BS EN 60286-3:2013

Incorporating corrigendum October 2013

BSI Standards Publication

Packaging of components for automatic handling

Part 3: Packaging of surface mount components on continuous tapes

National foreword

This British Standard is the UK implementation of EN 60286-3:2013, incorporating corrigendum October 2013. It is identical to IEC 60286-3:2013. It supersedes BS EN 60286-3:2007, BS EN 60286-3-1:2009 and BS EN 60286-3-2:2009, which are withdrawn.

The UK participation in its preparation was entrusted to Technical Committee EPL/40X, Capacitors and resistors for electronic equipment.

A list of organizations represented on this committee can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

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Compliance with a British Standard cannot confer immunity from legal obligations.

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Amendments/corrigenda issued since publication

Date	Text affected
30 November 2013	Implementation of CENELEC corrigendum October 2013: CENELEC foreword supersession information corrected

EUROPEAN STANDARD

NORME EUROPÉENNE

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August 2013

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Incorporating corrigendum October 2013

English version

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

(IEC 60286-3:2013)

Emballage de composants pour opérations automatisées - Partie 3: Emballage des composants pour montage en surface en bandes continues (CEI 60286-3:2013)

Gurtung und Magazinierung von Bauelementen für die automatische Verarbeitung - Teil 3: Gurtung von oberflächenmontierbaren Bauelementen auf Endlosgurten (IEC 60286-3:2013)

CENELEC

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

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Foreword

The text of document 40/2200/FDIS, future edition 5 of IEC 60286-3, prepared by IEC/TC 40 "Capacitors and resistors for electronic equipment" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN 60286-3:2013.

The following dates are fixed:

• latest date by which the document has to be implemented at national level by publication of an identical national standard or by endorsement	(dop)	2014-03-21
• latest date by which the national standards conflicting with the document have to be withdrawn	(dow)	2016-06-21

This document supersedes EN 60286-3:2007, EN 60286-3-1:2009 and EN 60286-3-2:2009.

EN 60286-3:2013 includes the following significant technical changes with respect to EN 60286-3:2007:

a) integration of EN 60286-3-1:2009 as type 1b (Packaging of surface mount components on continuous pressed carrier tapes);

b) integration of EN 60286-3-2:2009 as type 2b (Packaging of surface mount components on blister carrier tapes 4 mm in width).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CENELEC [and/or CEN] shall not be held responsible for identifying any or all such patent rights.

Endorsement notice

The text of the International Standard IEC 60286-3:2013 was approved by CENELEC as a European Standard without any modification.

In the official version, for Bibliography, the following notes have to be added for the standards indicated:

IEC 60286-3-1:2009	NOTE	Harmonised as EN 60286-3-1:2009 (not modified).
IEC 60286-3-2:2009	NOTE	Harmonised as EN 60286-3-2:2009 (not modified).
IEC/TR 62258-3	NOTE	Harmonised as CLC/TR 62258-3.
ISO 11469	NOTE	Harmonised as EN ISO 11469.

Annex ZA
(normative)

Normative references to international publications with their corresponding European publications

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

NOTE When an international publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

Publication	Year	Title	EN/HD	Year
IEC 60191-2	-	Mechanical standardization of semiconductor devices - Part 2: Dimensions	-	-
IEC 61340-5-1	-	Electrostatics - Part 5-1: Protection of electronic devices from electrostatic phenomena - General requirements	EN 61340-5-1	-
IEC/TR 61340-5-2	-	Electrostatics - Part 5-2: Protection of electronic devices from electrostatic phenomena - User guide	CLC/TR 61340-5-2	-

CONTENTS

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 General

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

1.2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. 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 61340-5-1, *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*

2 Terms and definitions

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

2.1
components
unless specifically mentioned otherwise, for all packaging types for bare die products, the term components refers to components as well as singulated die products

2.2
component sizes
all component sizes are identified with their metric size code (size code, followed by a capital M)

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

Table 1 – component size codes

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

2.3
packaging
product made of any material of any nature to be used for the containment, protection, structured alignment for automatic assembly, handling and delivery

2.4
pressed carrier tape
(type 1b) carrier tape with concave cavities formed by compression of the base material

2.5
fluff
(type 1b) fibre from the base material attached inside the cavity

SEE: Figure 1.

2.6
burr
(type 1b) surface projection of tape unintentially produced when cavity is formed

SEE: Figure 1.

2.7
deformation
(type 1b) bulge on the inner wall of the cavity

SEE: Figure 1.

2.8
puff
(type 1b) bulge on the reverse side of the cavity

SEE: Figure 1.

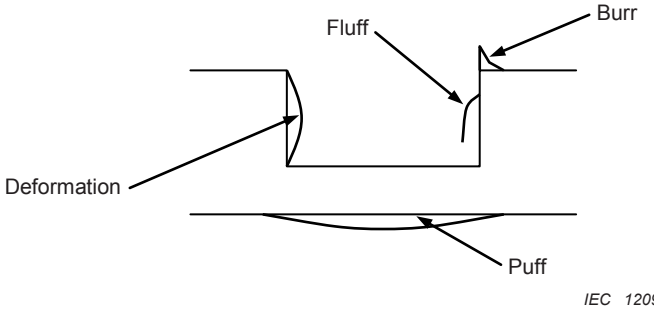

Figure 1 – Sectional view of component cavity (type 1b)

2.9
blister carrier tape
tape types 2a, 2b and 3 are identified as blister carrier tapes

Note 1 to entry: These types of carriers are also known as ‘embossed’ carrier types.

3 Structure of the specification

The various types of tapes are as follows.

NOTE 1 The separation of the prior type 1 into two sub-types 1a and 1b is new in this edition of this standard. Any reference to type 1 not being specific to type 1a or type 1b is considered as referring to type 1a.

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)

NOTE 2 The separation of the prior type 2 into two sub-types 2a and 2b is new in this edition of this standard. Any reference to type 2 not being specific to type 2a or type 2b is considered as referring to type 2a.

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)

4 Dimensional requirements for taping

4.1 Component cavity positioning requirements

4.1.1 Requirements for types 1a, 1b, 2a, 2b and 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 dimensions E_1 and P_0. The centre of the compartment shall be defined by P_2 and F, relative to the round sprocket hole. 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.

4.1.2 Requirements for types 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 dimensions E_1 and P_0. The centre of the component location shall be defined by P_{2A} and F_A,

relative to the sprocket hole. 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;

b) the component shall not protrude above the top surface of the carrier tape (see Figure 23, sketch R);

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.

4.2 Component cavity dimension requirements (tape types 1a, 1b, 2a, 2b and 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 types 1a, 1b, 2a, 2b and 3:

a) dimensions $A_0 \leq B_0$, 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.

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

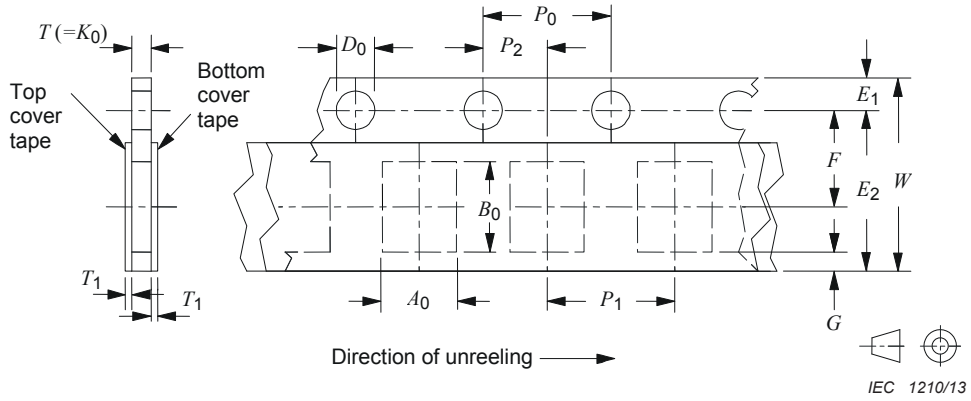

Figure 2 – 8 mm and 12 mm punched carrier-tape dimensions (4 mm cavity pitch)

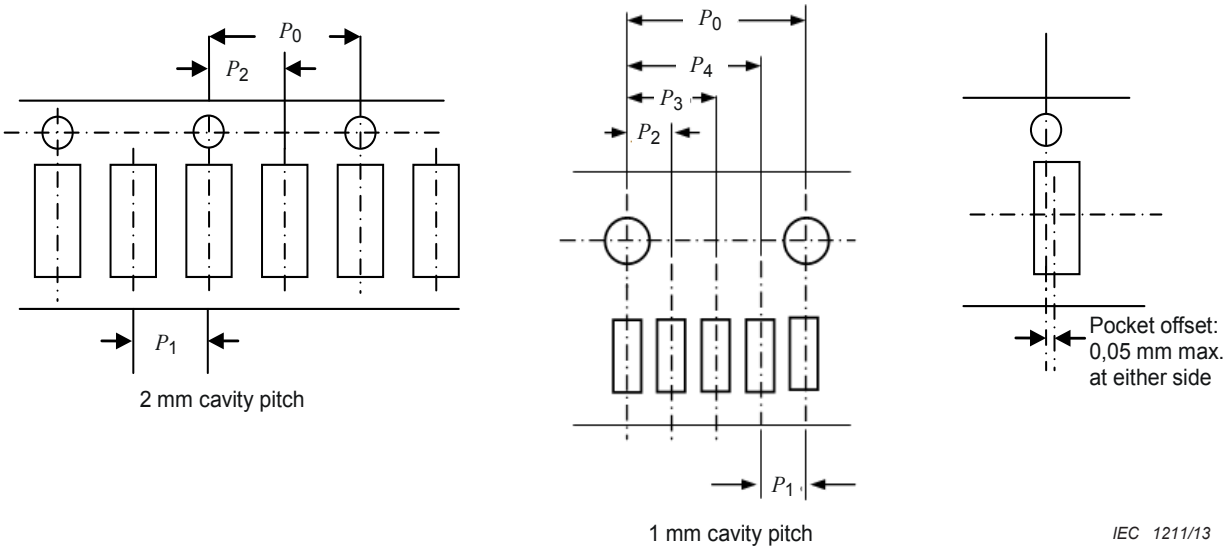

Figure 3 – Illustration of 2 mm and 1 mm cavity pitch and maximum pocket offset

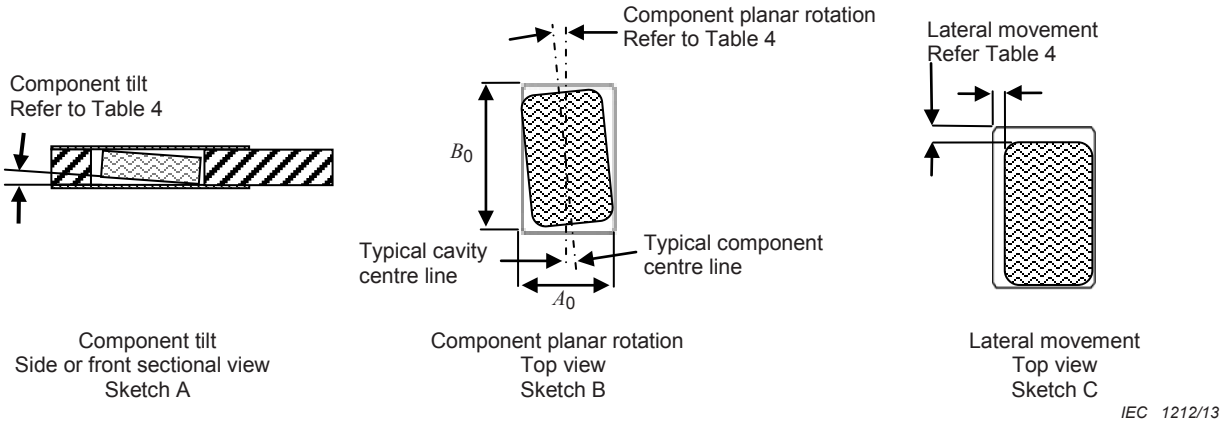

Figure 4 – Maximum component tilt, rotation and lateral movement

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

Tape size	D_0	E_1	P_0	G_{min}	T_{max}	T_{1max} (each T_1)	P_0 pitch cumulative tolerance
8 and 12	$1{,}5^{+0{,}1}_{0}$	1,75 ± 0,1	4,0 ± 0,1 ($P_1 \geq 4$) 4,0 ± 0,05 ($P_1 = 2$, $P_1 = 1$)	0,75	1,1 paper 1,6 non-paper	0,1	± 0,2 / 10 pitches

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

Tape size	$E_{2\,min}$	F	P_1	P_2	P_3	P_4	W	A_0, B_0, K_0
8	6,25	3,5 ± 0,05	1,0 ± 0,05 ($P_1 = 1$) 2,0 ± 0,05 ($P_1 = 2$) 4,0 ± 0,1 ($P_1 = 4$)	1,0 ± 0,05 ($P_1 = 1$) 2,0 ± 0,05 ($P_1 = 2$) 2,0 ± 0,05 ($P_1 = 4$)	2,0 ± 0,05 ($P_1 = 1$)	3,0 ± 0,05 ($P_1 = 1$)	$8{,}0^{+0{,}3}_{-0{,}1}$	See 4.2
12	10,25	5,5 ± 0,05	2,0 ± 0,05 ($P_1 = 2$) 4,0 ± 0,1 ($P_1 \geq 4$)	2,0 ± 0,05	–	–	$12{,}0^{+0{,}3}_{-0{,}1}$	

Table 4 – Component tilt, planar rotation and lateral movement

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

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 minimum 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 minimum lateral movement of 0,15 mm maximum for either cavity dimension should be allowed.

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

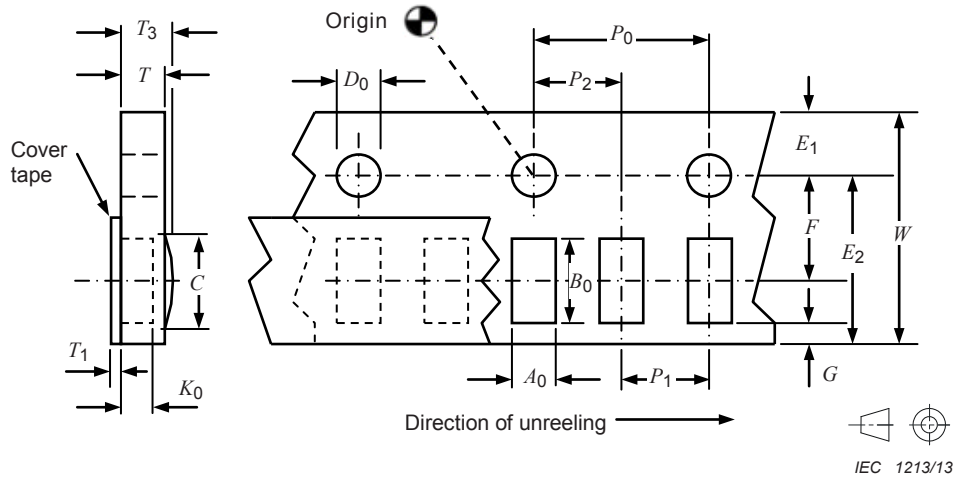

Figure 5 – Dimensions (P_0 = 4 mm/P_1 = 2 mm) and (P_0 = 4 mm/P_1 = 1 mm)

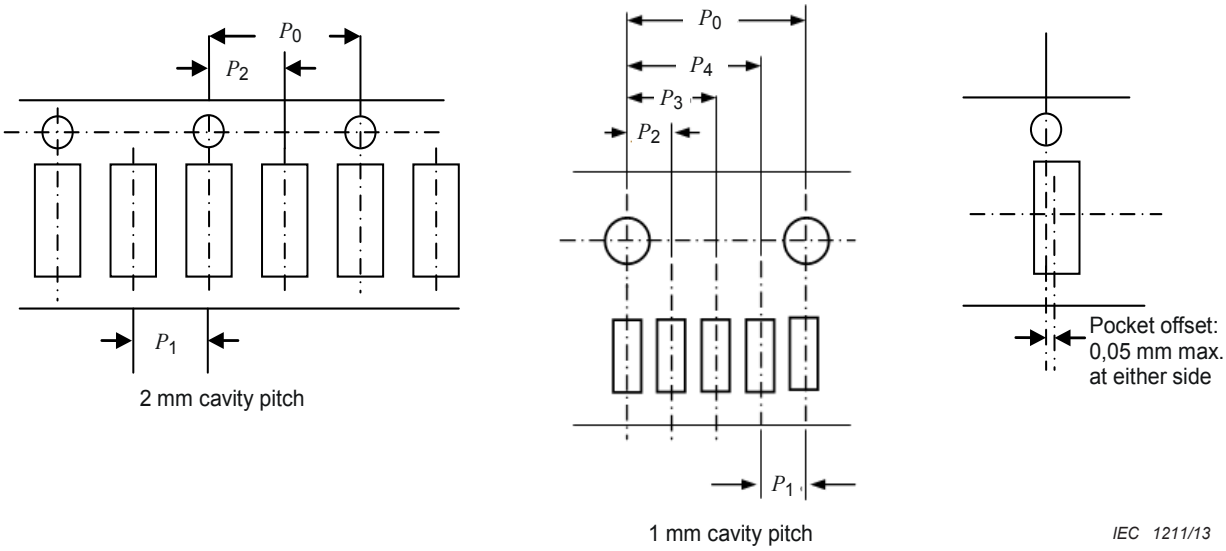

Figure 6 – Illustration of 2 mm and 1 mm cavity pitch and maximum pocket offset

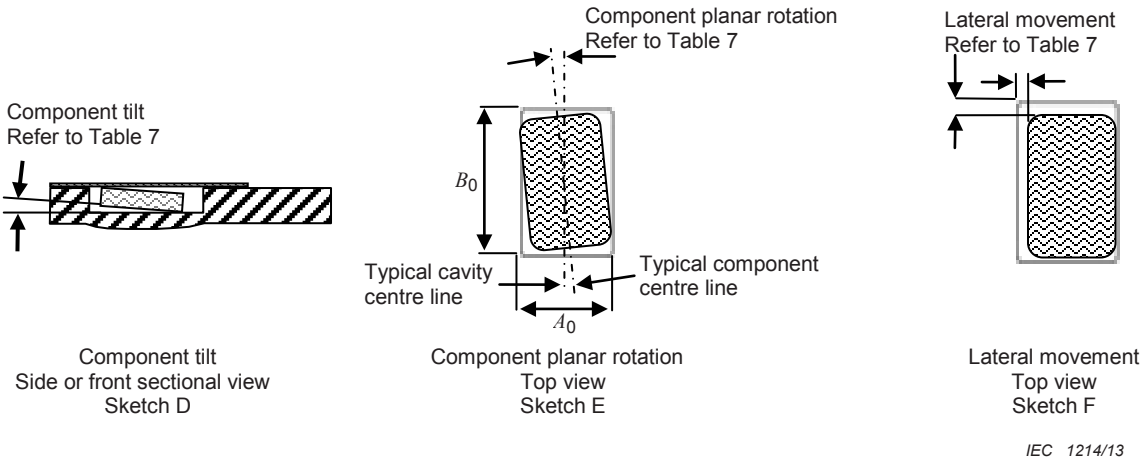

Figure 7 – Maximum component tilt, rotation and lateral movement

Table 5 – Constant dimensions of 8 mm pressed carrier tape

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

[a] If positioning precision is required, for example when components ≤ size 1005M are mounted in 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 6 – Variable dimensions of 8 mm pressed carrier tape

Tape size	$C_{max.}$	$E_{2\ min}$	F	P_1	P_2	P_3	P_4	W	A_0, B_0, K_0
8	4,35	6,25	3,5 ± 0,05	1,0 ± 0,05 (P_1 = 1) 2,0 ± 0,05 (P_1 = 2) 4,0 ± 0,1 (P_1 = 4)	1,0 ± 0,05 (P_1 = 1) 2,0 ± 0,05 (P_1 = 2) 2,0 ± 0,05 (P_1 = 4)	2,0 ± 0,05 (P_1 = 1)	3,0 ± 0,05 (P_1 = 1)	$8{,}0\ ^{+0{,}3}_{-0{,}1}$	See 4.2

Table 7 – Component tilt, planar rotation and lateral movement

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

4.5 Type2a – 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)

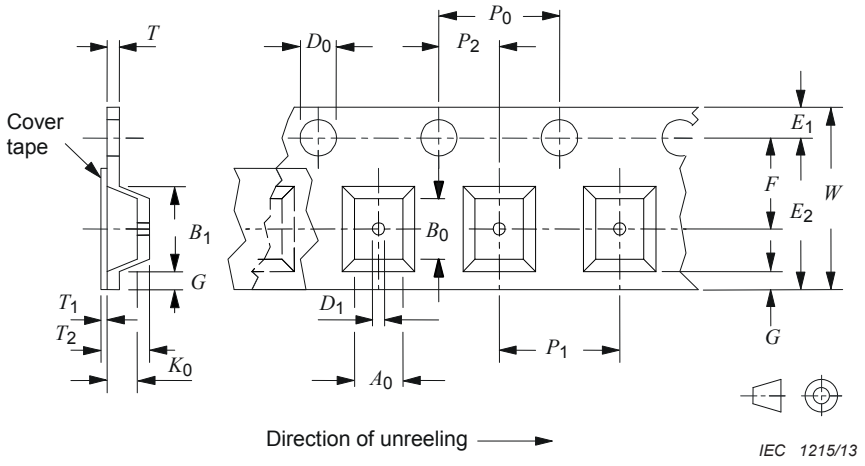

Figure 8 – Blister carrier tape dimensions (8 mm, 12 mm, 16 mm and 24 mm)

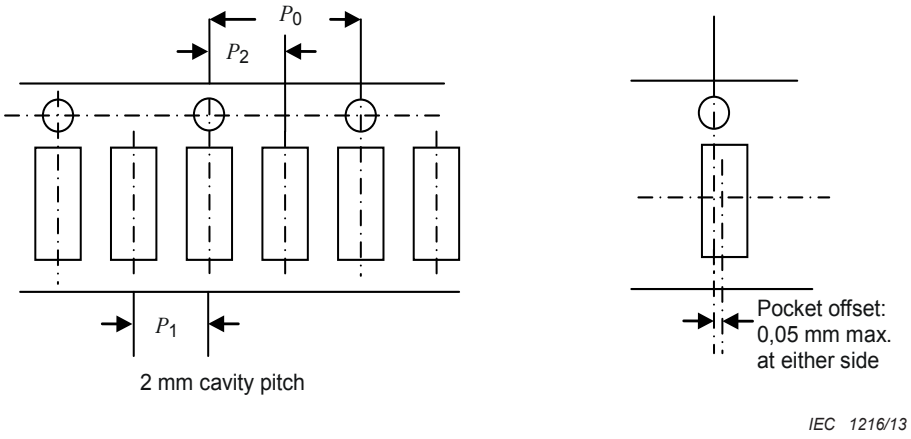

Figure 9 – Illustration of 2 mm cavity pitch and pocket offset

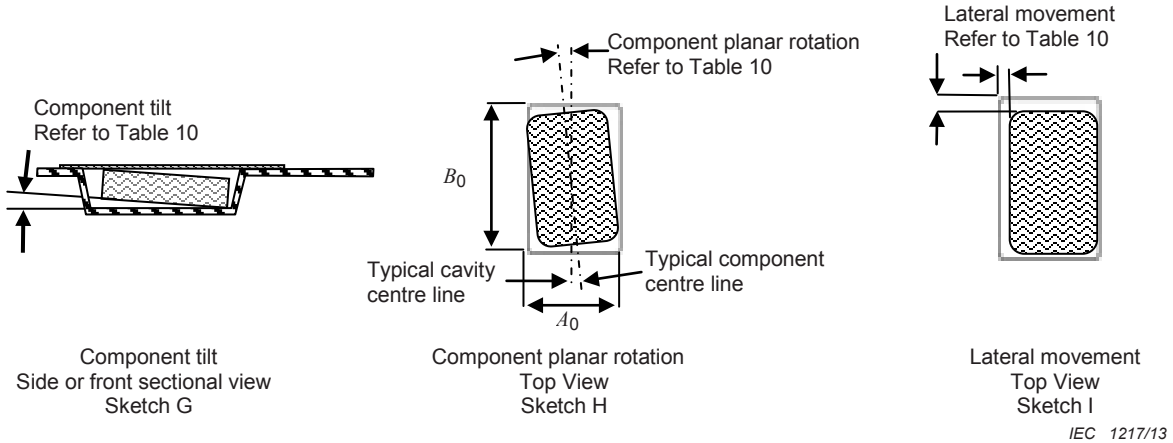

Figure 10 – Maximum component tilt, rotation and lateral movement

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

Tape size	D_0	E_1	G_{min}	P_0	T_{max}	T_{1max}	P_0 pitch cumulative tolerance
8 to 24	$1{,}5\ ^{+0,1}_{0}$	1,75 ± 0,1	0,75	4,0 ± 0,1 ($P_1 \geq 4$) 4,0 ± 0,05 (P_1 = 2)	0,6	0,1	±0,2 / 10 pitches

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

Tape size	$B_{1max.}$	$D_{1\ min}$ [a]	$E_{2\ min}$	F	P_1	P_2	$T_{2\ max}$	W	A_0, B_0, K_0
8	4,35	0,3	6,25	3,5 ± 0,05	2,0 ± 0,05 4,0 ± 0,1	2,0 ± 0,05	3,5	$8{,}0\ ^{+0,3}_{-0,1}$	See 4.2
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	$24{,}0\ ^{+0,3}_{-0,1}$	

[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 10 – Component tilt, rotation and lateral movement

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

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 minimum 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 minimum lateral movement of 0,15 mm maximum for either cavity dimension should be allowed.

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

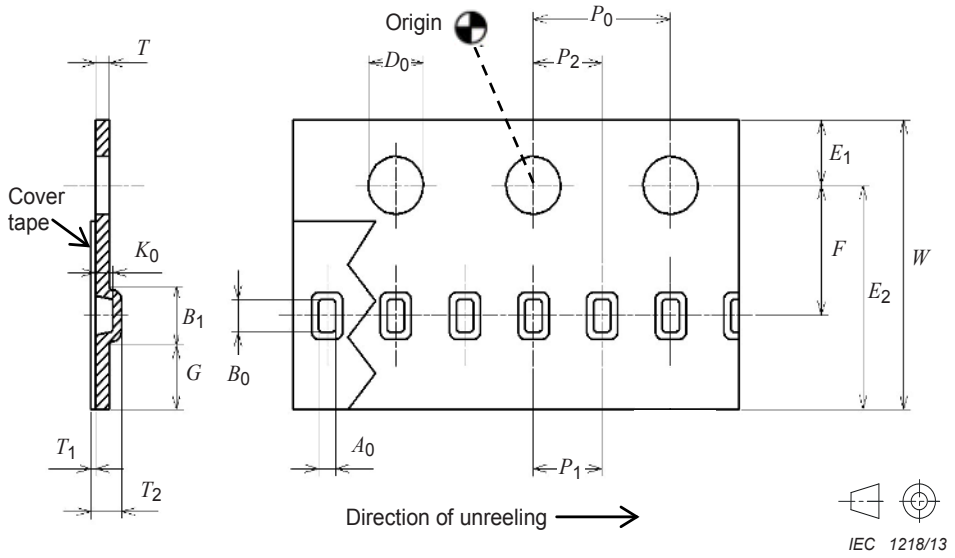

Figure 11 – Type 2b carrier tape

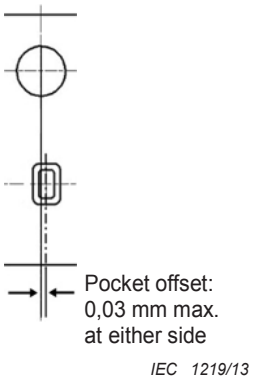

Figure 12 – Maximum pocket offset

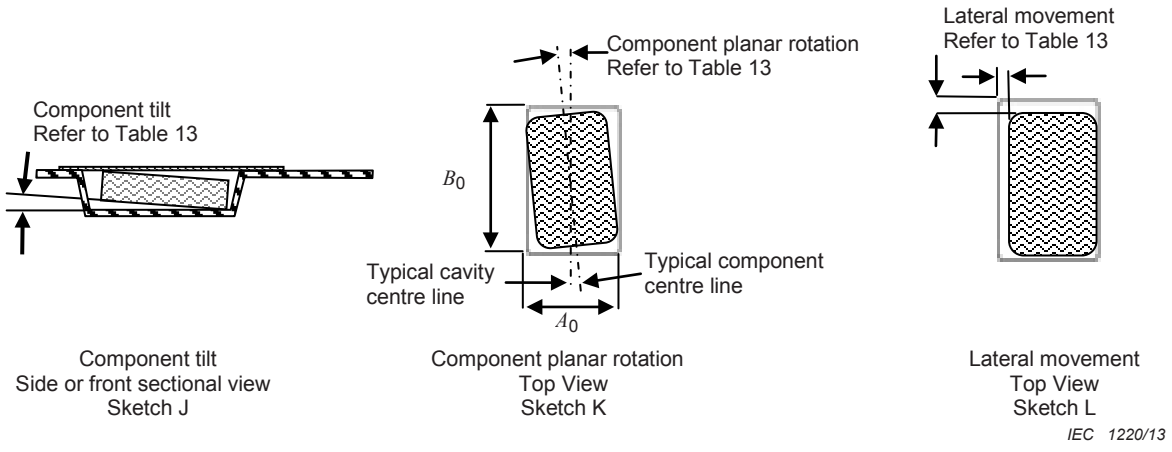

Figure 13 – Maximum component tilt, rotation and lateral movement

Table 11 – Constant dimensions of 4 mm carrier tape

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

Table 12 – Variable dimensions of 4 mm carrier tape

Tape size	$B_{1max.}$	$E_{2\ min}$	F	P_1	P_2	$T_{2\ max}$	W	A_0, B_0, 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 4.2
[a] Reference dimension.								

Table 13 – Component tilt, planar rotation and lateral movements

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

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

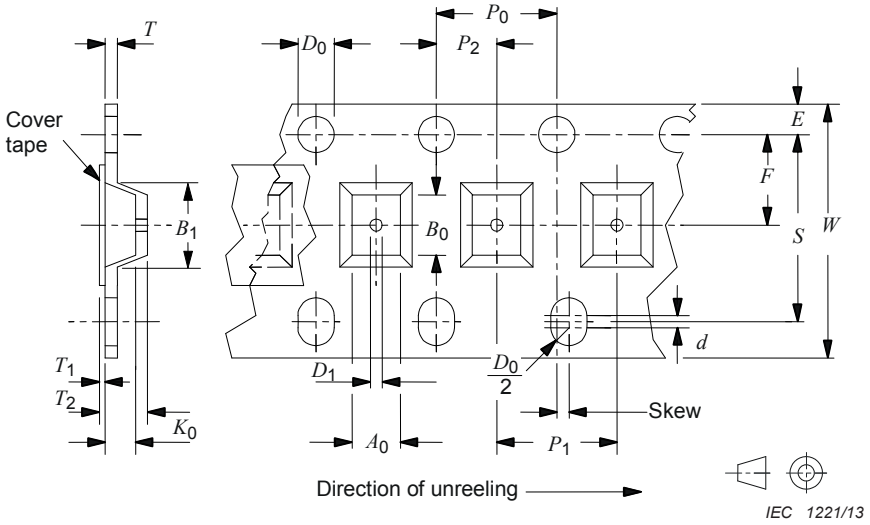

Figure 14 – Blister carrier tape

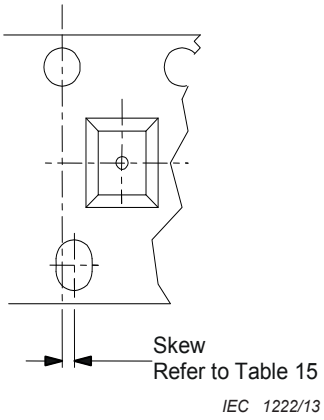

Figure 15 – Elongated sprocket hole skew

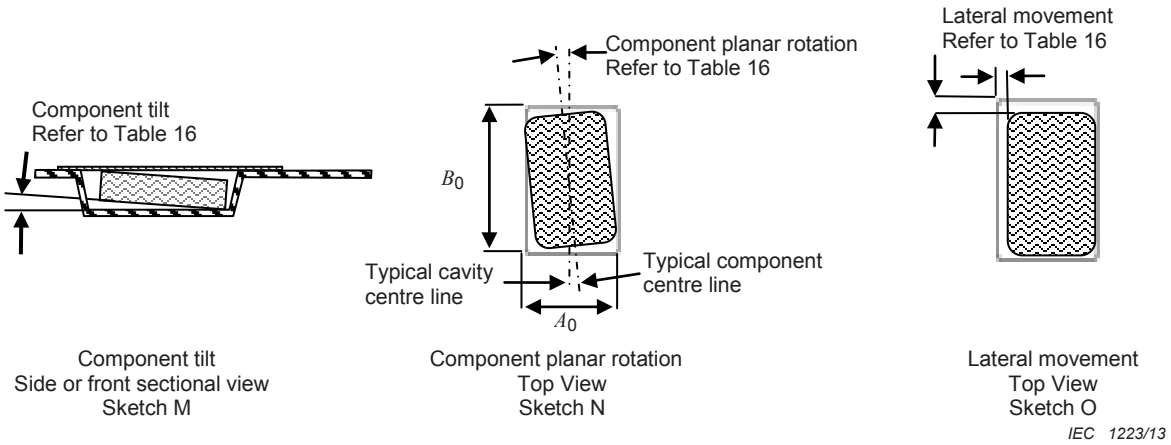

Figure 16 – Maximum component tilt, rotation and lateral movement

Table 14 – Constant dimensions of 32 mm to 200 mm blister carrier tape

Tape size	D_0	$D_{1\ min}$ [a]	d	E	P_0	T_{max}	$T_{1\ max}$	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

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

Tape size	$B_{1\ max}$	F	P_1	P_2	S	Skew max.	$T_{2\ max}$	W	A_0, B_0, K_0
32	23,0	14,2 ± 0,1	4,0 ± 0,1 to 32,0 ± 0,1 in 4,0 increments	2,0 ± 0,1	28,4 ± 0,1	0,05	12,5	32,0 ± 0,3	See 4.2
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	
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	

Table 16 – Component tilt, planar rotation and lateral movements

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

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

Type 4 carrier is designed specifically for automated handling of components such as singulated bare die. Components are placed on an adhesive film in compartments. The compartment is defined by dimensions V1 and V2 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 8.4.2 for component positioning and lateral placement.

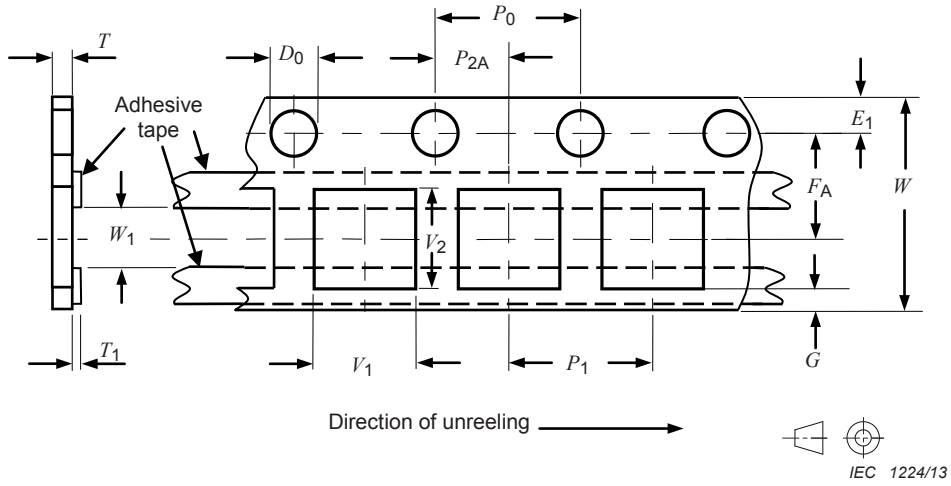

Figure 17 – Adhesive-backed punched carrier-tape dimensions (4 mm compartment pitch)

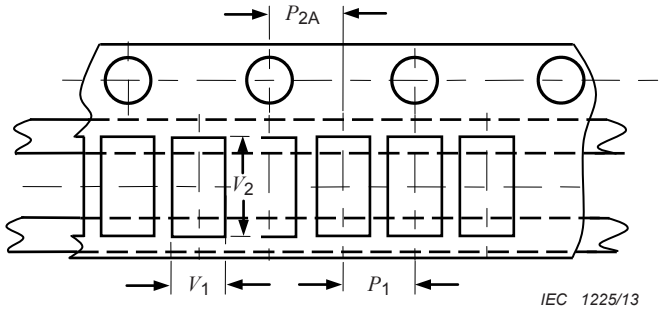

Figure 18 – Illustration of 2 mm compartment pitch

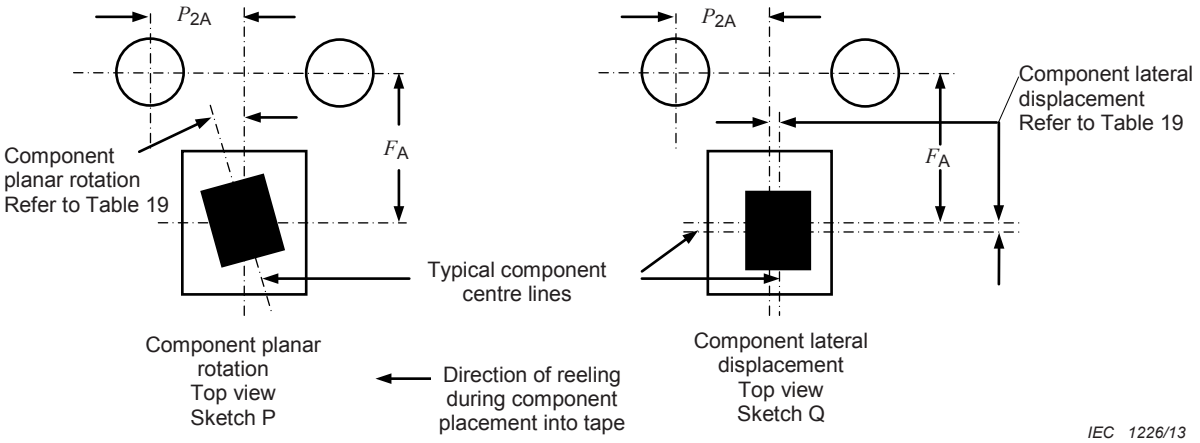

Figure 19 – Maximum component planar rotation and lateral displacement

Table 17 – Dimensions of adhesive backed punched carrier tape

Tape size	D_0	E_1	P_0	P_{2A}	$T_{1\ max}$	G_{min}	T_{max}	W_1	P_0 pitch cumulative tolerance
8, 12, 16, 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	See [a, b, c]	±0,2 / 10 pitches

[a] Gap W_1 is optional and is defined together with the end-user. W_1 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_1 is typically ≤(0,5 × component dimension B).

[c] Gap W_1 is centered along the F_A centerline.

Table 18 – Variable dimensions of adhesive-backed punched carrier tape

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	

NOTE Dimension E_2, as defined in tape types 1a, 1b, 2a and 2b, is for type 4 tape minimum value only, but can be derived as a reference dimension by subtracting E_1 from W_{max}.

Table 19 – Component planar rotation and lateral displacement

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

5 Polarity and orientation requirements of components in the tape

5.1 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.

5.2 Specific requirements for type 1a

Type 1a has effectively a cover tape on either side. Therefore, components may be placed with the mounting side orientated to the bottom or the top side of the tape. If the mounting side needs to be reversed (as is the case for some surface mounted components), then the tape is re-spooled and the alternate cover tape removed, effectively inverting the component.

5.3 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.

6 Carrier tape requirements

6.1 Taping materials

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

6.2 Minimum bending radius (for all types)

When the tape is bent with the minimum radius (measured at the bottom side of the tape) given for a particular tape width as indicated in Table 20, 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 20. Otherwise, the tape cannot be handled any more.

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

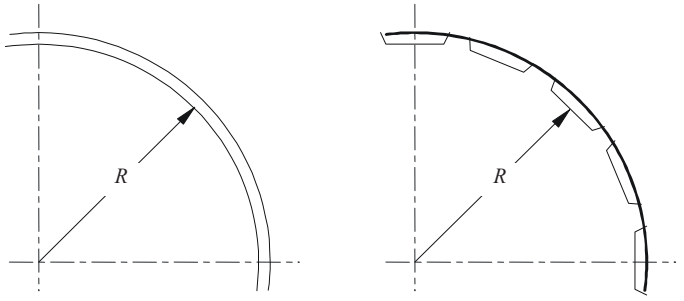

Figure 20 – Bending radius

Table 20 – Minimum bending radius

W	P_1	R_{min} Types 1a, 1b, 2a, 2b and 3	R_{min} Type 4 only [b]
4	1	25	25
8	1/2/4	25	25
12	2/4/8	30[a]	50
16	4/8/12/16	30	50
24	4/8/12	30	50
24	16/24	30	89
32	4 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 24).

6.3 Camber

The camber shall be measured without tension applied to the tape according to Figure 21. The camber shall not exceed 1 mm over 250 mm in either direction.

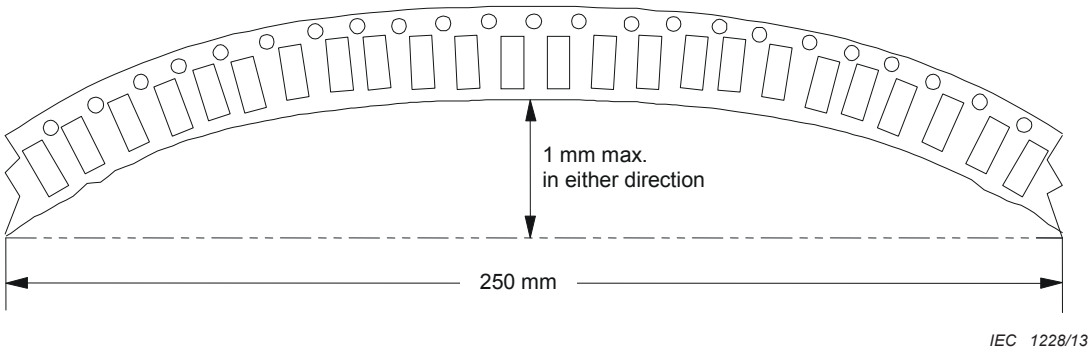

Figure 21 – Camber (top view)

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

For tape types 1a, 1b, 2a, 2b and 3 the following cover tape requirements apply.

a) The cover tapes shall not cover the round sprocket holes (type 1a, 1b, 2a, 2b and 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.

NOTE An exception may apply in those cases where thin components, during reeling or de-reeling, may slide from pocket to pocket. In these cases, the surface between two adjacent pockets may be dot sealed according the peel force requirements.

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

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

i) The peel force with a peel speed of 300 mm/min ± 10 mm/min shall be as indicated in Table 21.

Table 21 – Peel force

Tape width W	**Peel force**
4 mm	0,1 N to 0,7 N
8 mm	0,1 N to 1,0 N
12 mm to 56 mm	0,1 N to 1,3 N
72 mm to 200 mm	0,1 N to 1,5 N
Tape types 1a, 1b and 2b: For ultra 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 tapes shall not be reversed.	

8 Component taping and additional tape requirements

8.1 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 types 1a, 1b, 2a, 2b and 3, which use cover tapes, are listed in Clause 7. 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 according to the guidelines in IEC 61340-5-1 and IEC/TR 61340-5-2.

8.2 Specific requirements for type 1b

The presence of burr, 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.

8.3 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.

8.4 Specific requirement for type 4

8.4.1 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.

8.4.2 Coordinate system

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

a) The coordinate system shown in Figure 22 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 centerpoints within the virtual boundaries. See Figures 22 and 23.

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 17 and Table 18 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 22 – Absolute referencing data for component target position

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

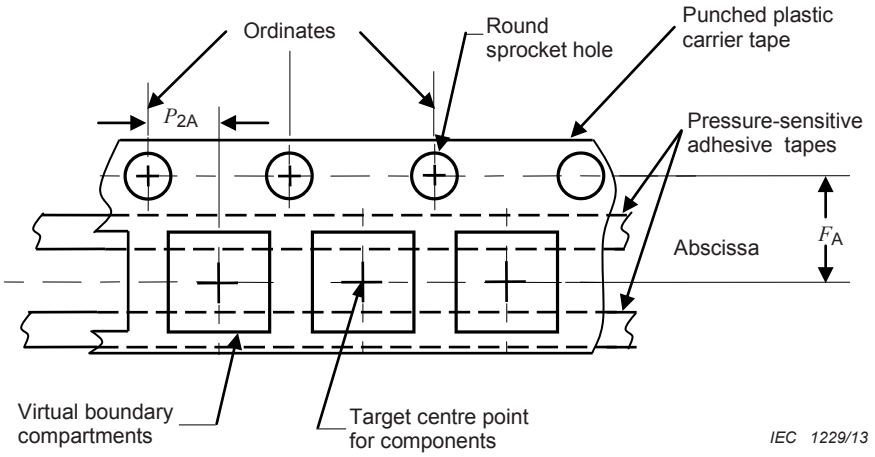

Figure 22 – Type 4 coordinate system

8.4.3 Component positioning and lateral displacement (see Figures 19 and 23)

The component position in type 4 tape is not measured with respect to the compartment, as in types 1a, 1b, 2a, 2b and 3, but relative to a virtual target point at an absolute position given by P_{2A} and F_A. Table 22 gives the absolute position of this target point relative to the sprocket-hole centroid for different tape sizes.

The maximum displacement of the actual component position from this target location is shown in sketch S of Figure 23 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 sketches R and S, 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 Sketch R of Figure 23 where the component thickness (Z) shall not be more than the punched tape thickness (T).

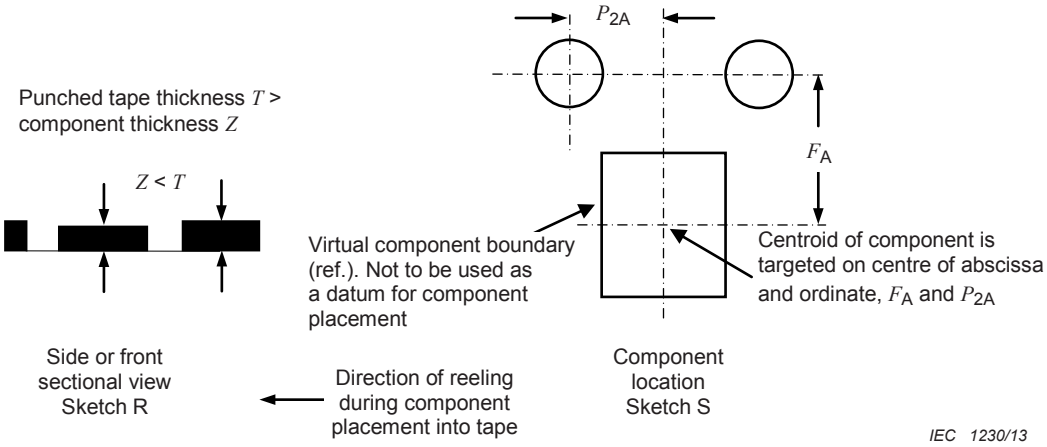

Figure 23 – Component clearance and positioning method

8.5 Specific requirements for tapes containing die products

8.5.1 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.

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

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

8.5.2 Tape design for tapes containing die products

Types 1a, 2a, and 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.

Types 2a and 2b should include special features in the base of the cavity to protect bumped die, where the die are placed in the pocket ‘bumps down’.

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

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

8.5.3 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 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.

8.5.4 Die lateral movement (Types 1a, 2a and 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.

9 Reel requirements

9.1.1 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).

9.1.2 Reel dimensions related to tape (see Figure 24 and Table 23)

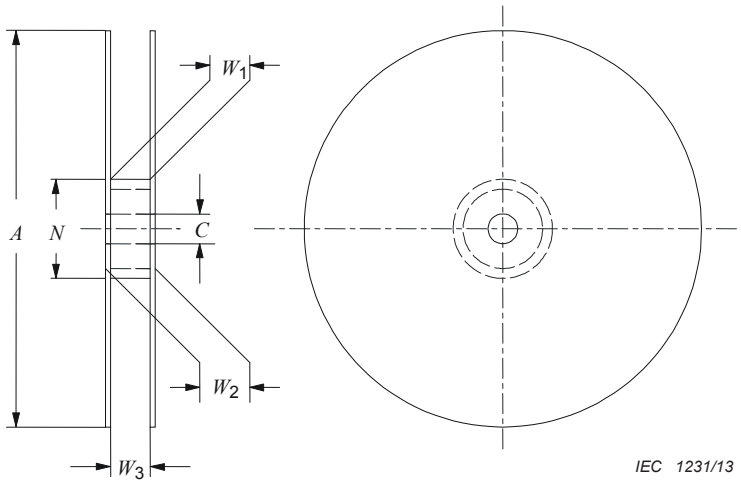

Figure 24 – Reel

Table 23 – Reel dimensions

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		

[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.

9.1.3 Reel hole dimensions (see Figure 25 and Table 24)

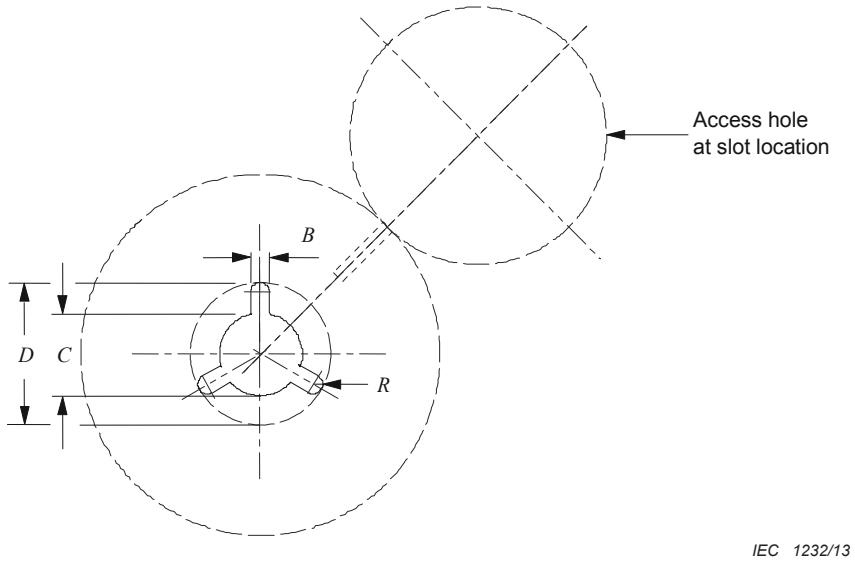

Figure 25 – Reel hole presentation

Table 24 – Reel hole dimensions

Dimensions	
	All types
B min.	1,5
D min.	20,2
C min.	12,8
R	0,5B

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.

9.2 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 26).

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, 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.

10 Tape reeling requirements

10.1 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 of the feeder looking towards the bed of the assembly machine.

Tape with components shall wrap around the hub (see dimension N in Figure 24) 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 26).

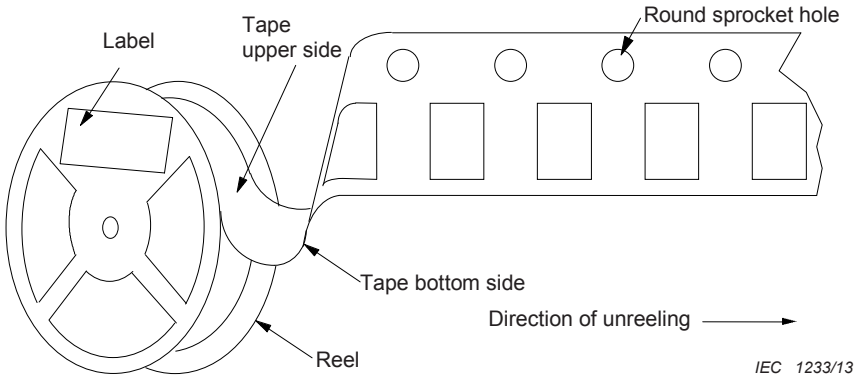

Figure 26 – Tape reeling and label area on the reel

10.2 Specific requirements for type 1a

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

10.3 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.

10.4 Leader and trailer tape (see Figure 27)

10.4.1 Leader

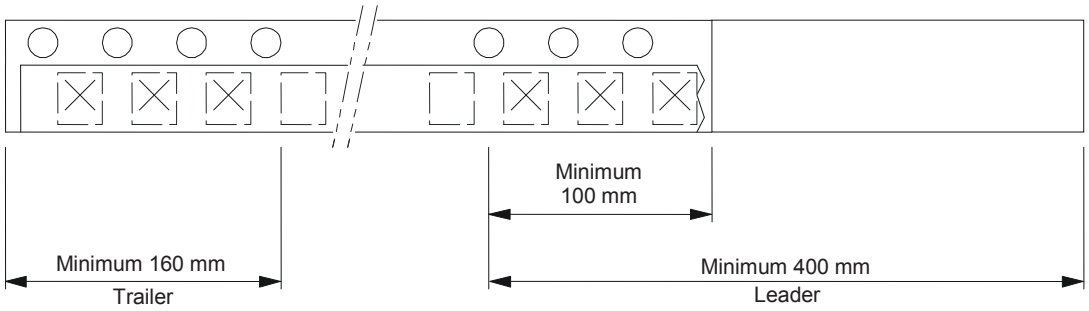

Figure 27 – Leader and trailer

For type 1a, 1b, 2a, 2b and 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 the 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.

10.4.2 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.

10.5 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.

ISO 11469 shall preferable be used for marking the material.

10.6 Missing components

The maximum number of missing components 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.

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

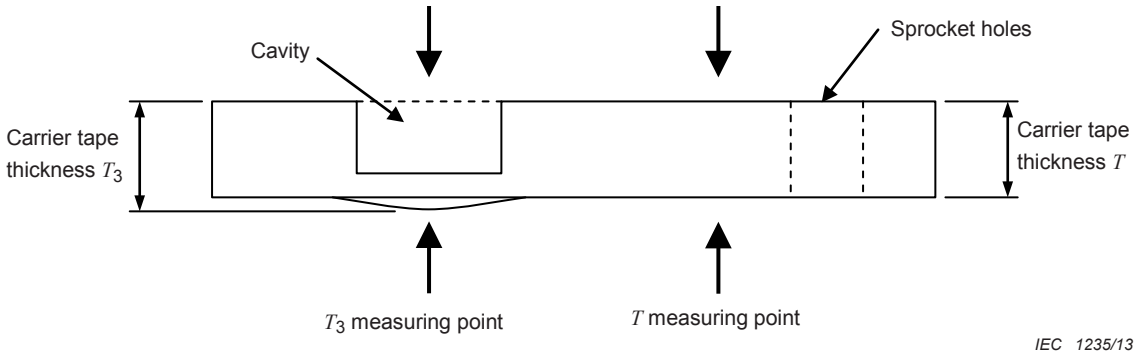

Figure A.1 – Carrier tape thickness measurement points

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

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

For dimensions A_0 and 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.

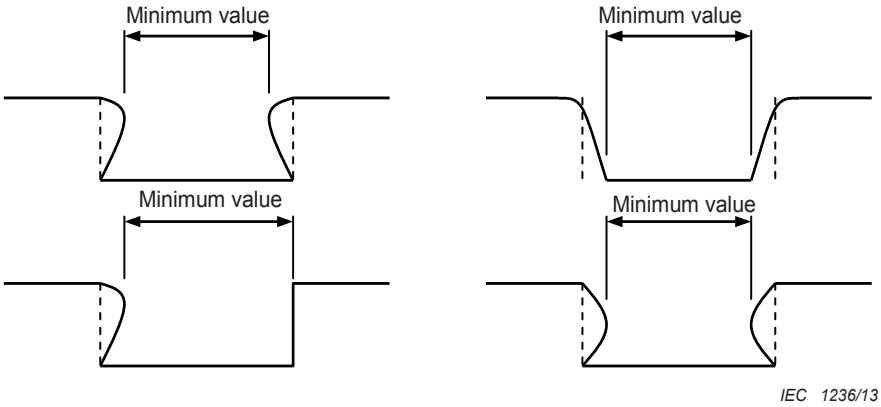

Figure A.2 – Cavity cross-section

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 according to Figure A.3.

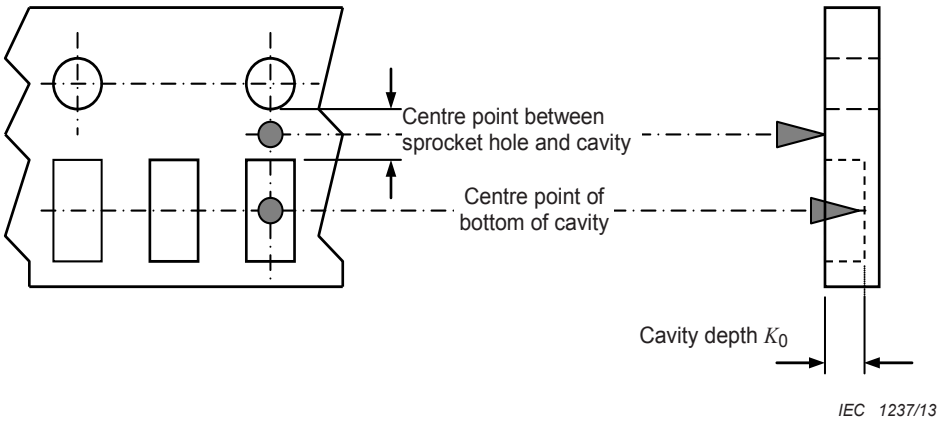

Figure A.3 – Cavity depth dimension

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