

TECHNICAL REPORT



**Packaging of components for automatic handling –
Part 3-3: Packaging of surface mount components on continuous paper tapes
for Auto Loading Feeder**

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for Auto Loading Feeder**

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

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CONTENTS

| | |
|---|----|
| FOREWORD..... | 4 |
| INTRODUCTION..... | 6 |
| 1 Scope..... | 7 |
| 2 Normative references | 7 |
| 3 Terms, definitions and symbols..... | 7 |
| 3.1 Terms and definitions..... | 7 |
| 3.2 Symbols..... | 8 |
| 4 Requirements and required dimensions for paper taping for Auto Loading Feeder..... | 8 |
| 4.1 General..... | 8 |
| 4.2 Required dimensions for the cover tape sealed positions | 9 |
| 4.3 Required dimensions for the distance between the upper side of the carrier tape and the top surface of a component | 9 |
| 4.4 Required specifications for the sealing method for the cover tape | 10 |
| 4.5 Requirements about fluff generated at removal of cover tape..... | 10 |
| 4.6 Required specifications for the maximum trailer length..... | 10 |
| Annex A (informative) Overview and features of Auto Loading Feeder | 11 |
| Annex B (informative) Methods and mechanisms of automatically exposing the pockets in using Auto Loading Feeder | 12 |
| B.1 General..... | 12 |
| B.2 Single-door method..... | 12 |
| B.3 Double-door method | 12 |
| Annex C (informative) Discussion for paper taping for Auto Loading Feeder | 14 |
| C.1 General..... | 14 |
| C.2 Discussion items..... | 14 |
| C.2.1 Necessity of M_1 and M_2 as the cover tape sealed positions..... | 14 |
| C.2.2 Necessity of K_1 as the distance between the upper side of the carrier tape and the top surfaces of a component | 15 |
| C.2.3 Sealing method for the cover tape | 15 |
| C.2.4 Dent of the cover tape over the pockets..... | 16 |
| C.2.5 Lower limit of peel-off strength of the cover tape..... | 16 |
| C.2.6 Adhesion of components on the cover tape..... | 16 |
| C.2.7 Bending stiffness of the carrier tape | 17 |
| C.2.8 Fluff entering the pockets at removal of the cover tape | 17 |
| C.2.9 Maximum trailer length | 18 |
| C.2.10 Fixing the tail end of the carrier tape..... | 18 |
| C.2.11 Cut shape of the tail end of the carrier tape | 18 |
| Annex D (informative) Glossary | 20 |
| Bibliography..... | 22 |
| Figure 1 – Specified dimensions for paper taping for Auto Loading Feeder | 8 |
| Figure 2 – Leader part and trailer part..... | 10 |
| Figure A.1 – Operation and features when another tape is re-supplied automatically by the Auto Loading Feeder..... | 11 |
| Figure B.1 – Overview of the single-door method | 12 |
| Figure B.2 – Overview of the double-door method..... | 13 |

| | |
|--|----|
| Figure C.1 – Example dent of the cover tape over the pocket (embossed tape)..... | 16 |
| Figure C.2 – Example of fluff entering the pocket possible in using Auto Loading Feeder | 17 |
| Figure C.3 – Examples of cut shapes available/unavailable for Auto Loading Feeder and a tape deformed at its top end..... | 19 |
| Table 1 – Symbols used in figures and tables | 8 |
| Table 2 – The cover tape sealed positions required for paper taping for Auto Loading Feeder | 9 |
| Table 3 – Distance between the upper side of the carrier tape and top surface of a component required for paper taping for Auto Loading Feeder | 9 |
| Table D.1 – Glossary of mounter and feeder related terms | 20 |

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PACKAGING OF COMPONENTS FOR AUTOMATIC HANDLING –**Part 3-3: Packaging of surface mount components
on continuous paper tapes for Auto Loading Feeder**

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IEC TR 60286-3-3 has been prepared by IEC technical committee 40: Capacitors and resistors for electronic equipment. It is a Technical Report.

The text of this Technical Report is based on the following documents:

| | |
|-------------|------------------|
| Draft | Report on voting |
| 40/2843/DTR | 40/2865/RVDTR |

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 Technical Report is English.

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/standardsdev/publications.

A list of all parts in the IEC 60286 series, published 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 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

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INTRODUCTION

This Technical Report was developed by the technical committee 40 working group 36 on components packaging, in which the members, such as mounter manufacturers, component manufacturers and packaging material manufacturers, had proposed, considered and discussed the possible standardization of the application of Auto Loading Feeder to enable automatically exchange SMD continuous tapes, using paper carrier tape during mounter operation, aiming to support IEC 60286-3, Edition 6, issued in 2019.

This document includes data expressed in the form of provisions, such as requirements or recommendations. These data, however, do not claim to be provisions and are just suggested as the results of the discussion.

The International Electrotechnical Commission (IEC) draws attention to the fact that it is claimed that compliance with this document may involve the use of a trademark concerning Auto Loading Feeder given in 3.1.1.

- Trademark ... AUTO LOADING FEEDER™
- Trademark registration number ... No.5983611 (Japan)

IEC takes no position concerning the evidence, validity and scope of this trademark right.

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PACKAGING OF COMPONENTS FOR AUTOMATIC HANDLING –

Part 3-3: Packaging of surface mount components on continuous paper tapes for Auto Loading Feeder

1 Scope

This part of IEC 60286 describes the possible requirements for paper taping for the Auto Loading Feeder mechanism to mount electronic components without leads or with stump type leads used for electric circuits. This document is applicable to the punched carrier tape with the bottom cover tape (nominal tape width: 8 mm only) among the tapes of Type 1a, and the pressed carrier tape (nominal tape width: 8 mm) of Type 1b in IEC 60286-3.

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 60286-3:2019, *Packaging of components for automatic handling – Part 3: Packaging of surface mount components on continuous tapes*

3 Terms, definitions and symbols

3.1 Terms and definitions

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

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

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

NOTE Annex D features a Glossary of mounter and feeder related terms.

3.1.1

Auto Loading Feeder

AUTO LOADING FEEDER™

tape feeder that can keep supplying components by automatically carrying a tape of re-supplied SMD at the filling-in position into the components supply position, just after the components in the tape of previously supplied SMD are fed up during the assembly production

Note 1 to entry: Auto Loading Feeder has the mechanism that the cover tape of a SMD tape is automatically cut or peeled off to expose the pockets during the operation to supply components.

3.1.2

seal

bonding of a part of the top cover tape and a part of the carrier tape

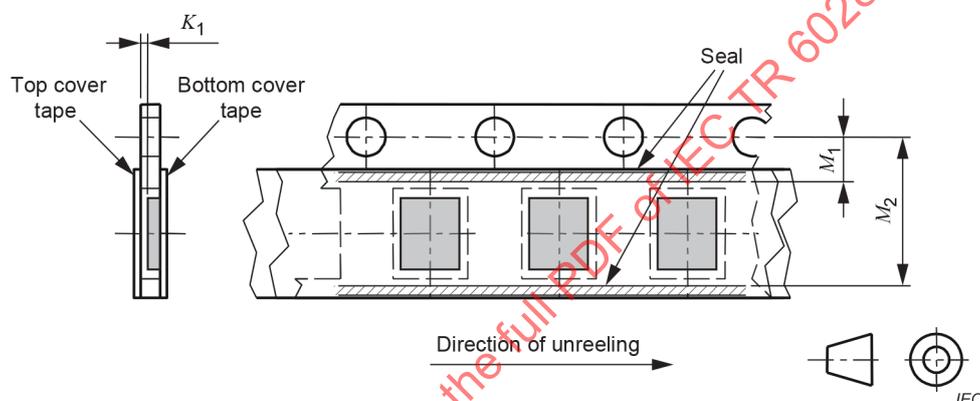
Note 1 to entry: The top cover tapes are classified as heat welding type and adhesive type by the way to bond itself on the carrier tape.

3.2 Symbols

The symbols used in this document are shown in Table 1 and Figure 1.

Table 1 – Symbols used in figures and tables

| Symbol | Description | Figures and tables using the symbol |
|--------|--|-------------------------------------|
| M_1 | Distance between the reference point of the sprocket holes (centre) and the inner side of the seal on the upper end side, which is near the sprocket holes, of the carrier tape. | Figure 1 and Table 2 |
| M_2 | Distance between the reference point of the sprocket holes (centre) and the inner side of the seal on the lower end side, which is far from the sprocket holes, of the carrier tape. | Figure 1 and Table 2 |
| K_1 | Distance between the upper side of the carrier tape and the top surface of a component. | Figure 1 and Table 2 |



NOTE These symbols are the same as the ones for Type 1a and Type1b in IEC 60286-3.

Figure 1 – Specified dimensions for paper taping for Auto Loading Feeder

4 Requirements and required dimensions for paper taping for Auto Loading Feeder

4.1 General

The requirements and required dimensions for paper taping are classified as follows:

- Required dimensions for the cover tape sealed positions (see 4.2);
- Required dimensions for the distance between the upper side of the carrier tape and the top surface of a component (see 4.3);
- Required specifications for the sealing method of the cover tape (see 4.4);
- Requirements about fluff generated at removal of the cover tape (see 4.5);
- Required specifications for the maximum trailer length (see 4.6).

The overview and features of Auto Loading Feeder are shown in Annex A. The methods and mechanisms of automatically exposing the pockets in using Auto Loading Feeder are shown in Annex B. The history of discussion on the proposed requirements and dimensions for paper taping for Auto Loading Feeder are shown in Annex C.

4.2 Required dimensions for the cover tape sealed positions

The required dimensions for the cover tape sealed positions for Auto Loading Feeder are shown in Table 2.

Table 2 – The cover tape sealed positions required for paper taping for Auto Loading Feeder

Dimensions in millimetres

| Target nominal component dimensions ^a | Required dimensions (design values) | |
|--|-------------------------------------|--------------------------|
| | M_1 | M_2 |
| 0402M | 2,9 or less | 4,1 or more |
| 0603M | 2,9 or less | 4,1 or more |
| 1005M | 2,6 or less | 4,4 or more |
| 1608M | 2,4 or less ^b | 4,6 or more ^b |
| 2012M | 2,2 or less ^b | 4,8 or more ^b |
| 3216M | 1,7 or less | 5,3 or more |

NOTE 1 The symbols are shown in Table 1 and Figure 1.
 NOTE 2 SMD tape with sealed pockets is not applicable to Auto Loading Feeder.
 NOTE 3 Sealing tape should be attached symmetric to the centre of the pocket.

^a Components with intermediate size between each nominal dimension follow the larger nominal dimension.
^b Considering the maximum lateral deviation of components in the pockets specified in IEC 60286-3, if possible, the target design values should be set out by about 0,2 mm smaller for M_1 and about 0,2 mm larger for M_2 .

4.3 Required dimensions for the distance between the upper side of the carrier tape and the top surface of a component

The required dimensions for the distance between the upper side of the carrier tape and the top surface of a component for Auto Loading Feeder are shown in Table 3.

Table 3 – Distance between the upper side of the carrier tape and top surface of a component required for paper taping for Auto Loading Feeder

Dimensions in millimetres

| Target nominal component dimensions ^a | Required dimensions (design values) |
|--|-------------------------------------|
| | K_1 |
| 0402M | (0,03 or more) ^b |
| 0603M | (0,03 or more) ^b |
| 1005M | 0,03 or more |
| 1608M | 0,03 or more |
| 2012M | 0,03 or more |
| 3216M | 0,03 or more |

NOTE The symbols are shown in Table 1 and Figure 1.

^a Components with intermediate size between each nominal dimension follow the larger nominal dimension.
^b Since components can be inverted in the pockets and there are some restrictions in the assembly manufacturing, the dimensions are shown as reference values in brackets. If the tapes do not meet these dimensions, persons involved should discuss in advance whether Auto Loading Feeder can be used.

4.4 Required specifications for the sealing method for the cover tape

The cover tape sealed by heat welding is only used for Auto Loading Feeder.

4.5 Requirements about fluff generated at removal of cover tape

Fluff of the carrier tape that is generated at removal of the cover tape should not enter pockets, so that the tape can be used for Auto Loading Feeder.

4.6 Required specifications for the maximum trailer length

Trailer length should be 300 mm or less, see Figure 2.

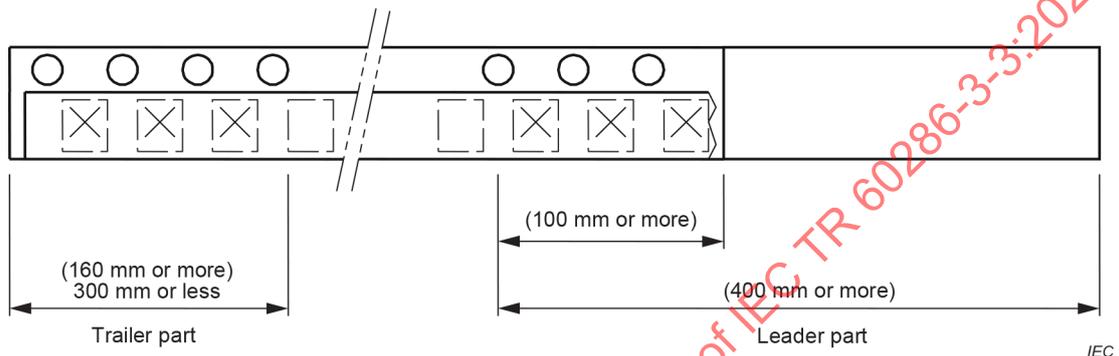


Figure 2 – Leader part and trailer part

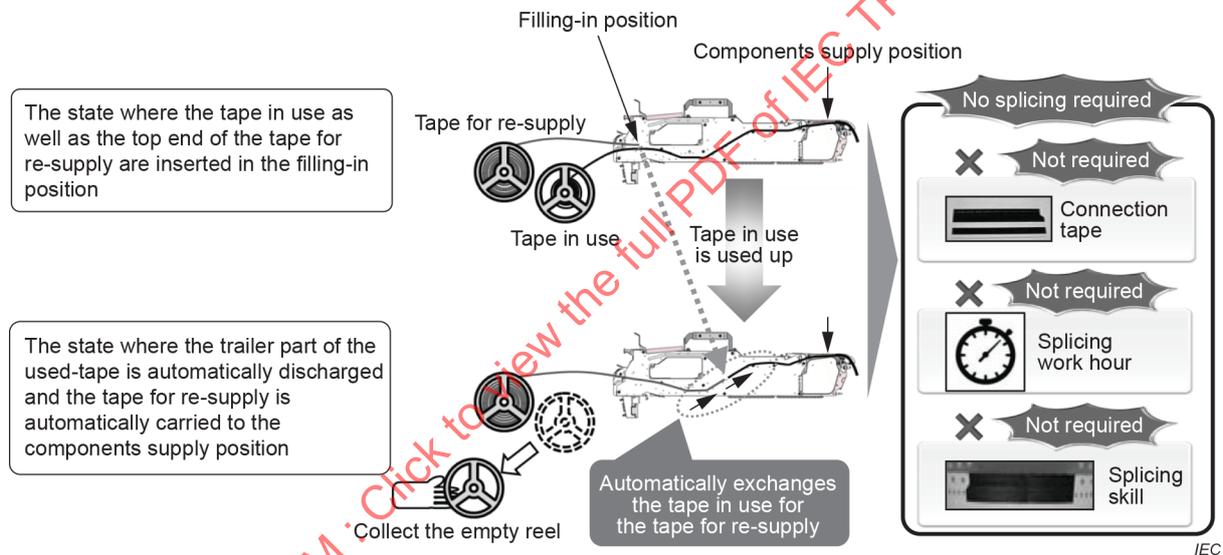
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Annex A (informative)

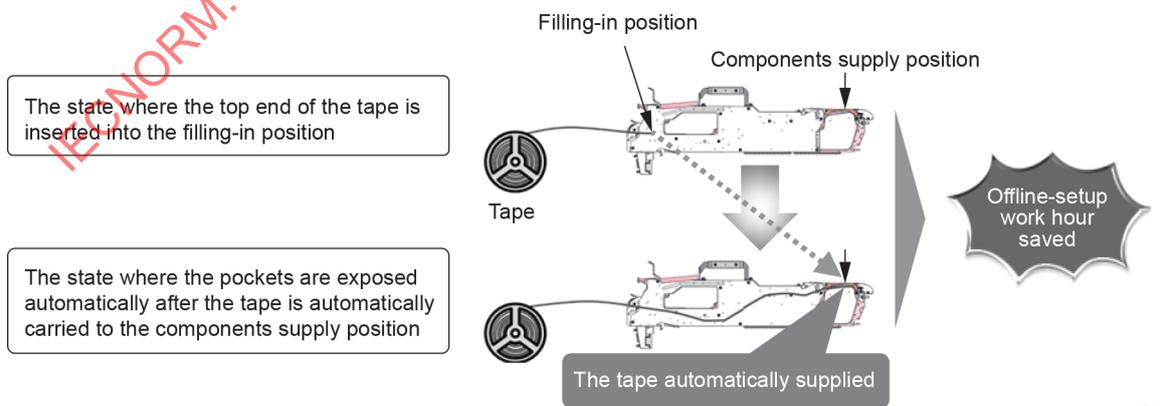
Overview and features of Auto Loading Feeder

A characteristic example for operation of an Auto Loading Feeder is shown in Figure A.1. Just after the components in a SMD tape get used up in the mounting process, another tape for re-supply set at the filling-in position is automatically carried to the components supply position and the pockets are automatically exposed. This results in re-supplying the components automatically. That is to say, this mechanism enables to keep supplying components without the conventional splicing work using a connection tape, which requires man-hours and specific skills. In addition, it largely reduces work hours during the work at offline setup, because inserting the top end of the tape in the re-supply position enables to supply the tape automatically in the same way as during supplying components in the mounting process. Auto Loading Feeder enables to boost up operating rate of mounters, save man-power and resources in the components mounting field of electrical and electronic manufactures, and is expected to get more popularization as the next generation supply system.

NOTE The splicing work is to connect the cut-off end of the trailer part of an in-use SMD tape and the cut-off tip of the leader part of a SMD tape for re-supply, by using a connection tape.



a) Supplying components during the assembly production



b) Supplying tape at offline setup

Figure A.1 – Operation and features when another tape is re-supplied automatically by the Auto Loading Feeder

Annex B (informative)

Methods and mechanisms of automatically exposing the pockets in using Auto Loading Feeder

B.1 General

The methods and mechanisms of automatically exposing pockets in using Auto Loading Feeder are classified with some explanation as follows, but they are not specified as requirements. If any of the following methods is applied to Auto Loading Feeder, attention is drawn to the industrial property rights:

- a) Single-door method with which only one sealed side of the cover tape is peeled off to expose pockets (see Clause B.2);
- b) Double-door method with which the cover tape is cut in its centre to expose pockets (see Clause B.3).

B.2 Single-door method

The overview of the single-door method with which only one sealed side of the cover tape is peeled off to expose the pockets is shown in Figure B.1.

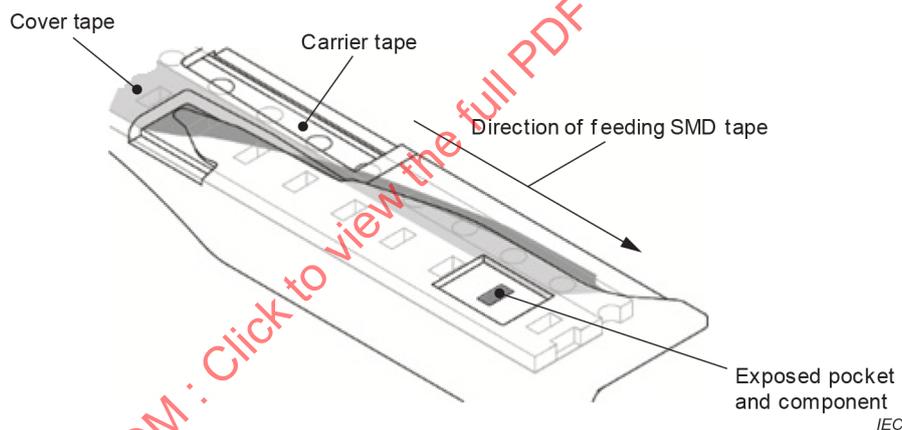


Figure B.1 – Overview of the single-door method

B.3 Double-door method

The overview of the double-door method with which the cover tape is cut in its centre to expose the pockets is shown in Figure B.2.

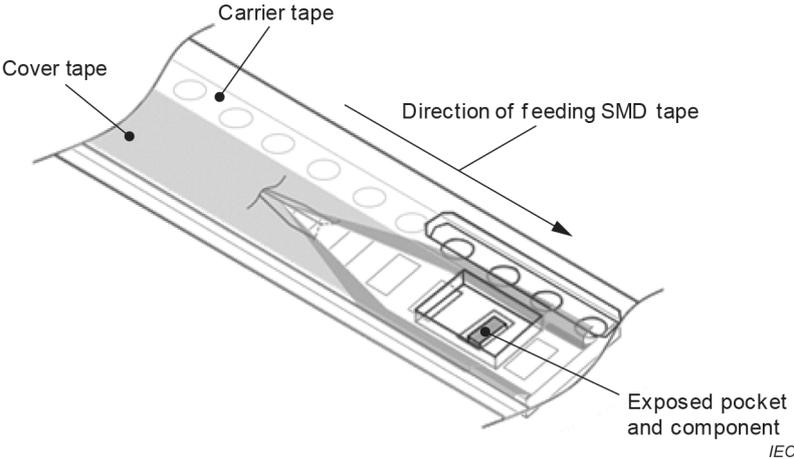


Figure B.2 – Overview of the double-door method

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Annex C (informative)

Discussion for paper taping for Auto Loading Feeder

C.1 General

The details of discussion among the Project Group on the major requirements and required dimensions and specifications for paper taping for Auto Loading Feeder, which were proposed by the mounter manufacturers, are classified as follows:

- a) Necessity of M_1 and M_2 as the cover tape sealed positions (see C.2.1);
- b) Necessity of K_1 as the distance between the upper side of carrier tape and the top surface of a component (see C.2.2);
- c) Sealing method for the cover tape (see C.2.3);
- d) Dent of the cover tape over the pockets (see C.2.4);
- e) Lower limit of the cover tape peel-off strength (see C.2.5);
- f) Adhesion of components on the cover tape (see C.2.6);
- g) Specified bending stiffness of the carrier tape (see C.2.7);
- h) Fluff sneaking to the pockets at removal of the cover tape (see C.2.8);
- i) Specified maximum trailer length (see C.2.9);
- j) Fixing the tail end of the carrier tape (see C.2.10);
- k) Cut shape of the tail end of the carrier tape (see C.2.11).

C.2 Discussion items

C.2.1 Necessity of M_1 and M_2 as the cover tape sealed positions

Necessity of M_1 and M_2 as the cover tape sealed positions was discussed as follows:

- a) Background and discussed items for the requirements

Since M_1 and M_2 are important dimensions for the basic operation of Auto Loading Feeder, which automatically exposes components, and it is impossible to realize to supply components stably without the control of these potential dimensions, the mounter manufacturers proposed M_1 and M_2 as the control values for every nominal component dimensions (0402M, 0603M, 1005M, 1608M, 2012M, and 3216M). According to this proposal, the components manufacturers and the packaging material manufacturers discussed if they can deal with the values, reviewing them.

- b) Resolved policy

It was decided that dimensions of the sealed positions required for Auto Loading Feeder are described as the design values for every nominal component dimensions. Additionally, the notes are added for additional recommended conditions and unsupported conditions.

- c) Justification for the policy

IEC 60286-3 describes the cover tape peel-off strength and break strength provided that the cover tape is generally removed by peel-off, but it does not specify any requirement or statement on the sealed positions. The mounter manufacturers explained the Auto Loading Feeder mechanism to the component manufacturers, so that the component manufacturers understand it is most important to control the sealed positions, in order to expose pockets automatically in Auto Loading Feeder.

Additionally, it was discussed whether the required sealed positions should be specified as the design values or the guaranteed values, then the component manufacturers have their opinion

that they cannot adopt the dimensions as the guaranteed values, because it is difficult to measure and check the positions. Finally, they adopted the required sealed positions as the design values as a compromise with the mounter manufacturers.

C.2.2 Necessity of K_1 as the distance between the upper side of the carrier tape and the top surfaces of a component

Necessity of K_1 as the distance between the upper side of the carrier tape and the top surface of a component was discussed as follows:

a) Background and discussed items for the requirements

K_1 is a distance required to avoid any damage to the components in the relationship between the components and the processing mechanism to expose the pockets in using Auto Loading Feeder, and it is an important dimension in order to judge whether Auto Loading Feeder can be used. Therefore, the values requested by the mounter manufacturers were discussed among the Project Group, checking the control range (guaranteed items) and the restrictions in manufacturing components.

b) Resolved policy

It was decided that the required values shall be described as the design values, considering the mounter manufacturers' request to show the required values as numerical indicators to judge whether Auto Loading Feeder can be used. On the other hand, the required dimensions to which the component manufacturers did not agree are described as reference dimensions in brackets. The note is added showing that persons involved should discuss in advance whether the SMD tape which does not meet the required dimensions can be used for Auto Loading Feeder or not.

c) Justification for the policy

All component manufacturers practice the control as per IEC 60286-3 that specifies "The component shall not protrude above the top surface of the carrier tape". The values for which the mounter manufacturers meet the required values are specified in IEC 60286-3, but a comment was raised that the components can be tilted and rotated largely in the pockets and the distance between the components and the nozzles picking them up becomes longer when a mounter picks up the components, possibly affecting the pick-up rate of small components. However, it was decided to describe the values requested by the mounter manufacturers, because the mounter manufacturers requested to show the values as indicators to judge whether Auto Loading Feeder can be used.

C.2.3 Sealing method for the cover tape

The sealing method for the cover tape was discussed as follows:

a) Background and discussed items for the requirements

The sealing method for the cover tape which can be used for Auto Loading Feeder was focused on. Auto Loading Feeder with the single-door method (see Clause B.2) has the mechanism to peel off the tape at one side, sealing and carrying the cover tape together with the carrier tape. Therefore, the cover tape with adhesive seal affects adversely carriage of the SMD tape, because the adhesive part of the seal can adhere to the inside of Auto Loading Feeder. For this reason, the mounter manufacturers requested that paper tapes sealed with cover tape of adhesive type should be excluded from the scope. Their request has been discussed.

b) Resolved policy

It was decided that only the paper tapes sealed with cover tape of heat welding type shall be used for Auto Loading Feeder.

c) Justification for the policy

The cover tapes of adhesive type are not applicable for Auto Loading Feeder, because they possibly cause failures in supply due to the seals adhered to the component exposure mechanism.

C.2.4 Dent of the cover tape over the pockets

A dent of the cover tape over the pockets was discussed as follows:

a) Background and discussed items for the requirements

Since a dent of the cover tape over the pockets, including a dent made by winding reels strongly, possibly causes adhesion of components, it was discussed whether the requirement "the cover tape should not have any dent over the pocket" is added or not. An example dent is shown in Figure C.1.

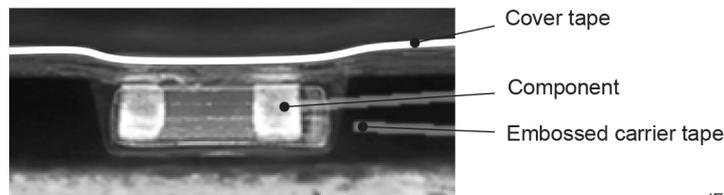


Figure C.1 – Example dent of the cover tape over the pocket (embossed tape)

b) Resolved policy

It was decided that such requirement is not specified.

c) Justification for the policy

Since such requirement is included in IEC 60286-3 that specifies "Component shall not stick to the carrier tape or to the cover tape", it was concluded that the requirement does not need to be described in this document with individual factors.

C.2.5 Lower limit of peel-off strength of the cover tape

The lower limit of peel-off strength of the cover tape was discussed as follows:

a) Background and discussed items for the requirements

Requirements for the lower limit of peel-off strength for Auto Loading Feeder were discussed, because the mounter manufacturers requested to specify limit values applicable for Auto Loading Feeder, in order to prevent seals from peeling away the positions where the seal should not be peeled off, although peel-off strengths of 0,1 N to 1,0 N for the carrier tape with the width: 8 mm are described in IEC 60286-3.

b) Resolved policy

It was decided that such requirement is not specified.

c) Justification for the policy

The lower limit values required for Auto Loading Feeder are not clear and the component manufacturers control different values based on IEC 60286-3 now. Therefore, it is impossible for the component manufacturers to control the specific values individually for Auto Loading Feeder, and an opinion was raised that the change of the control values possibly causes unexpected failures.

C.2.6 Adhesion of components on the cover tape

Adhesion of components on the cover tape was discussed as follows:

a) Background and discussed items for the requirements

Adhesion of components on the cover tape possibly causes the adhered components to interfere with the pocket exposure mechanism of Auto Loading Feeder. It was mentioned that static electricity or close stickiness to the cover tape possibly causes the trouble. The mounter manufacturers commented that they will continue to improve Auto Loading Feeder to avoid such trouble, and asked the component manufacturers for further improvement of

the quality control to realize “no components are adhered”. Therefore, the possible problems were discussed.

b) Resolved policy

It was decided that such requirement is not specified.

c) Justification for the policy

Such requirement complies with IEC 60286-3, and it was confirmed that the component manufacturers would keep designing and controlling quality in order to avoid adhesion of components.

C.2.7 Bending stiffness of the carrier tape

Specified bending stiffness of the carrier tape was discussed as follows:

a) Background and discussed items for the requirements

Bending stiffness of the carrier tape in its longitudinal direction possibly causes inconvenience that the tape gets buckled when fed automatically, or possibly causes failure in feeding the tape, due to insufficient correction of winding curl of the tape. Therefore, the moulder manufacturers proposed to specify the bending stiffness of the carrier tape. The proposal was discussed.

b) Resolved policy

It was decided that such requirement is not specified.

c) Justification for the policy

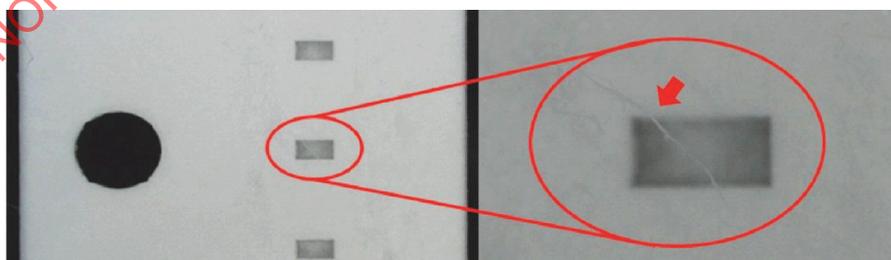
Such requirement was not to be specified, since it is difficult at present to specify the values required for Auto Loading Feeder clearly, and the component manufacturers insisted that they cannot control the bending stiffness under the individual criteria for Auto Loading Feeder during the manufacturing.

C.2.8 Fluff entering the pockets at removal of the cover tape

Fluff entering the pockets at removal of the cover tape was discussed as follows:

a) Background and discussed items for the requirements

Any mechanical restraint, including any effects caused by fluff, which prevents components from being taken out from the pockets smoothly, shall be avoided as specified in IEC 60286-3. Since, using Auto Loading Feeder, the sealed part of the cover tape used for peeling the tape off can be peeled off over the pockets depending on the way to expose the components, any fluff generated at the time possibly enters the pockets, which possibly results in mechanical restraint to pick up the components. An example of fluff entering the pocket is shown in Figure C.2.



IEC

Figure C.2 – Example of fluff entering the pocket possible in using Auto Loading Feeder

b) Resolved policy

It was decided that such requirement was to be specified as “any paper fluff of the carrier tape should not enter the pockets when the cover tape is being peeled off”.

c) Justification for the policy

Specification on the extent of fluff was also discussed, and it was concluded that the expression of the requirement was to be kept as described in C.2.8b).

C.2.9 Maximum trailer length

The maximum trailer length was discussed as follows:

a) Background and discussed items for the requirements

IEC 60286-3 states “Trailer length is the tape part sealed with the cover tape of the length with 160 mm or more without containing components”, but does not specify any upper limit value. Auto Loading Feeder detects the tail end of the tape and exchanges the tape in use for the tape for re-supply by itself, but cannot detect the tail end of the tape with the trailer length over 300 mm, due to the mechanism of Auto Loading Feeder that possibly makes errors in picking up at empty pockets that do not contain components. Therefore, the mounter manufacturers requested to introduce the requirement “Trailer length shall be 300 mm or less”. That was discussed.

b) Resolved policy

It was decided to introduce the requirement “Trailer length should be 300 mm or less” for the value proposed by the mounter manufacturers in order to realize the advantage of Auto Loading Feeder.

c) Justification for the policy

Although the component manufacturers commented that they control the operation with the minimum length 160 mm or more, defining no maximum length, and the trailer length can be 500 mm due to the factory issues, it was decided to specify the values recommended by the mounter manufacturers, so that the operating rate can improve by detecting the tail end of the tape.

C.2.10 Fixing the tail end of the carrier tape

Fixing the tail end of the carrier tape was discussed as follows:

a) Background and discussed items for the requirements

If the tail end of the tape cannot be released from the reel hub, Auto Loading Feeder pulls the reel in and stops operating, due to the overload, and then the tape in use cannot be exchanged for the tape for re-supply. Therefore, the mounter manufacturers requested to discuss the requirement to control so that “The tail end of the tape can be released easily from the reel (e.g. an empty reel can be removed by its weight)”. That was discussed.

b) Resolved policy

It was decided that such requirement is not specified.

c) Justification for the policy

IEC 60286-3 states “The carrier tape shall be released from the reel hub as the last portion of the carrier tape unwinds from the reel”, meaning “not fixed, not taped with adhesive tape and releasable”. It was concluded that the mounter manufacturers proposal “easily releasable, and releasable by own weight”, which is the new expression of requirement, needs another specification of the control values and the evaluation methods.

C.2.11 Cut shape of the tail end of the carrier tape

Cut shapes of the tail end of the carrier tape were discussed as follows:

a) Background and discussed items for the requirements

A used-up tape is pushed out by another tape for re-supply to be exchanged, then the deformed tail end possibly affects exchanging tapes, and it possibly stops the machine operation if the tail end of the used-up tape is not flat.

The mounter manufacturers proposed to discuss the specification on the cut shape, since they hope that the reduction of operating rate due to the outage of the machine, and the