

INTERNATIONAL STANDARD

**Packaging of components for automatic handling –
Part 2: Packaging of components with unidirectional leads on continuous tapes**

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INTERNATIONAL STANDARD

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Part 2: Packaging of components with unidirectional leads on continuous tapes**

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

PRICE CODE



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International Standard IEC 60286-2 has been prepared by IEC technical committee 40: Capacitors and resistors for electronic equipment.

This third edition cancels and replaces the second edition published in 1997 and its amendment 1 (2002) and constitutes a minor revision related to tables, figures and references.

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

FDIS	Report on voting
40/1870/FDIS	40/1887/RVD

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

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

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

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

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- withdrawn,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

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

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PACKAGING OF COMPONENTS FOR AUTOMATIC HANDLING –

Part 2: Packaging of components with unidirectional leads on continuous tapes

1 General

1.1 Scope

This part of IEC 60286 applies to the packaging of components with two or more unidirectional leads for use in electronic equipment. In general, the tape is applied to the component leads.

This standard covers requirements for taping techniques used with equipment for automatic handling, preforming of leads, insertion and other operations and includes only those dimensions which are essential to the taping of components intended for the above-mentioned purposes.

1.2 Normative references

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

IEC 60097, *Grid systems for printed circuits*

IEC 60301, *Preferred diameters of wire terminations of capacitors and resistors*

IEC 60717, *Method for the determination of the space required by capacitors and resistors with unidirectional terminations*

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

2 Terms and definitions

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

2.1

package

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

2.2

short terminal without tape

not held between the carrier tape and the cover tape (see Figure 1)

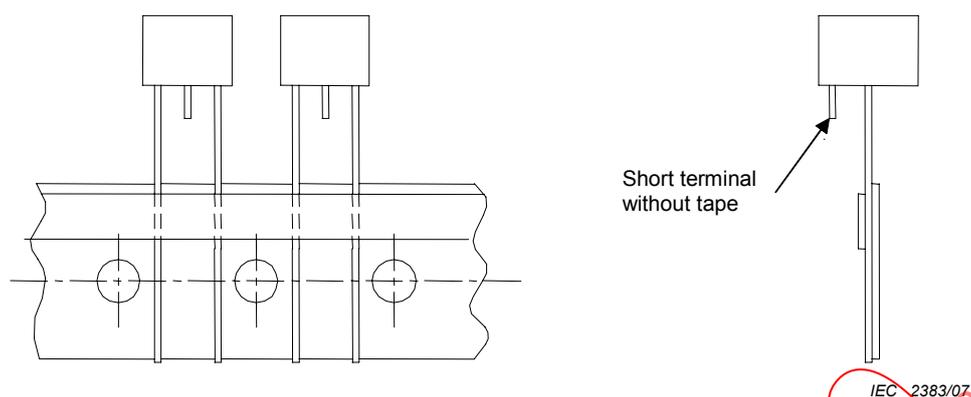


Figure 1 – Short terminal without tape

3 Dimensions

NOTE For the symbols and dimensions given below, reference is made to Figures 2, 4, 6, 7, 8, 9, and 10, and Annex A through Annex F.

3.1 Dimensions common to tapes and taped components

See Figure 2 and 3.1.1 to 3.1.7.

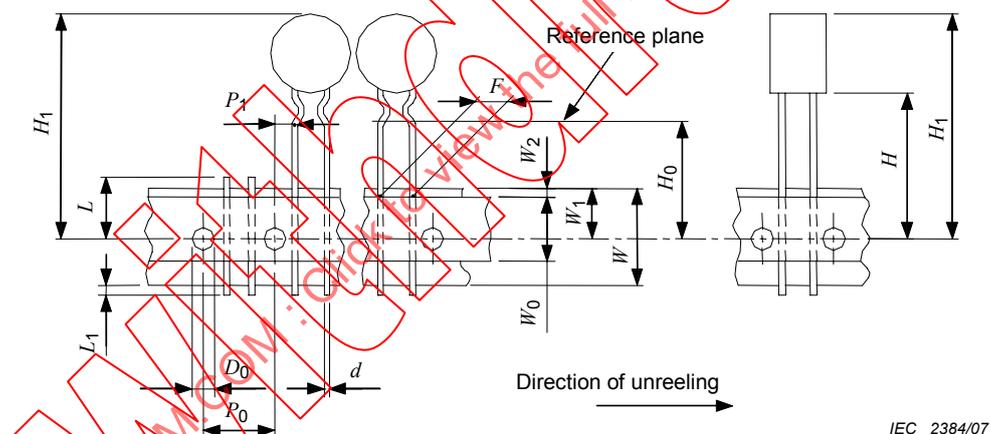


Figure 2 – Dimensions common to tapes and taped components

3.1.1 Coordinate system

The coordinate system as shown in Figure 3 shall be used as follows.

- The abscissa is a straight line through the centres of the sprocket holes in the direction of unreeling.
- The ordinate is a straight line perpendicular to the abscissa through the centre of the sprocket hole that follows the component to be checked.

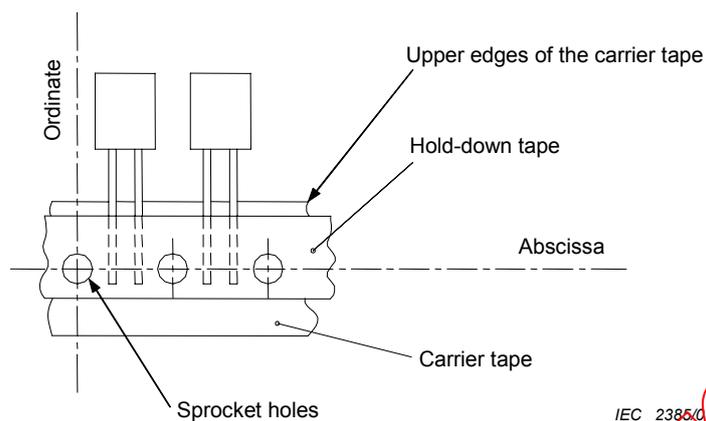


Figure 3 – Coordinate system

3.1.2 Tape width

- Carrier tape width W

$$W = 18 \text{ mm}^{+1}_{-0,5} \text{ mm}$$

- Hold-down tape width W_0

This dimension is governed by the retention of the components in the tape. The hold-down tape shall not protrude beyond the carrier tape.

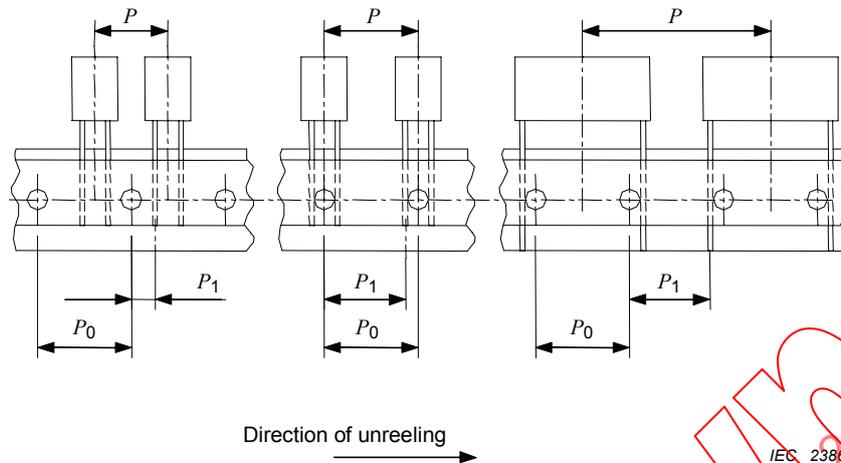
- Position of sprocket hole W_1
- Distance W_2

Between the upper edges of the carrier tape and the hold-down tape

$$W_2 = 3 \text{ mm max.}$$

3.1.3 Pitches of components and sprocket holes

- Pitch P of the mutual components (see Annex A to Annex F)
- Pitch P_0 of the sprocket holes (see Annex A to Annex F)
- Pitch P_1 between ordinate and first lead terminal of the drawer side (see Annex A to Annex F)
- Diameter D_0 of the sprocket holes



NOTE The tolerance over any 20 sprockets hole pitches is ± 1 mm.

Figure 4 – Pitches of components sprocket holes

The grid is defined as lead spacing $e = 2,5$ mm shall be used (see IEC 60097).

NOTE 1 Components with a lead spacing of $F = 3 \times e$ may be delivered with the sprocket holes arranged between the leads of the component (see Figure 4).

NOTE 2 Components with a lead spacing of $F = 8 \times e$ to $11 \times e$ may be delivered with one or two sprocket holes arranged between the leads of the component (see Figure 4).

3.1.4 Dimensions of either components position from abscissa

– Distance H

Between the abscissa and the bottom plane of the component body

$$H = 18 \text{ mm } \begin{matrix} +2 \\ -0 \end{matrix} \text{ mm}$$

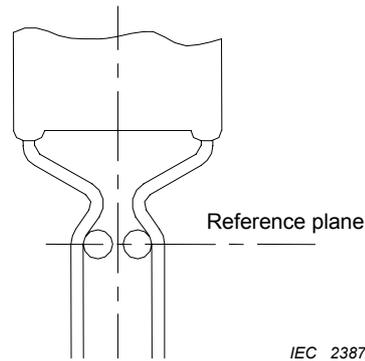
Seating plane

The method for determining the seating plane is given in IEC 60717.

- For components with straight leads: The bottom of the component body, including any projections which support the component on the printed board (line in parallel to the reference abscissa through the bottom point nearest to the tape).
- For components with crimped (or otherwise preformed) leads: The seating plane depends on the profile of the crimp, the diameter of the leads and the hole size in the printed board. For this reason a reference plane is defined, for components with crimped leads only, as follows.

Reference plane

The line parallel to the abscissa through the lowest centre of the radius of curvature of the bending of the crimp (see Figure 5).



IEC 2387/07

Figure 5 – Reference plane

- Distance H_0 (for crimped leads only)

Between the abscissa and the reference plane of components with crimped leads.

$$H_0 = 16 \text{ mm} \pm 0,5 \text{ mm}$$

- Distance H_1

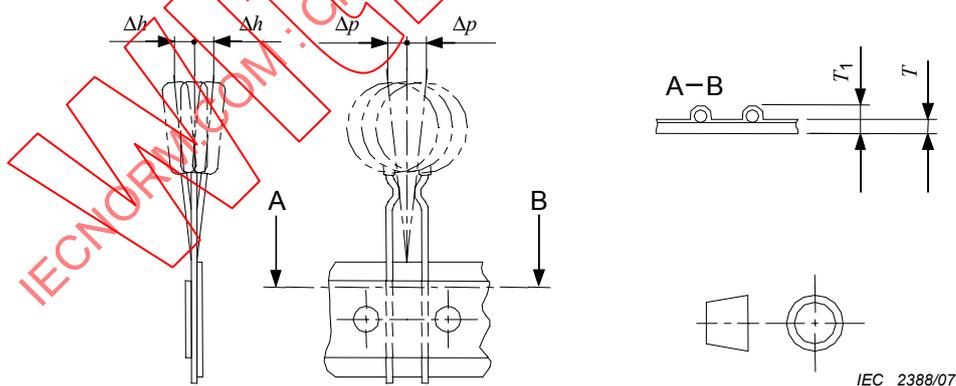
Between the abscissa and the top of the body of the components (see Annex A to Annex F).

3.1.5 Diameter d of lead terminal and tape thickness

- Diameter d of lead terminal

Diameter d of lead terminal select in accordance with IEC 60301.

Market trend for automatic insertion: Where lead spacing is $F = 5 \text{ mm}$, the recommended lead diameters are 0,6 mm max.; and where lead spacing is $F = 7,5 \text{ mm}$, the recommended lead diameters are 0,8 mm max.



IEC 2388/07

NOTE When the lead type is not a circle, a circle going through the corners of the non-circular cross-section is considered to be the equivalent circular cross-section.

Figure 6 – Diameter d of lead terminal and thickness and maximum permissible deviation

- Thickness T

(See Annex A to Annex F.)

- Thickness T_1

$$T_1 = T + d$$

3.1.6 Maximum permissible deviation

From the nominal position: Maximum lateral deviation Δh of the component body vertical to the tape plane: $l\Delta h = 2 \text{ mm max.}$

Maximum deviation of the component body in the tape plane ΔP : $l\Delta P = 1,3 \text{ mm max.}$

Maximum deviation of the component leads in the seating plane (valid from the upper edge of the tape for all values of P_1 to the seating plane or reference plane respectively) ΔP_1 :

$$l\Delta P_1 = 0,7 \text{ mm max.}$$

P_1 is the distance between the ordinate and the first lead of the following component (in the direction of unreeling).

NOTE 1 For new designs, $e = 2,5 \text{ mm}$ should be used (see IEC 60097).

NOTE 2 When this option (sprocket holes between the leads) is used, care should be taken that the leads do not interfere with the sprocket holes.

NOTE 3 For cases where interchangeability cannot be guaranteed, see the notes in 3.1.3.

3.1.7 Maximum permissible protrusion of the ends of the leads (see Figure 2)

- Protrusion L_1 beyond the lower side of the carrier tape $L_1 = 2 \text{ mm max.}$

NOTE Market trend is towards smaller values.

- Protrusion L (In the case of cut-out components)

The length L of the residual leads beyond the upper tape edge measured from the abscissa: $L = 11 \text{ mm max.}$

NOTE Any protrusion on either side should be avoided whenever possible.

3.2 Dimensions common to tapes and taped components with two leads

(See Figures 2, 6 and 7.)

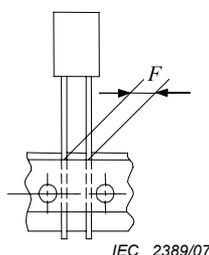


Figure 7 – Dimensions common to tapes and taped components with two leads

3.2.1 Lead spacing F of components

(See Annex A to Annex F.)

3.2.2 Tolerance on lead spacing F

Tolerance on lead spacing F shall be $^{+0,5}_{-0,2} \text{ mm}$

NOTE Components should be taped and handled so that the lead spacings can easily be maintained within tolerances after separation or removal from the tape.

3.3 Dimensions common to tapes and taped components with three leads

(See Figure 8.)

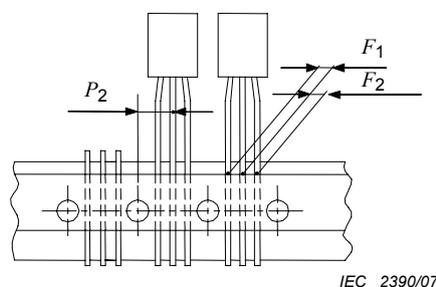


Figure 8 – Dimensions common to tapes and taped components with three leads

3.3.1 Lead spacing F_1 and F_2 of components

(See Annex E to Annex F.)

3.3.2 Tolerance on lead spacing F_1 and F_2

Tolerance on lead spacing F_1 and F_2 shall be $\begin{matrix} +0,4 \\ -0,1 \end{matrix}$ mm

3.3.3 Distance P_2

Between the ordinate and the centre lead of the component on the drawer side (see Annex E and Annex F).

3.4 Dimensions common to tapes and taped components with short terminal without tape

3.4.1 Type of taping with short terminal without tape

3.4.1.1 Single line for carrier tape with short terminal without tape

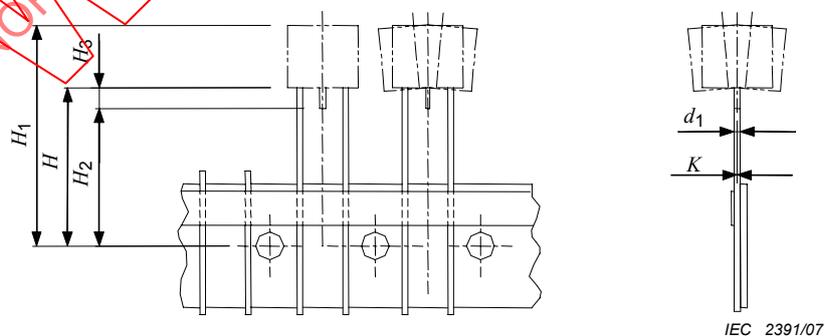


Figure 9 – Single line for carrier tape with short terminal without tape

3.4.1.2 Double line for carrier tape short terminal without tape

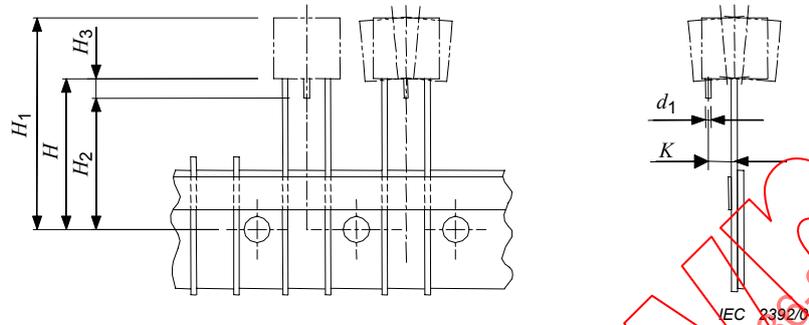


Figure 10 – Double line for carrier tape with short terminal without tape

3.4.2 Distance H_2

Between the abscissa and tip of short terminal without tape.

3.4.3 Distance K

Between the lead terminal and the short terminal without tape in single line for carrier tape.

3.4.4 Diameter d_1 of short terminal without tape

Table 1 – Dimensions common to tapes and taped components with short terminal without tape

Dimensions in mm

Symbols	H a	H_2	H_3 b	H_1	d	T	$T_1 = d + T$	d_1	K
Tolerance	+2/0	+2/0	± 0,5						± 0,3
Dimension	(20,0)	17,0	–	46,5	0,6	0,9	1,5	0,6	2,5
Dimension	(20,0)	17,0	–	46,5	0,8	0,9	1,7	0,8	2,5

^a Distance between abscissa and the bottom of components

^b Dimension H_3 is partly sticking out of the lower part of the printed circuit board after inserting components to it. Tolerance shall only be specified because of soldering part.

3.4.5 Position and tolerance of short terminal without tape

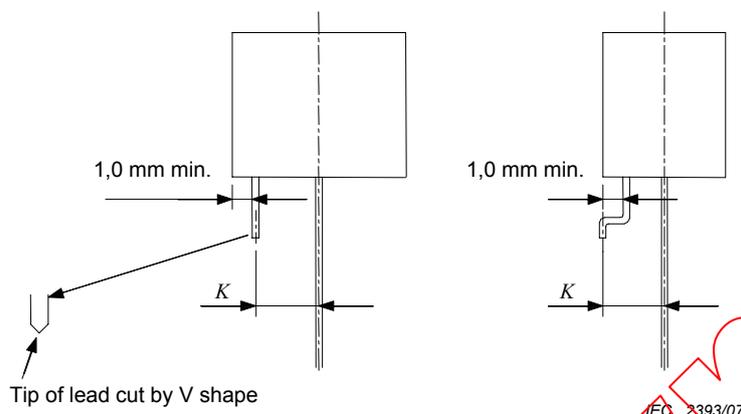


Figure 11 – Position and tolerance of short terminal without tape

4 Taping

4.1 Dimensions of taping

- Dimensions of taping shall be in accordance with Annex A and Annex F.
- Unless otherwise specified by agreement between the manufacture and the customer, the thickness of the tape shall be as follows.

Total thickness T of the combined carrier and hold-down tape $T = 0,9 \text{ mm max.}$

Total thickness T_1 of the combined carrier and hold-down tape including the leads. $T_1 = T + d$

- When the lead terminal is formed, the types and the dimensions shall be agreed upon between the manufacturer and the customer.

4.2 Splices

Splices shall be at least as strong as the original tape and shall not hamper the transport and the cutting of the tape. When splicing is applied, the misalignment of the holes on each side of the splice shall not be more than $\pm 0,3 \text{ mm}$ in any direction. Splices shall not interfere with sprocket feed holes nor shall the overall thickness exceed $1,5 \text{ mm}$. When used, staples shall not interfere with the transport and cutting operations.

NOTE This includes deformation of lead ends due to shearing operations.

4.3 Leader and trailer of tape

When the leader and/or trailer of tape is required, the length of such leader and/or trailer shall be at least three (3) sprocket-hole distance (see Figure 12).

If necessary, a leader and a trailer either of which may include at least three (3) sprocket holes (see Figure 10).

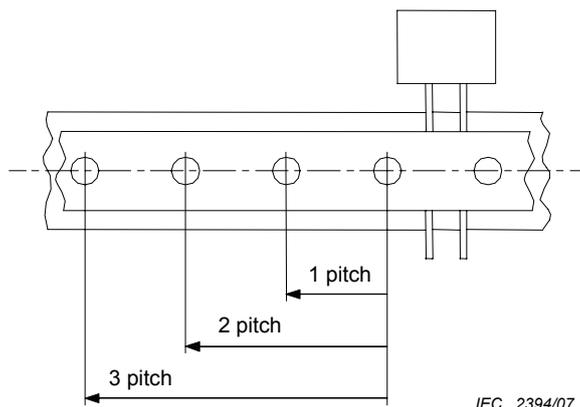


Figure 12 – Leader and trailer of tape

5 Performance of tape

5.1 Polarity direction on tape

All polarized components shall be oriented in one direction. The cathode lead and, for transistors (except for TO-92 packages), the emitter lead shall be the last one to leave the package, unless otherwise specified in the detail specification. For TO-92 packages the flat side shall be on the upper side of the tape.

5.2 Kinks or bends on tape

The wire terminations of the taped components shall be free from kinks or bends between the seating or reference plane and the carrier tape.

5.3 Pull strength from taping and peel strength of cover tape

The components shall be held sufficiently in the tape, so that their position remains within the permitted tolerances.

The extraction force for components in the tape plane, vertical to the direction of unreeling shall be 5 N or more (see Figure 13).

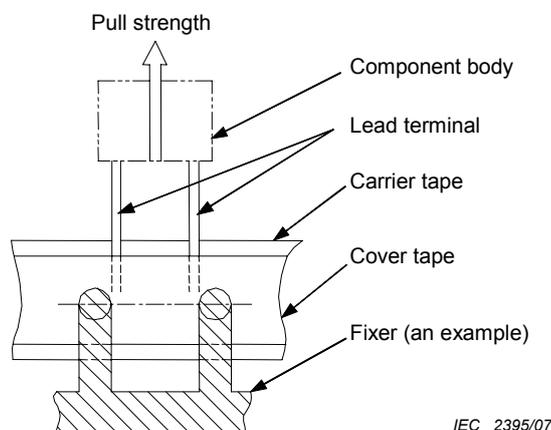


Figure 13 – Pull strength from taping and peel strength of cover tape

5.4 Break force of tape

The break force of the tape shall be 15 N or more.

5.5 Material of tape

The tapes shall be suitable to withstand storage of the taped components. The tape material shall not migrate along the leads or give off vapour that may affect solderability or deteriorate the mechanical and electrical characteristics of component or leads by chemical reaction (for example, corrosion).

In addition, the hold-down tape shall not become detached so that the components do not remain in position after storage, and the carrier tape material shall not age and therefore lose strength in such a way that it breaks on unreeling when the taped components are fed from the package by hand into the assembly machines.

Tapes in adjacent layers shall not stick together in the packaging because of exposed adhesive, for instance.

The sprocket holes shall be free from burrs and traces of adhesive from the hold-down tape.

5.6 Hold-down tape

For tapes in fan-fold arrangement, the hold-down tape shall preferably not become separated from the carrier tape in the region of the fold. If this cannot be avoided, the value of the maximum tape thickness shall not be exceeded.

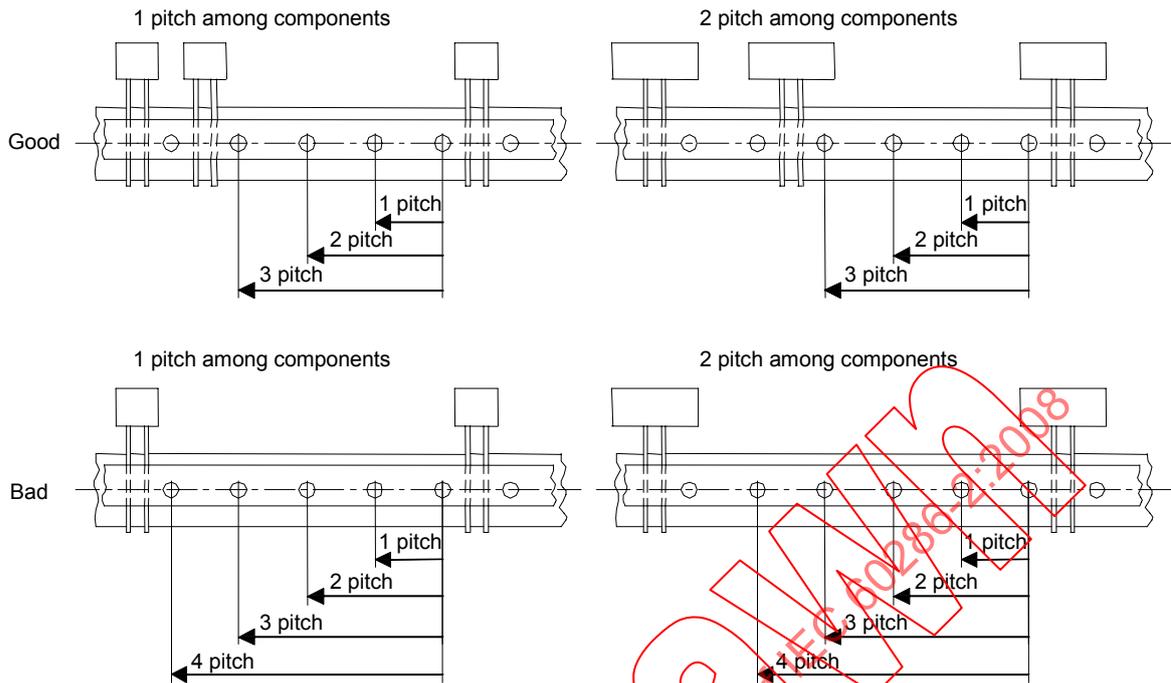
5.7 Storage

Under consideration

5.8 Missing components

For automatic insertion, the number of empty places in the tape per reel or fan-fold arrangement shall not exceed consecutive three (3) sprocket holes (see Figure 14).

Empty places, for example, programmed empty places at the bend or fan-fold package, or for other reasons, shall be by agreement between the manufacturer and the customer.



IEC 2396/07

Figure 14 - Missing components

6 Packing

The tapes of components may either be wound on reels or folded (for example, in a fan-fold arrangement).

The unit of packing shall preferably be

- a) for all components with lead spacing: $F \leq 9 \times e$: multiples of 100;
- b) for all components with lead spacing: $F > 9 \times e$: multiples of 50.

When winding the tape on the reel, the carrier tape shall be closest to the centre of the reel.

6.1 Dimensions of the reel

The preferred reel dimensions are shown in Figure 15 and Table 2. The reeling is shown in Figure 16.

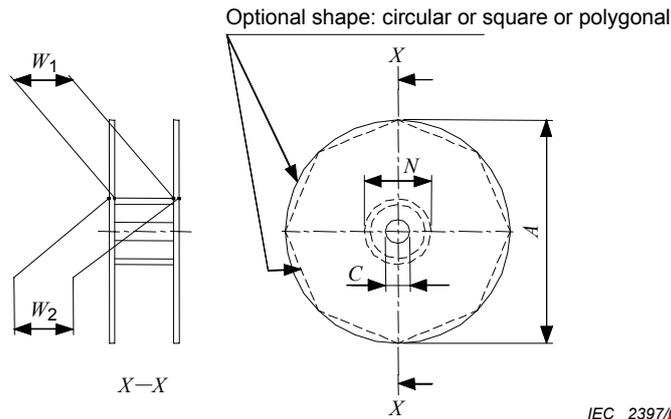


Figure 15 – Reel dimensions

Table 2 – Reel dimensions and unit dimensions

Total reel width, measured at hub W_2	Width between flanges, measured at hub W_1	Reel diameter A	Hub diameter N	Arbour hole C
65 mm max.	See the NOTE below.	320 mm max.	80 mm min.	14 mm to 38 mm
		370 mm max.		
		400 mm max.		
90 mm max		500 mm max.	125 mm max.	
		609 mm max.		

NOTE The distance W_1 between the flanges is governed by the overall dimensions of taped component and is allowed proper reeling and unreeling.

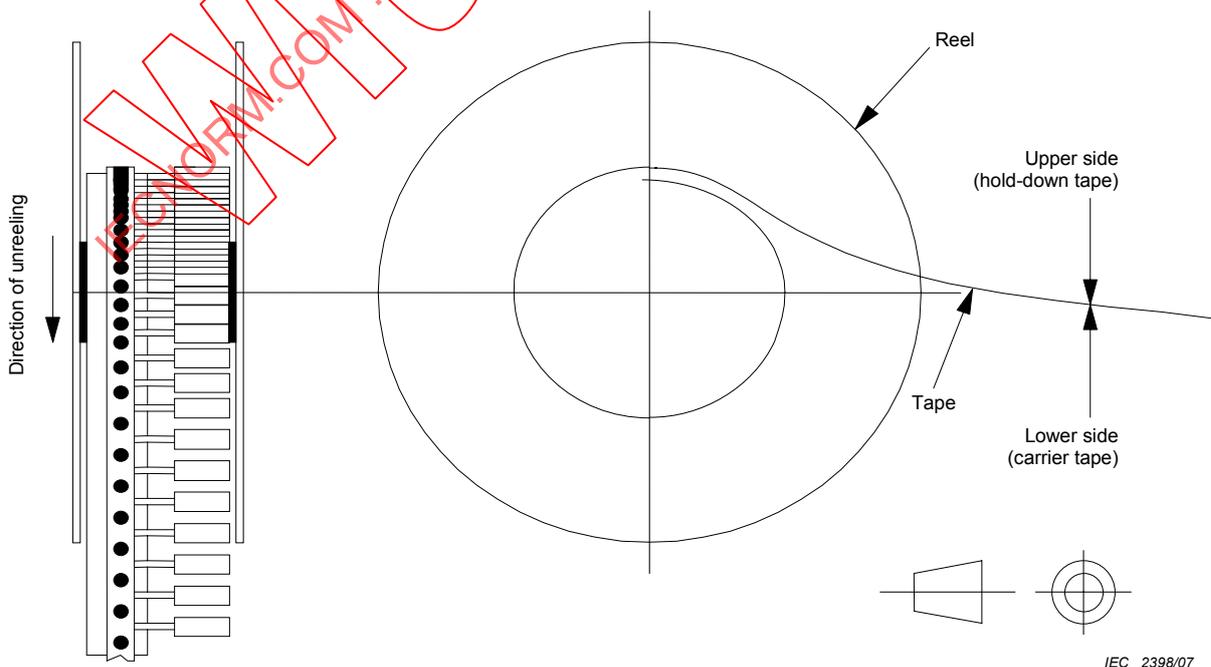


Figure 16 – Reeling

6.1.1 Protection of components

In order to prevent component damage and lead distortion, protection between layers of components and over the last layer may be necessary.

In this case protection materials shall not cause deterioration of the components or of lead solderability.

6.1.2 Reel filling

The total number of components on the reel shall be such that the components and the final cover shall not extend beyond the smallest dimension of the flange in the radial direction.

6.2 Dimensions of the fan-fold container

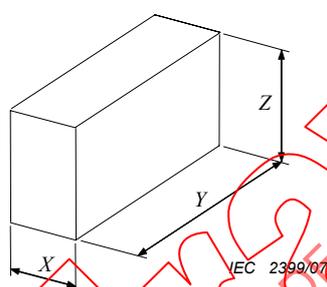


Figure 17 – Outer dimensions for a fan-fold arrangement

Table 3 – Outer dimensions for a fan-fold arrangement

Dimension	Standard	Exceptions
X - Width	65 mm max.	78 mm max.
Y - Length	372 mm max.	510 mm max.
Z - Height	372 mm max.	450 mm max.

NOTE 1 The depth of the box fan-fold arrangement is about 3 mm.

NOTE 2 X-width is: 65 mm max. = dimension 46,5 mm + half of width of tape 9 mm + protrusion L1 beyond the lower side of the carrier tape 0,5 mm + clearance in box fan-fold arrangement 1,5 mm × 2 mm + depth of box fan-fold arrangement 3 mm × 2 mm.

NOTE 3 The normal dimension of X-width suggested as a design limit value from a machine maker is 65 mm max.

NOTE 4 The fan-fold arrangement has outer dimension for each component. The dimensions are designed so that components do not collapse in a fan-fold container and are for the maximum.

6.3 Recycling

Reels as defined in Figure 15 shall preferably be made of recyclable material. When such material is used, the reel shall be permanently marked with the recycling symbol.

ISO 11469 shall preferably be used.

6.4 Marking

The information given in the marking on the containers shall be, at least, as listed below. Items c) and d) may be omitted when space is limited.

- a) Manufacturer's type designation
- b) Quantity
- c) Year and month (or week) of manufacture
- d) Lot number
- e) Manufacturer's name and trademark

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Annex A
(informative)

Dimensions for two formed leads, sprocket hole between parts

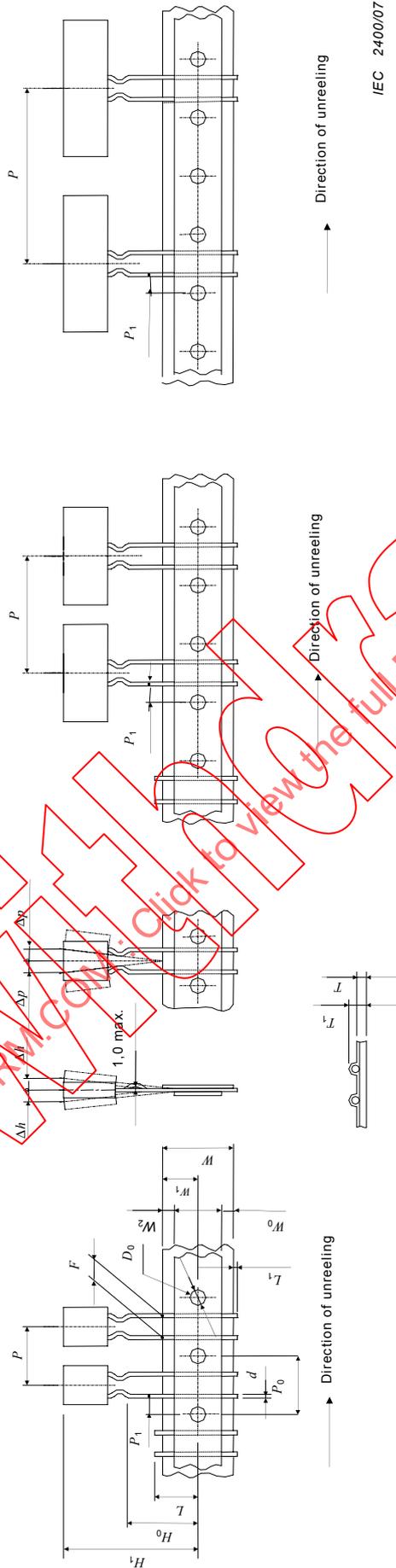
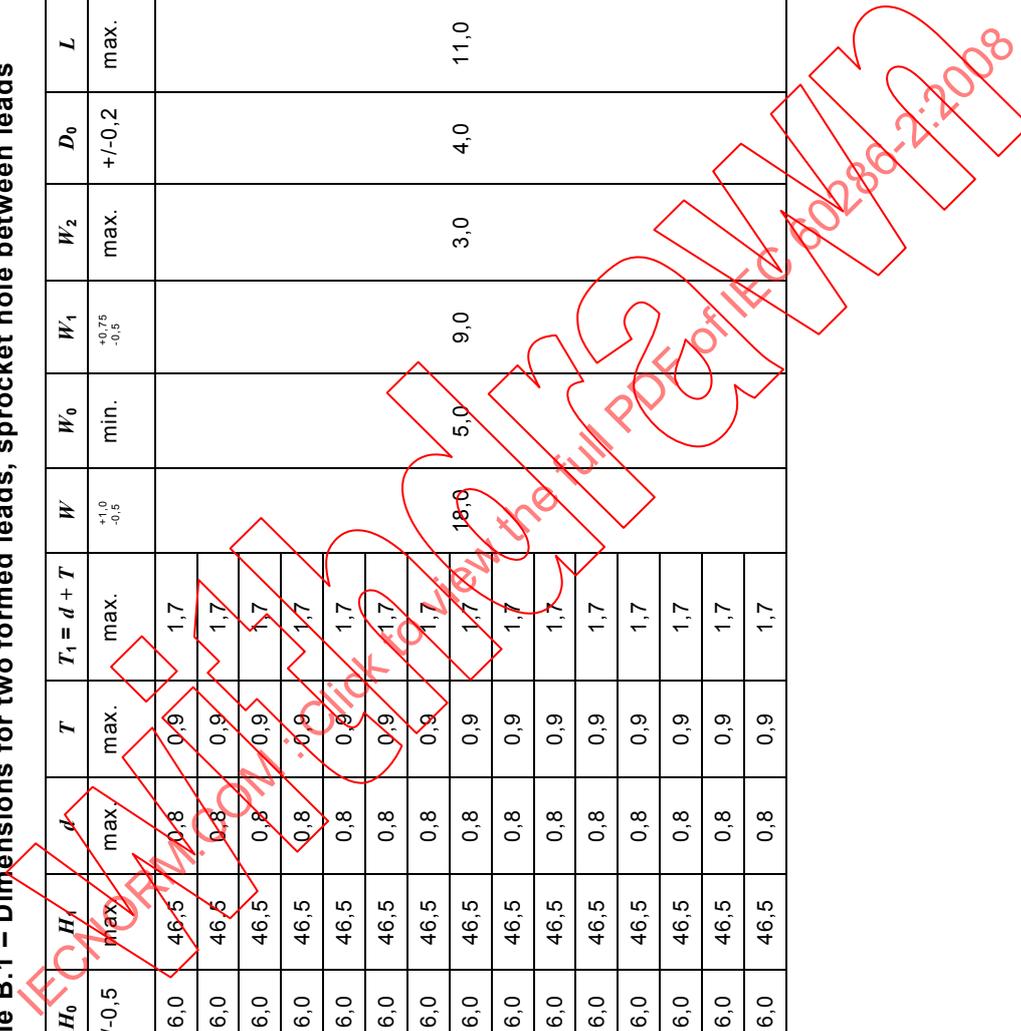


Figure A.1 – Dimensions for two formed leads, sprocket hole between parts

Table B.1 – Dimensions for two formed leads, sprocket hole between leads

P	P ₀	P ₁	F	H ₀	H ₁	d	T	T ₁ = d + T	W	W ₀	W ₁	W ₂	D ₀	L	L ₁	Δh	Δp	ΔP ₁
+/-1	+/-0,3	+/-0,7	+0,5/ -0,2	+/-0,5	max.	max.	max.	max.	+1,0 -0,5	min.	+0,75 -0,5	max.	+/-0,2	max.	max.	max.	max.	max.
12,7	12,7	8,95	7,5	16,0	46,5	0,8	0,9	1,7										
15,0	15,0	10,0	10,0	16,0	46,5	0,8	0,9	1,7										
25,4	12,7	8,95	7,5	16,0	46,5	0,8	0,9	1,7										
25,4	12,7	7,70	10,0	16,0	46,5	0,8	0,9	1,7										
25,4	12,7	6,45	12,5	16,0	46,5	0,8	0,9	1,7										
25,4	12,7	5,20	15,0	16,0	46,5	0,8	0,9	1,7										
30,0	15,0	11,25	7,5	16,0	46,5	0,8	0,9	1,7	18,0	5,0	9,0	3,0	4,0	11,0	0,5	2,0	1,3	0,7
30,0	15,0	10,0	10,0	16,0	46,5	0,8	0,9	1,7										
30,0	15,0	8,75	12,5	16,0	46,5	0,8	0,9	1,7										
30,0	15,0	7,50	15,0	16,0	46,5	0,8	0,9	1,7										
30,0	15,0	5,00	20,0	16,0	46,5	0,8	0,9	1,7										
38,1	12,7	8,95	7,5	16,0	46,5	0,8	0,9	1,7										
38,1	12,7	7,70	10,0	16,0	46,5	0,8	0,9	1,7										
38,1	12,7	6,45	12,5	16,0	46,5	0,8	0,9	1,7										
38,1	12,7	5,20	15,0	16,0	46,5	0,8	0,9	1,7										



Annex C
(informative)

Dimensions for two straight leads, sprocket hole between parts

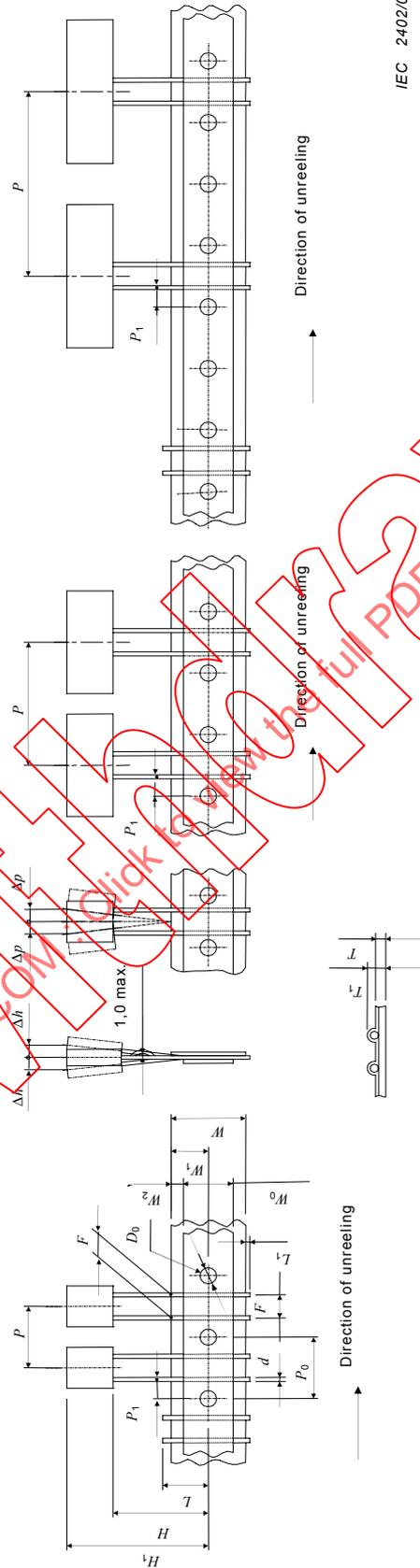
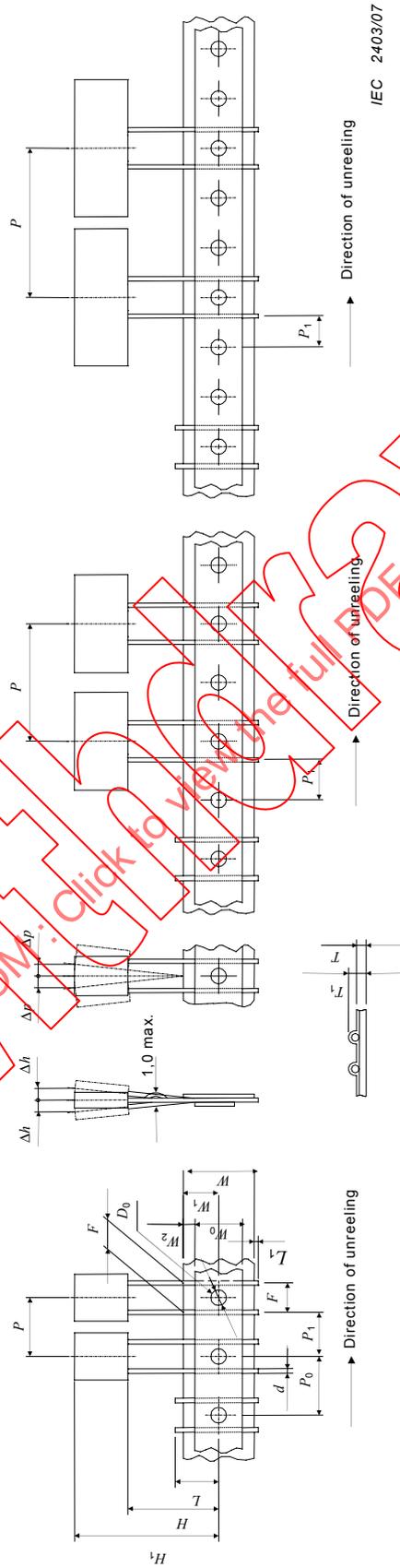


Figure C.1 – Dimensions for two straight leads, sprocket hole between parts

Annex D
(informative)

Dimensions for two straight leads, sprocket hole between leads



IEC 2403/07

Figure D.1 – Dimensions for two straight leads, sprocket hole between leads