 5, 8, 11 and 14
F_A	Distance in direction of width between the origin point of round sprocket hole and the centre of compartment	17, 19, 24 and 25
G	Shorter distance in direction of width between the cavity and the edge of a side of tape	2, 5, 8, 11 and 17
K_0	Cavity depth	2, 5, 8 ,11, 14 and A.3
M	Distance between the reel hole centre and the drive hole centre	28
N	Hub diameter	26
P_0	Pitch of the sprocket holes	2, 3, 5, 6, 8, 9, 11, 14 and 17
P_1	Cavity pitch	2, 3, 5, 6, 8, 9, 11, 14, 17 and 18
P_2	Pitch between the centre of a cavity on the same line with the origin point of round sprocket hole and the centre of the next cavity in direction of unreeling	2, 3, 5, 6, 8, 9, 11 and 14
$P_{2\mathrm{A}}$	Pitch between the centre line of the origin point of round sprocket hole and the centre line of compartment in direction of unreeling	17, 18, 19, 24 and 25
P_3	Pitch between the centre of a cavity on the same line with the origin point of round sprocket hole and the centre of the second next cavity in direction of unreeling	3 and 6
P_4	Pitch between the centre of a cavity on the same line with the origin point of round sprocket hole and the centre of the third next cavity in direction of unreeling	3 and 6
S	Sprocket hole pitch in direction of width	14
R	Bending radius of carrier tape	21
r	Curvature radius of reel hole key's groove	27
T	Carrier tape thickness without cover tape	2, 5, 8, 11, 14, 17, 25 and A.1
T_1	Top cover tape thickness	2, 5, 8, 11 and 14
T_2	Sum of outer cavity height and top cover tape thickness	8, 11 and 14
T_3	Thickenss of pressed carrier tape including bulge	5 and A.1
T_4	Bottom cover tape thickness or Adhesive tape thickness	2 and 17
V_1	Compartment dimension in direcion of unreeling	17 and 18
V_2	Compartment dimension in direction of width	17 and 18
W	Carrier tape width	2, 5, 8, 11, 14 and 17
W_P	Distance between adhesive tapes	17
W_1	Reel inner width (measured at hub)	26
W_2	Reel overall width	26
W_3	Reel inner width in the rim	26
Z	Component thickness	25

4 Structure of the specification

The various types of tapes are as follows.

Type 1 – Punched and pressed carrier tape

- **Type 1a:** Punched carrier tape, with top and bottom cover tape (tape widths: 8 mm and 12 mm)
- **Type 1b:** Pressed carrier tape, with top cover tape (tape width: 8 mm)

Type 2 – Blister carrier tape, with single round sprocket holes

- **Type 2a:** Blister carrier tape, with single round sprocket holes, with top cover tape and tape pitches down to 2 mm (tape widths: 8 mm, 12 mm, 16 mm and 24 mm)
- **Type 2b:** Blister carrier tape, with single round sprocket holes, with top cover tape and with 1mm tape pitch (tape widths: 4 mm)

Type 3 – Blister carrier tape, with double sprocket holes (tape widths: 32 mm to 200 mm)

Type 4 – Adhesive-backed punched plastic carrier tape for singulated bare die and other surface mount components (tape widths: 8 mm, 12 mm, 16 mm, and 24 mm)

5 Dimensional requirements for taping

5.1 Component cavity positioning requirements

5.1.1 Requirements for type 1a, type 1b, type 2a, type 2b and type 3

For defined component positioning, the cavity shall be defined to an origin point. The origin is the centre of the round sprocket hole, defined by the crosshair of the dimension E_1 and dimension P_0. The centre of the compartment shall be defined by P_2 and F, relative to the round sprocket hole (see Figure 2, Figure 5, Figure 8, Figure 11 and Figure 14). When dimension P_1 is smaller or equal to 2 mm, the maximum allowed pocket offset, relative to the centre of the round sprocket hole, shall be applied (see Figure 3, Figure 6, Figure 9 and Figure 12).

5.1.2 Requirements for type 4

For defined component positioning, the component placement and location shall be defined to an origin. The origin is the centre of the sprocket hole, defined by the crosshair of the dimension E_1 and dimension P_0. The centre of the component location shall be defined by $P_{2\text{A}}$ and F_A, relative to the sprocket hole (see Figure 17). Type 4 does not have cavities that are used to position components. Therefore, all position measurements should be made according to the principle defined here and not to the compartments or 'pockets', which are virtual boundaries for component protection only. The term 'pocket offset' does not apply to type 4. The following applies to type 4:

a) rotation and lateral movement of the component is defined by the accuracy to which it has been placed in the compartment, with reference to the target;

b) the component shall not protrude above the top surface of the carrier tape (see Figure 25a);

c) the components shall not change their orientation within the tape;

d) the component shall be able to be removed from the cavity or compartment in a vertical direction, without mechanical restriction.

5.2 Component cavity dimension requirements (type 1a, type 1b, type 2a, type 2b and type 3)

The size of the component cavity, including applicable tolerances, is governed by the dimensions of the component for which the packaging applies, to ensure that the component is adequately protected and that tilt, rotation and lateral movement of the component complies with the requirements detailed for each type of tape. The following applies to type 1a, type 1b, type 2a, type 2b and type 3:

a) dimension A_0 ≤ dimension B_0, unless otherwise specified in the component detail specification;

b) maximum and minimum dimensions of the component shall be taken from the component detail specification;

c) the component shall not protrude above the top surface of the carrier tape, except for type 1a where the component shall not protrude beyond either surface of the carrier tape;

d) the components shall not change their orientation within the tape;

e) the component shall be able to be removed from the cavity or compartment in a vertical direction, without mechanical restriction, after the top cover has been removed, where a cover tape is used.

f) Unless otherwise defined in the detail specification, for punched carrier tapes, K_0 shall be equivalent to T. For pressed and embossed tapes K_0 shall be defined in each detail specification.

5.3 Type 1a – Punched carrier tape, with top and bottom cover tape (tape widths: 8 mm and 12 mm)

For respective dimensional codes, see Figure 2 to Figure 4 and Table 3 to Table 5.

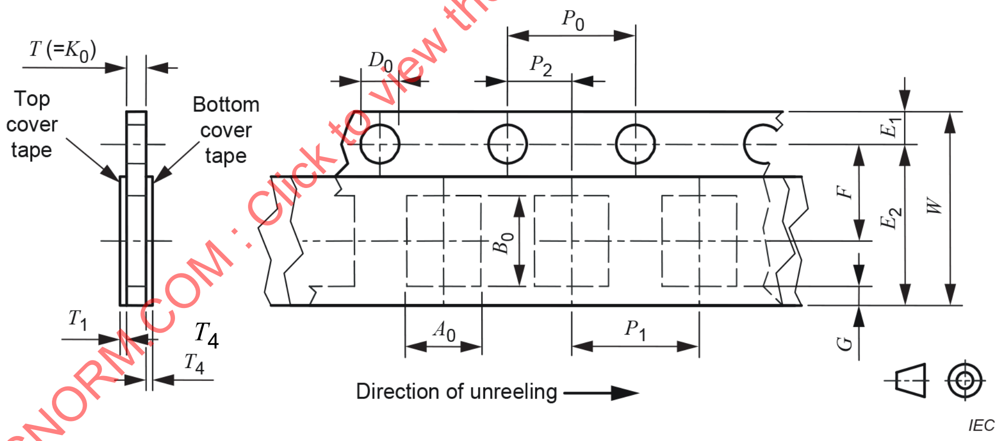
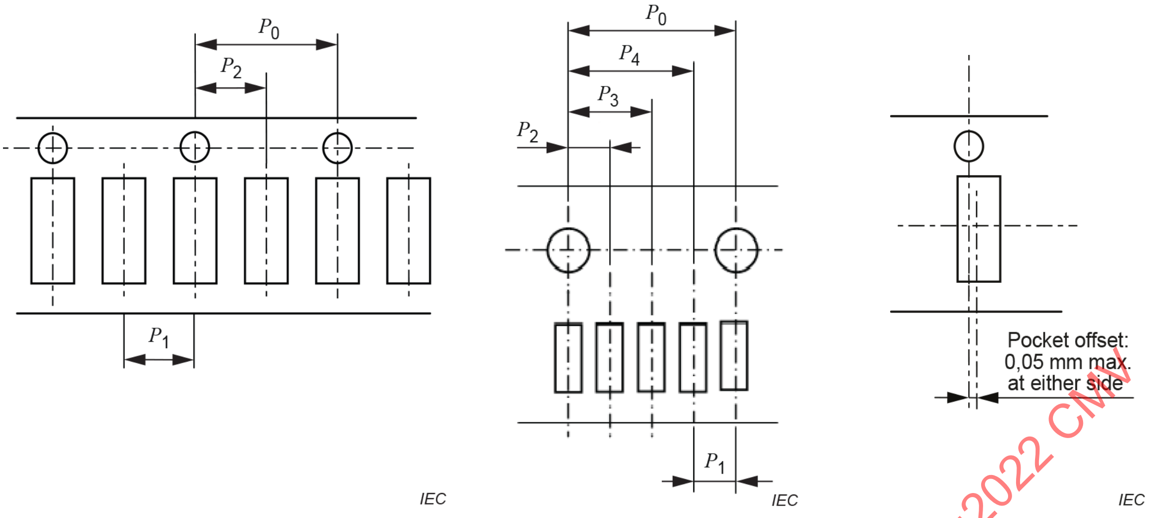
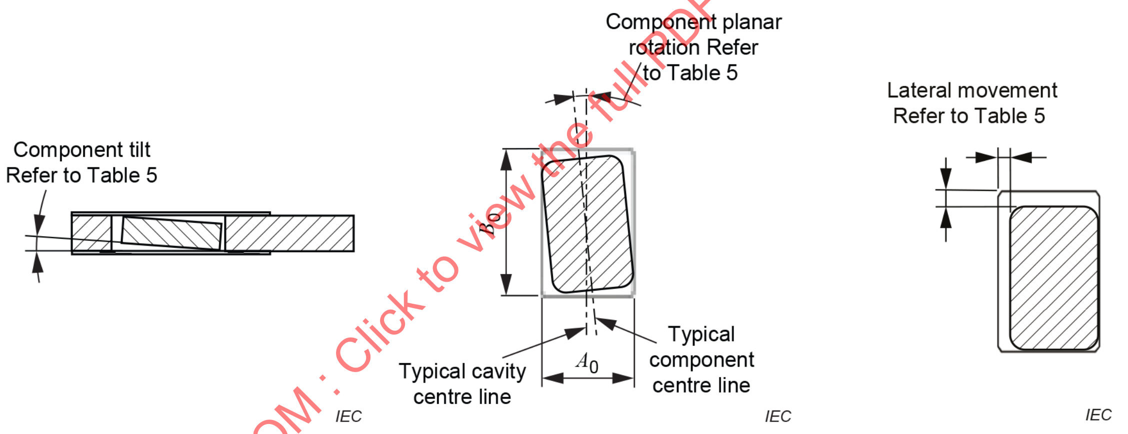


Figure 2 – 8 mm and 12 mm punched carrier-tape dimensions (4 mm cavity pitch)



a) 2 mm cavity pitch b) 1 mm cavity pitch c) Pocket offset

Figure 3 – Illustration of 2 mm and 1 mm cavity pitch and maximum pocket offset



a) Sketch A
Component tilt
Side view

b) Sketch B
Component planar rotation
Top view

c) Sketch C
Lateral movement
Top view

Figure 4 – Maximum component tilt, rotation and lateral movement

Table 3 – Constant dimensions of 8 mm and 12 mm punched carrier tape

Dimensions in millimetres

Tape size	D_0	E_1	P_0	G min.	T max.	T_1 max.	T_4 max.	P_0 **pitch cumulative tolerance**
8 and 12	$1,5^{+0,1}_{0}$	1,75 ± 0,1	4,0 ± 0,1 (P_1 ≥ 4)	0,75	1,1 paper[a]	0,1	0,1	± 0,2 / 10 pitches
			4,0 ± 0,05 (P_1 = 2, P_1 = 1)		1,6 non-paper			

For respective dimensional codes, see Figure 2.

[a] The paper is the material of the punched carrier tape.

Table 4 – Variable dimensions of 8 mm and 12 mm punched carrier tape

Dimensions in millimetres

Tape size	E_2 min.	F	P_1	P_2	P_3	P_4	W	A_0, B_0, **and** K_0
8	6,25	3,5 ± 0,05	1,0 ± 0,05 (P_1 = 1)	1,0 ± 0,05 (P_1 = 1)	2,0 ± 0,05 (P_1 = 1)	3,0 ± 0,05 (P_1 = 1)	$8,0^{+0,3}_{-0,1}$	See 5.2
			2,0 ± 0,05 (P_1 = 2)	2,0 ± 0,05 (P_1 = 2)				
			4,0 ± 0,1 (P_1 = 4)	2,0 ± 0,05 (P_1 = 4)				
12	10,25	5,5 ± 0,05	2,0 ± 0,05 (P_1 = 2)	2,0 ± 0,05	–	–	$12,0^{+0,3}_{-0,1}$	
			4,0 ± 0,1 (P_1 ≥ 4)					

For respective dimensional codes, see Figure 2 to Figure 4.

Table 5 – Component tilt, planar rotation and lateral movement

Tape size mm	**Component tilt (design value)** [a]	**Component planar rotation (design value)** [a]	**Lateral movement** mm
8 and 12	10° maximum	20° maximum	0,3 maximum (P_1 = 1, P_1 = 2)
			0,5 maximum ($P_1 \geq 4$)

For respective dimensional codes, see Figure 4.

The trend for allowed component planar rotation of components with either length or width less than 1,2 mm is 10° maximum.

For components with either length or width dimensions of less than 1,2 mm, market trends are towards a lateral movement of 0,2 mm maximum.

When handling bare die products in tape size 8 mm, the lateral movement of 0,1 mm maximum for either cavity dimension should be allowed.

When handling bare die products in tape size 12 mm, the lateral movement of 0,15 mm maximum for either cavity dimension should be allowed.

[a] A design value is a calculated value for design purposes only. For example, component tilt is not intended to be measured, but is intended to be the calculated value for the pocket design of a carrier tape.

5.4 Type 1b – Pressed carrier tape, with top cover tape (tape width: 8 mm)

For respective dimensional codes, see Figure 5 to Figure 7 and Table 6 to Table 8.

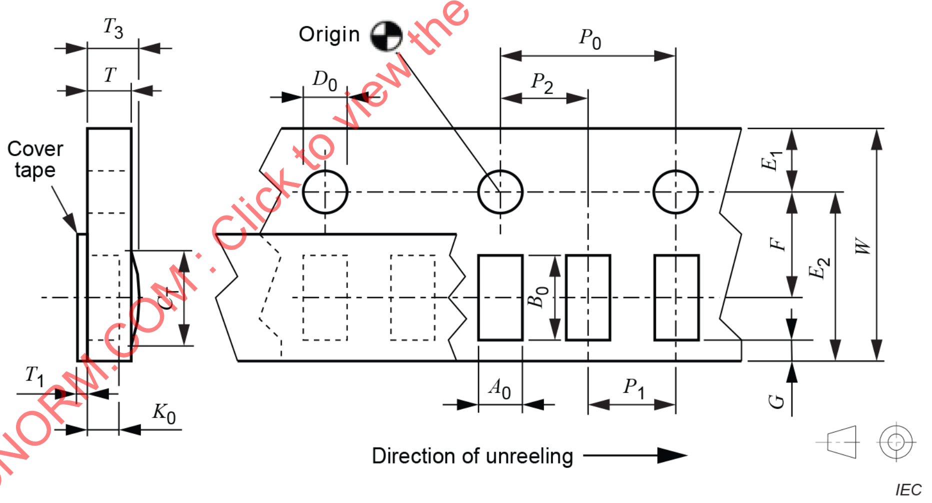
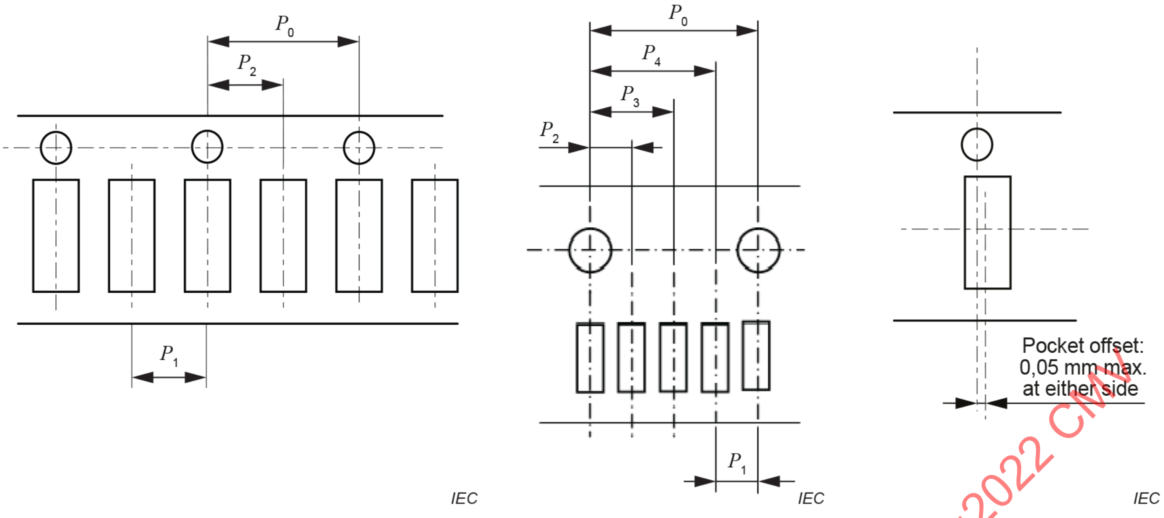
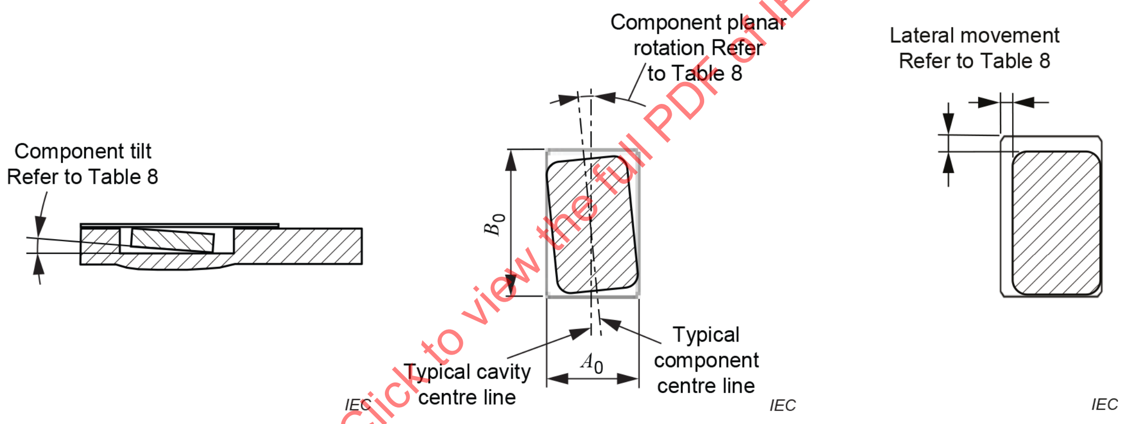


Figure 5 – Dimensions (P_0 = 4 mm/P_1 = 2 mm) and (P_0 = 4 mm/P_1 = 1 mm)



a) **2 mm cavity pitch** b) **1 mm cavity pitch** c) **Pocket offset**

Figure 6 – Illustration of 2 mm and 1 mm cavity pitch and maximum pocket offset



a) **Sketch D**
Component tilt
Side or front sectional view

b) **Sketch E**
Component planar rotation
Top view

c) **Sketch F**
Lateral movement
Top view

Figure 7 – Maximum component tilt, rotation and lateral movement

Table 6 – Constant dimensions of 8 mm pressed carrier tape

Dimensions in millimetres

Tape size	D_0 [a]	E_1	G min.	P_0	T max.	T_1 max.	T_3-T [b] max.	**P_0 pitch cumulative tolerance**
8	$1{,}5^{+0{,}1}_{0}$	1,75 ± 0,1	0,75	4,0 ± 0,1	1,1	0,1	0,1	± 0,1 / 10 pitches

For respective dimensional codes, see Figure 5 and Figure 6.

[a] If positioning precision is required, for example when components ≤ size 1005M are mounted in a narrow space, then the tolerance on D_0 should be +0,05 / −0,00 mm.

[b] For components with size designation of 1005M or smaller, the puff (T_3 − T) should be limited to 0,05 mm maximum.

Table 7 – Variable dimensions of 8 mm pressed carrier tape

Dimensions in millimetres

Tape size	C_T max.	E_2 min.	F	P_1	P_2	P_3	P_4	W	A_0, B_0 and K_0
8	4,35	6,25	3,5 ± 0,05	1,0 ± 0,05 (P_1 = 1)	1,0 ± 0,05 (P_1 = 1)	2,0 ± 0,05 (P_1 = 1)	3,0 ± 0,05 (P_1 = 1)	$8{,}0^{+0{,}3}_{-0{,}1}$	See 5.2
				2,0 ± 0,05 (P_1 = 2)	2,0 ± 0,05 (P_1 = 2)				
				4,0 ± 0,1 (P_1 = 4)	2,0 ± 0,05 (P_1 = 4)				
For respective dimensional codes, see Figure 5 to Figure 7.									

Table 8 – Component tilt, planar rotation and lateral movement

Tape size mm	**Component tilt (design value)** [a]	**Component planar rotation (design value)** [a]	**Lateral movement** mm
8	20° maximum	20° maximum	0,12 maximum (Component size ≤ 0603M)
			0,20 maximum (Component size 1005M)
			0,30 maximum (Component size ≥ 1608M)
For respective illustration, see Figure 7.			

[a] A design value is a calculated value for design purposes only. For example, component tilt is not intended to be measured, but is intended to be the calculated value for the pocket design of a carrier tape.

5.5 Type 2a – Blister carrier tape, with single round sprocket holes and tape pitches down to 2 mm (tape widths: 8 mm, 12 mm, 16 mm and 24 mm)

For respective dimensional codes, see Figure 8 to Figure 10 and Table 9 to Table 11.

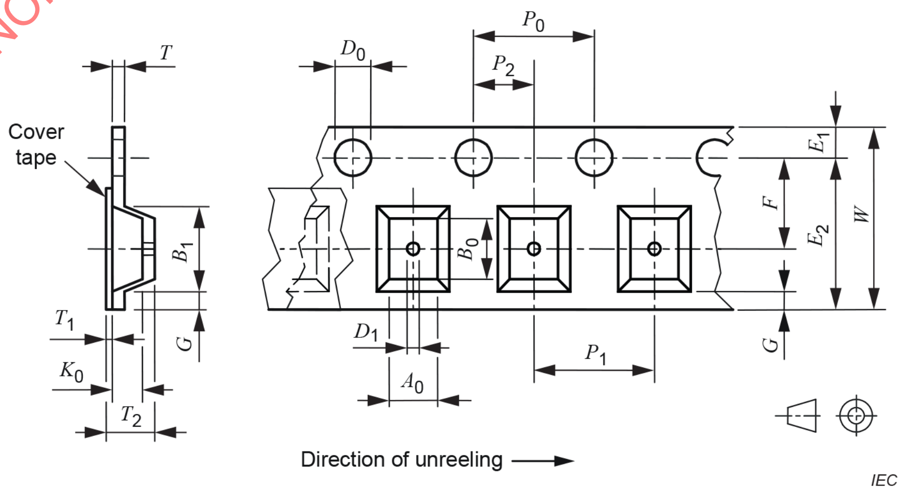
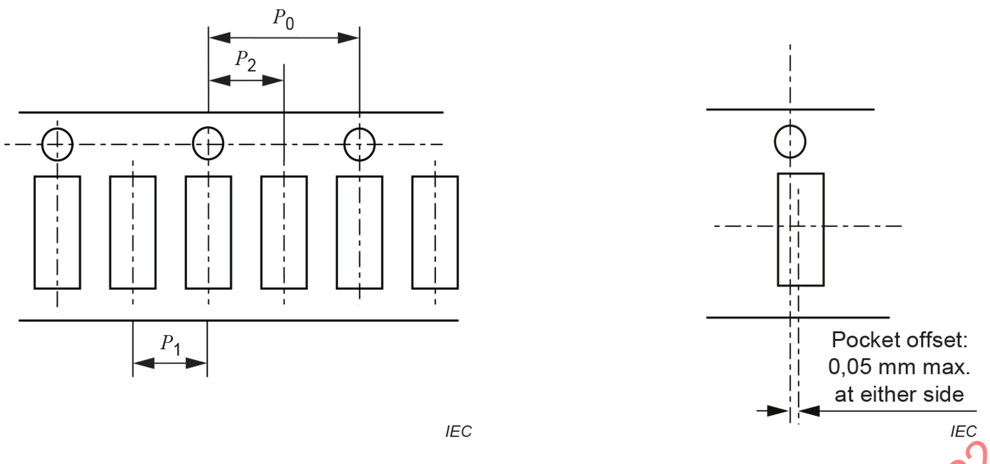
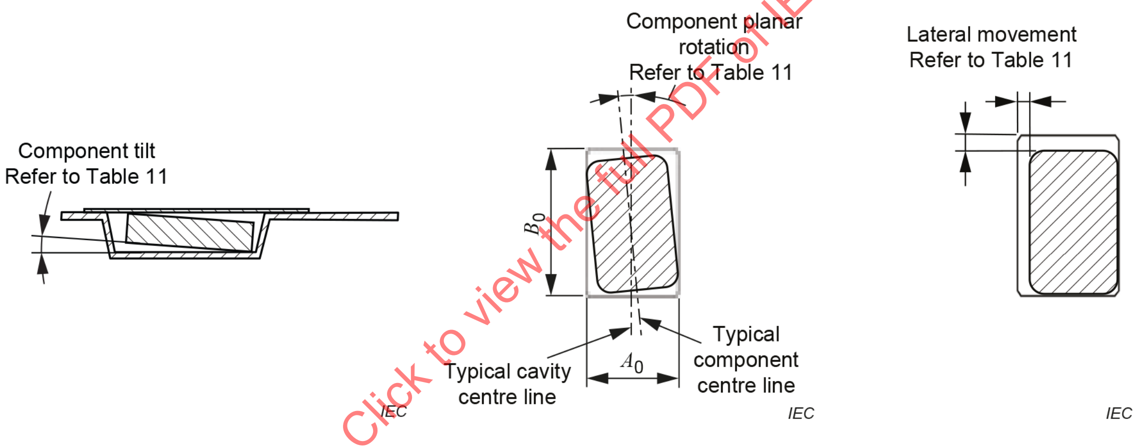


Figure 8 – Blister carrier tape dimensions (8 mm, 12 mm, 16 mm and 24 mm)



a) 2 mm cavity pitch **b) Pocket offset**

Figure 9 – Illustration of 2 mm cavity pitch and pocket offset



a) Sketch G
Component tilt
Side or front sectional view

b) Sketch H
Component planar rotation
Top view

c) Sketch I
Lateral movement
Top view

Figure 10 – Maximum component tilt, rotation and lateral movement

Table 9 – Constant dimensions of 8 mm to 24 mm blister carrier tape

Dimensions in millimetres

Tape size	D_0	E_1	G	P_0	T	T_1	P_0 pitch cumulative tolerance
			min.		max.	max.	
8 to 24	$1,5^{+0,1}_{0}$	1,75 ± 0,1	0,75	4,0 ± 0,1 (P_1 ≥ 4) 4,0 ± 0,05 (P_1 = 2)	0,6	0,1	±0,2 / 10 pitches
For respective dimensional codes, see Figure 8 and Figure 9.							

Table 10 – Variable dimensions of 8 mm to 24 mm blister carrier tape

Dimensions in millimetres

Tape size	B_1 max.	D_1 [a] min.	E_2 min.	F	P_1	P_2	T_2 max.	W	A_0, B_0 and K_0
8	4,35	0,3	6,25	3,5 ± 0,05	2,0 ± 0,05 4,0 ± 0,1	2,0 ± 0,05	3,5	$8{,}0^{+0{,}3}_{-0{,}1}$	See 5.2
12	8,2	1,5	10,25	5,5 ± 0,05	2,0 ± 0,05 4,0 ± 0,1 to 12,0 ± 0,1 in 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 16,0 ± 0,1 in 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 24,0 ± 0,1 in 4,0 increments	2,0 ± 0,1	12,5	$24{,}0^{+0{,}3}_{-0{,}1}$	

For respective dimensional codes, see Figure 8 to Figure 10.

[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.

Table 11 – Component tilt, rotation and lateral movement

Tape size mm	Component tilt (design value) [a]	Component planar rotation (design value) [a]	Lateral movement mm
8 and 12	10° maximum	20° maximum	0,5 maximum
16 and 24	10° maximum	10° maximum	0,5 maximum

For respective illustration, see Figure 10.

The trend for allowed component planar rotation of components with either length or width less than 1,2 mm is 10° maximum.

For components with either length or width dimensions of less than 1,2 mm, market trends are towards a lateral movement of 0,2 mm maximum.

When handling bare die products in tape size 8 mm, the lateral movement of 0,1 mm maximum for either cavity dimension should be allowed.

When handling bare die products in tape size 12 mm, the lateral movement of 0,15 mm maximum for either cavity dimension should be allowed.

[a] A design value is a calculated value for design purposes only. For example, component tilt is not intended to be measured, but is intended to be the calculated value for the pocket design of a carrier tape.

5.6 Type 2b – Blister carrier tape, with single round sprocket holes and with 1mm tape pitch (tape widths: 4 mm)

For respective dimensional codes, see Figure 11 to Figure 13 and Table 12 to Table 14.

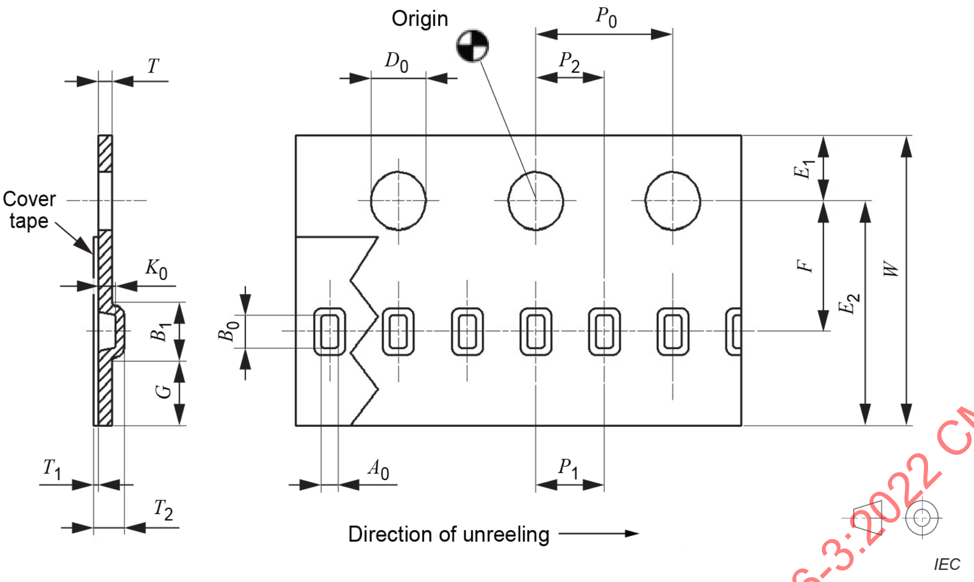


Figure 11 – Type 2b carrier tape

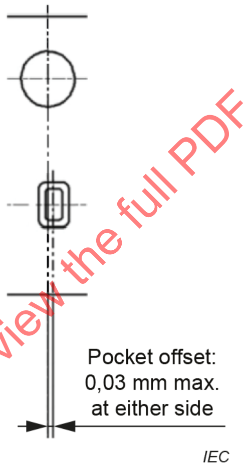
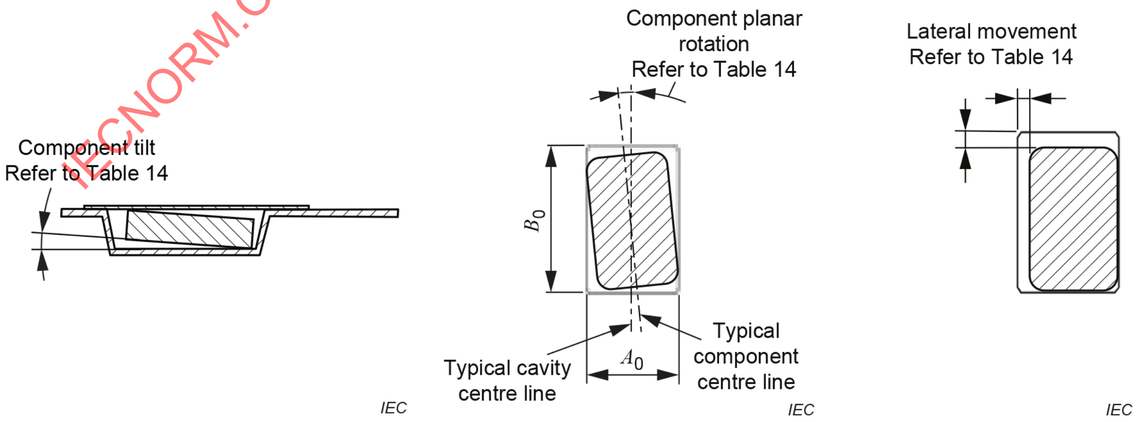


Figure 12 – Maximum pocket offset



a) Sketch J
Component tilt
Side or front sectional view

b) Sketch K
Component planar rotation
Top view

c) Sketch L
Lateral movement
Top view

Figure 13 – Maximum component tilt, rotation and lateral movement

Table 12 – Constant dimensions of 4 mm carrier tape

Dimensions in millimetres

Tape size	D_0	E_1	G min.	P_0	T min.	T max.	T_1 max.	P_0 pitch cumulative tolerance
4	0,80 ± 0,04	0,90 ± 0,05	0,50	2,00 ± 0,04	0,15	0,40	0,08	±0,1 / 20 pitches
For respective dimensional codes, see Figure 11.								

Table 13 – Variable dimensions of 4 mm carrier tape

Dimensions in millimetres

Tape size	B_1 max.	E_2 min.	F	P_1	P_2	T_2 max.	W	A_0, B_0 and K_0
4	1,48 [a]	3,07	1,8 ± 0,03	1,0 ± 0,03	1,0 ± 0,03	1,1	4,0 ± 0,08	See 5.2
For respective dimensional codes, see Figure 11 and Figure 13. [a] Reference dimension.								

Table 14 – Component tilt, planar rotation and lateral movements

Tape size mm	Component tilt (design value) [a]	Component planar rotation (design value) [a]	Lateral movement mm
4	20° maximum	20° maximum	0,08 maximum (Component size 0201M)
			0,10 maximum (Component size 0402M)
			0,12 maximum (Component size 0603M)
			0,20 maximum (Component size > 0603M)
For respective illustration, see Figure 13. [a] A design value is a calculated value for design purposes only. For example, component tilt is not intended to be measured, but is intended to be the calculated value for the pocket design of a carrier tape.			

5.7 Type 3 – Blister carrier tape, with double sprocket holes (32 mm to 200 mm)

For respective dimensional codes, see Figure 14 to Figure 16 and Table 15 to Table 17.

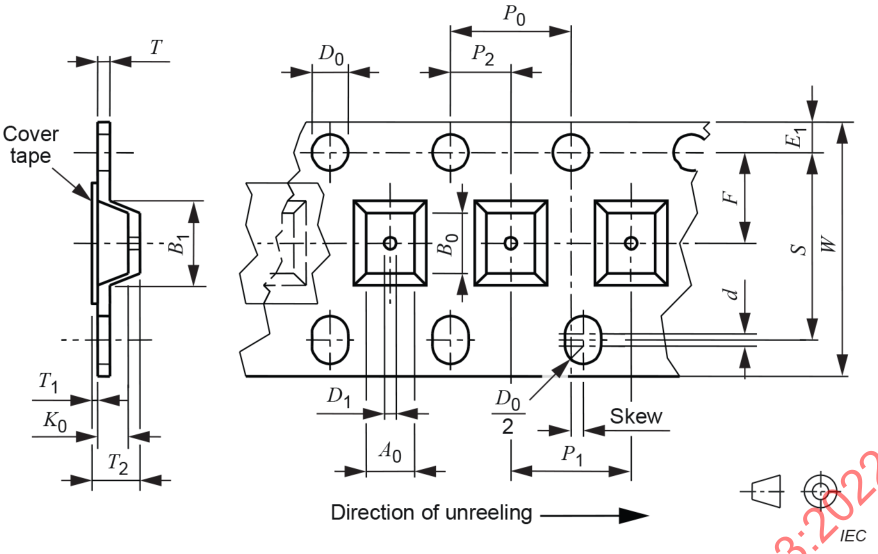


Figure 14 – Blister carrier tape

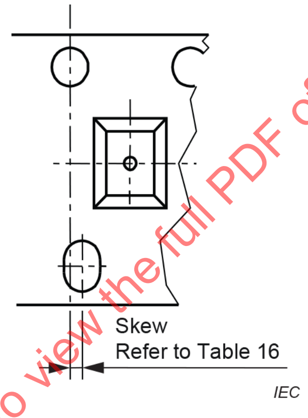
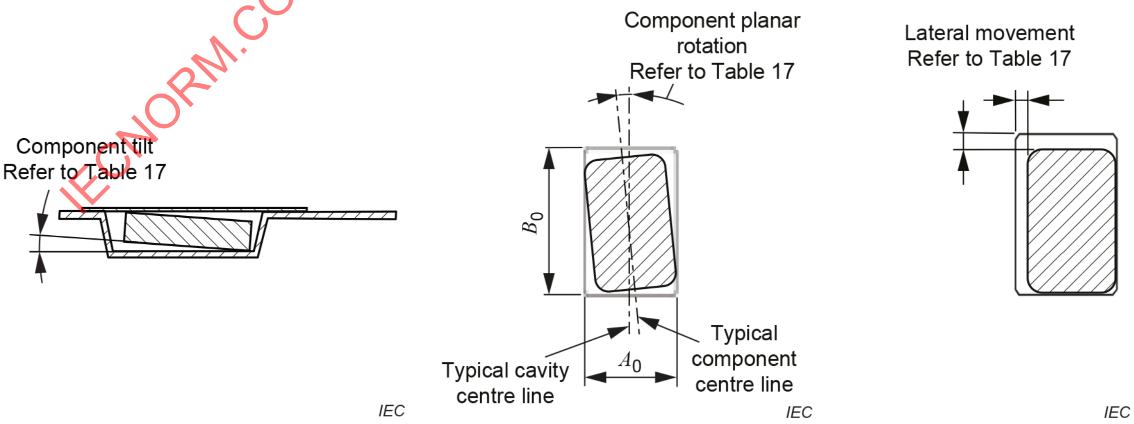


Figure 15 – Elongated sprocket hole skew



a) Sketch M
Component tilt
Side or front sectional view

b) Sketch N
Component planar rotation
Top view

c) Sketch O
Lateral movement
Top view

Figure 16 – Maximum component tilt, rotation and lateral movement

Table 15 – Constant dimensions of 32 mm to 200 mm blister carrier tape

Dimensions in millimetres

Tape size	D_0	D_1[a] min.	d	E_1	P_0	T max.	T_1 max.	P_0 pitch cumulative tolerance
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 / 10 pitches

For respective dimensional codes, see Figure 14.

[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 16 – Variable dimensions of 32 mm to 200 mm blister carrier tape

Dimensions in millimetres

Tape size	B_1 max.	F	P_1	P_2	S	Skew max.	T_2 max.	W	A_0, B_0 and 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 5.2
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	
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	

For respective dimensional codes, see Figure 14 and Figure 15.

Table 17 – Component tilt, planar rotation and lateral movements

Tape size mm	Component tilt (design value) [a]	Component planar rotation (design value) [a]	Lateral movement mm
32, 44 and 56	10° maximum	10° maximum	1,0 maximum
72 to 200	5° maximum	10° maximum	1,0 maximum

For respective illustration, see Figure 16.

[a] A design value is a calculated value for design purposes only. For example, component tilt is not intended to be measured, but is intended to be the calculated value for the pocket design of a carrier tape.

5.8 Type 4 – Adhesive-backed punched plastic carrier tape for singled bare die and other surface mount components (8 mm, 12 mm, 16 mm and 24 mm)

For respective dimensional codes, see Figure 17 to Figure 19 and Table 18 to Table 20. Type 4 carrier is designed specifically for automated handling of components, such as singled bare die. Components are placed on an adhesive film in compartments. The compartment is defined by dimensions V_1 and V_2, which are virtual boundaries of maximum practical sizes that enable use of a multiple of component footprints. The boundaries shall not be used as fiducials for component placement during taping. Refer to 9.4.2 for component positioning and lateral placement.

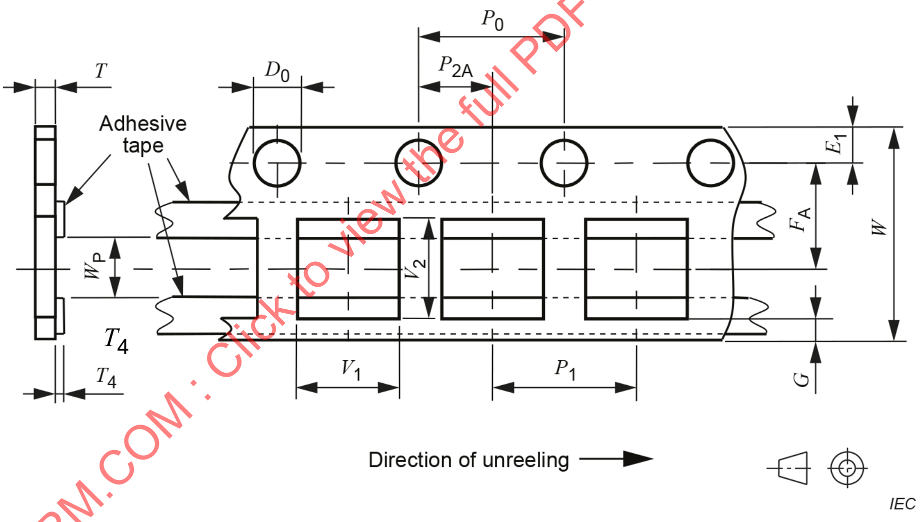


Figure 17 – Adhesive-backed punched carrier-tape dimensions (4 mm compartment pitch)

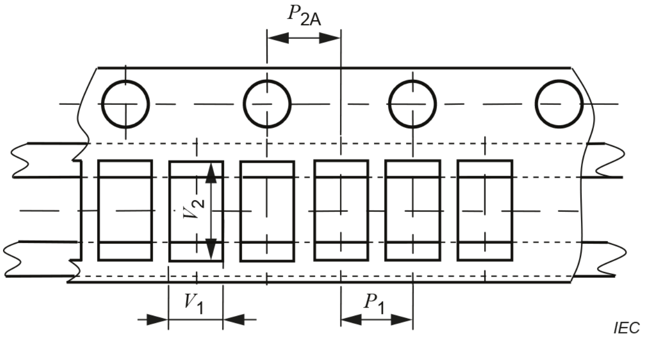
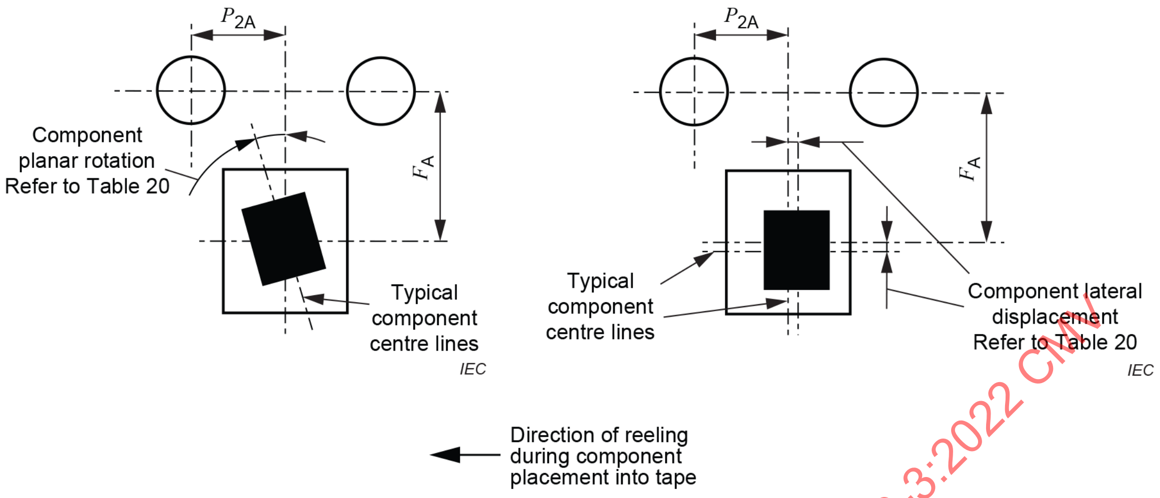


Figure 18 – Illustration of 2 mm compartment pitch



a) Sketch P
Component planar rotation
Top view

b) Sketch Q
Typical component centre lines
Top view

Figure 19 – Maximum component planar rotation and lateral displacement

Table 18 – Dimensions of adhesive backed punched carrier tape

Dimensions in millimetres

Tape size	D_0	E_1	P_0	P_{2A}	T_4 max.	G min.	T max.	W_P	P_0 **pitch cumulative tolerance**
8, 12, 16 and 24	$1{,}5\,^{+0{,}05}_{0}$	1,75 ± 0.1	4,0 ± 0,025	2,0 ± 0,05 (W = 8 and 12) 2,0 ± 0,1 (W = 16 and 24)	0,1	0,75	1,1	a, b, c	± 0,2 / 10 pitches

For respective dimensional codes, see Figure 17 to Figure 19.

[a] Gap W_P is optional and is defined together with the end-user. W_P is determined from the component specifications (dimension B and surface terrain). Its purpose is to

a) minimize adhesion of the component to optimize consistent retrieval at the pick point. This is especially important with components having a surface contact area of 10 mm^2 or greater with the adhesive film;

b) secure retention of component in compartment during reeling/unreeling.

[b] Gap W_P is typically ≤ (0,5 × component dimension in the direction of V_2), see Figure 17.

[c] Gap W_P is centred along the F_A centreline.

Table 19 – Variable dimensions of adhesive-backed punched carrier tape

Dimensions in millimetres

Tape size	F_A	P_1	V_1	V_2	W
8	3,50 ± 0,05	2,0 ± 0,05 4,0 ± 0,1	1,5	3,1	$8,0^{+0,2}_{-0,1}$
			3,1	3,1	
12	5,50 ± 0,05	2,0 ± 0,05 4,0 ± 0,1 to 12,0 ± 0,1 in 4,0 increments	1,5	6,35	$12,0^{+0,2}_{-0,1}$
			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	$16,0^{+0,2}_{-0,1}$
			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	$24,0^{+0,2}_{-0,1}$
			14,0	17,3	

For respective dimensional codes, see Figure 17 to Figure 19.

NOTE Dimension E_2, as defined in type 1a, type 1b, type 2a and type 2b, is for type 4 tape minimum value only, but can be derived as a reference dimension by subtracting E_1 from W (maximum).

Table 20 – Component planar rotation and lateral displacement

Tape size mm	Component planar rotation	Component lateral displacement mm
8, 12, 16 and 24	5° maximum	0,05 maximum (P_1 = 2)
		0,1 maximum (P_1 = 4)

For respective dimensional codes, see Figure 19.

6 Polarity and orientation requirements of components in the tape

6.1 Requirements for all types

For all tape types, the following requirements apply.

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

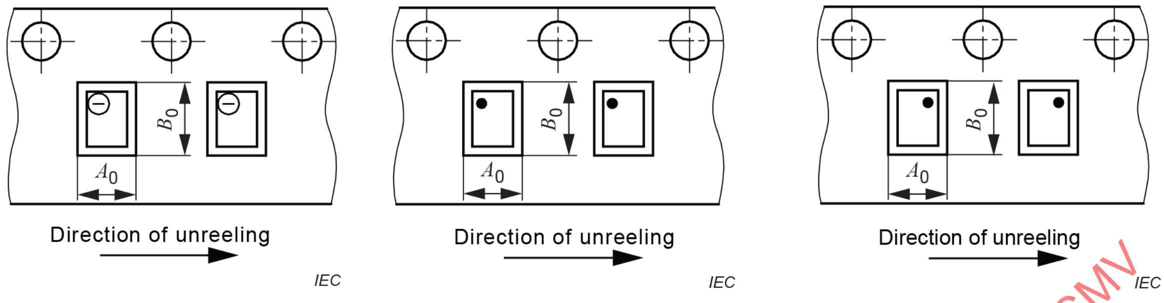
b) For components in flat packages (for example, chip carriers and SO-packages) with more than two terminations, termination No. 1 shall be adjacent to the round sprocket hole, unless otherwise specified in the detail specification;

c) 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;

d) 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 round sprocket holes in the tape and the mounting side shall face the bottom of the component compartment;

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

f) The polarity or orientation of components with other shapes or termination configurations shall be stated in the detail specification (see Figure 20).



a) Cathode is in the upper left

b) Termination No.1 is in the upper left

c) Termination No.1 is in the upper right

The graphical symbol "-", which stands for the position of the cathode side, is shown in a). The mark "●", which stands for the position of termination No.1, is shown in b). Another position of termination No.1 is shown in c), where the position cannot be settled as in b).

Figure 20 – Example of polarity and orientation

6.2 Specific requirements for type 1a

Type 1a has a top cover tape and a bottom cover tape on both sides of the carrier tape. Therefore, components may be placed with the mounting side orientated to the bottom or the top side of the tape (for the bottom side of the tape, see 11.1). If the mounting side needs to be reversed (as is the case for some type of surface-mounted components), the tape is re-spooled. Then, the bottom cover tape is removed to invert the components.

6.3 Specific requirements for type 4

The non-active side of the component is generally placed at the bottom side of the tape, i.e. affixed to the adhesive layer. This orientation enables additional visual inspection and probe testing 'in-situ', within an open compartment, since a cover tape is not required for component retention. In the case of flip-chips or WLCSP, the component may be placed 'bumps down' on a special adhesive layer designed for that purpose. Bumps down orientation, on adhesive tape, protects the bumps from damage attributable to abrasion or mechanical handling.

7 Carrier tape requirements

7.1 Taping materials

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

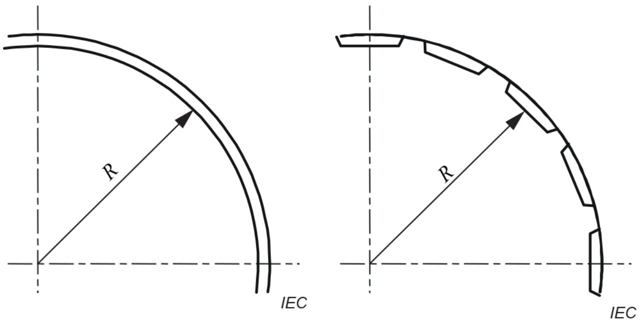
Components shall not stick to the carrier tape.

7.2 Minimum bending radius (for all types)

When the tape is bent with the minimum radius (measured at the bottom side of the tape, see Figure 21) given for a particular tape width as indicated in Table 21, the tape shall not be damaged and the components shall maintain their position and orientation in the tape.

Tape material should have such properties that without additional assistance the material can easily bend to the radius specified in Table 21. Otherwise, the tape cannot be handled anymore.

Tape with components shall pass around the radius R specified in Table 21 without damage.



a) Punched tape **b) Blister tape**

Figure 21 – Bending radius

Table 21 – Minimum bending radius

Dimensions in millimetres

W	P_1	$R_{\text{min.}}$	
		Type 1a, type 1b,type 2a, type 2b and type 3	**Type 4 only** [b]
4	1	25	25
8	1,2 and 4	25	25
12	2, 4 and 8	30[a]	50
16	4,8,12 and 16	30	50
24	4, 8 and 12	30	50
24	16 and 24	30	89
32	4 to 32	40	n/a
44	4 to 44	40	n/a
56	4 to 56	50	n/a
72 to 200	4 to 72[b]	75	n/a

n/a Not applicable.

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

[b] 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 17) 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 26).

7.3 Camber

The camber shall be measured with the carrier tape passed between two plates and without tension applied to the tape. To measure camber accurately, both left and right edges of the 250 mm carrier tape shall be in contact with the straight edge. Measure the largest camber between two edges of the tape in accordance with Figure 22. The camber shall not exceed 1 mm over 250 mm in either direction, unless otherwise specified in the relevant specification.

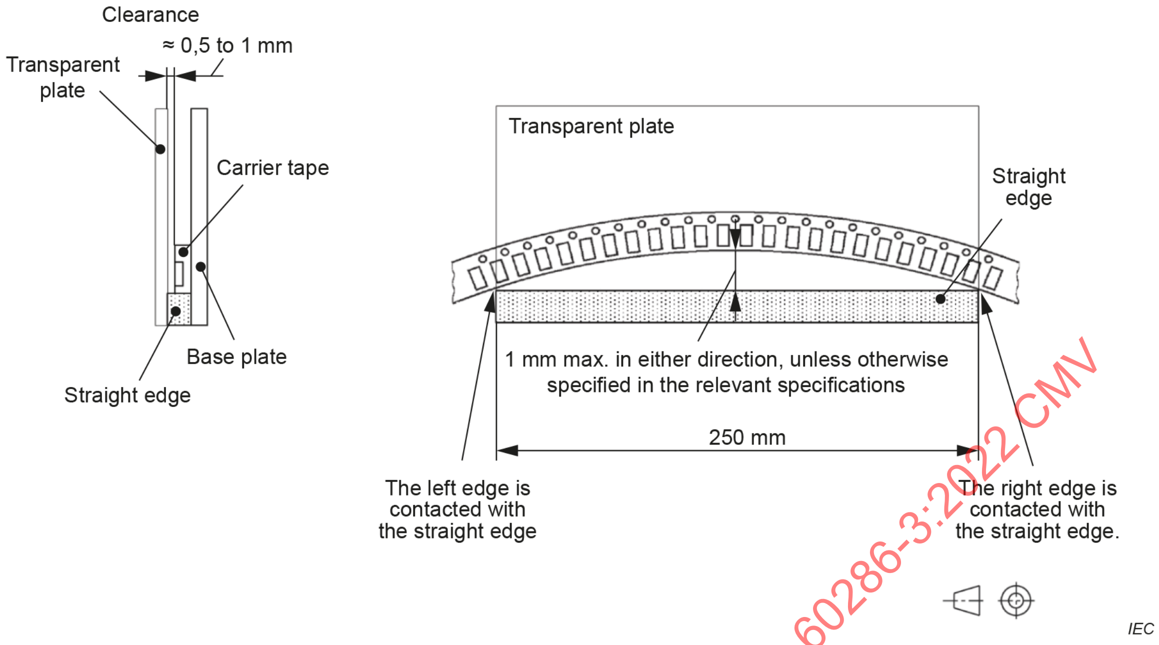


Figure 22 – Measuring method and camber

8 Cover tape requirements (for type 1a, type 1b, type 2a, type 2b and type 3)

For type 1a, type 1b, type 2a, type 2b and type 3 the following cover tape requirements apply:

a) the cover tapes shall not cover the round sprocket holes (type 1a, type 1b, type 2a, type 2b and type 3) and elongated sprocket holes (type 3);

b) the adhesive and material of the cover tape shall not adversely affect the mechanical and electrical characteristics and the marking of the components;

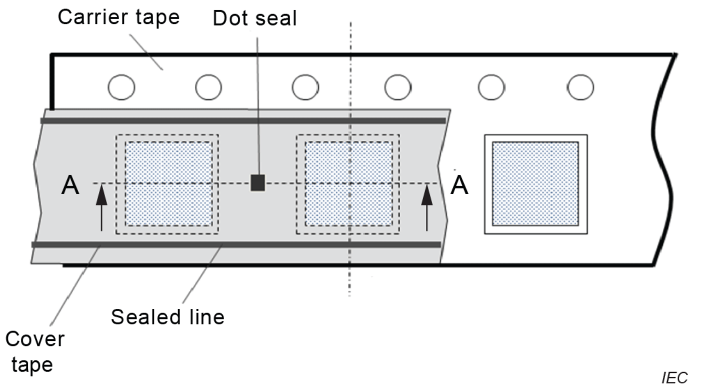
c) components shall not stick to the cover tape;

d) the cover tape(s) shall not become detached;

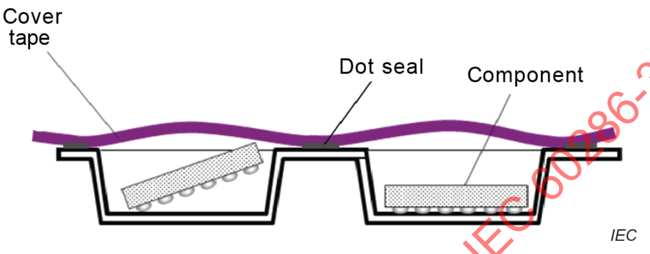
e) the cover tape(s) shall not protrude beyond the edge of the tape;

f) the cover tape shall not be attached to the carrier tape on the surface between two adjacent component pockets.

An exception may apply in those cases where thin components, during reeling or de-reeling, can slide from pocket to pocket. In these cases, the surface between two adjacent pockets may be dot sealed according to the peel force requirements (see Figure 23 and Table 22).



a) **Top view**



b) **Section A-A**

Figure 23 – Dot seals for thin components (as exceptions)

g) The break force of the cover tape shall be at least 10.

h) The angle at the peel strength test 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.

i) The peel force with a peel speed of 300 mm/min ± 10 mm/min shall be as indicated in Table 22.

Table 22 – Peel force

Tape width W mm	**Peel force** [a] N
4	0,1 to 0,7
8	0,1 to 1,0
12 to 56	0,1 to 1,3
72 to 200	0,1 to 1,5

Type 1a, type 1b and type 2b: For very small components 0603M size or smaller, the mass is so light that components may run-off from the component compartment when the cover tape is peeled. For these component sizes it is recommended to use a peel force of 0,2 N ± 0,1 N and, as aging may have an effect on the peel force, this peel force should be valid for at least 7 days after sealing.

Unless specifically requested by the end-user, the sealed tapes shall not be bent in the opposite direction to maintain the appropriate peel force of the cover tapes.

[a] Peel off forces might be higher in case a sealing between adjacent pockets is used, for example dot seal as shown in Figure 23.

9 Component taping and additional tape requirements

9.1 All types

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 type 1a, type 1b, type 2a, type 2b and type 3, which use cover tapes, are listed in Clause 8. Type 4 does not require a cover tape, because components are affixed to the adhesive backing when taped and are held in position.

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

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.

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.

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.

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.

NOTE See IEC 61340-5-1 and IEC TR 61340-5-2 for the guidelines.

In addition, the following measuring methods of electrostatic performance while the cover tape is peeled off the carrier tape in SMD taping with a tape width of 4 mm, 8 mm, 12 mm and 16 mm, are shown in Annex B:

a) electrostatic potential generated;

b) electrostatic charge decay performance acting in the longitudinal direction of the carrier tape.

9.2 Specific requirements for type 1b

The presence of burrs, fluff or deformation should be kept to a minimum and shall not affect the removal of components. The presence of fluff shall not affect the mounting of the component.

Recommended measuring methods for carrier tape thickness (T and T_3), cavity (A_0 and B_0) and cavity depth (dimension K_0) shall be in accordance with Annex A.

9.3 Specific tape requirements for type 2b

The carrier tape and cover tape shall be made of a plastic material which does not shed particulates and has antistatic characteristics.

The carrier tape material should be suitable for use in the applicable cleanroom classification for which it is intended.

9.4 Specific requirement for type 4

9.4.1 General

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.

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

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

9.4.2 Coordinate system

For the coordinate system of type 4, the following requirements apply.

a) The coordinate system shown in Figure 24 is established to define carrier tape dimensioning together with component placements on adhesive-backed punched plastic carrier tapes.

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

c) Ordinates are lines at right angles to the abscissa and uniformly spaced along its length to position the centre of each round sprocket hole aligned along the abscissa.

d) 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.

e) 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.

f) The centre of the components shall be located within a 0,2 mm diameter of the target centre-points within the virtual boundaries. See Figure 24 and Figure 25.

g) Component rotation shall be limited to 5° from the abscissa axis centre line of the round sprocket holes (see Figure 19).

h) Adherence to the tolerances defined in Table 18 and Table 19 ensures that the following critical criteria are maintained:

   1) precise alignment of all round sprocket hole centres along abscissa;
   2) consistent pitch of the round sprocket holes throughout the entire length of the tape;
   3) uniform diameters of all round sprocket holes;
   4) polarity and orientation of components in the tape.

Table 23 – Absolute referencing data for component target position

Dimensions in millimetres

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

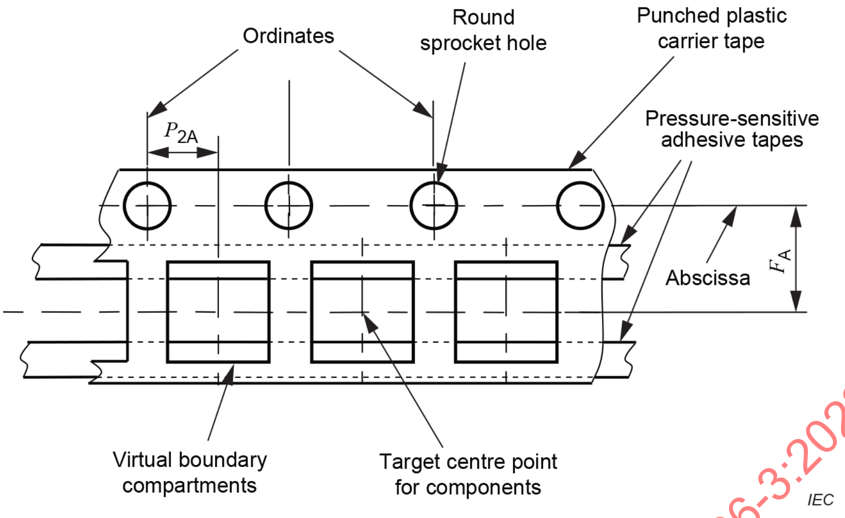


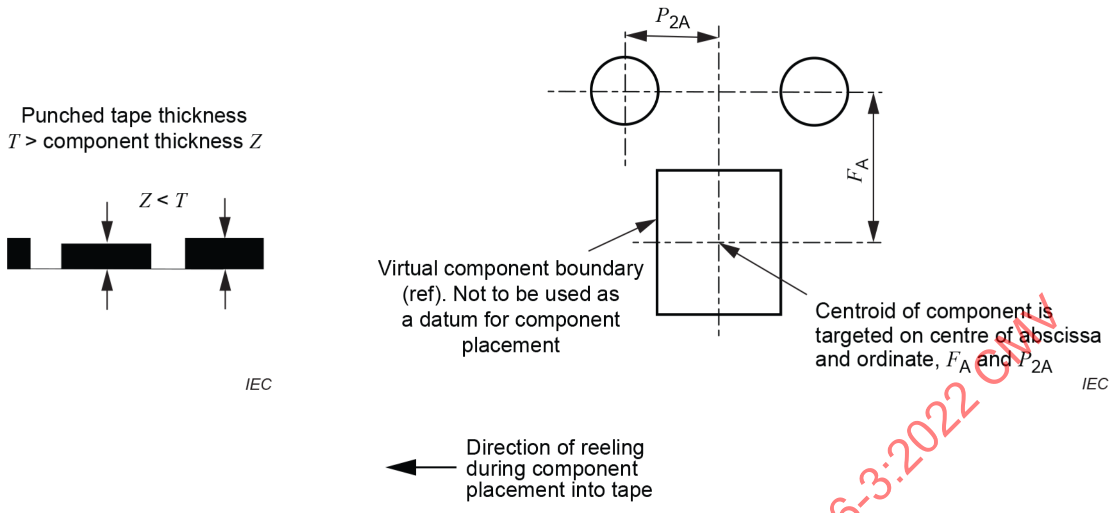
Figure 24 – Type 4 coordinate system

9.4.3 Component positioning and lateral displacement

For the component positioning and lateral displacement, see Figure 19 and Figure 25. The component position in type 4 tape is not measured with respect to the compartment, as in type 1a, type1b, type 2a, type 2b and type 3, but relative to a virtual target point at an absolute position given by P_{2A} and F_A. Table 23 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 Figure 25 b) 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 4, which may have a tighter tolerance than that shown in Table 18 and Table 19 [see Figure 25 b)], where the repeatability of the component position at the pick point is critical. The component should not protrude above the top surface of the carrier tape. This is shown in Figure 25 a) where the component thickness (Z) shall not be more than the punched tape thickness (T).



a) Sketch R
Side or front
Sectional view

b) Sketch S
Component location

Figure 25 – Component clearance and positioning method

9.5 Specific requirements for tapes containing die products

9.5.1 General

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.

NOTE Refer to IEC TR 62258-3 for handling recommendations.

The content of 9.5.2, 9.5.3 and 9.5.4 should be considered where the tape is used for die products.

9.5.2 Tape design for tapes containing die products

Type 1a, type 2a, and type 2b 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 2a and type 2b should include special features in the base of the cavity to protect bumped die, where the die is placed in the pocket 'bumps down'.

Type 4 does not require special features since it is inherently designed for die products.

NOTE Type 1b and type 3 are not suitable for use with die products.

9.5.3 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 shall be free from any burrs or particles that may dislodge during handling or storage; they can 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.

9.5.4 Die lateral movement (type 1a, type 2a and type 2b)

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.

Die products generally require tighter tape tolerances to minimize lateral movement.

Tapes with a width W of 8 mm and 4 mm should allow for a lateral movement of 0,1 mm maximum. Tapes with a width W of more than 8 mm should allow for a lateral movement of 0,15 mm maximum.

10 Reel requirements

10.1 Dimensions

10.1.1 General

For the reeling of tapes, reels with the essential dimensions listed hereinafter shall be used. The total number of components on the reel shall be such that the components and the final cover do not extend beyond the smallest dimension of the flange (in the radial direction).

10.1.2 Reel dimensions

For the reel dimensions, see Figure 26 and Table 24.

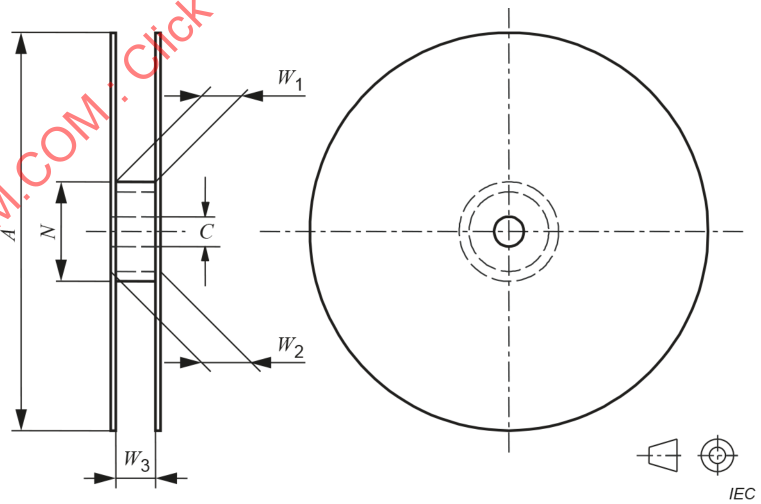


Figure 26 – Reel

Table 24 – Reel dimensions

Dimensions in millimetres

Tape width W	Reel diameter[a] A max.	Hub diameter N min.	Reel inner width W_1[b]	Reel overall width W_2 max.	Reel inner width W_3 min.	Reel inner width W_3 max.
4	180	50	4,2 + 0,75	7,95	3,9	5,95
8	382	50	8,4 + 1,5	14,4	7,9	10,9
12		60 [d]	12,4 + 2	18,4	11,9	15,4
16		60	16,4 + 2	22,4	15,9	19,4
24		60 [c]	24,4 + 2	30,4	23,9	27,4
32		80	32,4 + 2	38,4	31,9	35,4
44		80	44,4 + 2	50,4	43,9	47,4
56		100	56,4 + 2	62,4	55,9	59,4
72	609	150	72,4 min.	89,0	Shall accommodate tape width without interference	
88			88,4 min.	105,0		
104			104,4 min.	121,0		
120			120,4 min.	137,0		
136			136,4 min.	153,0		
152			152,4 min.	169,0		
168			168,4 min.	185,0		
184			184,4 min.	201,0		
200			200,4 min.	217,0		

For the respective dimensional codes, see Figure 26.

[a] Preferred nominal reel diameters, in millimetres, are 180, 254, 284, 330, 360, 382 and 560.

[b] Measured at the hub.

[c] For type 4: 100 min.

[d] For punched tapes, the minimum diameter shall be 50 mm.

10.1.3 Reel hole dimensions

For the reel hole dimensions, see Figure 27 and Table 25.

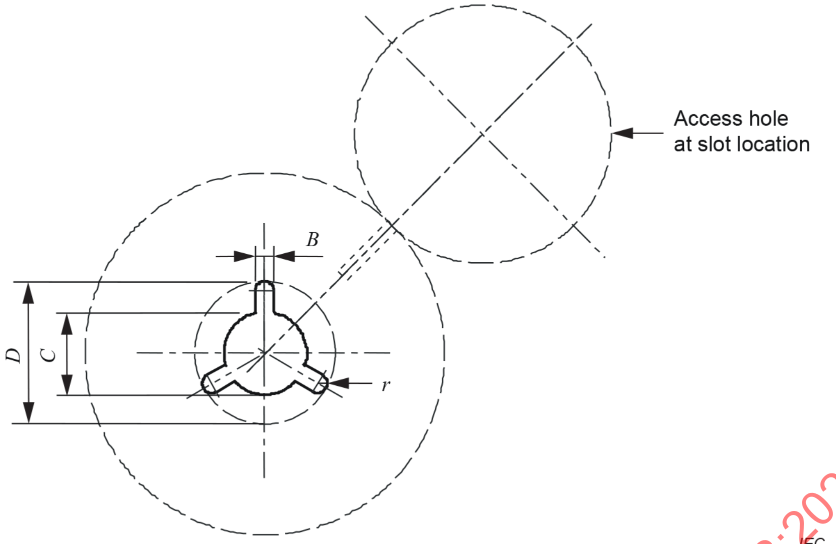


Figure 27 – Reel hole presentation

Table 25 – Reel hole dimensions

Dimensions in millimetres

Symbols	All types
B	1,5 minimum
D	20,2 minimum
C	13,0 +0,5/ −0,2
r	0,5 × *B*
For respective dimensional codes, see Figure 27.	

An adequate tape slot at the hub of the reel may be provided for the trailer. There should then also be a corresponding adequate access hole.

10.1.4 Drive hole dimensions (optional)

For the drive hole dimensions, see Figure 28 and Table 26.

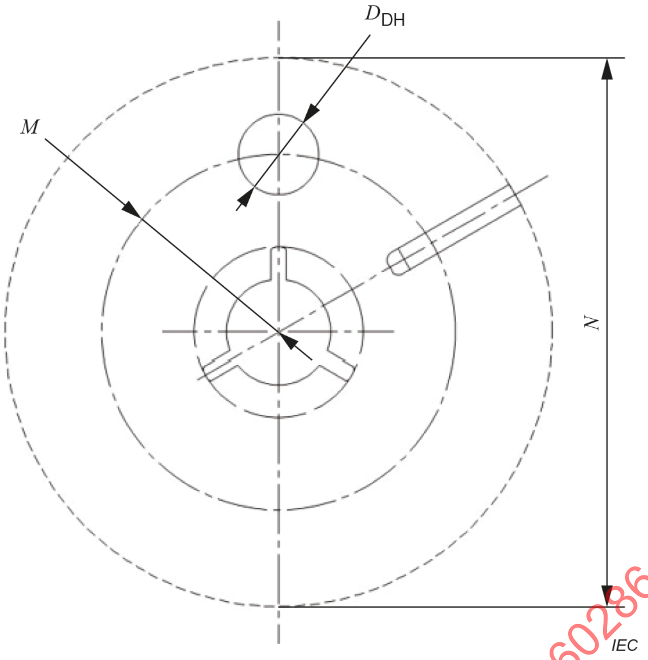


Figure 28 – Drive hole layout

Table 26 – Drive hole dimensions

Dimensions in millimetres

Symbols	All types
D_{DH}	7,6 to 9,5
M	25,4 to 28,55
For respective dimensional codes, see Figure 26 and Figure 28.	

The hub diameter should be chosen appropriately for the following conditions:

a) the drive holes shall be located inside the hub of the reel;

b) the drive hole shall not interfere with the tape slot at the hub of the reel.

10.2 Marking

The reel shall provide space for a label. The label shall be placed on the outside of the flange opposite the round sprocket holes (see Figure 29).

The marking on the reel shall comply with the requirements of the detail specification of the component.

Further information may be given by normal script or in code form for automatic reading, for example, OCR, bar code, and magnetic.

In the case of bar codes, it is recommended that bar code 39 be used, as specified in ISO/IEC 16388. For optical character recognition (OCR), OCR B should be used.

11 Tape reeling requirements

11.1 All types

Tape with components ready for assembly placement shall be spooled in such a way that the round sprocket holes shall be on the left-hand side as the tape enters the feeder as viewed from the back end of the feeder looking towards the bed of the assembly machine (see Figure 29).

Tape with components shall wrap around the hub (see dimension N in Figure 26) without damage.

Component tapes shall be wound on reels suitable for feeding automatic mounting machines.

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 29).

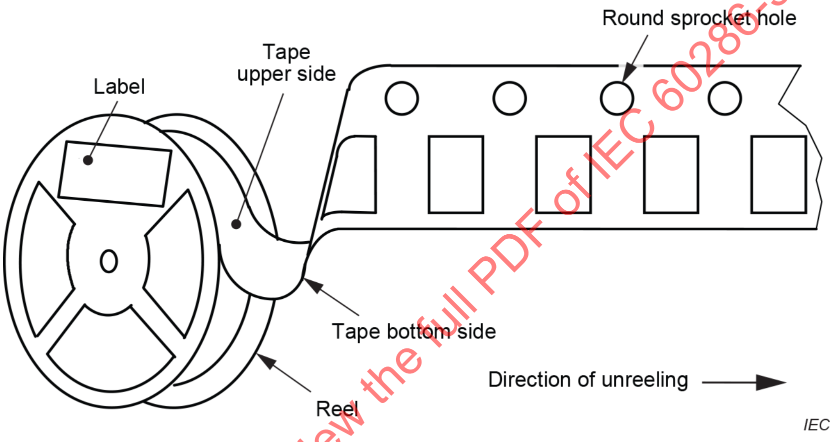


Figure 29 – Tape reeling and label area on the reel

11.2 Specific requirements for type 1a

Type 1a has a top cover tape and a bottom cover tape on both sides of the carrier tape. If the mounting side needs to be reversed (for some types of surface-mounted components), the tape shall be re-spooled. Then, the bottom cover tape shall be removed to invert the components.

11.3 Specific requirements for type 4

Generally, it is sufficient to wrap a layer of tape around the reel which normally comprises the leader for the tape to protect the components in the tape. However, for additional protection or where the leader is insufficient, a static dissipative wrap may be wound around the completed reel.

11.4 Leader and trailer tape

11.4.1 General

For the leader and trailer, see 11.4.2, 11.4.3 and Figure 30.

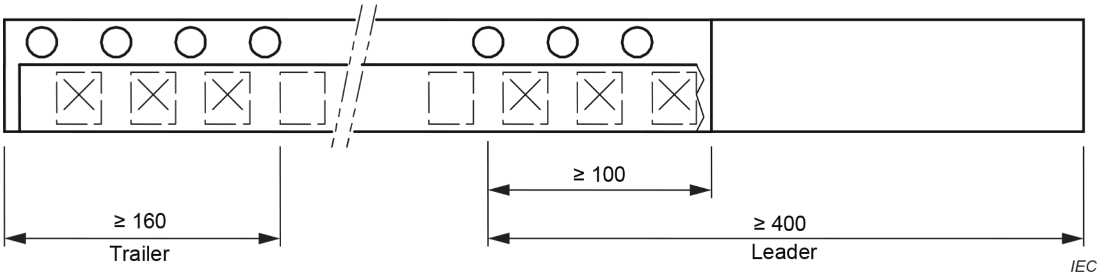


Figure 30 – Leader and trailer

11.4.2 Leader

For type 1a, type 1b, type 2a, type 2b and type 3 tapes, there shall be a leader of 400 mm minimum of cover tape, which includes at least 100 mm of carrier tape with empty compartments. All of leader may consist of the carrier tape with empty compartments sealed by cover tape.

Type 4 tapes, which have no cover tape, shall include at least a leader of 100 mm of carrier tape with empty compartments.

11.4.3 Trailer

There shall be a trailer with a minimum of 160 mm carrier tape with empty compartments and sealed by the cover tape. The carrier tape shall be released from the reel hub as the last portion of the carrier tape unwinds from the reel.

11.5 Recycling

Tape and reels should be made of recyclable material. When such material is used in reels, a recycling symbol shall be marked on the reel.

The requirements of ISO 11469 should be referred to for marking the material.

11.6 Missing components

The maximum number of empty pockets between the leader and the trailer shall be 1 per reel or 0,025 %, whichever is greater.

There shall not be consecutive components missing from any reel for any reason.

Annex A
(normative)

Recommended measuring methods for type 1b

A.1 Measurement method for carrier tape thickness (T and T_3)

The equipment used to conduct these measurements shall be an external micrometer with a measuring pressure of 1,5 N or smaller. To measure the tape thickness at the cavity, including the puff, the probe shall be made of super-hard material with a recommended probe head diameter of 2,0 mm.

The thickness of the carrier tape shall be measured with an accuracy of 0,001 mm. The dimension of the thickness excluding the puff of the bottom of the cavity is T, when the flat side is measured adjacent to the round sprocket holes. The dimension of the thickness including the puff on the bottom of the cavity is T_3.

Measurements shall be made at the points shown in Figure A.1.

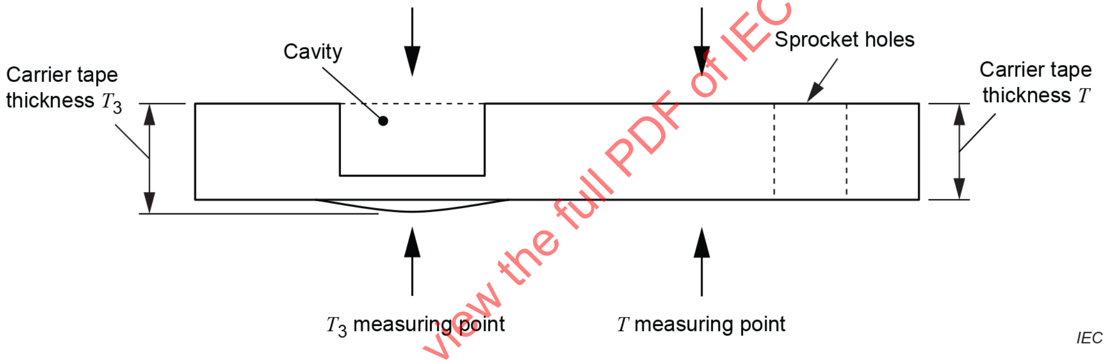


Figure A.1 – Carrier tape thickness measurement points

A.2 Measurement method for cavity (A_0 and B_0)

A measuring viewing scope with 10× magnification or more shall be used.

For dimension A_0 and dimension B_0, the minimum value including deformation of material shall be measured using an adequate light source to illuminate the surface of the tape and allow measurement of the features as shown in Figure A.2. Fluff should be excluded from the dimension.

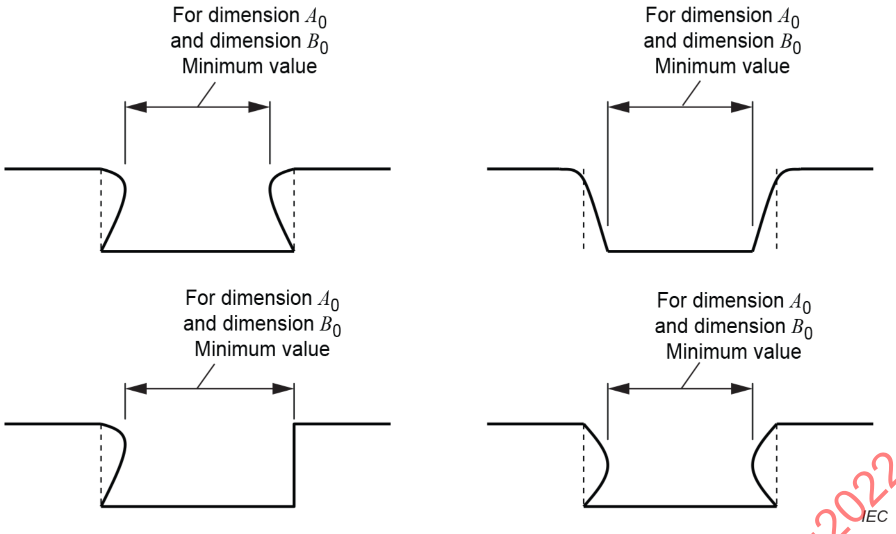


Figure A.2 – Cavity cross-section

A.3 Measurement method for cavity depth (dimension K_0)

The cavity depth K_0 should be the distance between the centre of the bottom of the cavity and the carrier surface at the centre point between the round sprocket hole and the cavity.

An example of a measurement of cavity depth K_0 is to use a non-contact measuring system to perform a measurement in accordance with Figure A.3.

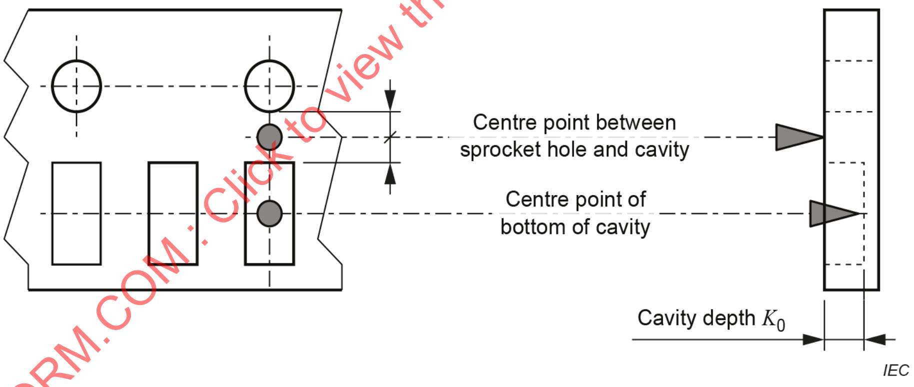


Figure A.3 – Cavity depth dimension

Annex B
(informative)

Measuring methods of electrostatic potential and charge decay performance while cover tape is peeled off from carrier tape containing surface mount devices

B.1 General

Surface mount devices (hereinafter referred to as SMDs) are usually packaged in the form of tape and reel. It is necessary to peel off the cover tape from the carrier tape in order to pick up an SMD from the cavity.

When peeling off the cover tape from the carrier tape, electrostatic charges are generated by the separation of materials. These charges can cause the following detrimental effects:

- the SMD is damaged by electrostatic discharge and/or its characteristics are degraded;
- the SMD sticks to the cover tape, and causes an empty cavity;
- the SMD sticks to the inside the cavity of the carrier tape, and the pick and place machine cannot pick it up.

The generated electrostatic potential and its subsequent decay time depend on the following factors:

- packaging materials and sealing methods for SMD taping, environmental conditions before and after peeling off the cover tape and the peeling off conditions;
- type and size of SMD, the reel size;
- the storage conditions.

However, no applicable standard that considers the above factors exists for the measurement of the electrostatic potential generated during peeling off the cover tape from the carrier tape.

NOTE There is a U.S.A. standard for measuring the electrostatic potential when peeling off adhesive tapes (e.g. ESD ADV 11.2:1995) but they are not applicable for non-adhesive tapes.

In addition, no applicable standard that considers the characteristics of the SMD taping exists for the measurement method of the electrostatic charge decay performance.

Therefore, a method for measuring the electrostatic potential and charge decay performance under the actual conditions of peeling off the cover tape needs to be specified in another standard which introduces a new way of thinking.

The data gained by the methods described in this annex are an important tool to develop and evaluate effective countermeasures against the above detrimental electrostatic effects.

This annex describes method for measuring the electrostatic potential generated when the cover tape is peeled off from a carrier tape, and a method for measuring the electrostatic charge decay performance by resistive properties acting in the longitudinal direction of the carrier tape.

This annex applies to SMD tapes with widths of 4 mm, 8 mm, 12 mm and 16 mm.

B.2 Method for measuring electrostatic potential and charge decay performance

B.2.1 General

Electrostatic potential and charge decay performance shall be measured in accordance with B.2.2 to B.2.7.

A configuration diagram of the measurement method using an electrostatic potential measuring instrument is shown in Figure B.1. Figure B.2 shows the measurement method of electrostatic potential generated when cover tape is peeled off the carrier tape. Figure B.3 shows the configuration of the measurement method for electrostatic charge decay performance, and Figure B.4 shows the measurement method:

a) the capacitance of the measuring position (the metal flat plate electrode and non-contact probe) is 10 pF or less;

b) the insulation between the metal flat plate electrode and the electrostatic-potential measuring device itself should be 1 × 10^{14} Ω or more;

c) all measuring instruments should be connected to the ground point.

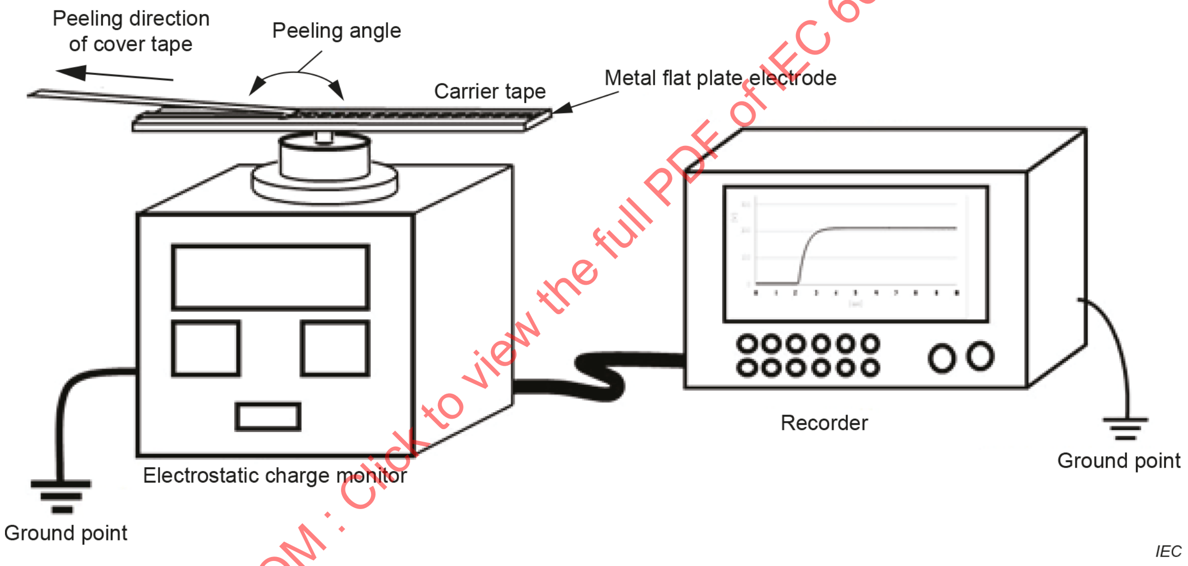


Figure B.1 – Configuration of measurement method using electrostatic potential measuring system

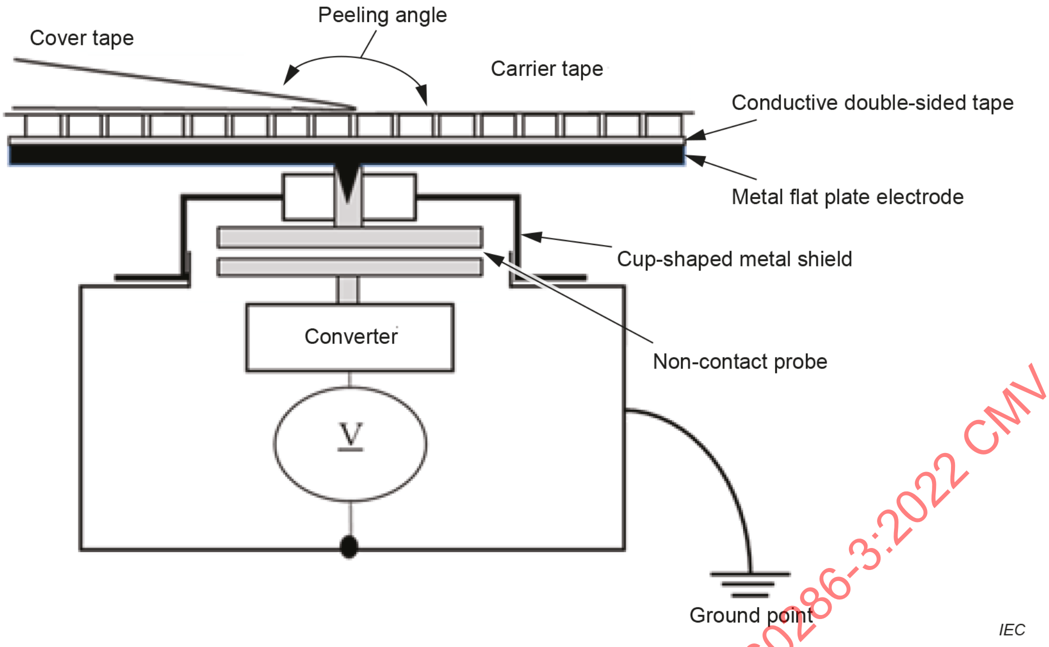
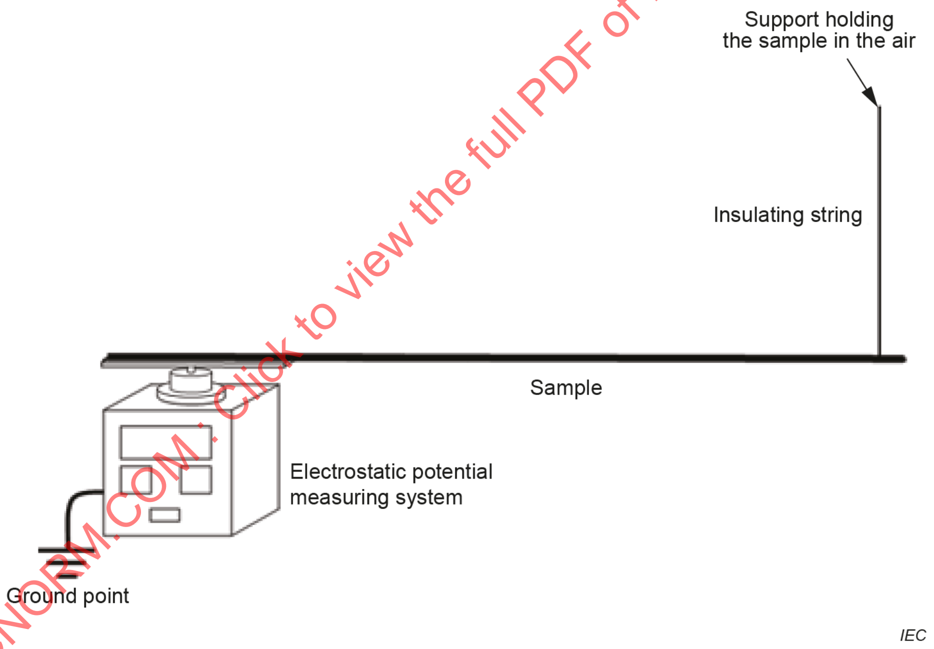


Figure B.2 – Diagram of measure electrostatic potential when peeling cover tape



NOTE Insulating string see B.2.2.11.

Figure B.3 – Configuration of electrostatic charge decay measurement method

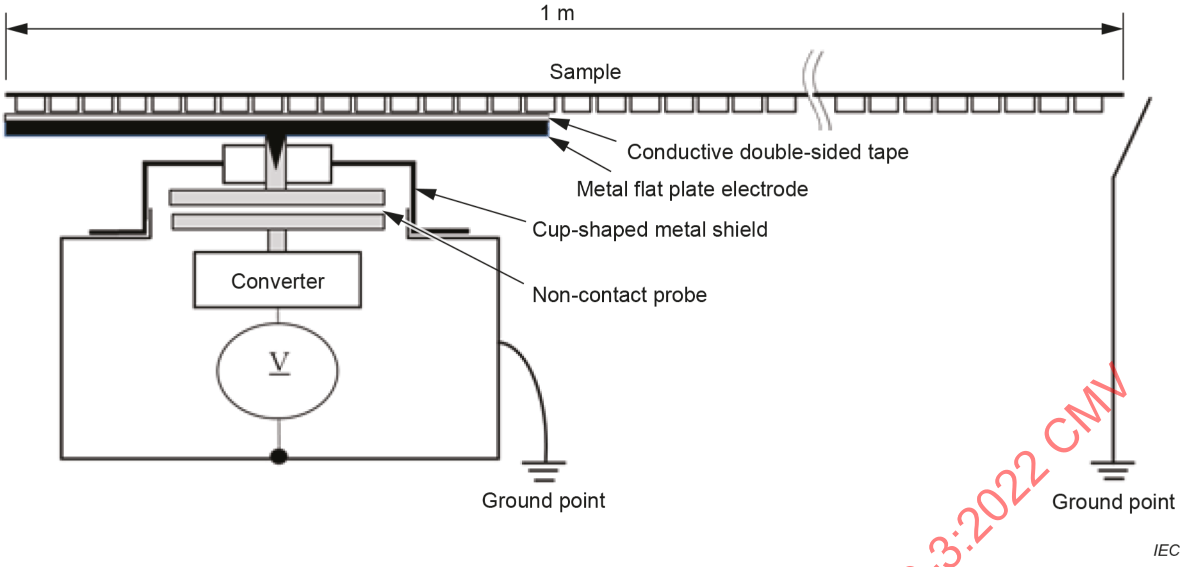


Figure B.4 – Diagram of the measurement of electrostatic charge decay performance

B.2.2 Measurement instrument and device

B.2.2.1 Electrostatic potential measurement instrument

The electrostatic potential measurement instrument used is a noncontact type which can measure electrostatic potential, satisfying the following requirements:

a) measure the electrostatic potential with the range up to ± 5 kV;

b) response time is not more than 100 ms, and preferably as fast as possible.

B.2.2.2 Wrist strap

The wrist strap shall be as specified in IEC 61340-4-6.

B.2.2.3 Metal flat plate electrode

Unless otherwise specified in a related standard, the metal flat plate electrode shall be as follows.

a) Material: stainless steel, specified in ISO 16143-1;

b) Structure: possibility to stick a conductive double-sided tape which fixes the sample at the time of measurement, and to firmly fix the non-contact probe portion of the cup-shaped metal shield without loosening;

c) Dimensions: it should be able to stick the sample and dimensions are as follows:

   length: 200 mm ± 10 mm

   width: 20 mm ± 1 mm

   thickness: 2,0 mm to 3,0 mm

B.2.2.4 Cup-shaped metal shield

The purpose of the cup-shaped metal shield is to cover the measuring portion to prevent the effect of disturbance, such as electrostatic induction.

B.2.2.5 Recording devices (data loggers, etc.)

The recording devices shall be capable of recording the time-course measurement data of the electrostatic potential specified in B.2.6 and the electrostatic discharge performance specified in B.2.7.

B.2.2.6 Ionizer

Ionizers shall comply with the provisions of IEC 61340-4-7.

B.2.2.7 Cleaning solvent

A volatile cleaning solvent shall be used to wash dust, chemicals, finger marks, etc. from the following:

a) metal flat plate electrode;
b) measuring equipment;
c) fingers of the operator, and so on.

For example: isopropyl alcohol.

B.2.2.8 Conductive double-sided tape

The conductive adhesive double-sided tape shall be made of such a material that the adhered test sample does not peel off from the metal flat plate electrode specified in B.2.3.3 while the cover tape of the test sample is peeled off. The surface resistance and volume resistance of the material shall be 100 Ω or less.

B.2.2.9 Electrostatic charger

The charger shall be capable of charging the sample above ±1 000 V to measure the electrostatic charge decay from the sample.

B.2.2.10 Insulating clip

It shall be possible to grasp the insulating clip by hand while the cover tape is peeled off the carrier tape, and the insulating clip is made of insulating material which does not release electrostatic discharge, and its surface resistance and volume resistance are 1×10^{14} Ω or more.

B.2.2.11 Insulating string

The insulating string shall be made of a material having enough strength to hold the sample in the air when measuring the leakage of electrostatic charge, and the surface resistance and the volume resistance of the material shall be 1×10^{14} Ω or more.

B.2.2.12 Crimping jig

The crimping jig shall be capable of uniformly crimping the metal flat plate electrode to the sample.

B.2.2.13 Anti-static shoes and anti-static floors

The combination of antistatic shoes and of the antistatic floor shall comply with IEC 61340-4-5.

As a result, the electrostatic potential of the human body is within ± 20 V.

B.2.2.14 Static control garments

The static control garments shall be as specified in IEC 61340-4-9 and the electrostatic potential shall be within ± 100 V, measured by a surface electrometer.

B.2.2.15 Surface electrometer

The surface electrometer shall be a non-contact type instrument capable of measuring electrostatic potential.

For example, the instrument is preferably a handheld instrument that can measure electrostatic potential in the range of ± 2 kV and has a response time of less than 100 ms.

B.2.3 Sample (test specimen)

B.2.3.1 General

The sample shall be a taped SMD with tape widths of 4 mm, 8 mm, 12 mm, and 16 mm or less, in accordance with B.2.3.2 to B.2.3.3.

The preparation of samples before measurement shall be in accordance with B.2.3.4.

B.2.3.2 Sample used for electrostatic potential measurement

The sample used for the measurement of electrostatic potential is a taped SMD:

a) the length of the carrier tape shall be 200 mm ± 10 mm, unless otherwise specified in the detail specification;

b) the length of the carrier tape is securely sealed by the cover tape, and the end of the cover tape is only about 30 mm in length, which can be gripped by an insulating clip, as shown in Figure B.5.

Dimensions in millimetres

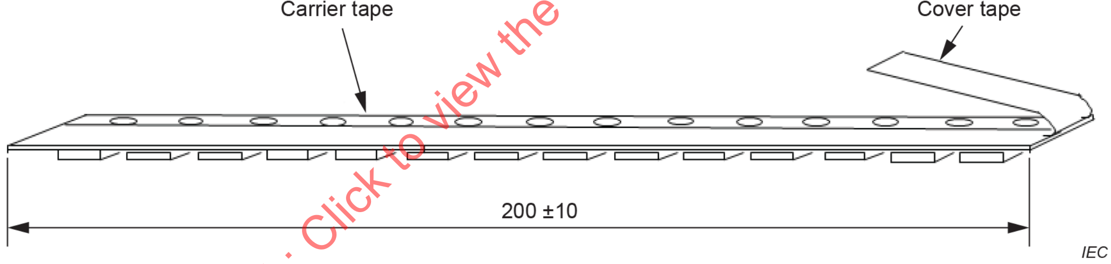


Figure B.5 – Dimensions of the sample

B.2.3.3 Test sample used to measure electrostatic charge decay performance

The length of the test sample used for the measurement of electrostatic charge decay performance shall be 1 m, unless otherwise specified in the detail specification.

B.2.3.4 Preparation of test samples before measurement

In order to improve the efficiency of measurement, the required number of samples shall be prepared before measurement and kept under the environmental conditions listed in Table B.1, in accordance with the related document.

B.2.4 Pre-treatment conditions and measurement environment conditions

The pre-treatment conditions (environmental storage conditions before measurement) and measurement environment conditions shall be in accordance with any of the conditions in Table B.1 specified in detail sepcifications. If there is any doubt about the judgment in Condition 2, the measurement shall be repeated in Condition 1.

Table B.1 – Conditions of the environment in which the samples are kept and the conditions of the measurement test environment before measurement

Condition	**Pre-treatment conditions**			**Measurement environment conditions**	
	Temperature °C	Relative humidity %	Standing time h	Temperature °C	Relative humidity %
1	23 ± 2	15 ± 3	48 or more	23 ± 2	15 ± 3
2	23 ± 2	50 ± 3	48 or more	23 ± 2	50 ± 3

NOTE According to the provisions of IEC 61340 series, the relative humidity in condition 1 is 12 %, but in this annex the relative humidity is changed from 12 % to 15 %.

B.2.5 Measurement conditions

B.2.5.1 Peeling speed

The peeling speed shall be measured in the range of 300 mm/min to 12 000 mm/min with higher speed than the peeling speed of the cover tape of the actual pick and place machine, and at the same speed every time, unless otherwise specified in the detail specification.

The peeling speed is confirmed by the rise time of electrostatic potential measurement data recorded in the recording equipment.

B.2.5.2 Peeling angle

The nominal peeling angle shall be between 165° and 180°, unless otherwise specified in the detail specification. However, in the case of a nearly horizontal angle of 180°, the peeled cover tape shall not be allowed to come into contact with measuring instruments such as the carrier tape and the electrostatic potential measuring instrument.

B.2.6 Method for measuring electrostatic potential

The electrostatic potential measurement procedure shall be as follows.

a) The measuring instruments and all samples are left in the environment before the measurement specified in B.2.4.

b) Set the electrostatic potential measurement system. Connect the measuring equipment to the ground point.

c) Turn on the power of the electrostatic potential measuring instrument specified in B.2.2.1 before starting the measurement.

d) The operator wears a wrist strap as specified in B.2.2.2 on the wrist. Connect the grounding conductor from the wrist strap securely to the ground point.

e) Clean the metal flat plate electrode specified in B.2.2.3 with the cleaning solvent specified in B.2.2.7 and dry in air for more than 5 min.

f) Fix the conductive double-sided tape specified in B.2.2.8 uniformly and firmly to the metal flat plate electrode specified in B.2.2.3.

g) Discharge the sample with the ionizer specified in B.2.2.6 by turning it on.

h) Align the end of the test piece of approximately 200 mm specified in B.2.3.2 with the end of the metal flat plate electrode and use a crimping jig specified in B.2.2.12 to fix the bottom of the test sample uniformly and firmly to the conductive double-sided tape fixed to the plate electrode as shown in Figure B.2.

i) Turn on the switch of the recording device specified in B.2.2.5. Turn off the power of the ionizer.

j) The operator shall hold the cover tape of the sample with an insulating clip, peel off the cover tape from the carrier tape under the conditions specified in B.2.5, and record the maximum value of the electrostatic potential measured by the electrostatic potential measuring instrument. The time transition waveform of the electrostatic potential displayed on the recording device is also recorded.

k) If multiple samples are measured, procedures e) to j) are repeated. The sample size is 3 or more.

l) After completion of all measurements, turn off all power switches.

B.2.7 Method for measuring the electrostatic charge decay performance

The measurement procedure of the electrostatic charge decay performance shall be as follows.

a) The measuring instruments and all samples are kept in the environment specified in B.2.4 before measurement.

b) Set the electrostatic potential measurement system. Connect the measuring equipment to the ground point.

c) Turn on the power of the electrostatic potential measuring instrument specified in B.2.2.1 before starting measurement.

d) The operator uses a wrist strap as specified in B.2.2.2 on the wrist. Connect the grounding conductor from the wrist strap securely to the ground point.

e) Clean the metal flat plate electrode specified in B.2.2.3 with the cleaning solvent specified in B.2.2.7 and dry it for more than 5 min.

f) Fix the conductive double-sided tape specified in B.2.2.8 uniformly and firmly to the metal flat plate electrode specified in B.2.2.3.

g) Discharge the sample with the ionizer specified in B.2.2.6 by turning it on.

h) Align the end of the 1 m test piece specified in B.2.2.3 with the end of the metal flat plate electrode as shown in Figure B.4, and fix the test sample uniformly and firmly to a conductive double-sided tape fixed to the plate electrode using a crimping jig specified in B.2.2.12. At this time, as shown in Figure B.3, the part protruding from the metal flat plate electrode is suspended from the top with an insulator, for example insulated string. specified in B.2.2.11, and to confirm the sample is insulated from the ground point (measuring instruments, walls, floors, etc.).

i) Turn on the power of the recording device specified in B.2.2.5. Turn off the power of the ionizer.

j) The operator shall charge the sample to more than 1 000 V with the electrostatic charger specified in B.2.2.9. The position to be charged is the part where the test sample is fixed to the metal flat plate electrode. After charging to more than 1 000 V, release the charger. Then connect the opposite end of the sample to the ground point, read and record the time taken for the electrostatic potential to decay from 1 000 V to 100 V, from the data shown on the equipment. The waveform displayed on the recording device shall also be recorded. Make measurements for both the positive and the negative charging conditions of the electrostatic charger.

k) If multiple samples are measured, procedures e) to j) are repeated. The sample size is 3 or more.

l) After completion of all measurements, turn off all power switches.

B.3 Items to be described in the test report and items to be specified in the related standards

B.3.1 Items to be described in the test report

The items described in the electrostatic potential and charge decay performance test score sheet should be shown as follows.

a) General:

   Test measurement date:

   Test measurement place:

   Measuring instrument name:

   Manufacturer:

   Model:

   Serial No:

   Calibration date:

   Name of measurer:

b) Description and identification of the sample material:

   1) Carrier Tape:

      Manufacturer Name:

      Name Model Number:

      Colour:

      Manufacture Date:

      Lot Number:

   2) Cover tape:

      Manufacturer name:

      Name model number:

      Colour:

      Manufacture date:

      Lot number:

   3) Bonding method of carrier tape and cover tape:

      Sealing machine:

      Setting conditions:

   4) Peeling strength between carrier tape and cover tape:

      Peeling strength measuring instrument:

      Peeling strength: N

   5) Presence or absence of surface mount components (SMD) in the sample:

      SMD item name (With or without):

      Dimension:

      Lot number:

c) Pre-treatment and test environment:

   1) Measurement condition:

      Temperature: °C;

      Humidity: %;

      Test time: h, min or s.

   2) Environment before measurement:

      Temperature: °C;

      Humidity: %;

   3) Standing time:

      From YYYY/MM/DD/TIME to YYYY/MM/DD/TIME, and total time

   4) Measurement environment:

      Temperature: °C;

      Humidity: %;

   5) Notes on the standing and measuring environment:

   6) Use detergent and standing time after washing:

d) Installation environment of measuring equipment and the status of measures against electrostatic of workers:

   1) Instrument grounding and capacitance: Ω, pF;

      Ionizer grounding status: Ω;

   2) Antistatic status of work bench;

      Existence of measures and ESD protection

   3) Floor anti-static condition of measurement work place;

   4) Combination of anti-static shoes and floor: V (at ground level)* Without wrist strap;

   5) Electrostatic potential when wearing the wrist strap of the worker: V (at ground level);

   6) Worker's clothes Surface potential: V.

e) Electrostatic measurement test conditions:

   1) Retraction speed;

   2) Retracting angle;

   3) Sample length: m, support material name: insulation resistance value: Ω;

   4) Sample number n (minimum 3): .

f) Electrostatic potential and electrostatic charge decay performance results

   The measurement chart is attached.

   1) Electrostatic potential measurement result:

      Maximum electrostatic potential: V, V, V;

      Average electrostatic potential: V.

   2) Electrostatic charge decay performance measurement results:

      The time for the electrostatic potential to decay from 1 000 V to 100 V: s, s, s;

      Average value: s.

B.3.2 Items specified in related standards

The matters specified in the relevant standards are as follows:

a) Pre-processing and measurement environment;

b) Measurement conditions (peeling speed and peeling angle);

c) Length of the sample used to measure electrostatic potential or to measure electrostatic charge decay performance;

d) Sample size.

Bibliography

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IEC 60068-2-45, *Basic environmental testing procedure – Part 2-45: Tests – Test XA and guidance: Immersion in cleaning solvents*

IEC 61340 (all parts), *Electrostatics*

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

ISO/IEC 16388, *Information technology – Automatic identification and data capture techniques – Code 39 bar code symbology specification*

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

ISO 16143-1:2004*, Stainless steels for general purposes – Part 1: Flat products*

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G. Gutman, S. Yau, R. Goetz, S. Koehn and D. Swenson, *A new Technology in Low Tribocharging Adhesives,* EOS/ESD Symposium, 1994, pages 230-236

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SOMMAIRE

COMMISSION ÉLECTROTECHNIQUE INTERNATIONALE

EMBALLAGE DE COMPOSANTS POUR OPÉRATIONS AUTOMATISÉES –

Partie 3: Emballage des composants pour montage en surface en bandes continues

AVANT-PROPOS

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L'IEC 60286-3 a été établie par le comité d'études 40 de l'IEC: Condensateurs et résistances pour équipements électroniques. Il s'agit d'une Norme internationale.

Cette septième édition annule et remplace la sixième édition parue en 2019. Cette édition constitue une révision technique.

Cette édition inclut les modifications techniques majeures suivantes par rapport à l'édition précédente:

a) ajout de termes et définitions;
b) ajout d'un tableau de classification des symboles relatifs au diamètre du trou d'entraînement et à la distance entre le centre de l'orifice de la bobine et le centre du trou d'entraînement;
c) ajout du trou d'entraînement par rapport à la bobine (facultatif);

d) révision des tolérances du diamètre de l'orifice de la bobine;
e) révision des tolérances de dimension de la largeur de la bande d'entraînement de 72 mm;
f) ajout de l'Annexe B (informative);
g) ajout de la taille de composant 0201M.

Le texte de cette Norme internationale est issu des documents suivants:

Projet	Rapport de vote
40/2972/FDIS	40/2984/RVD

Le rapport de vote indiqué dans le tableau ci-dessus donne toute information sur le vote ayant abouti à son approbation.

La langue employée pour l'élaboration de cette Norme internationale est l'anglais.

Une liste de toutes les parties de la série IEC 60268, publiée sous le titre général *Emballage de composants pour opérations automatisées*, peut être consultée sur le site Web de l'IEC.

Ce document a été rédigé selon les Directives ISO/IEC, Partie 2, il a été développé selon les Directives ISO/IEC, Partie 1 et les Directives ISO/IEC, Supplément IEC, disponibles sous www.iec.ch/members_experts/refdocs. Les principaux types de documents développés par l'IEC sont décrits plus en détail sous www.iec.ch/publications.

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INTRODUCTION

La mise sur bande correspond aux exigences des machines de placement automatique pour les composants, et couvre aussi l'utilisation de la mise sur bande des composants et des puces isolées pour des essais et autres opérations.

EMBALLAGE DE COMPOSANTS POUR OPÉRATIONS AUTOMATISÉES –

Partie 3: Emballage des composants pour montage en surface en bandes continues

1 Domaine d'application

La présente partie de l'IEC 60286 s'applique à la mise sur bande des composants électroniques sans fils de sortie ou avec tronçons de sortie destinés à être connectés à des circuits électroniques. Elle fournit uniquement les dimensions essentielles pour la mise sur bande des composants destinés aux opérations susmentionnées.

Le présent document inclut également des exigences relatives à l'emballage de produits à puce isolée incluant puces nues et puces à contact (puces retournées).

2 Références normatives

Les documents suivants sont cités dans le texte de sorte qu'ils constituent, pour tout ou partie de leur contenu, des exigences du présent document. Pour les références datées, seule l'édition citée s'applique. Pour les références non datées, la dernière édition du document de référence s'applique (y compris les éventuels amendements).

IEC 60191-2, *Normalisation mécanique des dispositifs à semiconducteurs – Partie 2: Dimensions*

IEC 61340-4-5, *Electrostatique – Partie 4-5: Méthodes d'essai normalisées pour des applications spécifiques – Méthodes de caractérisation de la protection électrostatique des chaussures et des revêtements de sol par rapport à une personne*

IEC 61340-4-6, *Electrostatique – Partie 4-6: Méthodes d'essai normalisées pour des applications spécifiques – Bracelets de conduction dissipative*

IEC 61340-4-7, *Electrostatique – Partie 4-7: Méthodes d'essai normalisées pour des applications spécifiques – Ionisation*

IEC 61340-4-9, *Electrostatique – Partie 4-9: Méthodes d'essai normalisées pour des applications spécifiques – Vêtements*

3 Termes, definitions et symboles

3.1 Termes et définitions

Pour les besoins du présent document, les termes et définitions suivants s'appliquent. Les définitions s'appliquent à tous les types, sauf mention spécifique.

L'ISO et l'IEC tiennent à jour des bases de données terminologiques destinées à être utilisées en normalisation, consultables aux adresses suivantes:

- IEC Electropedia: disponible à l'adresse https://www.electropedia.org/
- ISO Online browsing platform: disponible à l'adresse https://www.iso.org/obp

3.1.1
composant
partie électronique d'un produit qui ne peut pas être physiquement divisée en parties plus petites sans perdre sa fonction particulière

Note 1 à l'article: Cela inclut les produits à puce unique.

Note 2 à l'article: Cela est appliqué à tous les types d'emballages pour les puces nues isolées, sauf indication contraire.

3.1.2
taille de composant
taille du composant identifiée par son code de taille métrique

Note 1 à l'article: Ce code de taille est suivi par un M majuscule.

Note 2 à l'article: Pour éviter toute confusion possible avec les codes de taille en pouces, les équivalences sont données dans le Tableau 1.

Tableau 1 – Codes de taille des composants

Code de taille métrique	Code de taille en pouces
0201M	008004
0402M	01005
0603M	0201
1005M	0402
1608M	0603
2012M	0805

3.1.3
emballage
produit composé de n'importe quel matériau de n'importe quelle nature destiné à être utilisé pour le confinement, la protection, l'alignement structuré pour un montage automatisé, la manutention et la livraison

3.1.4
bande d'entraînement formée à la presse
<type 1b> bande d'entraînement présentant des cavités concaves formées par compression du matériau de base

3.1.5
peluche
<type 1b> fibre du matériau de base attachée à l'intérieur de la cavité

Note 1 à l'article: Voir Figure 1.

3.1.6
bavure
<type 1b> saillie en surface d'une bande produite accidentellement pendant la formation d'une cavité

Note 1 à l'article: Voir Figure 1.

3.1.7
déformation
<type 1b> renflement sur la paroi interne de la cavité

Note 1 à l'article: Voir Figure 1.

3.1.8
boursouflure

<type 1b> renflement sur le côté externe de la cavité

Note 1 à l'article: Voir Figure 1.

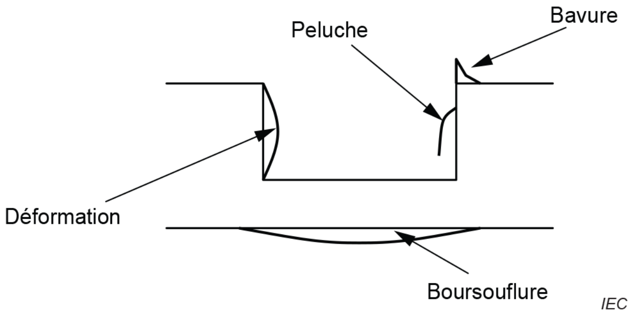


Figure 1 – Vue en coupe de la cavité du composant (type 1b)

3.1.9
bande d'entraînement gaufrée
bande d'entraînement estampée

bande d'entraînement identifiée comme faisant partie du type 2a, du type 2b et du type 3

3.1.10
bande d'entraînement perforée

<type 1a> bande d'entraînement dont les cavités concaves sont formées en perçant un trou sur le matériau de base et en recouvrant le fond avec la bande de couverture

3.2 Symboles

Les symboles utilisés dans le présent document sont répertoriés dans le Tableau 2.

Tableau 2 – Classification des symboles concernant les bandes, les bobines et les symboles courants

Symboles	Définitions	Références des figures
A	Diamètre de la bobine	26
A_0	Dimension du fond de la cavité dans le sens de déroulement	2, 4, 5, 7, 8, 10, 11, 13, 14, 16, 20 et A.2
B	Largeur de la rainure pour la clavette d'entraînement	27
B_0	Dimension du fond de la cavité dans le sens de la largeur de bande	2, 4, 5, 7, 8, 10, 11, 13, 14, 16, 20 et A.2
B_1	Rebord de la cavité dans le sens de la largeur de bande	8, 11 et 14
C	Diamètre de l'orifice de la bobine	26 et 27
C_T	Distance de la boursouflure sous la cavité dans le sens de la largeur de bande	5
d	Différence de diamètre entre le trou d'entraînement et le trou rond	14
D	Diamètre de la fente d'entraînement de la bobine	27
D_0	Diamètre du trou d'entraînement	2, 5, 8, 11, 14 et 17
D_1	Diamètre du trou au fond de la cavité	8 et 14
D_DH	Diamètre du trou d'entraînement	28

Symboles	Définitions	Références des figures
E_1	Distance minimale, dans le sens de la largeur, entre le point d'origine d'un trou d'entraînement rond et le bord d'une face de la bande	2, 5, 8, 11, 14 et 17
E_2	Distance maximale, dans le sens de la largeur, entre le point d'origine d'un trou d'entraînement rond et le bord d'une face de la bande	2, 5, 8 et 11
F	Distance, dans le sens de la largeur, entre le point d'origine d'un trou d'entraînement rond et le centre de la cavité	2, 5, 8, 11 et 14
F_A	Distance, dans le sens de la largeur, entre le point d'origine d'un trou d'entraînement rond et le centre du compartiment	17, 19, 24 et 25
G	Distance minimale, dans le sens de la largeur, entre la cavité et le bord d'une face de la bande	2, 5, 8, 11 et 17
K_0	Profondeur de la cavité	2, 5, 8,11, 14 et A.3
M	Distance entre le centre de l'orifice de la bobine et le centre du trou d'entraînement	28
N	Diamètre du mandrin	26
P_0	Pas des trous d'entraînement	2, 3, 5, 6, 8, 9, 11, 14 et 17
P_1	Pas de la cavité	2, 3, 5, 6, 8, 9, 11, 14, 17 et 18
P_2	Pas entre le centre d'une cavité aligné sur le point d'origine d'un trou d'entraînement rond et le centre de la cavité suivante, dans le sens de déroulement	2, 3, 5, 6, 8, 9, 11 et 14
$P_{2\mathrm{A}}$	Pas entre la ligne centrale du point d'origine d'un trou d'entraînement rond et la ligne centrale du compartiment, dans le sens de déroulement	17, 18, 19, 24 et 25
P_3	Pas entre le centre d'une cavité aligné sur le point d'origine d'un trou d'entraînement rond et le centre de la deuxième cavité, dans le sens de déroulement	3 et 6
P_4	Pas entre le centre d'une cavité aligné sur le point d'origine d'un trou d'entraînement rond et le centre de la troisième cavité, dans le sens de déroulement	3 et 6
S	Pas du trou d'entraînement dans le sens de la largeur	14
R	Rayon de cintrage de la bande d'entraînement	21
r	Rayon de courbure de la rainure pour la clavette d'entraînement	27
T	Épaisseur de la bande d'entraînement sans bande de couverture	2, 5, 8, 11, 14, 17, 25 et A.1
T_1	Épaisseur de la bande de couverture supérieure	2, 5, 8, 11 et 14
T_2	Somme de la hauteur externe de la cavité et de l'épaisseur de la bande de couverture	8, 11 et 14
T_3	Épaisseur de la bande d'entraînement formée à la presse avec le renflement	5 et A.1
T_4	Épaisseur de la bande de couverture inférieure ou épaisseur de la bande adhésive	2 et 17
V_1	Dimension du compartiment dans le sens de déroulement	17 et 18
V_2	Dimension du compartiment dans le sens de la largeur	17 et 18
W	Largeur de la bande d'entraînement	2, 5, 8, 11, 14 et 17
W_P	Distance entre les bandes adhésives	17
W_1	Largeur intérieure de la bobine (mesurée au niveau du mandrin)	26
W_2	Largeur extérieure de la bobine	26
W_3	Largeur intérieure de la bobine au niveau du rebord	26
Z	Épaisseur du composant	25

4 Structure de la spécification

Les différents types de bandes sont les suivants.

Type 1 – Bande d’entraînement perforée et formée à la presse

- **Type 1a:** Bande d’entraînement perforée, avec bande de couverture inférieure et supérieure (largeurs de bande: 8 mm et 12 mm)
- **Type 1b:** Bande d’entraînement formée à la presse, avec bande de couverture supérieure (largeur de bande: 8 mm)

Type 2 – Bande d’entraînement gaufrée, avec trous d’entraînement ronds simples

- **Type 2a:** Bande d’entraînement gaufrée, avec trous d’entraînement ronds simples, une bande de couverture supérieure et des pas de bande jusqu’à 2 mm (largeurs de bande: 8 mm, 12 mm, 16 mm et 24 mm)
- **Type 2b:** Bande d’entraînement gaufrée, avec trous d’entraînement ronds simples, une bande de couverture supérieure et un pas de bande de 1 mm (largeurs de bande: 4 mm)

Type 3 – Bande d’entraînement gaufrée, avec trous d’entraînement doubles (largeurs de bande: 32 mm à 200 mm)

Type 4 – Bande d’entraînement en plastique perforée et adhésive pour puce nue isolée et autres composants pour montage en surface (largeurs de bande: 8 mm, 12 mm, 16 mm et 24 mm)

5 Exigences dimensionnelles pour la mise sur bande

5.1 Exigences sur le positionnement des cavités de composants

5.1.1 Exigences pour le type 1a, le type 1b, le type 2a, le type 2b et le type 3

Pour le positionnement défini d’un composant, la cavité doit être définie à un point d’origine. L’origine est le centre du trou d’entraînement rond, défini par le pointeur en croix des dimensions E_1 et P_0. Le centre du compartiment doit être défini par P_2 et F, par rapport au trou d’entraînement rond (voir Figure 2, Figure 5, Figure 8, Figure 11 et Figure 14). Lorsque la dimension P_1 est inférieure ou égale à 2 mm, le décalage de logement maximal autorisé, par rapport au centre du trou d’entraînement rond, doit être appliqué (voir Figure 3, Figure 6, Figure 9 et Figure 12).

5.1.2 Exigences pour le type 4

Pour le positionnement défini d’un composant, le placement et l’emplacement du composant doivent être définis par rapport à un point d’origine. L’origine est le centre du trou d’entraînement, défini par le pointeur en croix des dimensions E_1 et P_0. Le centre de l’emplacement du composant doit être défini par P_{2A} et F_A, par rapport au trou d’entraînement (voir Figure 17). Le type 4 ne possède pas de cavités utilisées pour positionner les composants. Ainsi, il convient d’effectuer l’ensemble des mesures de position conformément au principe défini ici et non aux compartiments ou "logements" qui constituent des frontières virtuelles uniquement destinées à la protection des composants. Le terme "décalage de logement" ne s’applique pas au type 4. Les points suivants s’appliquent au type 4:

a) le mouvement latéral et la rotation du composant sont définis par la précision à laquelle le composant a été placé dans le compartiment, par rapport à la cible;

b) le composant ne doit pas dépasser la surface supérieure de la bande d'entraînement (voir Figure 25a);

c) les composants ne doivent pas changer d'orientation à l'intérieur de la bande;

d) le composant doit pouvoir être retiré verticalement de la cavité ou du compartiment sans restriction mécanique.

5.2 Exigences sur les dimensions des cavités des composants (type 1a, type 1b, type 2a, type 2b et type 3)

La taille de la cavité du composant, y compris les tolérances applicables, dépend des dimensions du composant auquel s'applique l'emballage pour assurer que le composant est bien protégé et que les mouvements d'inclinaison, de rotation et latéraux du composant sont conformes aux exigences décrites pour chaque type de bande. Les exigences suivantes s'appliquent au type 1a, au type 1b, au type 2a, au type 2b et au type 3:

a) dimension A_0 ≤ dimension B_0, sauf indication contraire dans la spécification particulière du composant;

b) les dimensions minimales et maximales du composant doivent être prises dans la spécification particulière du composant;

c) le composant ne doit pas dépasser la surface supérieure de la bande d'entraînement, sauf pour le type 1a où le composant ne doit dépasser aucune surface de la bande d'entraînement;

d) les composants ne doivent pas changer d'orientation à l'intérieur de la bande;

e) le composant doit pouvoir être retiré verticalement de la cavité ou du compartiment sans restriction mécanique, après que la bande de couverture supérieure a été enlevée, lorsqu'une bande de couverture est utilisée;

f) sauf indication contraire dans la spécification particulière, pour les bandes d'entraînement perforées, K_0 doit être égal à T. Pour les bandes formées à la presse ou gaufrées, K_0 doit être défini dans chaque spécification particulière.

5.3 Type 1a – Bande d'entraînement perforée, avec bande de couverture inférieure et supérieure (largeurs de bande: 8 mm et 12 mm)

Pour les codes dimensionnels correspondants, voir les figures de la Figure 2 à la Figure 4 et les tableaux du Tableau 3 au Tableau 5.

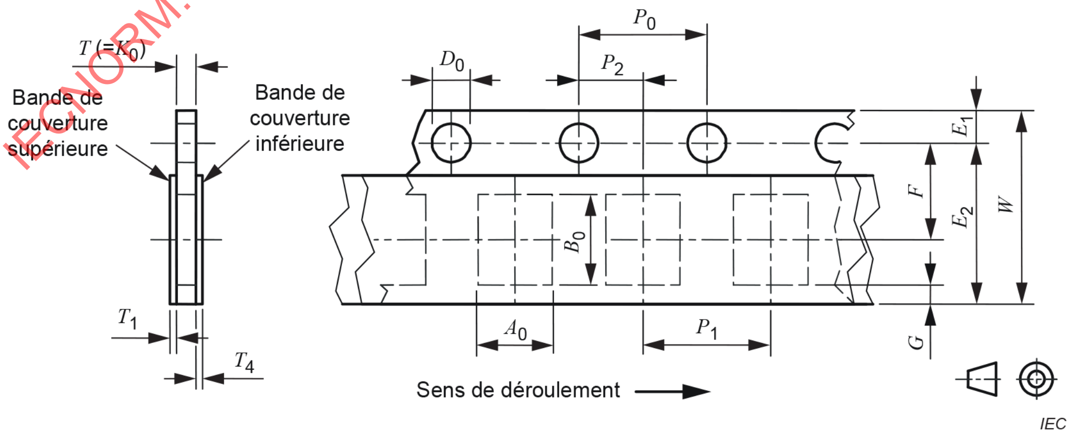
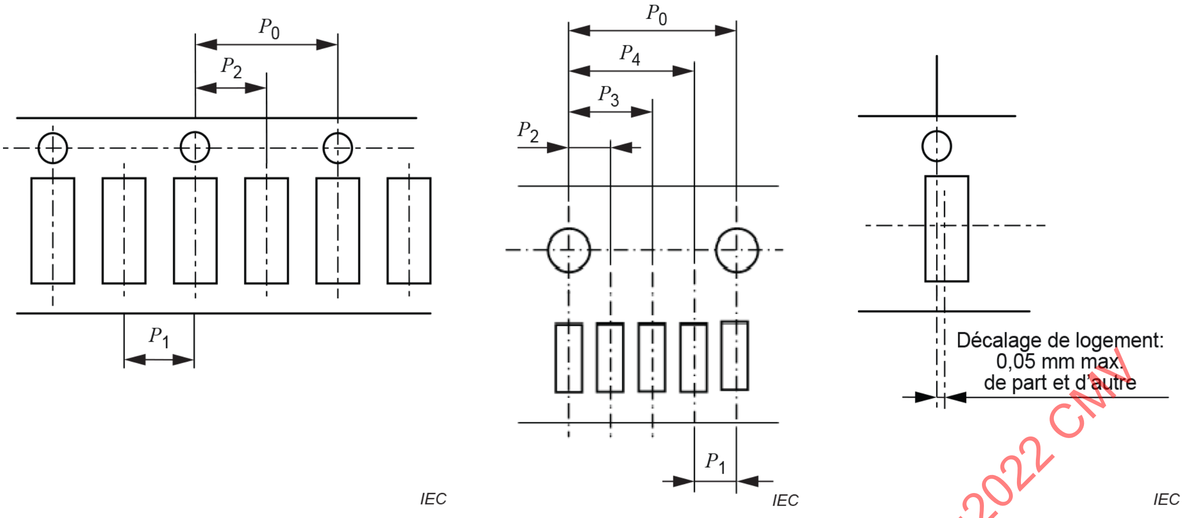
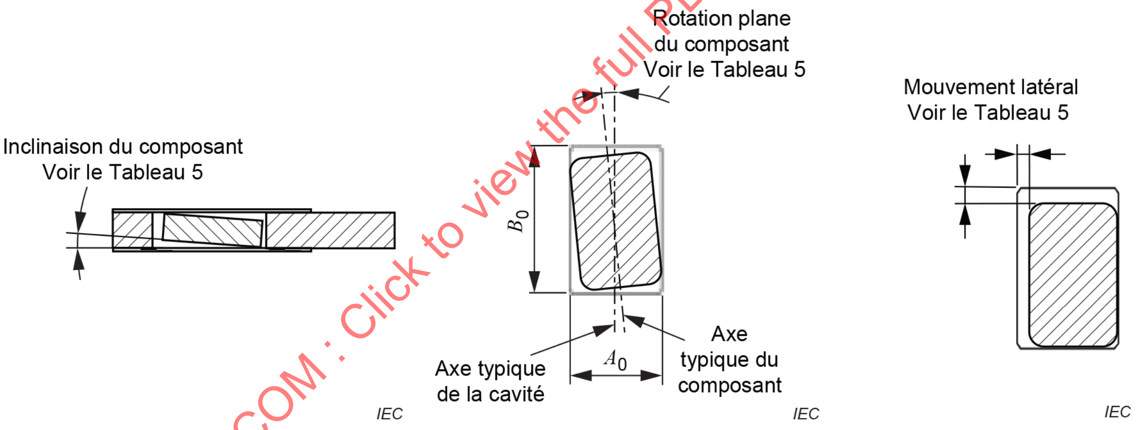


Figure 2 – Dimensions d'une bande d'entraînement perforée de 8 mm et 12 mm (pas de cavité 4 mm)



a) **Pas de cavité de 2 mm** b) **Pas de cavité de 1 mm** c) **Décalage de logement**

Figure 3 – Représentation du pas de cavité de 2 mm, du pas de cavité de 1 mm et du décalage de logement maximal



a) **Croquis A**
Inclinaison du composant
Vue de côté

b) **Croquis B**
Rotation plane du composant
Vue de dessus

c) **Croquis C**
Mouvement latéral
Vue de dessus

Figure 4 – Inclinaison, rotation et mouvement latéral maximaux du composant

Tableau 3 – Dimensions constantes d'une bande d'entraînement perforée de 8 mm et 12 mm

Dimensions exprimées en millimètres

Largeur de bande	D_0	E_1	P_0	G min.	T max.	T_1 max.	T_4 max.	Tolérance cumulée sur le pas P_0
8 et 12	$1{,}5\,^{+0{,}1}_{\ 0}$	1,75 ± 0,1	4,0 ± 0,1 ($P_1 \geq 4$) 4,0 ± 0,05 ($P_1 = 2$, $P_1 = 1$)	0,75	1,1 papier[a] 1,6 sans papier	0,1	0,1	± 0,2 pour 10 pas
Pour les codes dimensionnels correspondants, voir Figure 2.								

[a] Le papier est le matériau utilisé pour la bande d'entraînement perforée.

Tableau 4 – Dimensions variables d'une bande d'entraînement perforée de 8 mm et 12 mm

Dimensions exprimées en millimètres

Largeur de bande	E_2 min.	F	P_1	P_2	P_3	P_4	W	A_0, B_0 et K_0
8	6,25	3,5 ± 0,05	1,0 ± 0,05 ($P_1 = 1$)	1,0 ± 0,05 ($P_1 = 1$)	2,0 ± 0,05 ($P_1 = 1$)	3,0 ± 0,05 ($P_1 = 1$)	$8{,}0\,^{+0{,}3}_{-0{,}1}$	Voir 5.2
			2,0 ± 0,05 ($P_1 = 2$)	2,0 ± 0,05 ($P_1 = 2$)				
			4,0 ± 0,1 ($P_1 = 4$)	2,0 ± 0,05 ($P_1 = 4$)				
12	10,25	5,5 ± 0,05	2,0 ± 0,05 ($P_1 = 2$)	2,0 ± 0,05	–	–	$12{,}0\,^{+0{,}3}_{-0{,}1}$	
			4,0 ± 0,1 ($P_1 \geq 4$)					
Pour les codes dimensionnels correspondants, voir les figures de la Figure 2 à la Figure 4.								

Tableau 5 – Inclinaison, rotation plane et mouvement latéral du composant

Largeur de bande mm	Inclinaison du composant (valeur de conception) [a]	Rotation plane du composant (valeur de conception) [a]	Mouvement latéral mm
8 et 12	10° au maximum	20° au maximum	0,3 au maximum (P_1 = 1, P_1 = 2)
			0,5 au maximum ($P_1 \geq 4$)

Pour les codes dimensionnels correspondants, voir Figure 4.

Pour les composants dont la longueur ou la largeur est inférieure à 1,2 mm, la tendance pour la rotation plane admise des composants est de 10° au maximum.

Pour les composants dont la longueur ou la largeur est inférieure à 1,2 mm, la tendance du marché est un mouvement latéral de 0,2 mm au maximum.

Lorsque des produits à puce nue sont manipulés dans des largeurs de bande de 8 mm, il convient d'autoriser un mouvement latéral maximal de 0,1 mm pour n'importe quelle dimension de cavité.

Lorsque des produits à puce nue sont manipulés dans des largeurs de bande de 12 mm, il convient d'autoriser un mouvement latéral maximal de 0,15 mm pour n'importe quelle dimension de cavité.

[a] La valeur de conception est une valeur calculée à des fins de conception uniquement. Par exemple, l'inclinaison du composant n'est pas destinée à être mesurée. Il s'agit de la valeur calculée destinée à la conception du logement dans une bande d'entraînement.

5.4 Type 1b – Bande d'entraînement formée à la presse, avec bande de couverture supérieure (largeur de bande: 8 mm)

Pour les codes dimensionnels correspondants, voir les figures de la Figure 5 à la Figure 7 et les tableaux du Tableau 6 au Tableau 8.

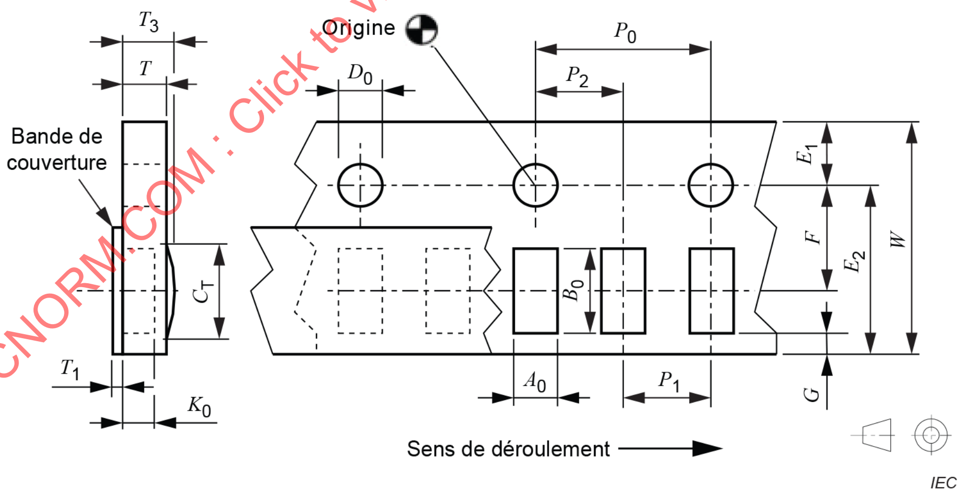
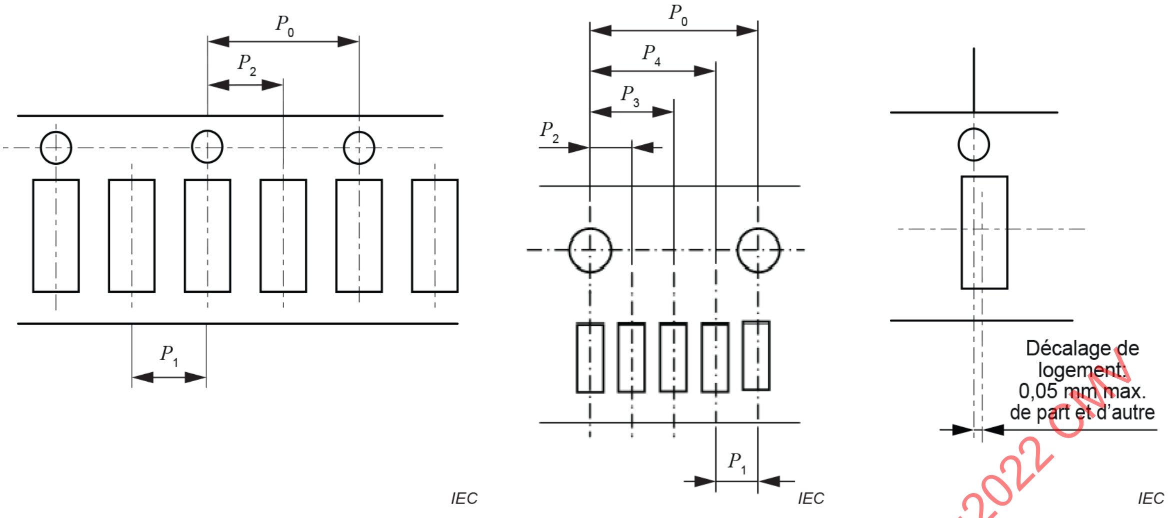
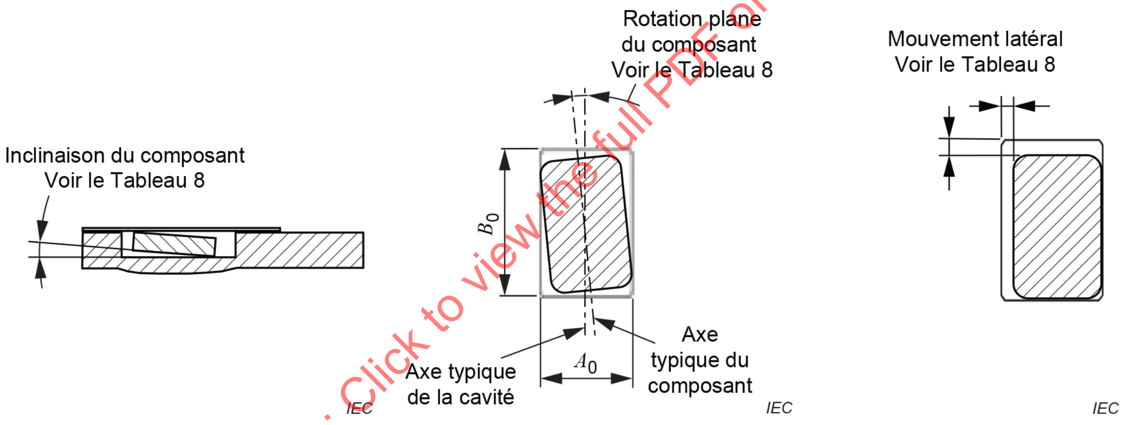


Figure 5 – Dimensions (P_0 = 4 mm/P_1 = 2 mm) et (P_0 = 4 mm/P_1 = 1 mm)



a) Pas de cavité de 2 mm **b) Pas de cavité de 1 mm** **c) Décalage de logement**

Figure 6 – Représentation du pas de cavité de 2 mm, du pas de cavité de 1 mm et du décalage de logement maximal



a) Croquis D
Inclinaison du composant
Vue en coupe de côté ou de face

b) Croquis E
Rotation plane du composant
Vue de dessus

c) Croquis F
Mouvement latéral
Vue de dessus

Figure 7 – Inclinaison, rotation et mouvement latéral maximaux du composant

Tableau 6 – Dimensions constantes d’une bande d’entraînement formée à la presse de 8 mm

Dimensions exprimées en millimètres

Largeur de bande	D_0 [a]	E_1	G min.	P_0	T max.	T_1 max.	T_3-T [b] max.	Tolérance cumulée sur le pas P_0
8	$1,5^{+0,1}_{0}$	1,75 ± 0,1	0,75	4,0 ± 0,1	1,1	0,1	0,1	± 0,1 pour 10 pas

Pour les codes dimensionnels correspondants, voir Figure 5 et Figure 6.

[a] Si une précision de positionnement est exigée, par exemple lorsque des composants de taille ≤ 1005M sont montés dans un espace réduit, alors il convient que la tolérance sur D_0 soit +0,05 / -0,00 mm.

[b] Pour les composants de taille 1005M ou inférieure, il convient de limiter la boursouflure ($T_3 - T$) à 0,05 mm au maximum.

Tableau 7 – Dimensions variables d’une bande d’entraînement formée à la presse de 8 mm

Dimensions exprimées en millimètres

Largeur de bande	C_T max.	E_2 min.	F	P_1	P_2	P_3	P_4	W	A_0, B_0 et K_0
8	4,35	6,25	3,5 ± 0,05	1,0 ± 0,05 (P_1 = 1)	1,0 ± 0,05 (P_1 = 1)	2,0 ± 0,05 (P_1 = 1)	3,0 ± 0,05 (P_1 = 1)	$8,0^{+0,3}_{-0,1}$	Voir 5.2
				2,0 ± 0,05 (P_1 = 2)	2,0 ± 0,05 (P_1 = 2)				
				4,0 ± 0,1 (P_1 = 4)	2,0 ± 0,05 (P_1 = 4)				

Pour les codes dimensionnels correspondants, voir Figure 5 à Figure 7.

Tableau 8 – Inclinaison, rotation plane et mouvement latéral du composant

Largeur de bande mm	Inclinaison du composant (valeur de conception) [a]	Rotation plane du composant (valeur de conception) [a]	Mouvement latéral mm
8	20° au maximum	20° au maximum	0,12 au maximum (taille de composant ≤ 0603M)
			0,20 au maximum (taille du composant 1005M)
			0,30 au maximum (taille de composant ≥ 1608M)

Pour la représentation correspondante, voir Figure 7.

[a] La valeur de conception est une valeur calculée à des fins de conception uniquement. Par exemple, l’inclinaison du composant n’est pas destinée à être mesurée. Il s’agit de la valeur calculée destinée à la conception du logement dans une bande d’entraînement.

5.5 Type 2a – Bande d'entraînement gaufrée, avec trous d'entraînement ronds simples et des pas de bande jusqu'à 2 mm (largeurs de bande: 8 mm, 12 mm, 16 mm et 24 mm)

Pour les codes dimensionnels correspondants, voir les figures de la Figure 8 à la Figure 10 et les tableaux du Tableau 9 au Tableau 11.

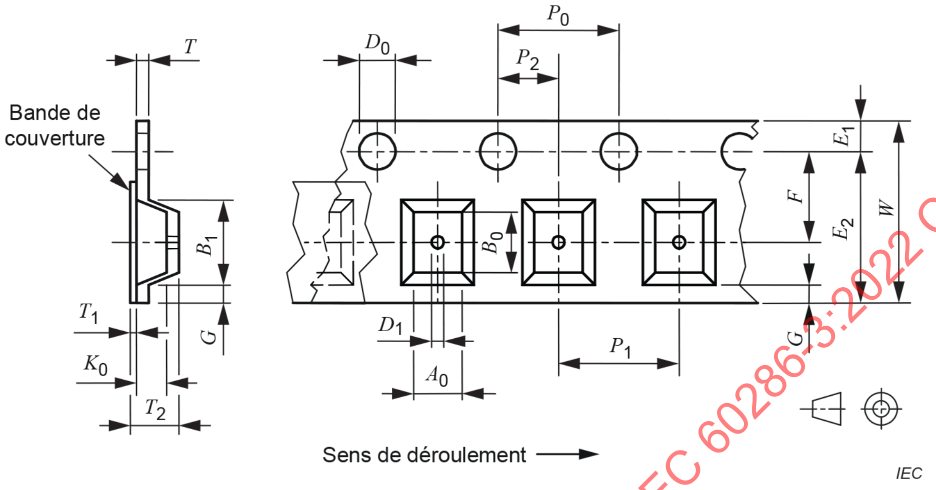
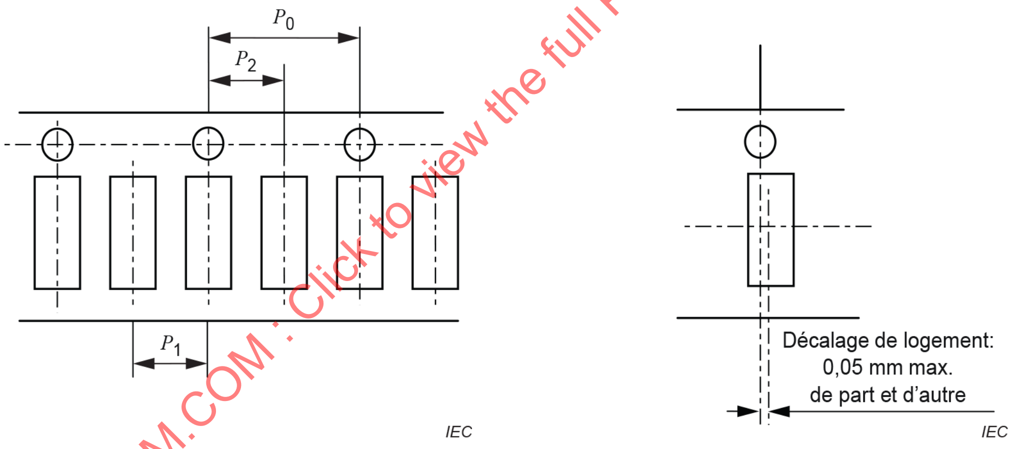


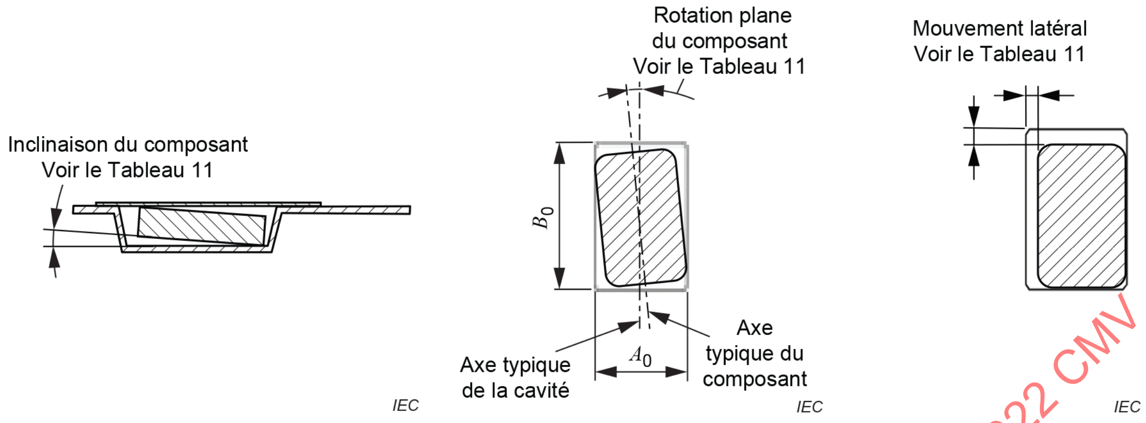
Figure 8 – Dimensions d'une bande d'entraînement gaufrée (8 mm, 12 mm, 16 mm et 24 mm)



a) **Pas de cavité de 2 mm**

b) **Décalage de logement**

Figure 9 – Représentation du pas de cavité de 2 mm et du décalage de logement



a) Croquis G
Inclinaison du composant
Vue en coupe de côté ou de face

b) Croquis H
Rotation plane du composant
Vue de dessus

c) Croquis I
Mouvement latéral
Vue de dessus

Figure 10 – Inclinaison, rotation et mouvement latéral maximaux du composant

Tableau 9 – Dimensions constantes d'une bande d'entraînement gaufrée de 8 mm à 24 mm

Dimensions exprimées en millimètres

Largeur de bande	D_0	E_1	G min.	P_0	T max.	T_1 max.	Tolérance cumulée sur le pas P_0
8 à 24	$1,5^{+0,1}_{0}$	1,75 ± 0,1	0,75	4,0 ± 0,1 (P_1 ≥ 4)	0,6	0,1	± 0,2 pour 10 pas
				4,0 ± 0,05 (P_1 = 2)			
Pour les codes dimensionnels correspondants, voir Figure 8 et Figure 9.							

Tableau 10 – Dimensions variables d'une bande d'entraînement gaufrée de 8 mm à 24 mm

Dimensions exprimées en millimètres

Largeur de bande	B_1 max.	D_1 [a] min.	E_2 min.	F	P_1	P_2	T_2 max.	W	A_0, B_0 et K_0
8	4,35	0,3	6,25	3,5 ± 0,05	2,0 ± 0,05 4,0 ± 0,1	2,0 ± 0,05	3,5	$8,0^{+0,3}_{-0,1}$	Voir 5.2
12	8,2	1,5	10,25	5,5 ± 0,05	2,0 ± 0,05 4,0 ± 0,1 à 12,0 ± 0,1 par incréments de 4,0	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 à 16,0 ± 0,1 par incréments de 4,0	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 à 24,0 ± 0,1 par incréments de 4,0	2,0 ± 0,1	12,5	$24,0^{+0,3}_{-0,1}$	

Pour les codes dimensionnels correspondants, voir les figures de la Figure 8 à la Figure 10.

[a] (facultatif) Pour faciliter et optimiser le retrait du composant ou pour inspecter le composant pour n'importe quelle application applicable, le centre du fond de la cavité peut comporter un trou.

Tableau 11 – Inclinaison, rotation et mouvement latéral du composant

Largeur de bande mm	Inclinaison du composant (valeur de conception) [a]	Rotation plane du composant (valeur de conception) [a]	Mouvement latéral mm
8 et 12	10° au maximum	20° au maximum	0,5 au maximum
16 et 24	10° au maximum	10° au maximum	0,5 au maximum

Pour la représentation correspondante, voir Figure 10.

Pour les composants dont la longueur ou la largeur est inférieure à 1,2 mm, la tendance pour la rotation plane admise des composants est de 10° au maximum.

Pour les composants dont la longueur ou la largeur est inférieure à 1,2 mm, la tendance du marché est un mouvement latéral de 0,2 mm au maximum.

Lorsque des produits à puce nue sont manipulés dans des largeurs de bande de 8 mm, il convient d'autoriser un mouvement latéral maximal de 0,1 mm pour n'importe quelle dimension de cavité.

Lorsque des produits à puce nue sont manipulés dans des largeurs de bande de 12 mm, il convient d'autoriser un mouvement latéral maximal de 0,15 mm pour n'importe quelle dimension de cavité.

[a] La valeur de conception est une valeur calculée à des fins de conception uniquement. Par exemple, l'inclinaison du composant n'est pas destinée à être mesurée. Il s'agit de la valeur calculée destinée à la conception du logement dans une bande d'entraînement.

5.6 Type 2b – Bande d'entraînement gaufrée, avec trous d'entraînement ronds simples et un pas de bande de 1 mm (largeurs de bande: 4 mm)

Pour les codes dimensionnels correspondants, voir les figures de la Figure 11 à la Figure 13 et les tableaux du Tableau 12 au Tableau 14.

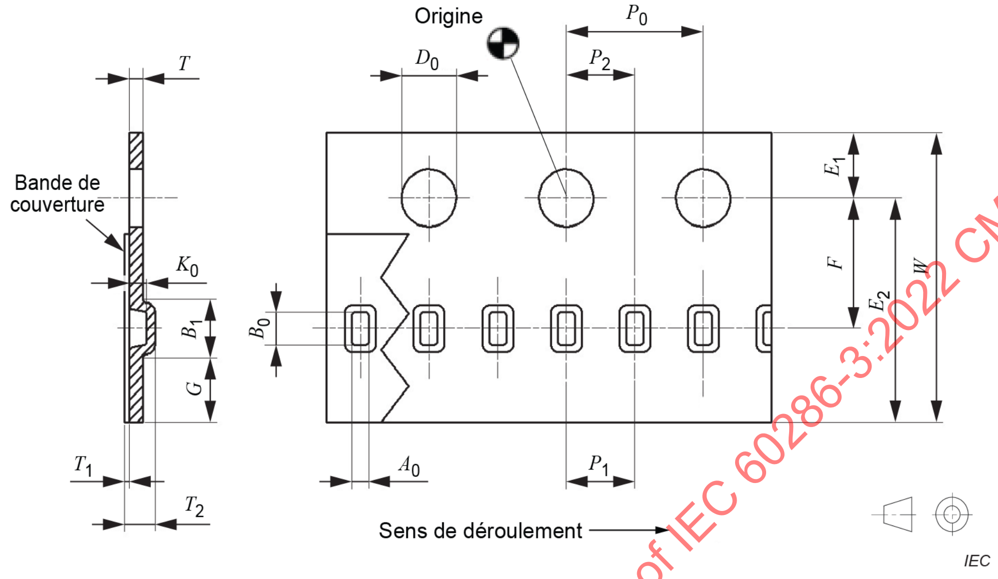


Figure 11 – Bande d'entraînement de type 2b

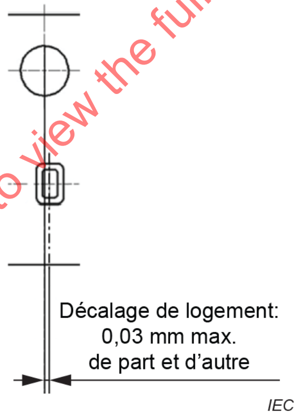
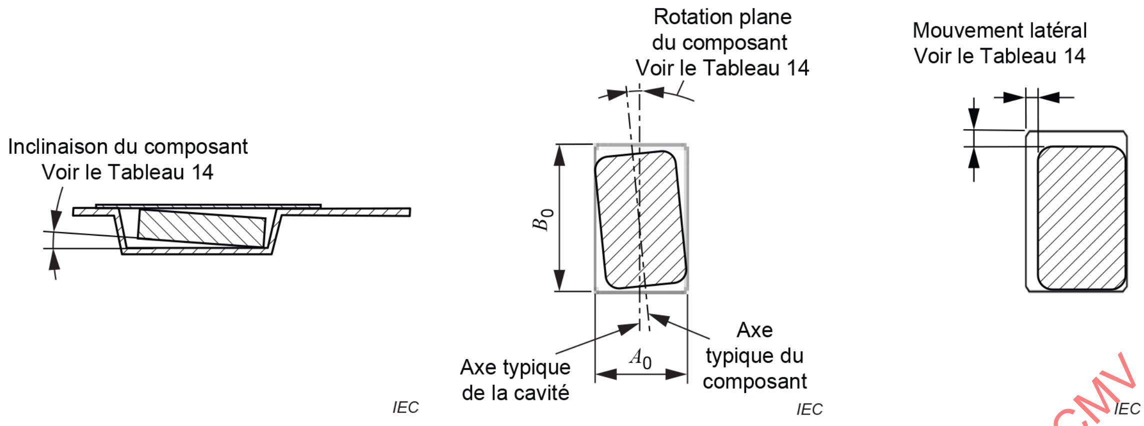


Figure 12 – Décalage de logement maximal



a) Croquis J
Inclinaison du composant
Vue en coupe de côté ou de face

b) Croquis K
Rotation plane du composant
Vue de dessus

c) Croquis L
Mouvement latéral
Vue de dessus

Figure 13 – Inclinaison, rotation et mouvement latéral maximaux du composant

Tableau 12 – Dimensions constantes d'une bande d'entraînement de 4 mm

Dimensions exprimées en millimètres

Largeur de bande	D_0	E_1	G min.	P_0	T min.	T max.	T_1 max.	Tolérance cumulée sur le pas P_0
4	0,80 ± 0,04	0,90 ± 0,05	0,50	2,00 ± 0,04	0,15	0,40	0,08	± 0,1 pour 20 pas
Pour les codes dimensionnels correspondants, voir Figure 11.								

Tableau 13 – Dimensions variables d'une bande d'entraînement de 4 mm

Dimensions exprimées en millimètres

Largeur de bande	B_1 max.	E_2 min.	F	P_1	P_2	T_2 max.	W	A_0, B_0 et K_0
4	1,48 [a]	3,07	1,8 ± 0,03	1,0 ± 0,03	1,0 ± 0,03	1,1	4,0 ± 0,08	Voir 5.2
Pour les codes dimensionnels correspondants, voir Figure 11 et Figure 13. [a] Dimension de référence.								

Tableau 14 – Inclinaison, rotation plane et mouvements latéraux du composant

Largeur de bande mm	Inclinaison du composant (valeur de conception) [a]	Rotation plane du composant (valeur de conception) [a]	Mouvement latéral mm
4	20° au maximum	20° au maximum	0,08 au maximum (taille de composant 0201M)
			0,10 au maximum (taille de composant 0402M)
			0,12 au maximum (taille du composant 0603M)
			0,20 au maximum (taille de composant > 0603M)

Pour la représentation correspondante, voir Figure 13.

[a] La valeur de conception est une valeur calculée à des fins de conception uniquement. Par exemple, l'inclinaison du composant n'est pas destinée à être mesurée. Il s'agit de la valeur calculée destinée à la conception du logement dans une bande d'entraînement.

5.7 Type 3 – Bande d'entraînement gaufrée, avec trous d'entraînement doubles (32 mm à 200 mm)

Pour les codes dimensionnels correspondants, voir les figures de la Figure 14 à la Figure 16 et les tableaux du Tableau 15 au Tableau 17.

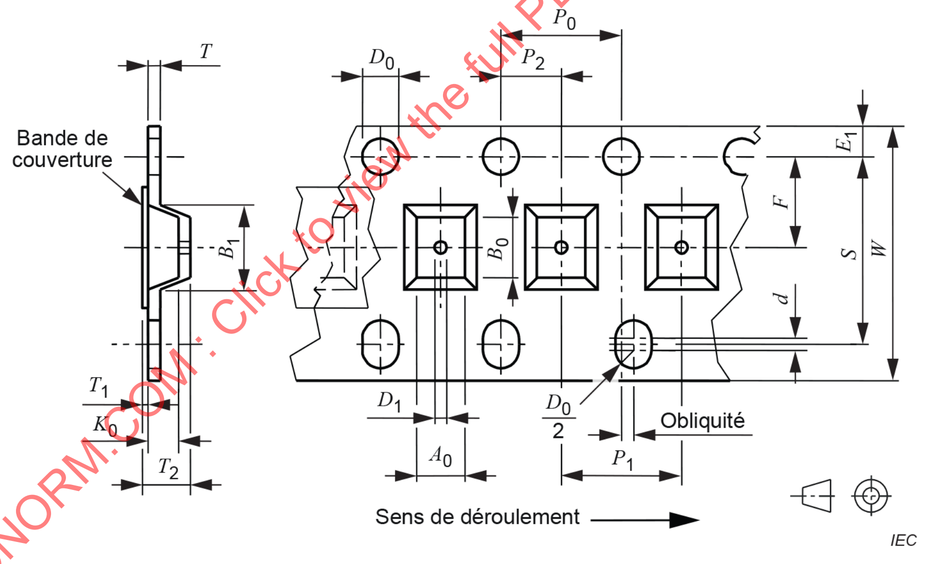


Figure 14 – Bande d'entraînement gaufrée

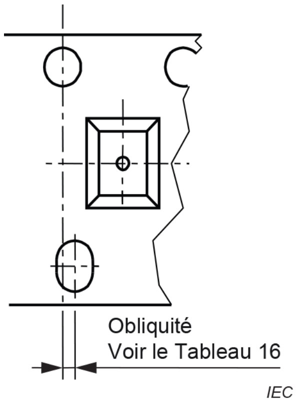
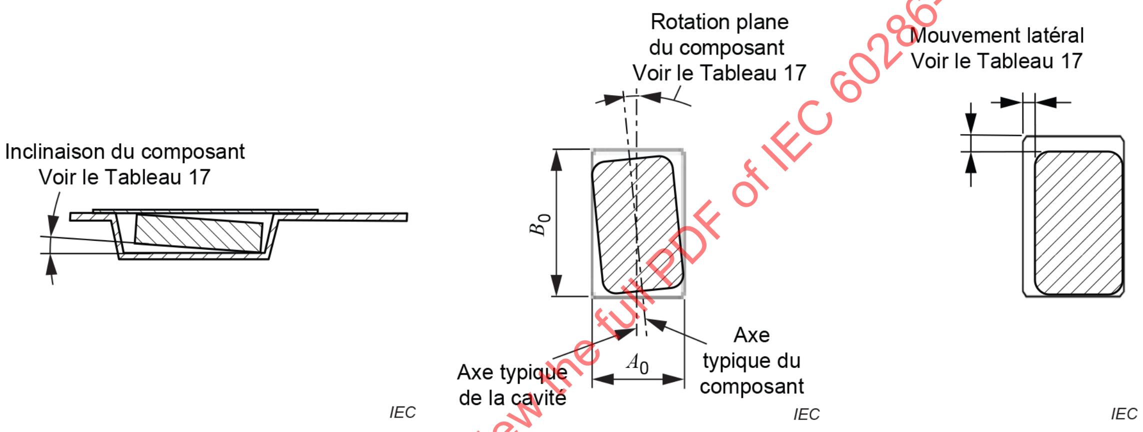


Figure 15 – Obliquité du trou d'entraînement allongé



a) Croquis M
Inclinaison du composant
Vue en coupe de côté ou de face

b) Croquis N
Rotation plane du composant
Vue de dessus

c) Croquis O
Mouvement latéral
Vue de dessus

Figure 16 – Inclinaison, rotation et mouvement latéral maximaux du composant

Tableau 15 – Dimensions constantes d'une bande d'entraînement gaufrée de 32 mm à 200 mm

Dimensions exprimées en millimètres

Largeur de bande	D_0	D_1[a] min.	d	E_1	P_0	T max.	T_1 max.	**Tolérance cumulée sur le pas P_0**
32 à 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 pour 10 pas

Pour les codes dimensionnels correspondants, voir Figure 14.

[a] (facultatif) Pour faciliter et optimiser le retrait du composant de son compartiment par une machine de prélèvement automatique, le centre du fond de la cavité peut comporter un trou.