# Specification

KRONES Label Specifications

TD10022638 EN 01

KRONES

# Table of Contents





KRONES

# 1 General Information

## 1.1 Basic information

The indicated dimensions and tolerances are the minimum requirements necessary for the configuration of the different machines. Deviations of this specification must be reported in advance to the special field departments.

This concerns the following parameters:
1. Shape/geometry and dimensional accuracy
2. Physical properties

The specification is valid for the following label types:
1. Single-sheet labels made of paper
2. Endless labels made of plastic or paper – flat
3. Endless labels made of plastic – tubular
4. self-adhesive labels

The specification is to be understood as a supplement and as a clarification of a label drawing.

Label-dependent parts can only be designed in conjunction with the original sample material. The sample must be provided by the customer. This is especially the case when there are different label suppliers (each supplier shall provide sample material).

Despite the adherence to all the points indicated here, the label manufacturer is not released from the obligation to test the processability of all labels under operating conditions at the customer's plant. We therefore recommend always producing a small quantity of labels beforehand for the test runs. Ultimately the final label production can only be approved after successful test runs.

If the order is placed, sufficient original labels and product samples should be sent at the same time to KRONES. These label and product samples are part of the final test. If no original labels and product samples are made available, KRONES undertakes no warranty for the functioning of the labeller.

The goal of this label specification is to provide specifications for the label condition for a certain labeller. However, in the process only the requirements of the labeller with regard to the processability will be considered, but not the basic suitability of the labelling technology for the specific application.

Therefore, the it is essential that the following be observed when selecting the labelling technology: Not all labelling methods are suitable for a certain product.

Although, for example, a hotmelt-glued wrap-around label or a shrink sleeve could be used due to the container geometry, this kind of labelling technology cannot be used for returnable applications, as this kind of label could no longer be removed from the container. Containers that still expand after labelling can also cause problems depending on the labelling technology. Wrap-around labels are pulled on if the label material used cannot compensate for the expansion. With labels glued over the entire surface, the labels can wrinkle or fall off.

An unsuitable container geometry can also produce a poorer label decoration result or can make labelling impossible. Additional deciding factors can be the container temperature, the container surface, the container geometry, the container material, the container tolerances, the stability of the container and the further use of the labelled container. Therefore, a large number of factors must be considered when choosing the labelling technology and the correct labelling method for the individual case must be chosen. The label manufacturers are challenged to select a label material optimally matched to the application - within the framework of this specification. Not every label is suitable for every product!

All statements in this specification correspond to our current state of knowledge. This way they do not have the meaning to assure specific properties of the products or their suitability with a certain operation purpose. We therefore recommend that you make use of the advisory service of the label manufacturers.

## 1.2 Delivery and storage of labels

### 1.2.1 Processing information

The original packaging may be opened after removal from the store room only if the temperature of the labels has completely matched the ambient temperature of the processing point. Complete temperature assimilation can take anywhere from a few hours to a few days, depending on the pack size and the temperature difference.

We recommend supplying new labels in time!

| NOTICE |
| --- |
| **Never open packages with cold labels in warm surroundings or packages with warm labels in cold surroundings.**<br>Otherwise, water can spontaneously condense on the labels. In both cases flatness deviations and becoming wavy as well as corresponding processing difficulties are the possible consequence. |

In general, labels which have been stored longer should be used first.

### 1.2.2 Pre-cut labels

At least in a standard climate – relative humidity of 50 % at a temperature of 23 °C (see Chap. Standard climate [▸ 7]) – paper and tin foil labels must lie flat. The labels must be stored such that they remain flat and, if bent already, they should be flattened again with a corresponding water absorption. Labels must, by no means, lose water during storage. Dried-out labels are stiff, have a drastically reduced tensile strength and cause malfunctions and wrinkles.

The storage climate for tin foil labels can deviate from this. It is based on the requirement of lying flat. The aim should therefore be that tin foil labels and paper-backed labels remain flat at least in the standard climate.

Labels that come from a storage climate like this into the damp bottle hall then no longer cause any problems. Only countries with very dry climates are an exception to this.

| NOTICE |
| --- |
| Pre-cut labels should be supplied in pack size of 1,000 - 1,500 labels per pack unit if possible. KRONES must be notified of the position of the adhesive tape for package units larger than 1,500 labels before designing the label magazines. Before laying it in the label magazine, this stack should be thumbed through to separate the labels. |

### 1.2.3 Reel-fed labels

Reel-fed labels must be delivered carefully packed on a completely flat base - preferably a pallet. The reels must be stored on the face so that no deformations can occur.

If several reels are stacked on each other, the top reel may have at most the diameter of the reel directly below it. It is advisable to separate individual layers from each other with anti-slip paper. The packaging must not be damaged and must ensure that the reels are protected reliably against climatic influences – especially against air humidity variations. Reel packages made of shrink or stretch film are usually suitable for this purpose.

The reels must be stored originally packed. The storage facility is to be cool and dry (for guide values, see Chap. Standard climate [▸ 7]). There must be no heat sources (e.g. radiators, direct sunlight) in the direct vicinity of the pallet storage area. With heat-sensitive labels, the effects of heat during transport from the label manufacturer to the filling plant must be avoided.

The reels may not be stacked too high on the pallet (see Packaging of reel-fed labels [▸ 8]) and the pallets are not to be placed directly on each other. The effects of heat and pressure loading can cause deformations of the faces and must be avoided (see Storing endless labels [▸ 7]).

### 1.2.4 Sleeve labels

Sleeve labels must be delivered carefully packed on a completely flat base - preferably a pallet. The reels must be stored on the face so that no deformations can occur.

If several reels are stacked on each other, the top reel may have at most the diameter of the reel directly below it. It is advisable to separate individual layers from each other with anti-slip paper. The packaging must not be damaged and must ensure that the reels are protected reliably against climatic influences – especially against air humidity variations. Reel packages made of shrink or stretch film are usually suitable for this purpose.

The reels must be stored originally packed. The storage facility is to be cool and dry (for guide values, see Chap. Standard climate [▸ 7]). There must be no heat sources (e.g. radiators, direct sunlight) in the direct vicinity of the pallet storage area. With heat-sensitive labels (e.g. OPS labels), the effects of heat during transport from the label manufacturer to the filling plant must be avoided. The shelf life of PET and PVC labels is limited to a maximum of six months; that of OPS labels to a maximum of three months.

The reels may not be stacked too high on the pallet (see Packaging of reel-fed labels [▸ 8]) and the pallets are not to be placed directly on each other. The effects of heat and pressure loading can cause deformations of the faces and must be avoided (see Storing endless labels [▸ 7])

## Storing endless labels


*Fig. 1:* Storing endless labels

* The photos refer to the German standard DIN 50014 (Edition 1985-07)

## Standard climate

| | |
|---|---|
| Air temperature | 23 °C ± 2 °C |
| Relative humidity | 50 % ± 6 % |
| Condensation temperature | 12 °C |
| Air pressure | 860 hpa to 1,060 hpa |

**Packaging of reel-fed labels**

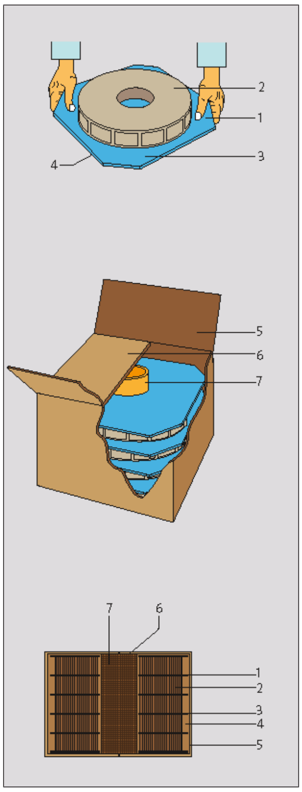


*Fig. 2:* Packaging of reel-fed labels

1. Support for removal from the packaging and for inserting the reel in the labeller
2. Possibility for gentle winding
3. Avoidance of telescopic effects on the label reel
4. Avoidance of worn labels due to external winding on the reel
5. Protection against moisture and dust by the PE coating on the inner surface of the box; pressure distribution with storage on pallets
6. Higher storage stability in the package due to the reducing fitting and avoidance of contact of box flaps with the label edges
7. Secure position of each reel against transport vibrations

# 1.3 Removal of labels from returnable bottles

For pre-cut labels applied to returnable bottles, it must be ensured that they can be removed from the bottle again. It must be possible for the caustic solution to penetrate the paper. For this reason, metallised paper must be embossed on the entire surface.

The labels are not to become fibrous or disintegrate, but instead can be removed again as a whole unit from the bottle washer. The printed colours are mostly to remain on the label in the cleaning process.

The penetration of the caustic solution should take a maximum of 120 sec. for white paper and a maximum of 180 sec. for metallised paper.

# 1.4 Printing methods

The printing methods can be divided into three main groups: Direct, indirect (conventional) and non-impact printing (NIP) methods.

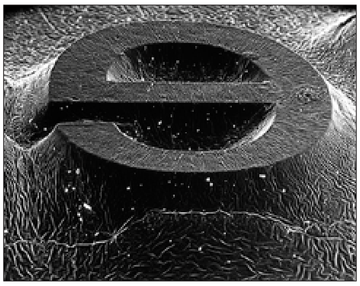

*Fig. 3:* Microscopic photo of a relief forme

The conventional printing methods are linked to a print form. Here the direct methods are designed so that the print form used in each case directly transfers the corresponding printing information to the material to be printed. With the so-called indirect printing method, the ink is initially transferred from the print form to an intermediate transfer cylinder and from there onto the printing material.

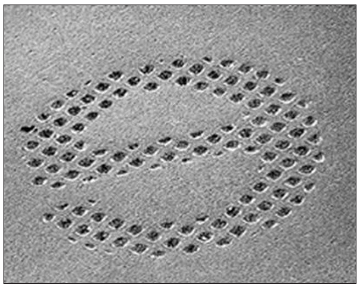

*Fig. 4:* Microscopic photo of a gravure forme

In contrast to this, the NIP printing method does not use conventional print forms. This means that with the conventional type, the information to be printed is fixed in place in the respective print form used and cannot be modified in the printing process. On the other hand, with the NIP method the printing information is regenerated after each cylinder unwinding. This enables a high degree of flexibility to be achieved, e.g. as required for personalisations.

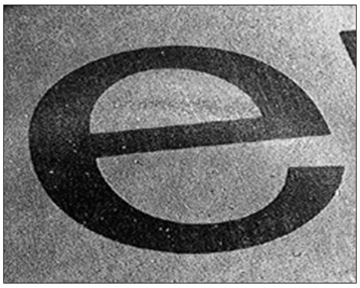

*Fig. 5:* Microscopic photo of an offset forme

The most widespread non-impact methods are electrophotography and inkjet. In electrophotography toner particles are fixed in place on the printing material with electrostatics, while with the inkjet method liquid inks are applied with a jet system. NIP methods can also be referred to as Direct Digital Printing (DDP) or Computer to Print (Ct PRINT).

On inkjet printing systems with their universal printing mechanisms, various flexible and heat and pressure-sensitive materials can be processed. The system is used for printed products in small and medium-sized print runs, which must be produced quickly and inexpensively. In the label sector such methods are used occasionally for raffles or basically for personalisation tasks.

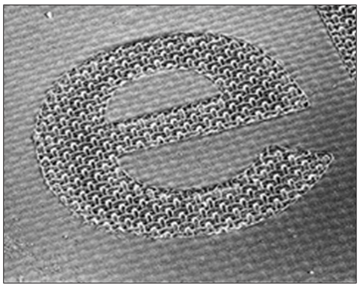

*Fig. 6:* Microscopic photo of a screen printing forme

In the case of "conventional" printing processes, the creation of a printed image can be further subdivided into four main groups (relief, gravure, offset and screen printing). This classification is based on the systematic way in which the print image is generated, i.e. how the print image is structured and how the ink transfer is achieved.

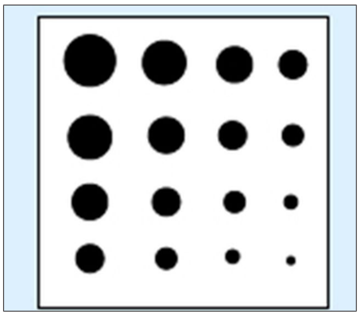

*Fig. 7:* Principle of rasterisation

In principle, the actual print information must be prepared for all industrially used printing processes to the extent that an image is split into its "individual colours". This means that a photorealistic image can be achieved with just four colours. In this case, the colours cyan (blue), magenta (red), yellow (yellow) and black (depth) are used. In order for this to take place, the original image must be broken down into the respective colour separations and the individual layers obtained from this must then be additionally "rasterised". Rasterising means that an image is divided into individual, precisely defined raster points (see illustration). If a printed image is viewed up close, the individual "halftone dots" of the respective colour can be recognised, depending on the resolution. By printing the individual colour separations together, a "real" image is then simulated to the human eye, as the eye's resolving power is no longer sufficient from a certain viewing distance and therefore a "picture" is produced.

### 1.4.1 Flexographic printing

The main feature of flexographic printing is the use of a soft, flexible printing form in which the printing elements are higher than the non-printing elements. A flexographic printing unit consists of the anilox roller, the forme cylinder with the soft printing forme (cliché), the impression cylinder and the inking unit with chambered doctor blade system (see : Principle of relief printing [▸ 10]).

Tiny cells with a defined scoop volume are engraved in the anilox roller, which take up the ink from an ink trough. The excess ink is scraped off by the doctor blade. By rolling and pressing, the ink is transferred from the anilox roller to the higher elements of the printing forme (see illustrations in : Microscopic image of screen dots on a flexographic printing plate [▸ 11]). Reliable ink transfer from the printing forme to the substrate is ensured by the hard (counter) impression cylinder.

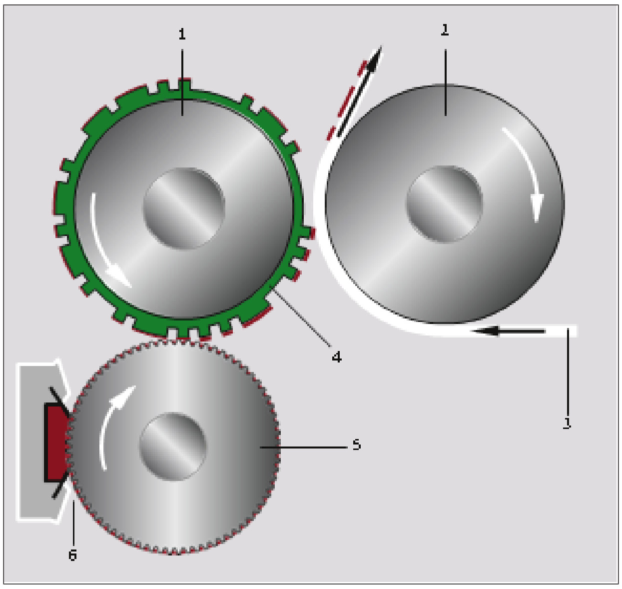


*Fig. 8:* Principle of relief printing

1. Forme cylinder
2. Impression cylinder (hard)
3. Printing material
4. Type forme (soft)
5. Anilox roller
6. Inking unit with doctor blade and anilox roller

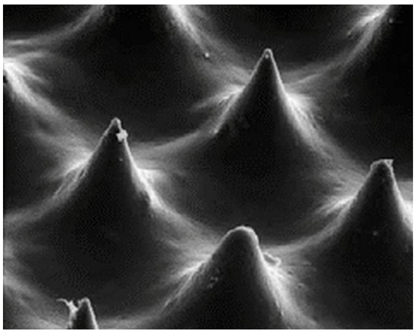

*Fig. 9:* Microscopic image of screen dots on a flexographic printing plate

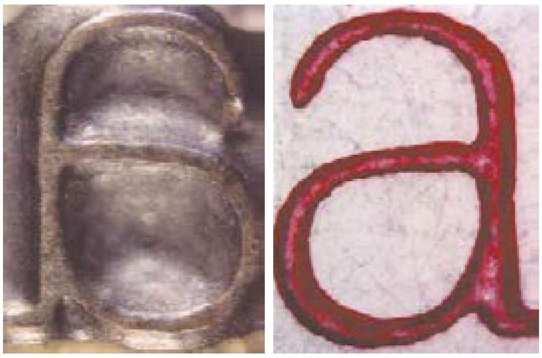

*Fig. 10:* Crimped edge - distinguishing feature of flexographic printing

## 1.4.2 Gravure printing

The most important gravure printing processes, which are of the greatest economic significance, include rotogravure and pad printing.

In rotogravure printing, the printing image elements are incorporated into the printing forme by etching or engraving and are therefore deeper than the non-printing elements. The cells can be created with variable areas and depths (see figure : Electromechanically engraved cells (maximum engraving depth) [▹ 12]) so that they can hold a different amount of ink. The different ink film thicknesses therefore produced on the substrate correspond to the tonal value gradations of the original artwork.

The printing forme is inked by dipping it directly into the ink tray. The excess ink is removed by scraping it off with the help of a doctor blade. A high contact pressure and the adhesion forces between the substrate and the ink cause the ink to transfer from the depressions to the substrate (see figure : Gravure printing [▹ 12]).

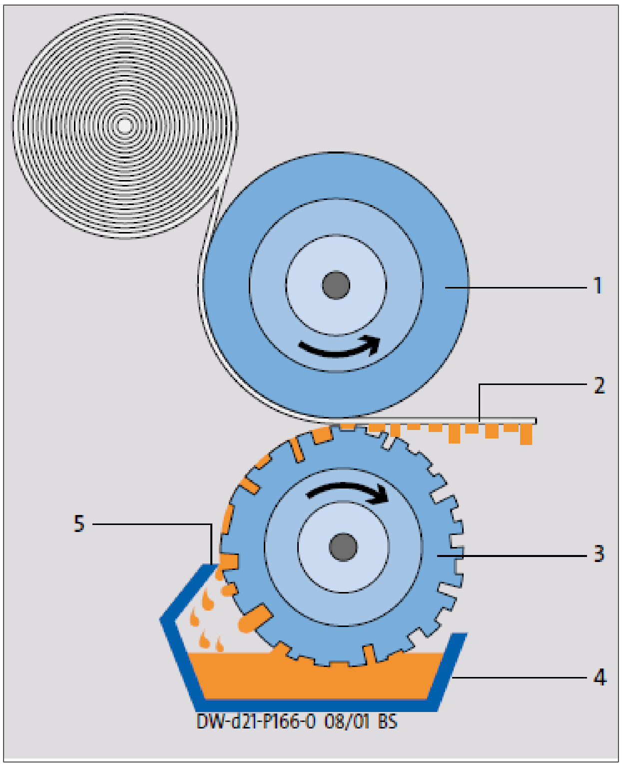


*Fig. 11:* Principle of gravure printing

In rotogravure printing, the printing image elements are incorporated into the printing forme by etching or engraving and are therefore deeper than the non-printing elements. The cells can be created with variable areas and depths (see figure : Electromechanically engraved cells (maximum engraving depth) [▸ 12]) so that they can hold a different amount of ink. The different ink film thicknesses therefore produced on the substrate correspond to the tonal value gradations of the original artwork.

The printing forme is inked by dipping it directly into the ink tray. The excess ink is removed by scraping it off with the help of a doctor blade. A high contact pressure and the adhesion forces between the substrate and the ink cause the ink to transfer from the depressions to the substrate (see figure : Gravure printing [▸ 12]).

1. Impression cylinder
2. Printed paper
3. Impression cylinder
4. Ink tray
5. Doctor blade

The highest image quality is achieved with gravure printing. However, due to the very high costs of printing forme production, rotogravure printing is only used cost-effectively for printing mass runs.

Typical characteristics of an gravure printing are a very good colour tone reproduction as well as jagged type and image edges (see figure : "Sawtooth" [▸ 13]).

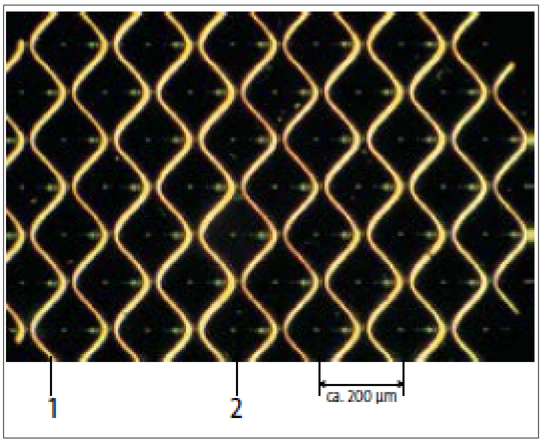


*Fig. 12:* Electromechanically engraved cells (maximum engraving depth)

1. Web
2. Cell
3. Approx. 200 µm

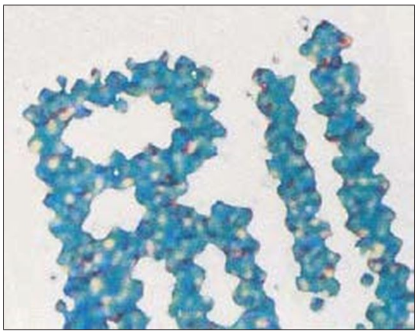

*Fig. 13:* "Sawtooth"

### 1.4.3 Printing inks

Today's printing processes use different ink systems based on different types of drying. Depending on the structure of the ink, drying can take place by chemical reaction (oxidation, polymerisation), physical processes (absorption, evaporation) or by a combination of both. The in some cases complex drying processes entail different advantages and disadvantages that cannot be discussed in detail here. As an example for the polymerisation process based on UV drying (drying of the ink using UV light), it should be mentioned that the chemical resistance to various fillers in the acidic and alkaline range as well as to dry abrasion is very high. However, UV inks only ever adhere adhesively to non-absorbent material surfaces. To ensure that good adhesion is nevertheless achieved, the printer must take special care when matching ink and substrate.

For the implementation of the printed product desired by the customer, this means that the knowledge and experience of the printer are crucial in order to use the appropriate printing processes and ink systems for the specific requirements.

#### Influence of printing inks

The treatment of the surfaces of printed products serves various purposes, such as the application of a barrier layer (against moisture, grease), the protection of the surface against mechanical stress (scratches, abrasion) or also an improvement of the further processing in printing and packaging machines via the coefficient of friction and the light fastness.

Special importance is attached to the finishing of surfaces in order to achieve certain visual and haptic effects. In the label sector, they can be achieved by finishing processes such as printing or varnishing, the use of a specific printing process or a combination of different printing processes, and the embossing of raised surface structures and holograms.

#### Layer thickness

Depending on the printing process chosen, the ink application varies greatly. In screen printing, for example, varnish and ink can be applied in such high layer thicknesses, usually between 20 and 100 µm, that the applied structures can be felt when touched and therefore provide a haptic similar to embossing (e.g. Braille). For the other printing processes, they range between 0.5 and 2 µm. Possible consequences to be considered are:

- A partially increased layer thickness can lead to "build-up" in the stack or on rolls (see chapter 2.2: Thickness tolerances for pre-cut labels [▹ 18]).
- With thin substrates and high ink film thickness, the ink film can influence the stiffness of the label via corresponding restoring forces (see chap. Layer thickness [▹ 13])

### Abrasive pigments

Due to its high opacity and strong lightening capacity, titanium dioxide is used as the most important white pigment. It is used in paints and as opaque white (background white). Both the inherent hardness of this pigment and its particle size and shape show abrasive properties in practice and have an influence on the service life of punching and cutting knives, among other things.

### Light fastness

The light fastness of a printing ink is assessed, for example, using the wool scale (WS). According to the DIN standard, light fastness is the resistance of a standard pressure sample to the effects of light without the direct influence of weathering. It is determined by the pigment used, its concentration in the ink, the ink film thickness, in the case of ink mixtures by the ink with the lowest light fastness as well as the type, duration and intensity of the light and the substrate. The wool scale (originating from the textile industry) has eight levels from very low to excellent. The degradation reactions of the colour pigments take place with a more or less strong fading. Usually, magenta and yellow are more affected than cyan and black. In packaging printing, mainly inks of the WS 5 - 6 levels are used, which corresponds to the rating "good" to "very good".

### Alkali resistance

Paper labels on returnable beverage bottles are washed off again in bottle washers using hot alkaline solutions. The labels should be discharged as a whole if possible and should not stain the alkali. The evaluation criteria for the alkali resistance of labels contained in DIN 16524-7, such as adhesion of the printing inks and no fraying of the printing paper, must be ensured through the selection of suitable papers and printing inks (see chapter 1.3: Removal of labels from returnable bottles [▸ 8]).

### Resistance to filling material, temperature and abrasion

The ink must bond with the substrate in such a way that it remains adherent even under load. In most cases, both physical and chemical resistance are required at the same time. The requirements for chemical resistance can be varied depending on the filling material. Depending on the intended use, resistance to solvents, grease, acids (e.g. fruit juices, vinegar), bases (e.g. cleaning agents), etc. is required. For critical products, it is advisable to carry out storage tests (with longer simulated climatic conditions) with the original printed product in advance.

### Static and dynamic friction properties

In many applications, certain static and dynamic friction values are required for the machine processability of labels.

Since printing inks or varnishes usually cover a large part of the surface of a label, the correct adjustment of the friction properties of the ink or varnish formulation is an essential criterion for good processability.

In certain cases, it is advisable to apply an overcoat to the entire surface of a label that has only been partially printed. This ensures constant rubbing properties over the entire label surface.

## 1.5 Dating device

The general rule for dating labels is that

- hot stamping is possible in almost all colours and
- laser or inkjet dating is also possible.

More information on dating labels can be found in the KRONES dating specification. A dating proposal drawing must be requested separately from KRONES.

*Fig. 14:* Hot-foil stamping unit

*Fig. 15:* Laser coding/dating


*Fig. 16:* Ink-jet coding/dating

# 2 Pre-cut labels

## 2.1 Types of pre-cut labels – terminology

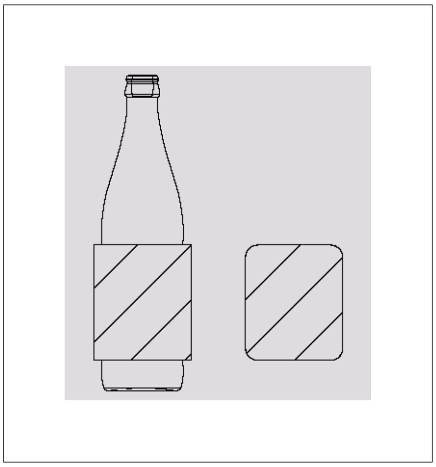

*Fig. 17:* Body label:
Rectangular or rectangular with rounded corners; on the front of the container

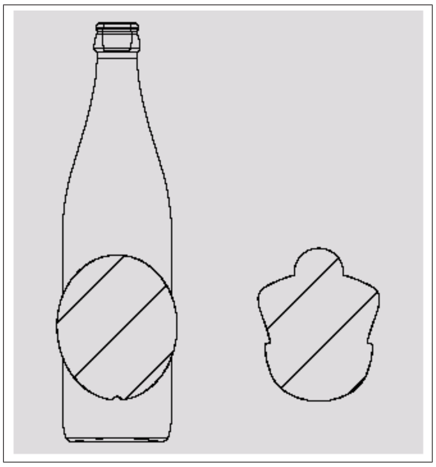

*Fig. 18:* Shaped body label
Any shapes; on the front of the container

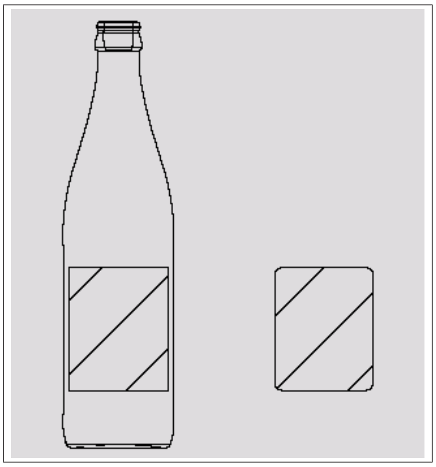

*Fig. 19:* Back label:
Rectangular or rectangular with rounded corners

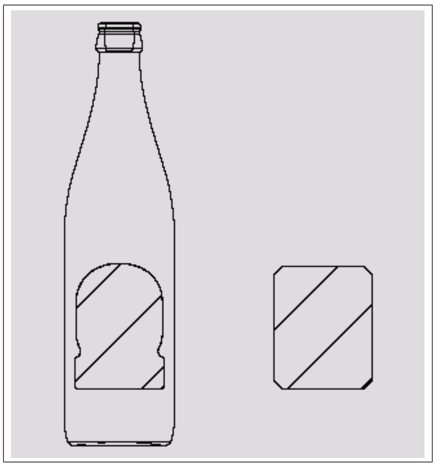

*Fig. 20:* Shaped back label:
Any shapes; on the back of the container

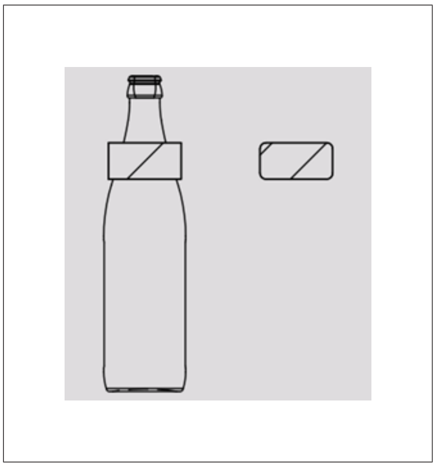

*Fig. 21:* Shoulder label:
Rectangular or rectangular with rounded corners; in the shoulder area of the container

*Fig. 22:* Shaped shoulder label:
Any shapes; in the shoulder area of the container

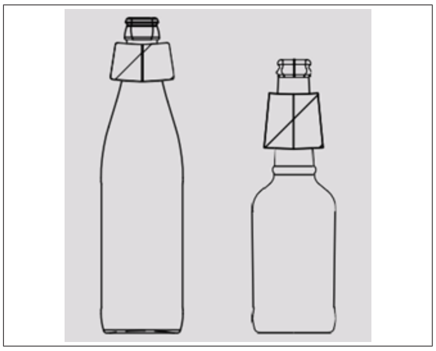

*Fig. 23:* Neck label:
In the neck area of the container

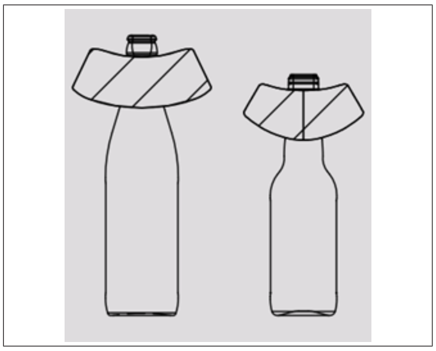

*Fig. 24:* Neck-around label:
Overlaps in the neck area

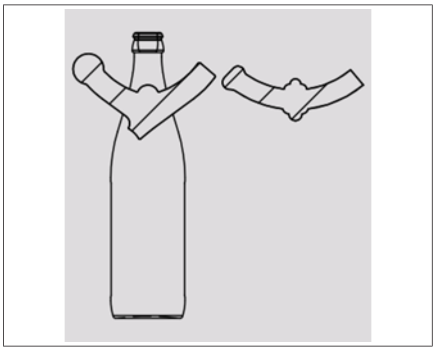

*Fig. 25:* Neck band:
Overlaps in the neck area

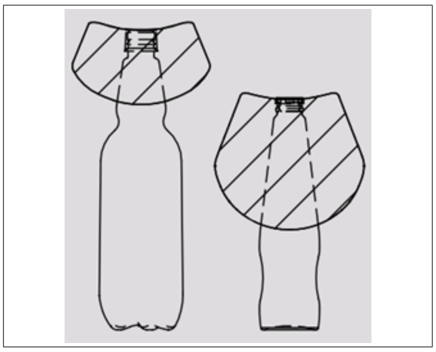

*Fig. 26:* Deep-cone wrap-around label:
Over neck and closure; overlaps in neck area

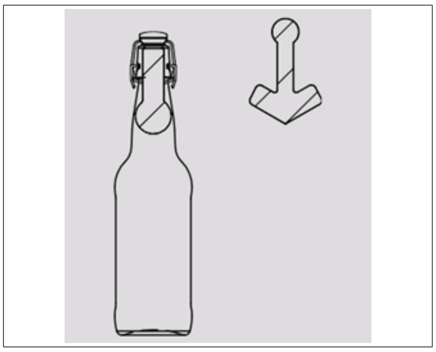

*Fig. 27:* Swing-stopper label:
Above the swing stopper

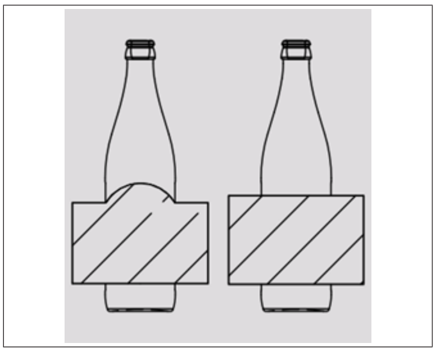

*Fig. 28:* Wraparound label/shaped wrap-around label:
With gap at the container back

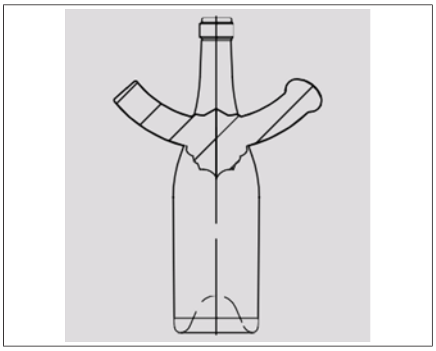

*Fig. 29:* Champagne band:
Especially for champagne bottles; overlaps in the neck/shoulder area

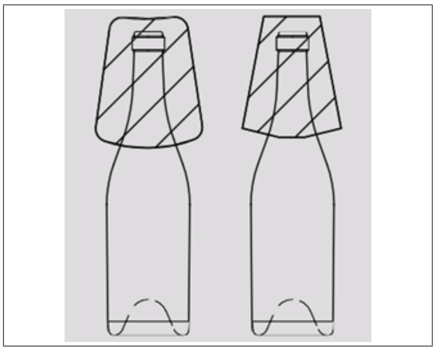

*Fig. 30:* Champagne foil:
Especially for champagne bottles; above the closure; overlapping in the neck area

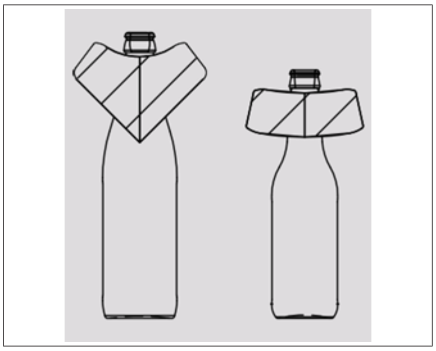

*Fig. 31:* Neck foil:
Below the mouthpiece; overlaps in the throat area

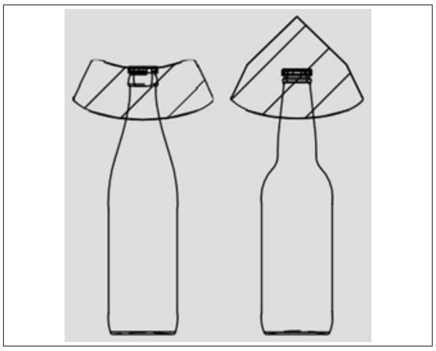

*Fig. 32:* Round neck foil:
Above the closure or 2 mm below the upper edge of the closure; with rounding on the lower edge

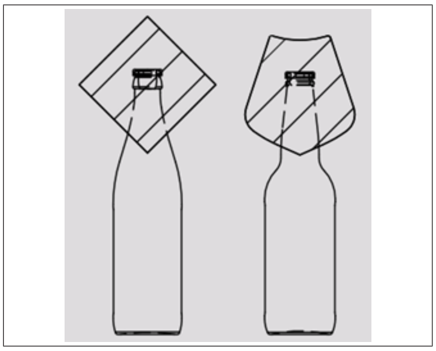

*Fig. 33:* Pointed neck foil:
Over the closure; with lace at lower edge; overlapped at neck area

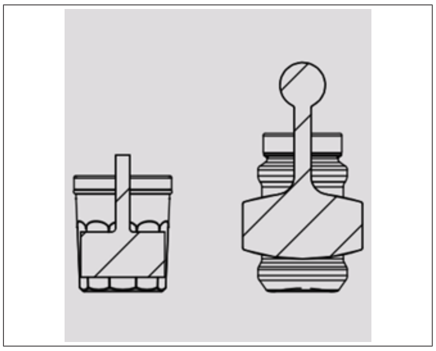

*Fig. 34:* Tamper-evident label:
Above the closure

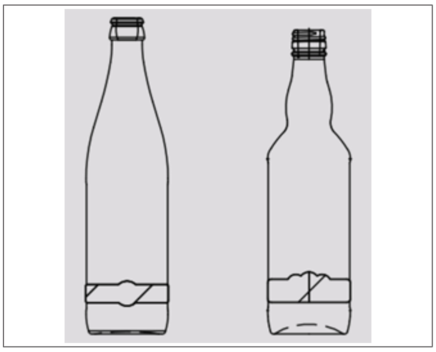

*Fig. 35:* Foot label:
In the foot area of the container

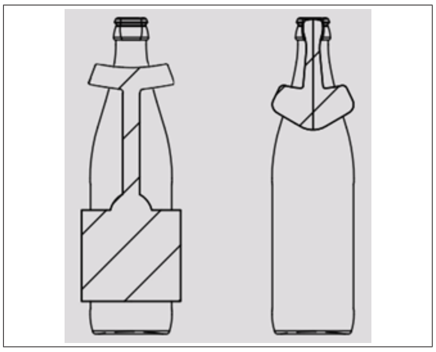

*Fig. 36:* Combination label:
Combines two label types

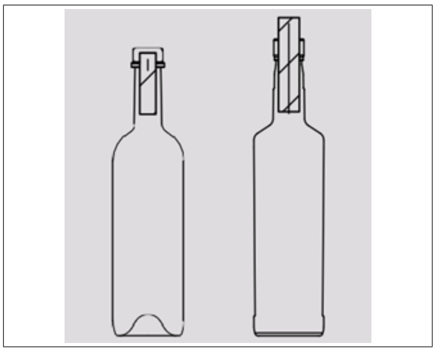

*Fig. 37:* Tax strips:
Above the closure; with control marking

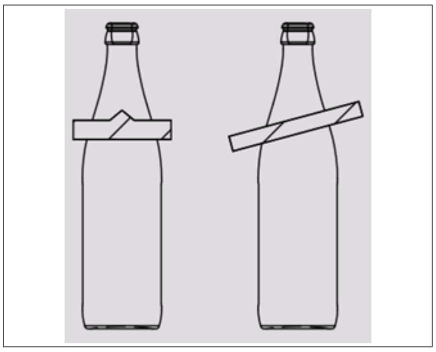

*Fig. 38:* Strip/diagonal strip:
In the chest area of the container

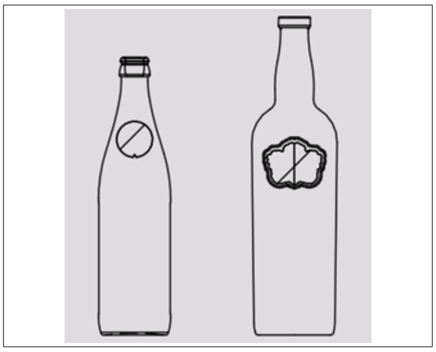

*Fig. 39:* Medallion:
Quality seal/award

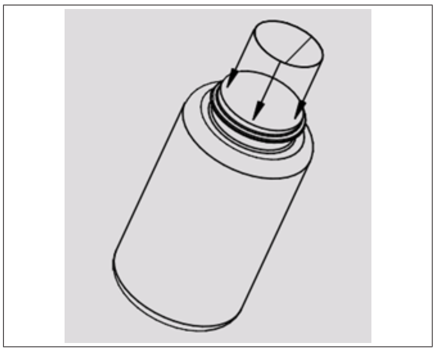

*Fig. 40:* Lid label:
On the lid/closure

## 2.2 Thickness tolerances for pre-cut labels

In the case of pre-cut labels, particular care must be taken to ensure that the stack height of the labels is flat and can be moved in the label magazine with an even counterpressure. For a label stack of approx. 1,000 pre-cut labels, the height between the minimum and maximum height may deviate by max. 1 mm (see dimension X on illustration).

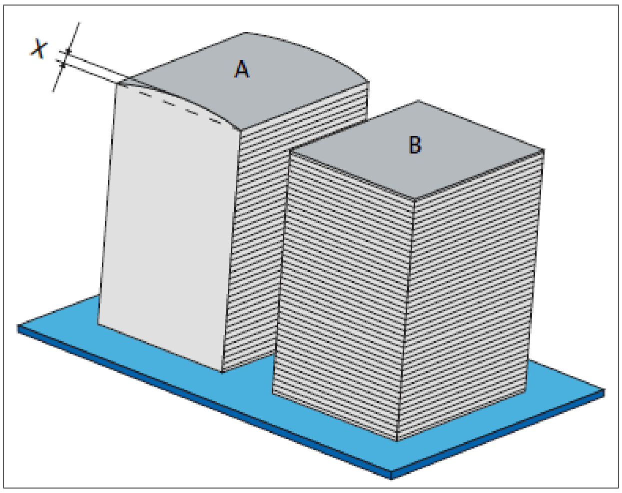


*Fig. 41:* Label stack flatness

Stack A represents an unacceptably deformed label stack. Stack B has an optimum flatness.

To obtain an optimum stack, a uniform colour application (constant coating thickness over the entire label surface) must be guaranteed.

If there are major deviations, particular due to partial embossings, only small quantities of the labels can be inserted in the label magazine and processed. KRONES can assure processability only after practical tests.

## 2.3 Paper grain direction for labels

Ensure the correct grain direction for the label. An incorrect grain direction can lead to faulty labelling or can make labelling impossible.

### Curling tendency after moistening rear of label.

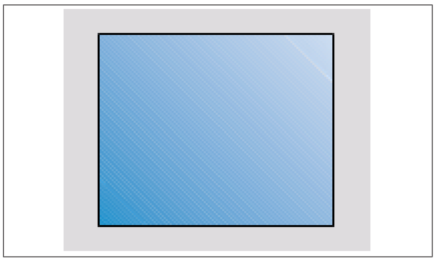

*Fig. 42:* Label shape – wrap-around label

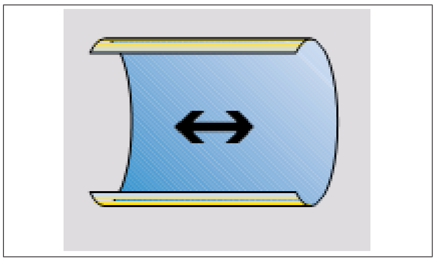

*Fig. 43:* Correct grain direction

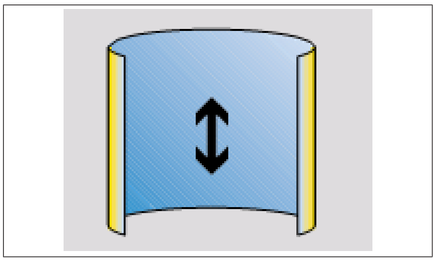

*Fig. 44:* Incorrect grain direction

### Paper grain direction for wrap-around label

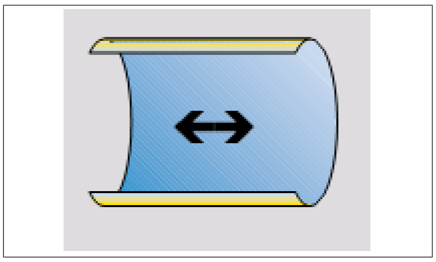

*Fig. 45:* Correct grain direction

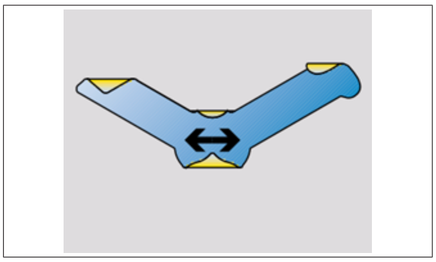

*Fig. 46:* Correct grain direction

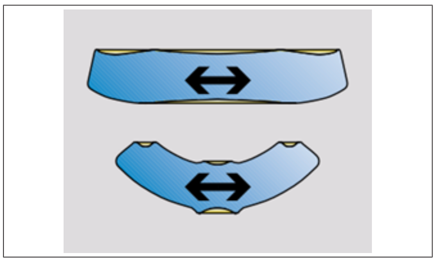

*Fig. 47:* Correct grain direction

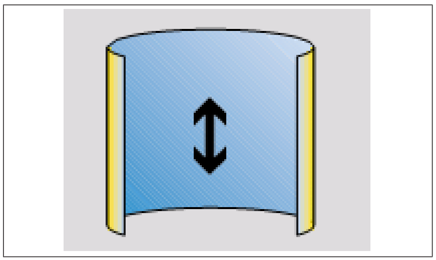
*Fig. 48:* Incorrect grain direction

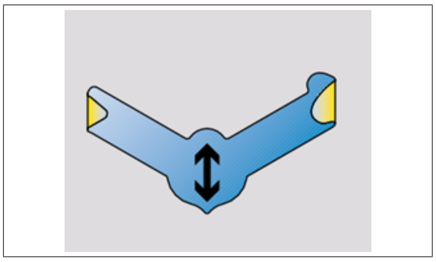
*Fig. 49:* Incorrect grain direction

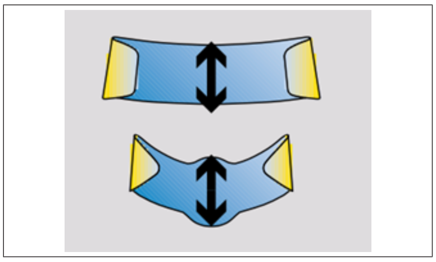
*Fig. 50:* Incorrect grain direction

## 2.4 Pre-cut labels for cold glue applications

Due to the variety of materials in the area of bottles and labels, it is unfortunately not possible to name an all-round adhesive for certain areas of application.

Rather, it is important to select the optimal adhesive for the respective application based on all known parameters and information.

Examples of criteria which can be important for the selection of the right adhesives:
- Bottle condition: Moisture, temperature before the labeller, etc.
- Label material: Shape, paper weight, Cobb value, special aspects (sample material)
- Bottles: Surface tension, returnable/non-returnable
- Machine type: Age, blocked, output in btl./h, glue roller (rubber/steel)
- Special requirements for the adhesive: Ice water proof, condensation proof, etc.

To select the right adhesive for your application, we recommend consulting our specialists at KIC KRONES (www.kic-krones.com).

### 2.4.1 Label contour

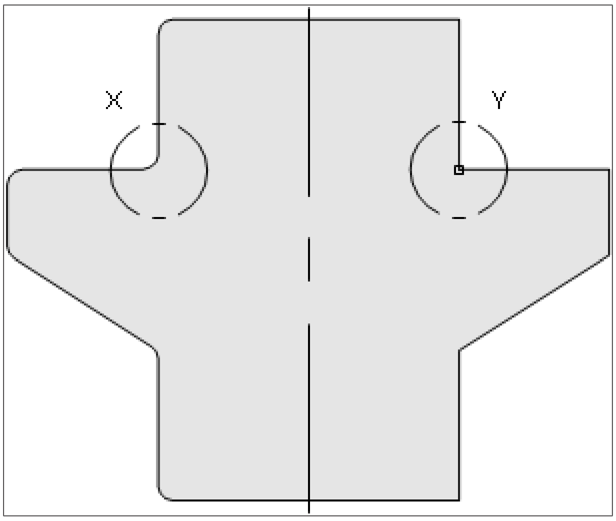

*Fig. 51:* Rounding radii

Correct rounding radii must be ensured, especially for form labels. Labels without rounding radii can tear easily and lead to unclean labelling.

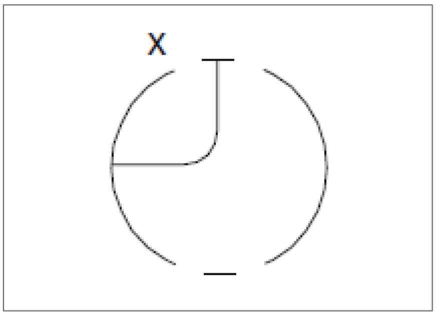


*Fig. 52:* Correct (with radius)

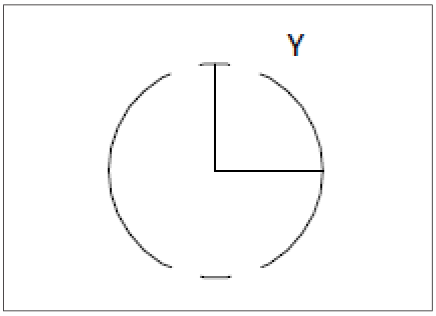


*Fig. 53:* Incorrect (without radius)

## 2.4.2 Label tolerances

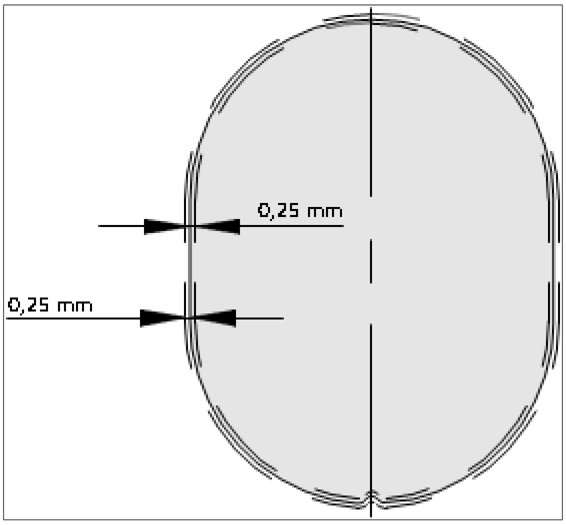


*Fig. 54:* Label tolerances

The cut edges of the labels must be perfect and free of burrs. The dimensions (width, height) of the labels upon arrival must be within the permissible tolerance range of the required dimension ± 0.25 mm (see illustration).

## 2.4.3 Material properties of paper labels

| Properties | Parameters |
|---|---|
| Tensile strength | Across the fibre direction, at least 24 N/15 mm strip width, ratio of tensile strength lengthwise to crosswise: lower than 2:1 |
| Bending strength | 0.03 – 0.07 N/cm for 15 mm strip width |
| Wet strength | Approximately 30 % of the required dry tensile strength. |
| Caustic resistance | 2.5 % NaOH up to 85 °C (DIN 16524-7),<br>for returnable bottles at least 30 min. |
| Paper weight | Shoulder labels, neck-around labels, body labels and banderoles: 68 to 90 g/m²<br>Champagne band: 80 to 90 g/m² |
| Paper structure | Sufficiently water-absorbent on the reverse side, if possible not too smoothed.<br>The water absorption capacity of the reverse side must not exceed or fall below the agreed tolerance limits. The water absorption capacity of the reverse side (Cobb value) influences the glue absorption and the labelling behaviour. The Cobb value may not be specified in general, but instead depends on the individual operational circumstances. If the water absorption capacity is too low, the labels will lift off at the edges. Excessive water absorption can lead to wrinkling of the affixed labels. Adhesives must not penetrate through to the rear of the label. Whilst fulfilling the above requirements, it is important to ensure that labels do not hinder operation by curling once the rear surface is wet.<br>For example, it is not functional if glued labels roll onto the bottle before they are glued on. |
| Expansion in the wet state (degree of saturation) | Maximum 1.5 % expansion perpendicular to the grain direction after 1 minute in 23 °C distilled water |



KRONES

## Metallised paper

Paper used primarily in the décor and label sector, which has been vapour-deposited in high-vacuum chambers with an extremely fine but nevertheless dense metal coating.

| Properties | Parameters |
|---|---|
| Tensile strength | Across the fibre direction, at least 24 N/15 mm strip width, ratio of tensile strength lengthwise to crosswise: lower than 2:1 |
| Bending strength | 0.03 – 0.07 N/cm for 15 mm strip width |
| Wet strength | Approximately 30 % of the required dry tensile strength. |
| Caustic resistance | 2.5 % NaOH up to 85 °C (DIN 16524-7), for returnable bottles at least 30 min. |
| Paper weight | Shoulder labels, neck-around labels, body labels and banderoles: 68 to 90 g/m²<br>Champagne band: 80 to 90 g/m² |
| Paper structure | Sufficiently water-absorbent on the reverse side, if possible not too smoothed.<br>The water absorption capacity of the reverse side must not exceed or fall below the agreed tolerance limits. The water absorption capacity of the reverse side (Cobb value) influences the glue absorption and the labelling behaviour. The Cobb value may not be specified in general, but instead depends on the individual operational circumstances. If the water absorption capacity is too low, the labels will lift off at the edges. Excessive water absorption can lead to wrinkling of the affixed labels. Adhesives must not penetrate through to the rear of the label.<br>Whilst fulfilling the above requirements, it is important to ensure that labels do not hinder operation by curling once the rear surface is wet.<br>For example, it is not functional if glued labels already roll onto the bottle before they are glued on. |
| Expansion in the wet state (degree of saturation) | Maximum 1.5 % expansion perpendicular to the grain direction after 1 minute in 23 °C distilled water |

## Metal-laminated paper

This is a two-layer laminate. The first layer is a paper that is glued to a second layer of metal foil.

Laminated paper labels are special applications and must be checked for processability by KRONES AG specialists in each individual case. The table below shows guide values for laminated pre-cut labels. These may vary depending on the manufacturing process.

| Properties | Parameters |
|---|---|
| Film thickness | 9 – 15 µm = 25 – 40 g/m² |
| Paper weight | 40 – 60 g/m² |
| Binding or laminating agent | Wax/paraffin or glue<br>Wax/paraffin lamination is necessary for labels for returnable bottles and when better flexibility is required, e.g. for neck-around labels. |

## Plastic-laminated paper labels

Plastic-laminated paper labels can only be approved after a test under operating conditions. Particular attention should be paid to low bending stiffness, high flatness and low curl (under normal climate according to DIN 50014) for these labels.

### 2.4.4 Aluminium foil for bottle neck foiling (tin foil labels)

#### Beer tin foil labels

| Properties | Parameters |
|---|---|
| Film thickness | 11 µm = 29.7 g/m² |
| Tensile strength | Perforated: 10 N/15 mm<br>Unperforated: 12 N/15 mm |
| Elongation at break | 2.5 % |
| Burst pressure | 40.0 kPa |
| Embossing | Generally worm embossing |

#### Can lid tin foil labels

| Properties | Parameters |
|---|---|
| Film thickness | 13 µm = 35.1 g/m² |
| Tensile strength | Unperforated: 12 N/15 mm |
| Elongation at break | 2.5 % |
| Burst pressure | 40.0 kPa |
| Embossing | Generally worm embossing |

#### Champagne tin foil labels

| Properties | Parameters |
|---|---|
| Film thickness | 13 – 15 µm = 35.1 – 40.5 g/m² |
| Tensile strength | Perforated: min. 10 N/15 mm<br>Unperforated: min. 12 N/15 mm |
| Elongation at break | Min. 2.5 % |
| Burst pressure | Min. 40.0 kPa |
| Embossing | Generally nub embossing |

## 2.5 Pre-cut labels for hotmelt applications (wrap-around labels)

Due to the variety of materials in the area of bottle and label materials, it is unfortunately not possible to name an all-round adhesive for specific areas of application. On the contrary, it is important to select the optimum adhesive for the respective application on the basis of all known parameters and information.

Examples of criteria which can be important for the selection of the right adhesives:
- Bottle condition: Moisture, temperature before the labeller, etc.
- Label material: Shape, paper weight, Cobb value, special aspects (sample material)
- Bottles: Surface tension, returnable/non-returnable
- Machine type: Age, blocked, output in btl./h, glue roller (rubber/steel)
- Special requirements for the adhesive: $CO_2$ expansion of the bottle, peel-off labels

The cut edges of the labels must be perfect and free of burrs. The dimensions (width, height) of the labels upon arrival must be within the permissible tolerance range (required dimension ± 0.25 mm; see illustration 2.4.2: Label tolerances [▸ 21]).

To select the right adhesive for your application, we recommend consulting our specialists at KIC KRONES (http://www.kic-krones.com).

### 2.5.1 Label dimensions and overlap width

- Max. label height: Height of the cylindrical labelling area - 3 mm
- Label length: Bottle circumference in the labelling area + overlap

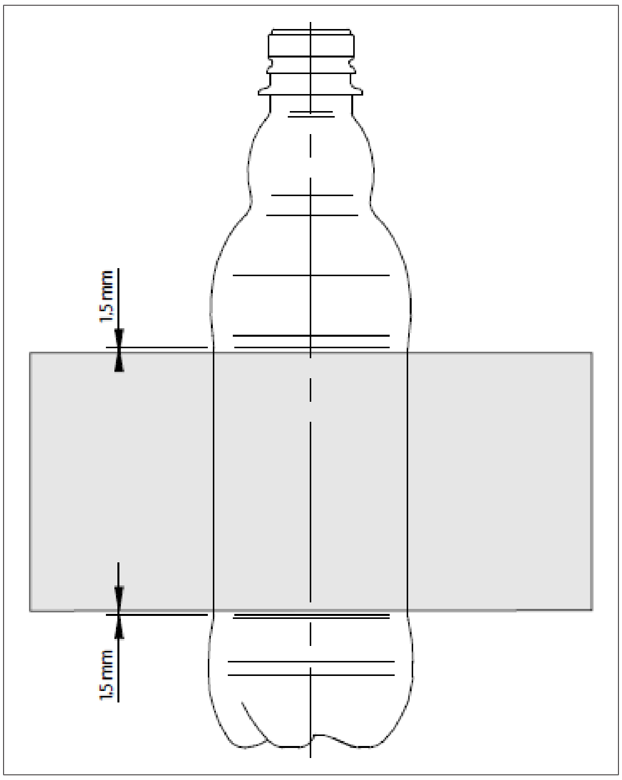


*Fig. 55:*

- Overlap width for plastic containers with $CO_2$: min. 15 mm
- Overlap area for glass containers: min. 12 mm
- Overlap width for plastic containers without $CO_2$: min. 10 mm
- Overlap width for metal containers: min. 8 mm

### 2.5.2 Overlap area for wrap-around labels

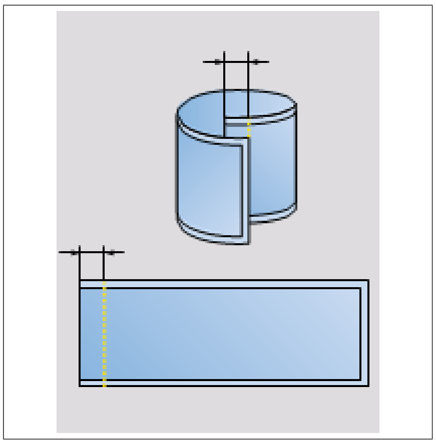

*Fig. 56:* Glued-over strip on machine with right-to-left design

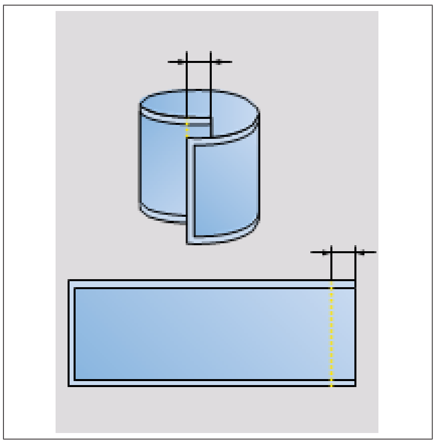

*Fig. 57:* Glued-over strip on machine with left-to-right design

## 2.5.3 Material properties of paper labels

This also includes labels made of aluminised paper.

### Unlaminated paper

| Properties | Parameters |
|---|---|
| Tensile strength | Across the fibre direction, at least 24 N/15 mm strip width, ratio of tensile strength lengthwise to crosswise: less than 2:1 |
| Paper weight | 80 – 110 g/m² |
| Water absorption | When labelling wet containers, both the back and front of the label should be adequately prepared to prevent water from penetrating the paper structure.<br>This requirement also applies to containers that are labelled dry but for which subsequent wetting with water is to be expected (e.g. splash water). |
| Ink abrasion | For containers with a non-retracted label surface (e.g. cans without a beaded rim), the front of the label should also be coated with an abrasion-resistant paintwork. |
| Inks and paints | All inks and paints used must be heat-resistant (up to max. 180 °C).<br>In principle, inks and paints must be used that do not promote static charging of the labels.<br>Only inks and paints that ensure perfect adhesion of the label ends with commercially available hotmelt types may be used. |

### Laminated paper (paper with plastic film)

Can only be approved after a test under operating conditions. Particular attention should be paid to low bending stiffness, high flatness and low curl tendency (under normal climate according to DIN 50014) for these labels.

### Metallised paper

| Properties | Parameters |
|---|---|
| Tensile strength | Across the fibre direction, at least 24 N/15 mm strip width, ratio of tensile strength lengthwise to crosswise: less than 2:1 |
| Paper weight | 80 – 110 g/m² |
| Water absorption | When labelling wet containers, both the back and front of the label should be adequately prepared to prevent water from penetrating the paper structure.<br>This requirement also applies to containers that are labelled dry but for which subsequent wetting with water is to be expected (e.g. splash water). |
| Ink abrasion | For containers with a non-retracted label surface (e.g. cans without a beaded rim), the front of the label should also be coated with an abrasion-resistant paintwork. |
| Inks and paints | All inks and paints used must be heat-resistant (up to max. 180 °C).<br>In principle, inks and paints must be used that do not promote static charging of the labels.<br>Only inks and paints that ensure perfect adhesion of the label ends with commercially available hotmelt types may be used. |

## 2.5.4 Properties of plastic labels

### Opaque plastic labels

The films specified below are processed in practice. Films other than those listed here require a practical test.

| Properties | Units | EUH 75.0 |
|---|---|---|
| Manufacturer | | Treofan |
| Thickness | µm | 75 |

| Properties | | Units | EUH 75.0 |
|---|---|---|---|
| Yield | | $m^2/kg$ | 24.2 |
| Specific weight | | $g/m^2$ | 41.3 |
| Density | | $g/m^3$ | 0.55 |
| Wettability | | mN/m | ≥36 |
| Gloss | | % | 35 |
| Turbidity | | % | 90 |
| Coefficient of friction | | | 0.35 |
| Elongation at break | MD | % | 110 |
| | TD | % | 25 |

| Properties | | Units | Label-Lytc 70 LTR 742 |
|---|---|---|---|
| Manufacturer | | | Jindal Films |
| Yield | | $m^2/kg$ | 20.3 |
| Specific weight | | $g/m^2$ | 49.4 |
| Gloss | | | 10 |
| E-module | MD | $N/mm^2$ | 1,700 |
| | TD | $N/mm^2$ | 2,800 |
| Elongation at break | MD | % (200 mm/min) | 170 |
| | TD | % (200 mm/min) | 55 |
| Tensile strength | MD | $N/mm^2$ (200 mm/min) | 105 |
| | TD | $N/mm^2$ (200 mm/min) | 185 |
| Light-transmitting capacity | | % | 20 |

*MD = machine direction*

*TD = transverse direction*

## Transparent plastic labels

Transparent labels are not recommended due to their unsightly appearance (glue pattern showing through).

# 3 Reel-fed labels

## 3.1 Label geometry

### 3.1.1 Label dimensions and overlap width

- Max. label height: Height of the cylindrical labelling area - 3 mm
- Label length: Bottle circumference in the labelling area + overlap

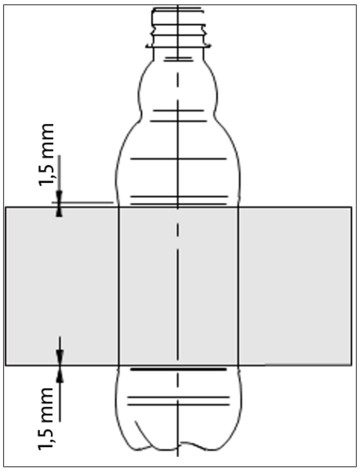


*Fig. 58:* Overlap width

- Overlap width for plastic containers with $CO_2$: min. 15 mm
- Overlap area for glass containers: min. 12 mm
- Overlap width for plastic containers without $CO_2$: min. 10 mm
- Overlap width for metal containers: min. 8 mm

Experience shows that not all label manufacturers can produce any desired label length. We therefore recommend that you have the desired label length checked for manufacturability by the label manufacturer as early as possible.

### 3.1.2 Label tolerances

The label length, measured from register mark to register mark, may vary by a maximum of + 0.5 % of the label length. Negative tolerances are not permitted. The label height may deviate by a maximum of + 1 mm from the specified nominal label size (see figure : Label tolerances for reel-fed labels [28]).

Due to the printing process and the design of the printing press, label manufacturers are sometimes bound to certain gradations. In such cases, it is advisable to select the next longer cut-off length available from the label manufacturer, based on the desired label length. If the deviation is more than 1 mm, an adjustment on the labeller is recommended.

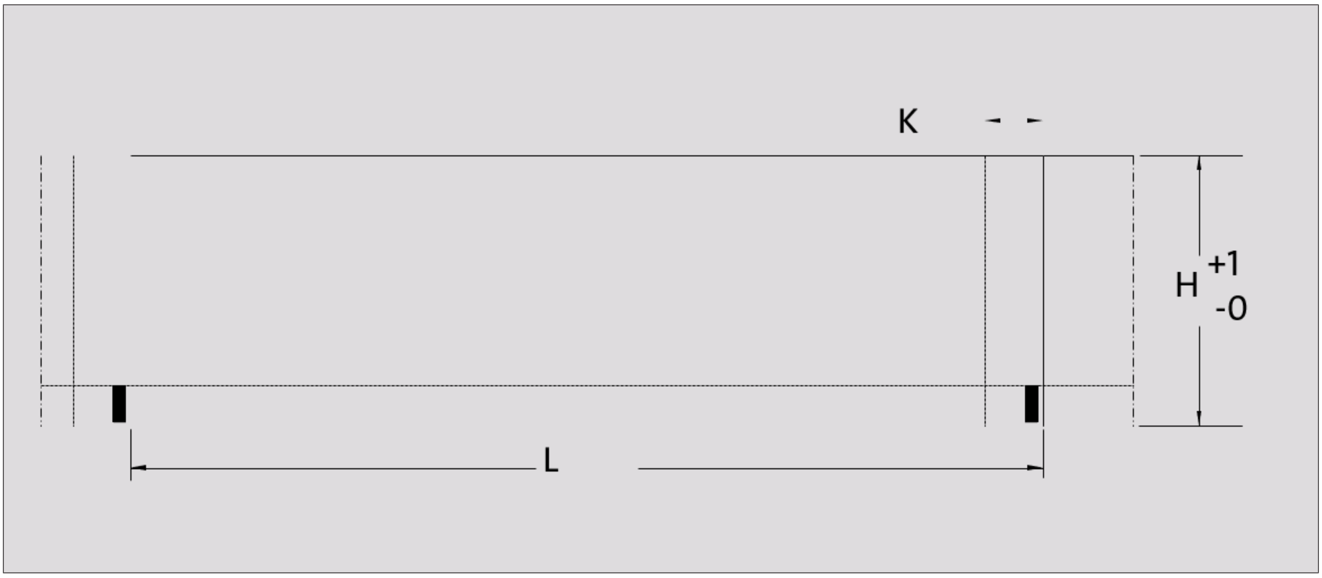


*Fig. 59:* Label tolerances for reel-fed labels

# 3.2 Physical properties of plastic reel-fed labels

## 3.2.1 Coefficient of friction according to EN ISO 8295

This standard determines the frictional behaviour of film/film, or between the film and a different material (e.g. metal) under defined conditions. This test is mainly used for quality control. This test is not sufficient for a comprehensive assessment of the operating characteristics, as, in practice, the friction is affected by additional factors, such as electrostatic charge, air entrainment, local temperature variations, material abrasion, etc.

Experience has shown that a coefficient of friction of 0.25 - 0.35 is required for proper functioning on the KRONES Contiroll (see illustration).

Films with a coefficient of friction < 0.25 are too smooth and usually slip.

Films with a coefficient of friction > 0.35 are too dull and also cause problems.

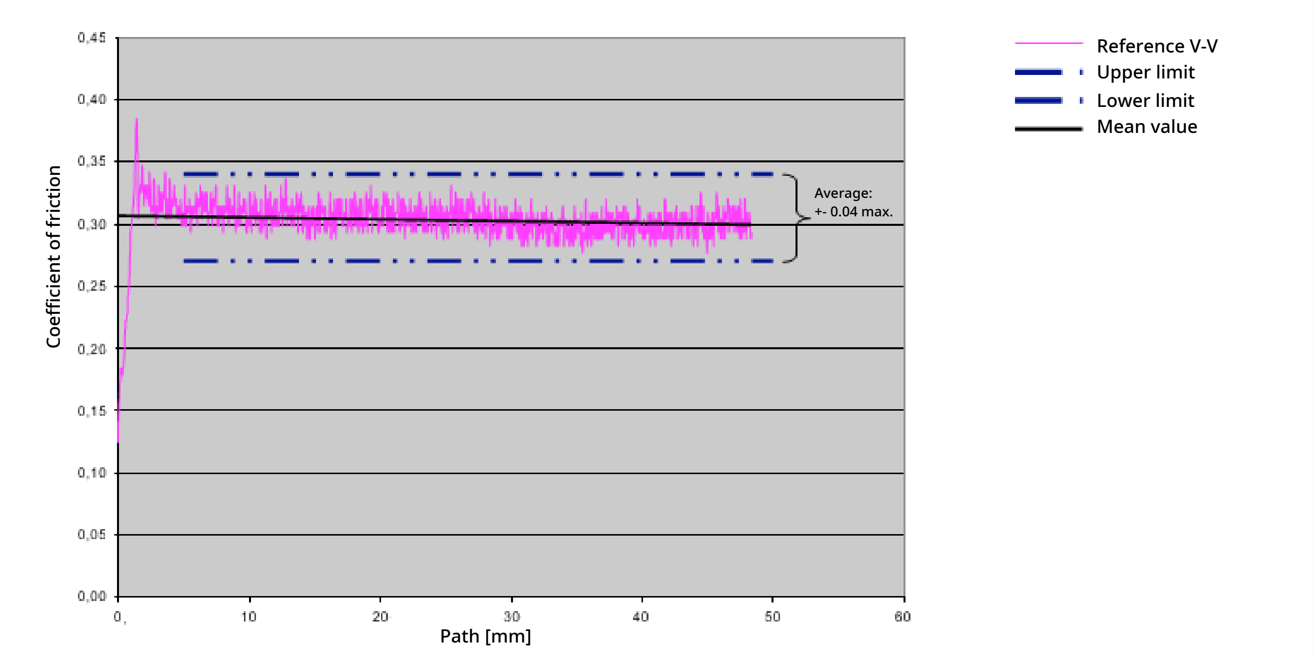


*Fig. 60:* Coefficients of friction of labels

The measurement of the friction values is to be carried out exclusively as follows:

- Film front side against film front side
- Film back side against film back side

Due to manufacturing procedures, the coefficients of friction of the basic films are different. The manufacturer must provide the film with a protective varnishing after printing to reach the ideal coefficient of friction of 0.3.

With opaque or white films, the label is printed and then coated with a protective varnish on the front of the label. When the film is rolled up, the parts of the protective coating transfer to the label backing and therefore improve the coefficient of friction to the desired factor.

The transparent films are usually printed in reverse. As a matter of principle, film manufacturers also recommend a protective coating for the inks applied to the reverse side of the label when using the reverse printing process.

## 3.2.2 Temperature resistance

The labels are glued with hotmelt. All inks and paints used must therefore be heat-resistant (up to max. 180 °C). In the case of films used for shrink applications, the inks and paints must be able to withstand temperatures of up to 250 °C for short periods without deterioration.

To test the temperature resistance, a 10 cm wide sample is covered on both sides with 25 µm aluminium foil and pressed together in the heat sealer at the prescribed temperature. The following conditions generally apply:

- Temperature: 130 °C
- Set pressure: 600 N corresponds to a sealing pressure of 20 N/cm² = approx. 2 bar
- Sealing time: 1 x 1 second

After cooling, the aluminium foil is lifted off and the sample is assessed.

### Evaluating the heat resistance:

| | | | |
|---|---|---|---|
| 0 | | No signs of adhesion, no change in colour shade | Can be processed |
| 1 | | Slight sticking to the bare aluminium foil, but no setoff and no colour change | Can be processed |
| 2 | a | Sticking to the bare aluminium foil | Cannot be processed |
| | b | Occasional setoff of the ink film, but no changes in hue | |
| 3 | a | Considerable adhesion to the bare foil | Cannot be processed |
| | b | Partial setoff of the ink film | |
| | c | Considerable change in colour tone | |
| 4 | a | Strong adhesion to the bare foil | Cannot be processed |
| | b | Setoff of the ink film | |

## 3.2.3 Electrostatic charge

Electrostatic charge can impede trouble-free processing of plastic reel-fed labels. Films with poor conductivity tend to be electrostatically charged. This is enhanced by friction and relatively low humidity. In order to rule out such phenomena to a large extent, static charging of the labels during the label production process must not be encouraged (inks, paints, process parameters, etc.). The label reels should be electrostatically neutral.

### Inspection method: Manual unwinding of the labels (see figures):

*Fig. 61:* Example of minor electrostatic charging

Label comes off easily when the reel is turned and is pulled down by its own weight.

No or only minor static charge

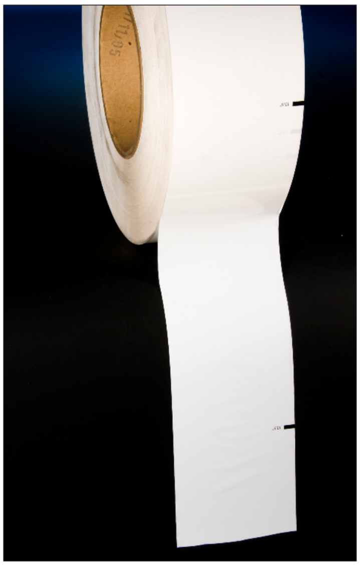

*Fig. 62:* Example of strong electrostatic charging

Label does not come off or comes off with difficulty when the reel is turned. The film sheets stick together due to the charge.

Strong static charge, problems with labelling possible

## 3.2.4 Flatness

The labels must lie flat after unwinding from the label reel and must not show any tendency to curl. Otherwise, problems may arise during labelling (see figure : Flatness [▸ 31]).

### Test method 1:

Unwind approx. 1 m label film and place on a flat surface.

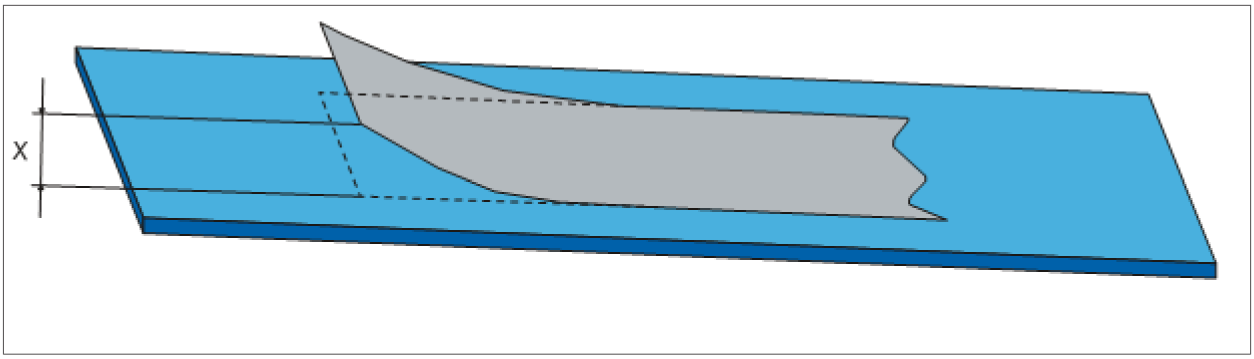


*Fig. 63:* Evaluation of the flatness

### Test method 2:

Cut out a 10 x 10 cm piece from an already coated material on which the longitudinal and transverse directions are to be marked. The sample is stored on a flat surface for one hour in a normal climate and then assessed.

A label is also placed with the printed side facing upwards for one hour in a normal climate (see table) and then assessed.

Assessment of already coated material

| | | |
|---|---|---|
| 0 | Flat | Can be processed |
| 1 | Curvature of the edges is less than 1.0 cm (X < 1.0 cm) | Can be processed |

| | | |
|---|---|---|
| 2 | Curvature of the edges is greater than 1.0 cm or the corners curl slightly (X < 1.0 cm) | Cannot be processed |
| 3 | Material rolls over the entire width | Cannot be processed |
| 4 | Material rolls up completely | Cannot be processed |

Paper label assessment

| | | |
|---|---|---|
| 0 | Flat | Can be processed |
| 1 | Curvature of the edges is less than 0.5 cm (X < 0.5 cm) | Can be processed |
| 2 | Curvature of the edges is greater than 0.5 cm or the corners curl slightly (X < 0.5 cm) | Cannot be processed |
| 3 | Material rolls over the entire width | Cannot be processed |
| 4 | Material rolls up completely | Cannot be processed |

### 3.2.5 Cut edges of labels

Endless labels that have a banana-shaped form or a curled label edge after the longitudinal cut at the label manufacturer cannot be processed and are therefore generally not permissible. An example of this is shown here.

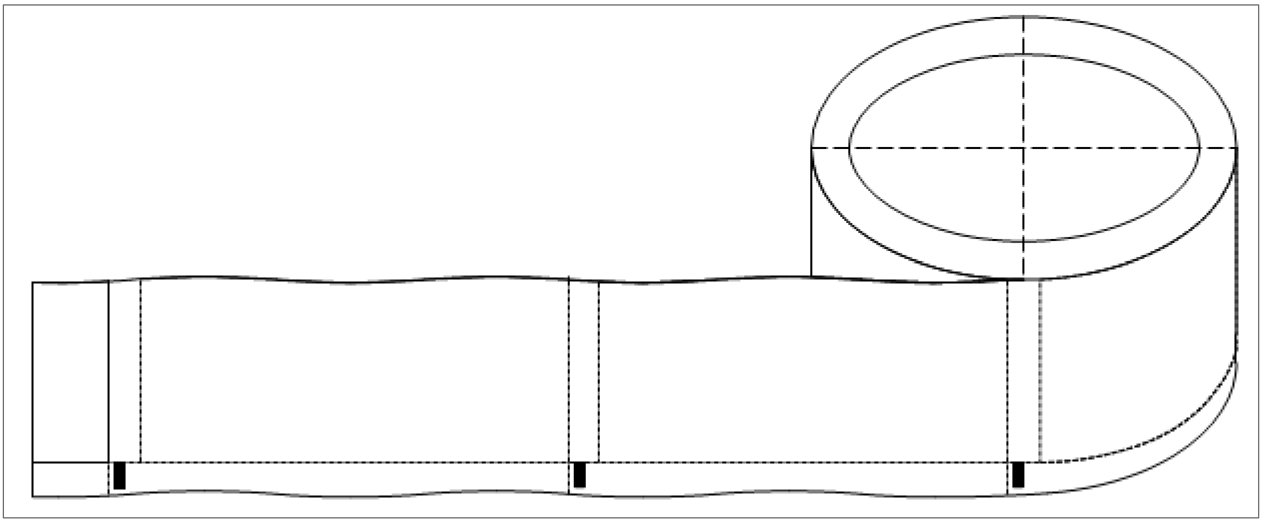

*Fig. 64:* Example of curled label edges

Endless labels that have a frayed cut edge after the longitudinal cut at the label manufacturer can lead to processing problems. The abrasion of the labels can cause contamination of the sensors and thus interrupt production.

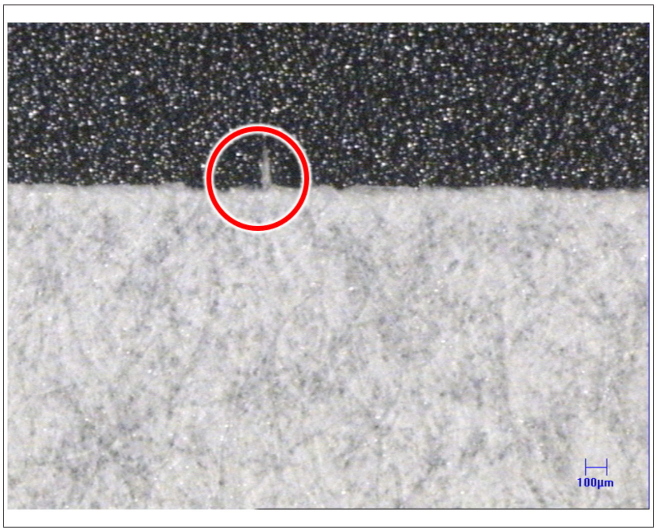


*Fig. 65:* Fringed cut edges

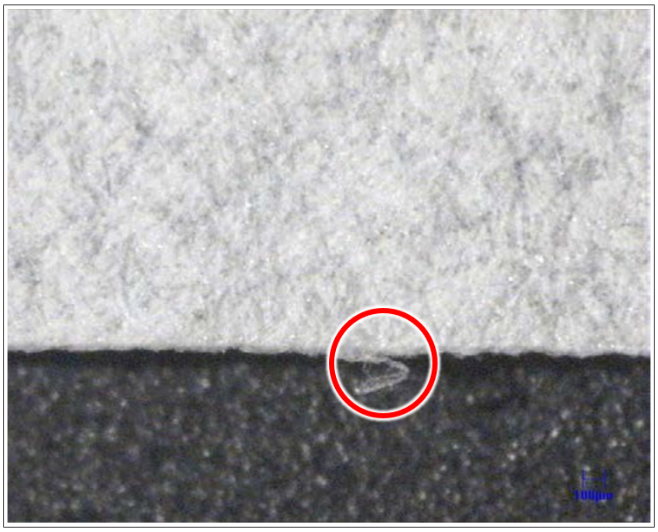

*Fig. 66:* Fringed cut edges

## 3.2.6 Ink and paint application


*Fig. 67:* Adhesive tape test

All inks and paints used must have the following properties:

- Heat resistant (see Chap. 3.2.2: Temperature resistance [▷ 29])
- Electrostatically neutral
- Not adhesive-repellent (give preference to adhesive surfaces)
- Abrasion-resistant.

To test the abrasion resistance, the adhesive tape test must be carried out.
In general, a strip of adhesive tape (Tesafilm No. 4104, colourless, 25 mm wide) is applied across the entire width with light thumb pressure and then removed again immediately. The take-off angle is 160° (see figure : Adhesive tape test [▷ 33]). No ink must remain on the adhesive tape strip, otherwise machine malfunctions may occur due to detachment.

The inks and paints must be completely dry when the labels are rewound to prevent the labels sticking to the reel. The label ink application must be uniform from beginning to the end of the reel. Excessive lightening (loss of intensity, loss of contrast) of an in ink over the reel length endangers the recognisability of the cut mark and can lead to machine malfunctions.

### 3.2.7 Reel winding direction

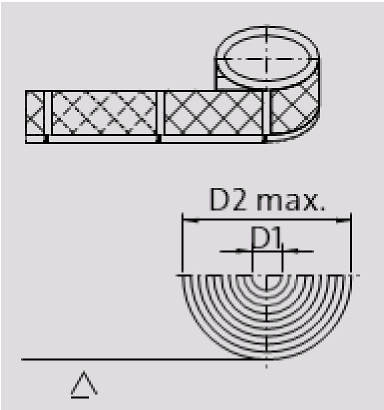


*Fig. 68:* Reel winding direction for machine running direction from left to right

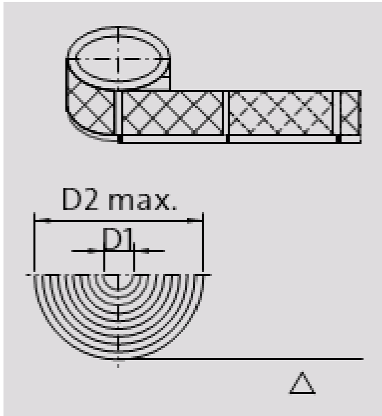


*Fig. 69:* Reel winding direction for machine running direction from right to left

D1 = sleeve core diameter: 152.4 mm (6“) or in special version 76.2 mm (3“)

D2 = max. reel outer diameter: 600 mm or in special version for foamed PS film 1,000 mm

Notes:

- Reels must not be telescoped, otherwise problems with web running will occur.
- Layer offset within a reel ± 1 mm (measured over the entire reel diameter)
- Layer offset of individual label windings not permissible (damage to label edges)
- Label edges must not be damaged (risk of web tearing).
- No material overstretching during printing or winding
- Use cardboard or plastic cores with a minimum wall thickness of 9 mm.
- Use the same cardboard or plastic core for all label types.
- The core height should be approx. 2 mm smaller than the label web width to prevent the core from protruding. The label reels must lie flat on the reel plate.

## 3.3 Field-tested basic films

### 3.3.1 Basic films

| Label material | Designation | Thickness | Label height < 40 mm | Film manufacturer |
|---|---|---|---|---|
| Polypropylene, transparent | LL 666 | 0.040 mm | Yes | Jindal Films Europe Virton LLC<br>Zoning Industriel de Latour<br>6761 Virton<br>Belgium<br><br>www.jindalfilms.com |
| Polypropylene, transparent | LL 666 | 0.035 mm | Yes | |
| Polypropylene, transparent | LL 666 | 0.030 mm | No | |
| Polypropylene, transparent | LL 410 | 0.035 mm | Yes | |
| Polypropylene, opaque | LL 247 | 0.038 mm | No | |
| Polypropylene, opaque | LL 247 | 0.047 mm | Yes | |
| Polypropylene, opaque | DL 247 | 0.038 mm | No | |
| Polypropylene, opaque | DL 247 | 0.033 mm | No | |
| Polypropylene, metallised | LW 280 | 0.038 mm | Yes | |
| * Polypropylene, transparent | LR 210 | 0.040 mm | Yes | |
| * Polypropylene, transparent | LR 210 | 0.050 mm | Yes | |

# Reel-fed labels

| Label material | Designation | Thickness | Label height<br>< 40 mm | Film manufacturer |
|---|---|---|---|---|
| Polypropylene, opaque | 400 W/T L II | 0.040 mm | Yes | Taghleef Industries GmbH<br>Reutig 2<br>56357 Holzhausen an der Haide<br>Germany<br><br>www.ti-films.com |
| Polypropylene, opaque | LGL | 0.038 mm | No | |
| Polypropylene, opaque | LGL | 0.047 mm | Yes | |
| Polypropylene, opaque | LXI | 0.038 mm | No | |
| Polypropylene, transparent | LTS | 0.035 mm | Yes | |
| Polypropylene, transparent | LTS | 0.030 mm | No | |
| Polypropylene, transparent | LTN | 0.035 mm | Yes | |
| Polypropylene, transparent | LTN | 0.030 mm | No | |
| Polypropylene, transparent | LTG | 0.040 mm | Yes | |
| Polypropylene, transparent | LTG | 0.035 mm | Yes | |
| Polypropylene, transparent | LTG | 0.030 mm | No | |
| Polypropylene, metallised | LZL | 0.038 mm | Yes | |
| Polypropylene, metallised | LZL | 0.047 mm | Yes | |

| Label material | Designation | Thickness | Label height<br>< 40 mm | Film manufacturer |
|---|---|---|---|---|
| Polypropylene, opaque | LHD | 0.038 mm | No | Treofan Germany GmbH & Co KG<br>Bergstraße<br>66539 Neunkirchen<br>Germany<br><br>www.treofan.com |
| Polypropylene, opaque | LWD | 0.038 mm | No | |
| Polypropylene, transparent | LTD | 0.030 mm | No | |
| Polypropylene, transparent | LTD | 0.035 mm | Yes | |
| Polypropylene, transparent | LTD | 0.040 mm | Yes | |

| Label material | Designation | Thickness | Label height<br>< 40 mm | Film manufacturer |
|---|---|---|---|---|
| Polypropylene, transparent | Stilian TP 30 | 0.030 mm | No | BIMO BOPP Division<br>Z.I. Val Di Sangro<br>66041 Atessa<br>Switzerland<br><br>www.irplastgroup.com |

| Label material | Designation | Thickness | Label height<br>< 40 mm | Film manufacturer |
|---|---|---|---|---|
| Polypropylene, opaque | LLM 38 | 0.038 mm | No | Manucor S.p.A.<br>Strada Cons. Cellole-<br>Piedimonte, Ioc. Quinola<br>81037 Sessa Aurunca<br>(Caserta) – Italy<br><br>www.manucor.com |
| Polypropylene, transparent | PL 35 | 0.035 mm | Yes | |
| Polypropylene, transparent | PL 30 | 0.030 mm | No | |

| Label material | Designation | Thickness | Label height<br>< 40 mm | Film manufacturer |
|---|---|---|---|---|
| * Polystyrene, expanded | - | 0.130 mm | Yes | Avifilm<br>60 South Street<br>Valetta VLT 11, Malta<br><br>www.avifilm.com |
| * Polystyrene, expanded | - | 0.160 mm | Yes | |

*) Shrinkable label types

These label films can be processed only on specially equipped labellers.

Important information:
- The basic films listed above can be processed with the KRONES Contiroll if they have been professionally printed.
- When the manufacturer selects the basic film, further labelling requirements must also be considered. For example, the visual appearance, secondary packaging, transport of the containers, storage, recycling, etc.
- For PET containers filled with products containing high levels of $CO_2$, ensure that the base film has sufficient elasticity to prevent the label ends from splitting.
- Transparent and especially metallised base film is suitable only to a limited extent for processing products which contain $CO_2$, as it expands only slightly after labelling and is therefore not able to compensate for changes in the bottle diameter. This must be taken into consideration when selecting a suitable film.
  Ideally, tests, including transport tests, will be carried out at the customer's plant.

## 3.3.2 Shrinkable base films - Roll2Shrink

The values given here for film properties refer to the LR210 film from Jindal Films Europe Virton LLC. Statements on the processability of other films can only be made after practical tests.

Furthermore, the application of the LR210 film on glass is not possible.

### Hotmelt

Guide values for Roll2Shrink films with hotmelt application

| Properties | | Units | LR210 | |
|---|---|---|---|---|
| | | | 40 µm thickness | 50 µm thickness |
| Yield | | $m^2/kg$ | 27.5 | 22.0 |
| Specific weight | | $g/m^2$ | 36.4 | 45.5 |
| Gloss | | % | 87 | 87 |
| Turbidity | | % | 2.5 | 2.8 |
| Coefficient of friction | | | 0.35 | 0.35 |
| Shrinkage | MD | % | -19 *) | -19 *) |
| | TD | % | -2 | -2 |

MD = machine direction

TD = transverse direction

*) 19 % is the maximum possible shrinkage rate under laboratory conditions. Depending on the bottle shape, a shrinkage value of approx. 6 % can be achieved when using hotmelt.

Due to different inks on the film, different shrinkage values are achieved. For shrink applications, it is recommended that the top and bottom edges of the label be designed as transparent strips.

Shrink films must withstand a minimum gluing temperature of 140 °C due to the glue used (KRONES colfix HM 5353).

*Fig. 70:* Examples of shrink applications with hot glue

*Fig. 71:* Examples of shrink applications with hot glue

### 3.3.3 Materials

#### Plastic

- PP (polypropylene):
  - Can be bonded with hotmelt only
- PVC (polyvinyl chloride):
  - Leading-edge gluing on bottle with hotmelt
  - Final bonding with solvent (only for shrink application)
- PE (polyethylene):
  - Special material (rarely used), can be glued with hotmelt

1. PS (polystyrene):
   - PS expanded (predominantly used); initial gluing with hotmelt, final gluing with solvent
   - PS transparent (rare); initial gluing with hotmelt, final gluing with solvent

#### Paper

| Label material | Thickness/weight | Leading-edge gluing | Trailing-edge gluing system | Shrinking possible |
|---|---|---|---|---|
| Paper | 65 – 90 g/m² | Hotmelt | Hotmelt | No |

| | | |
|---|---|---|
| Etiset paper label | 80 g/m² | Stora Enso<br>Feldmühleplatz 1<br>40545 Düsseldorf<br>Phone: +49-(0)211-58100 |
| Labelset paper label | 80 g/m² | |
| Teraset paper label | 80 g/m² | |
| Mediaset paper label | 80 g/m² | |

## 3.4 Endless label bonding

The labels webs must be spliced (either by the manufacturer or during manual reel change) in such a way that label processing is not affected negatively. See illustration for the necessary dimensions for optimal bonding.

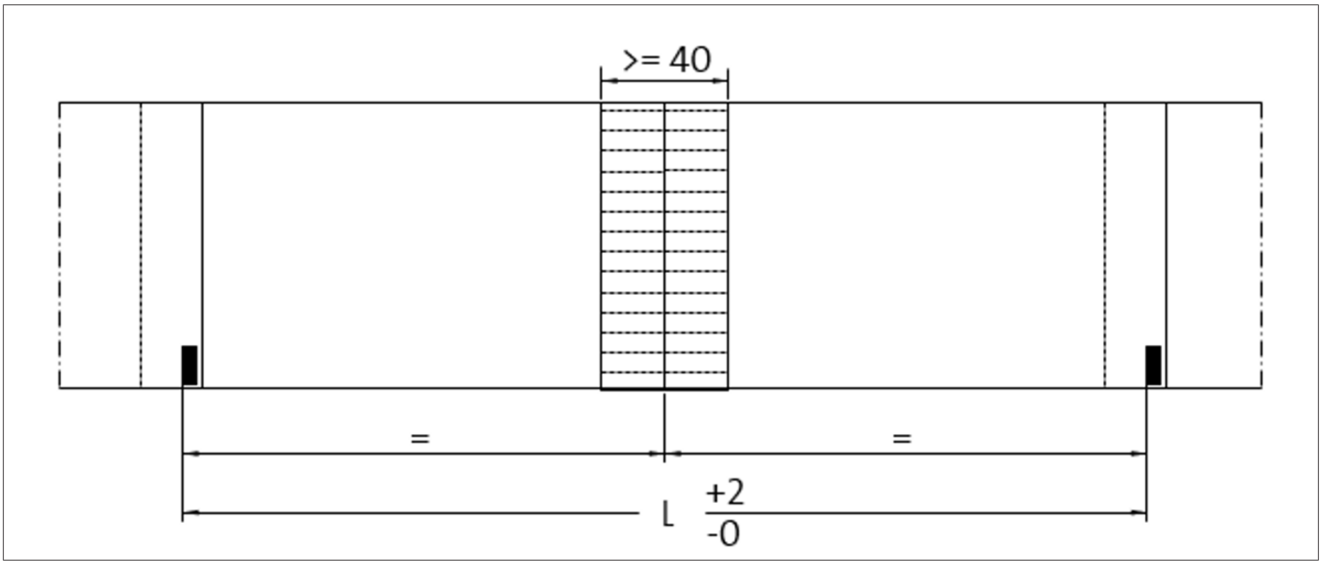


*Fig. 72:* Label drawing for endless label bonding

Note on gluing endless labels:

The labels must be glued in the middle between the two register marks and with a min. of a 40 mm wide black adhesive strip. A tolerance range of +2 mm and -0 mm is tolerated for the splicing point. The adhesive strip must run from the back of the label across the entire label width and the labels must be glued together joint to joint. It is also important to ensure that the splicing point does not negatively affect the tensile strength of the label material.

## 3.5 Register marks for reel-fed labels

### 3.5.1 Definition

*Fig. 73:* Sensory scanning of a register mark

A so-called register mark is required for the precise cutting of individual labels from the reel material. A register mark is a clear, geometrically defined colour contrast on the label, usually in the form of a small bar, that is used to cut individual labels from the reel.

This bar serves as a recognition mark on the label, which is scanned by a colour sensor. A register mark is usually positioned perpendicular to the label width, in as inconspicuous a place as possible, so that after labelling the register mark is not positioned directly in the visible area. A sufficiently large colour contrast between the register mark and the label base colour is important for recognition. We generally recommend sending all differently printed labels to KRONES for checking the respective contrast difference in order to have the processability of the labels confirmed. The illustration shows a register mark and the detection sensor.

The integration of a register mark, which should be as unobtrusive as possible, should already be taken into account during the label design in order to ensure proper functioning. The subsequent insertion of the register mark into already existing label designs often leads to less than optimal solutions. It is therefore necessary to consider the register mark at an early stage in the label design.

### 3.5.2 Register marks on opaque (white, opaque or metallised) labels

The requirements listed below for a register mark offer optimum production reliability and short machine changeover times:

- Exactly one register mark per label (label length L)
- Register mark size: Standard colour: 12 mm high, 4 mm wide
- Register mark position: 1.5 mm after the beginning of the label
- Register mark colour: Strong colour contrast to label base colour
- Label design in scanning area:
  Single-colour, printed all over, not marked, no colour transitions

We recommend positioning the register mark approx. 1 mm above the bottom edge of the label in the overlap area.
Alternatively, the register mark can be placed on the reverse side of the label, although not all label manufacturers are technically equipped to do this.

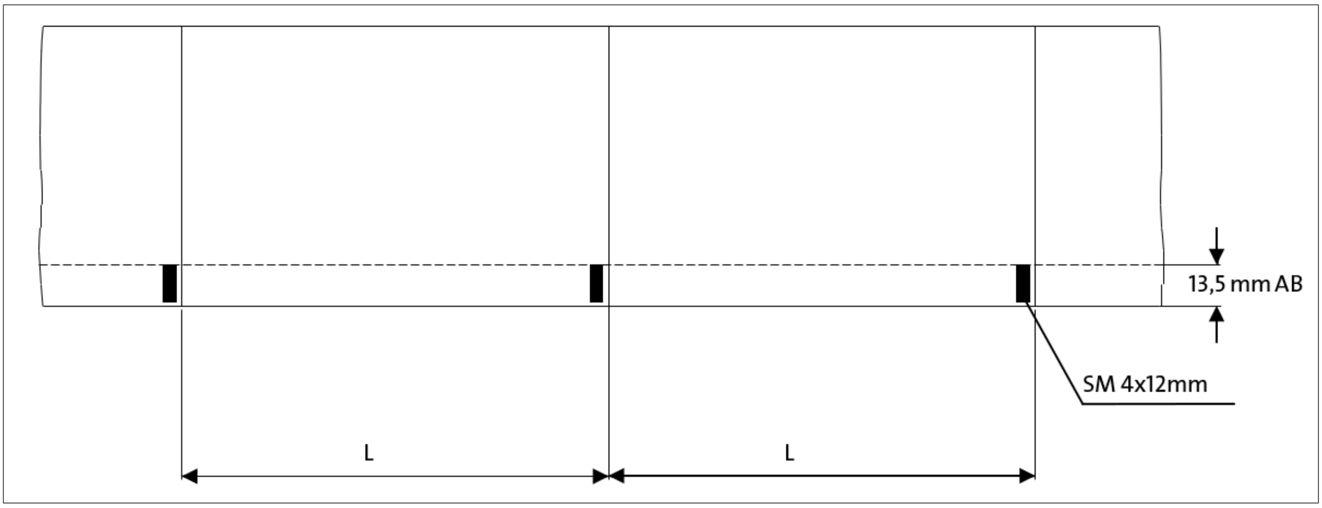


*Fig. 74:* Label drawing for register mark control

The scanning range can also be realised by setting a "window" in the area of the register mark detection (see figure : Register marks on opaque (white, opaque or metallised) labels [▸ 40]).

With this method, however, limitations with regard to production reliability and comparatively long change-over times must be expected. In addition, a loss of the register mark SM is possible with a larger offset as well as through the recognition of other similar colour transitions as a supposed register mark. In addition, the label must be threaded in exactly in position.

The so-called window defines as minimum scanning range AB (following figure) in running direction a size of

- 15 mm and
- 4 mm behind the register mark

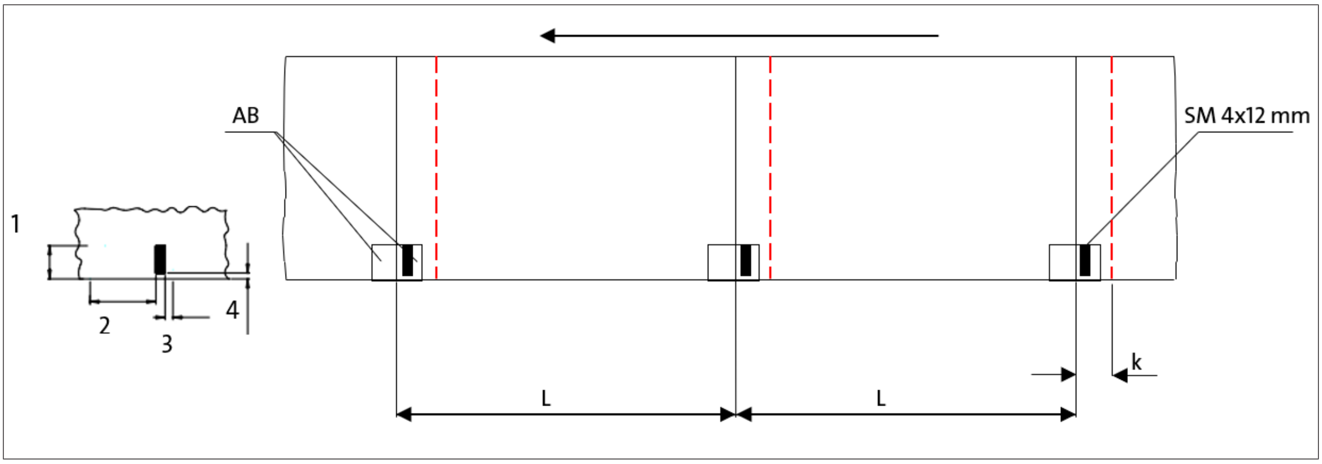


*Fig. 75:* Label with scanning area through a window

## Examples of functional register marks for window scanning

*Fig. 76:*

*Fig. 77:*

*Fig. 78:*

*Fig. 79:*

*Fig. 80:*

### 3.5.3 Register mark design "machine running left-to-right/right-to-left"

For the register mark design, the label running direction in the machine must be taken into account. A distinction is made between machines running left-to-right and right-to-left. Looking at the bottle table from above, a machine with a clockwise rotating table is a machine of left-to-right design.

## 3.5.4 Examples of readable register marks

### Register mark on the bottom edge of the label in the overlap area (left-to-right machine)


*Fig. 81:* Example of a register mark on bottom edge of label

Opaque polypropylene film with register mark on the bottom edge of the label.

This variant guarantees optimal detection, easy change-over and high operational safety.


*Fig. 82:* Example of a register mark on bottom edge of label

Opaque polypropylene film with register mark on the bottom edge of the label. Detectability only possible by setting a window by the register mark recognition. Designed for a left-to-right machine running direction. Label base colour blue in the scanning area before and after the white register mark.

### Register mark at the top edge of the label in the overlap area (left-to-right machine)


*Fig. 83:* Example of a register mark on top edge of label

Opaque polypropylene film with optimum register mark on the top edge of the label.

Optimum recognisability and extremely dependable production are also guaranteed with this variant.

The register mark detection must be adjusted.

### Register mark on the bottom edge of the label in the overlap area (right-to-left machine)


*Fig. 84:* Example of a register mark on bottom edge of label

Opaque polypropylene film with register mark on the bottom edge of the label. Detectability only possible by setting a window by the register mark recognition. Designed for a machine running direction right-left - label base colour red in the scanning area before and after the white register mark.

### Register mark on the back of the label

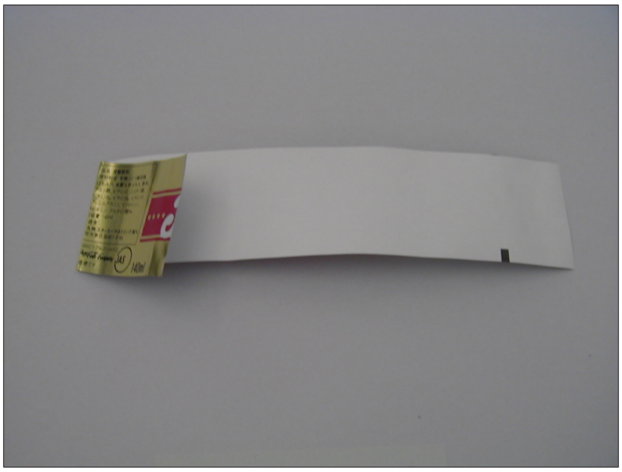

*Fig. 85:* Example of a register mark on back of label

Optimum recognisability with maximum design freedom on the front of the label

## 3.5.5 Register mark for transparent labels

For transparent labels, it is possible to use a transparent strip as a register mark (see fig. "Label drawing", SM = register mark = 4 mm). For this purpose, there must be no other transparent areas in the scanning area (see fig. "Label drawing"; AB = scanning area).

This variant offers the advantage that it is checked for see-through, and therefore graphic design or labelling is also possible in the scanning area (see fig. "Label drawing"; DB = printing area).

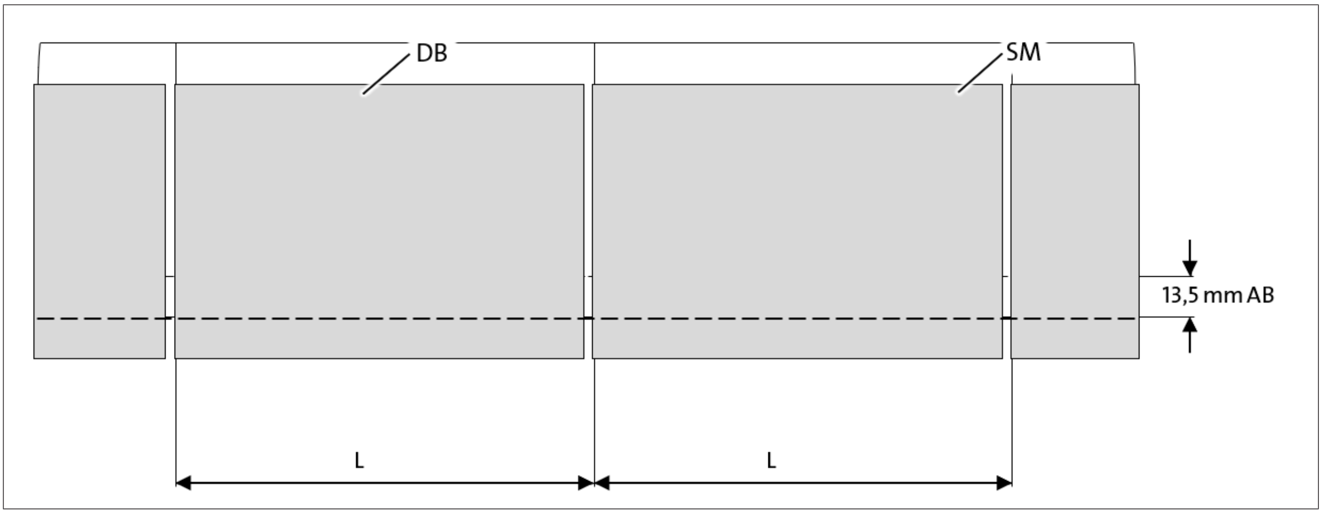


*Fig. 86:* Example of a label drawing with transparent register mark


*Fig. 87:* Example of a transparent label with unprinted transparent strip

Transparent label made of polypropylene, fully printed with unprinted transparent strip in the overlap area. This transparent strip is used as a register mark.

The printing is done by reverse printing; due to the internal ink application the label design is protected against abrasion.


*Fig. 88:* Example of a transparent label with unprinted, transparent register mark

Another transparent label made of polypropylene (shrinkable), fully printed with unprinted transparent register mark, width 4 mm, height 12 mm.

Here as well, no restriction is necessary with regard to the graphic design of the label.

## 3.5.6 Examples of NON-functional register marks

### Insufficient colour contrast


*Fig. 89:* Blue register mark on blue background, colour contrast not sufficient

### More than one colour in the scanning area before and after the register mark


*Fig. 90:* More than one colour in the scanning area before and after the register mark and colour contrast not sufficient

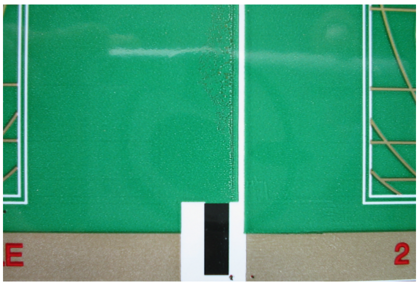


*Fig. 91:* More than one colour in the scanning area before and after the register mark and minimum size of the scanning area not considered


*Fig. 92:* More than one colour in the scanning area before and after the register mark and minimum size of the scanning area not considered


*Fig. 93:* More than one colour in the scanning area before and after the register mark


*Fig. 94:* More than one colour in the scanning area before and after the register mark

### 3.5.7 Luminescent register marks

When processing labels with register marks that can only be evaluated under UV light, it is essential to consult KRONES. In this special case, it must be checked individually which detection sensor is to be used. Furthermore, interference must be taken into account, which can lead to misinterpretation of the register mark signal.

Please refer to the illustration below for the minimum dimensions for a luminescent register mark S. It should also be noted that the register mark must have a wavelength spectrum of 370 nm.

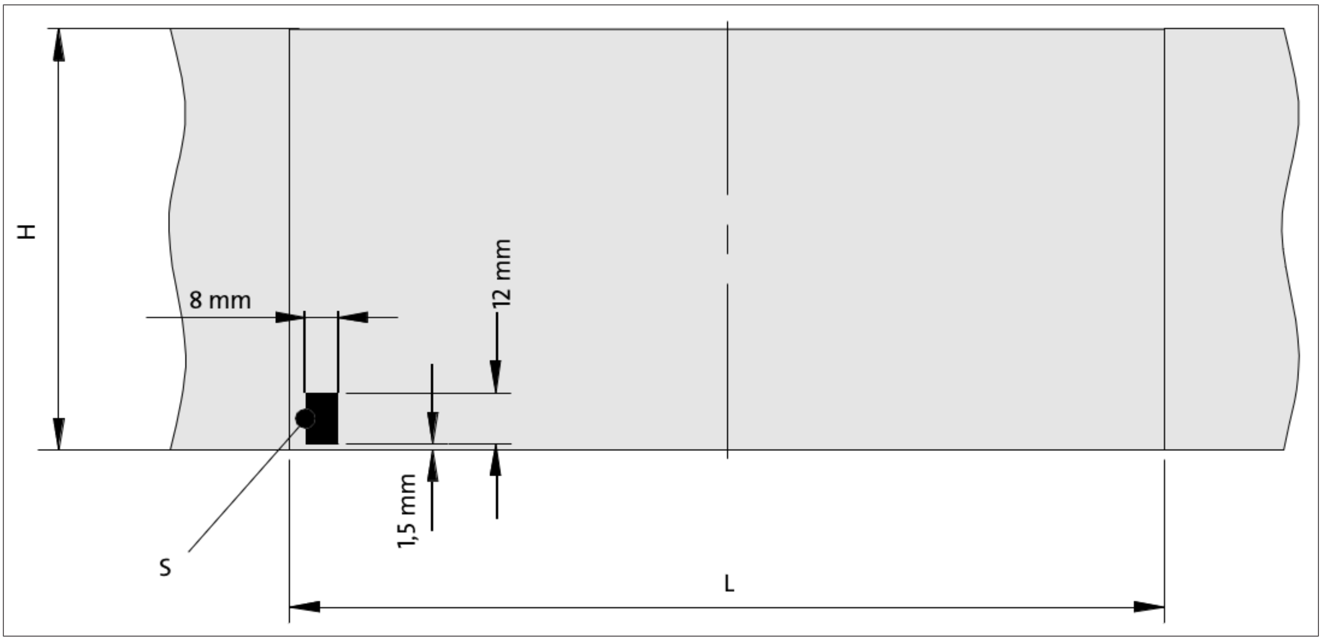


*Fig. 95:* Luminescent register mark

### 3.5.8 Other notes on register marks

The register mark design must be carried out according to the above specifications. The remaining design of the label printing is the responsibility of the customer.

## 3.6 Self-adhesive labels

### 3.6.1 Container requirements

| | |
|---|---|
| Bottle shape in the labelling area | Optimum: plane, cylindrical, conical<br>Not ideal: concave, convey, grooved bulges by the product due to too low stability |
| Smooth – no deformities | Irregularities and deformities can cause folds and trapped air (see figure) |
| Clean | No impurities due to bottle production, e.g. parting compound |
| Free of dust | No soiling due to transport or storage, no air pockets (see illustration). |
| Absolutely dry | Not fogged up<br>No condensation, results in poor adhesion and leads to clouding of the adhesive on transparent labels |
| Electrostatically neutral | Otherwise the container is a dust catcher |
| Processing temperature | 15 – 35 °C is optimal |

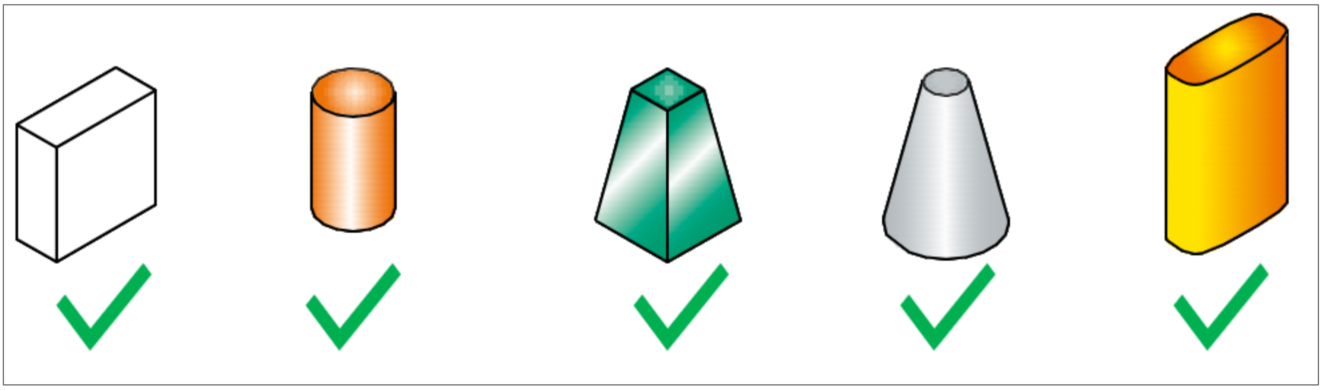

*Fig. 96:* Optimum: plane, cylindrical, conical

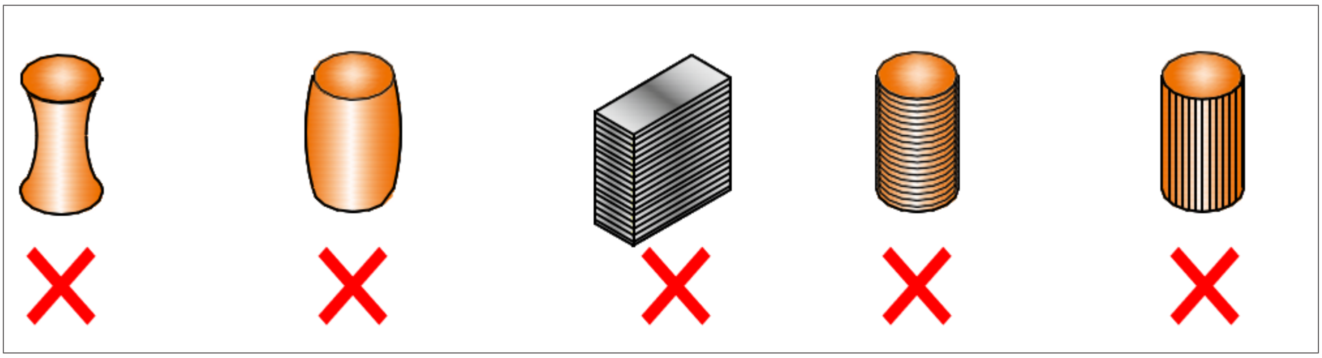

*Fig. 97:* Not ideal: concave, convey, grooved bulges by the product due to too low stability


*Fig. 98:* Example of air inclusions


*Fig. 99:* Example of air inclusions

## 3.6.2 Reel design for self-adhesive labels

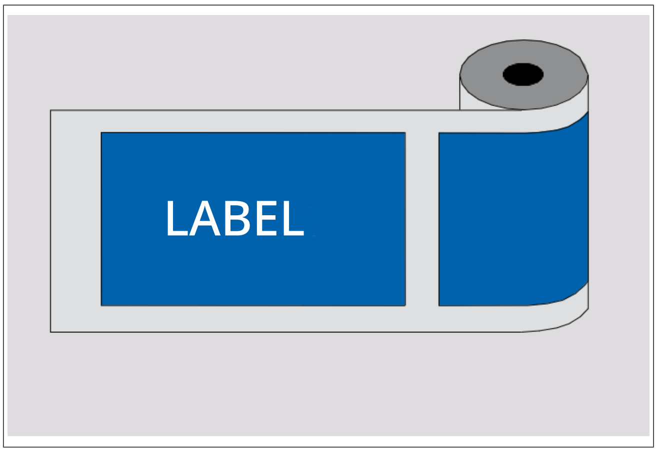


*Fig. 100:* Machine running direction left – right

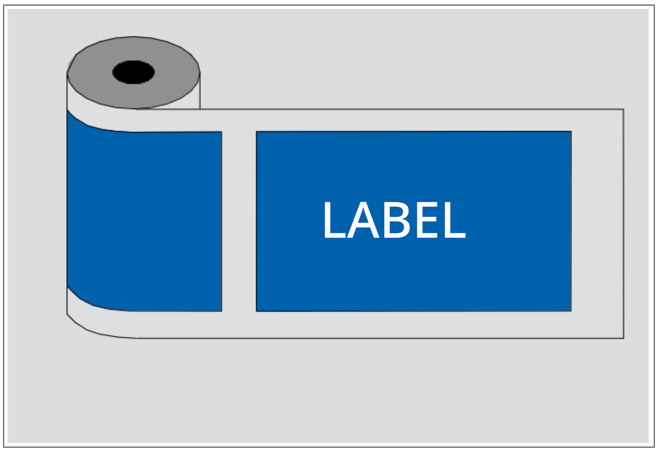


*Fig. 101:* Machine infeed direction right – left

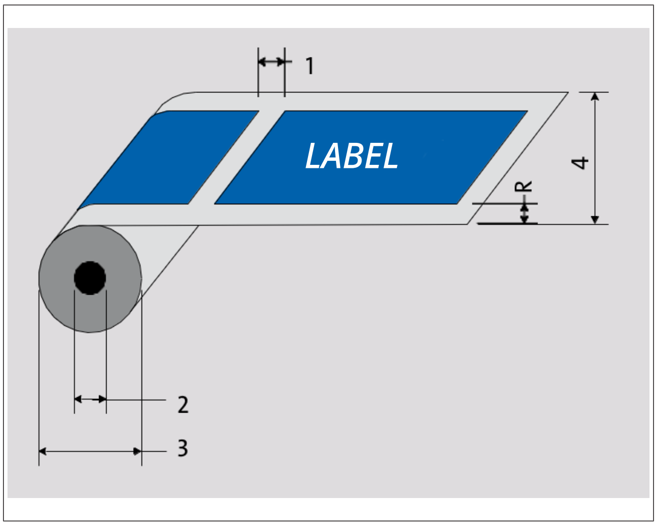


*Fig. 102:*

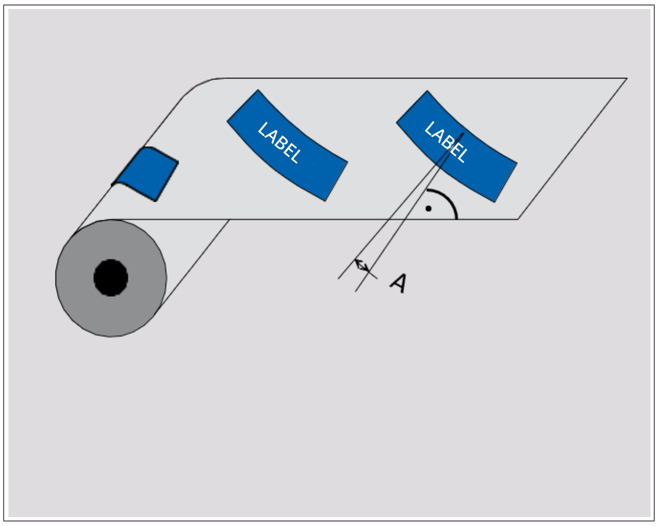


*Fig. 103:*

| | |
|---|---|
| 1: Label spacing | Min. 2 mm |
| 2: Sleeve core diameter | 76.2 mm (3“) |
| 3: Max. reel outer diameter | 390 mm |
| 4: Web width (label format plus 3 mm) | Max. 200 mm |
| R: Edge spacing | Max. 1.5 mm |
| A: Slanted position | Depending on cone, in degrees |

Please note:

- Reels must not be wound to tight, since otherwise the adhesive bleeds out and dirties the label applicator.
- Reels must not be telescoped, otherwise problems with web running will occur.
- Reel edges must not be damaged (risk of web tearing).
- Reels should behave electrostatically neutrally.
- Assistance possibly by antistatic unit
- Please enquire about the winding scheme for lid labels.
- Plastic carrier webs must be used for lid labels.
- The label and reel design will be determined bindingly customer-related by KRONES with a label code.

### 3.6.3 Label shape

Before you decide for a label shape or size, please note that the maximum possible label dimensions result from the limitation of the cylindrical, conical and "approximately conical" surfaces of the bottle and from the maximum processable label dimensions.

Therefore, the following individual points should be considered:

- The body labels do not project beyond the cylindrical part of the bottle, as otherwise folds result.
- The shoulder labels are adapted to the space available on the bottle shoulder if possible. The shoulder labels are not to project beyond the bottle curvature downwards and are also not to lie on the upper shoulder arch.

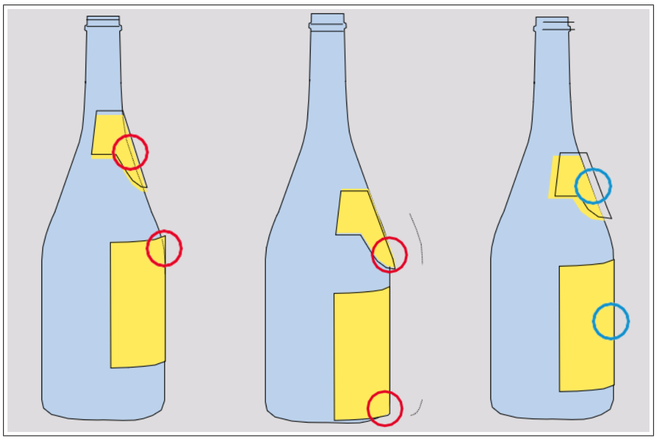

*Fig. 104:* Position of self-adhesive labels

### 3.6.4 Label material

#### Paper

80 – 120 g/m² (almost all printing methods)

(with neck-around label or champagne bands at least 120 g/m²)

#### Film

Basically with plastic containers, the container and label material are to match. The labels are not to be thinner than the recommended label thickness.

- PE 100 – 120 µm
- PP 50 – 60 µm
- Polyester 50 µm
- PS 60 – 70 µm
- PVC 100 – 120 µm

## Material build-up

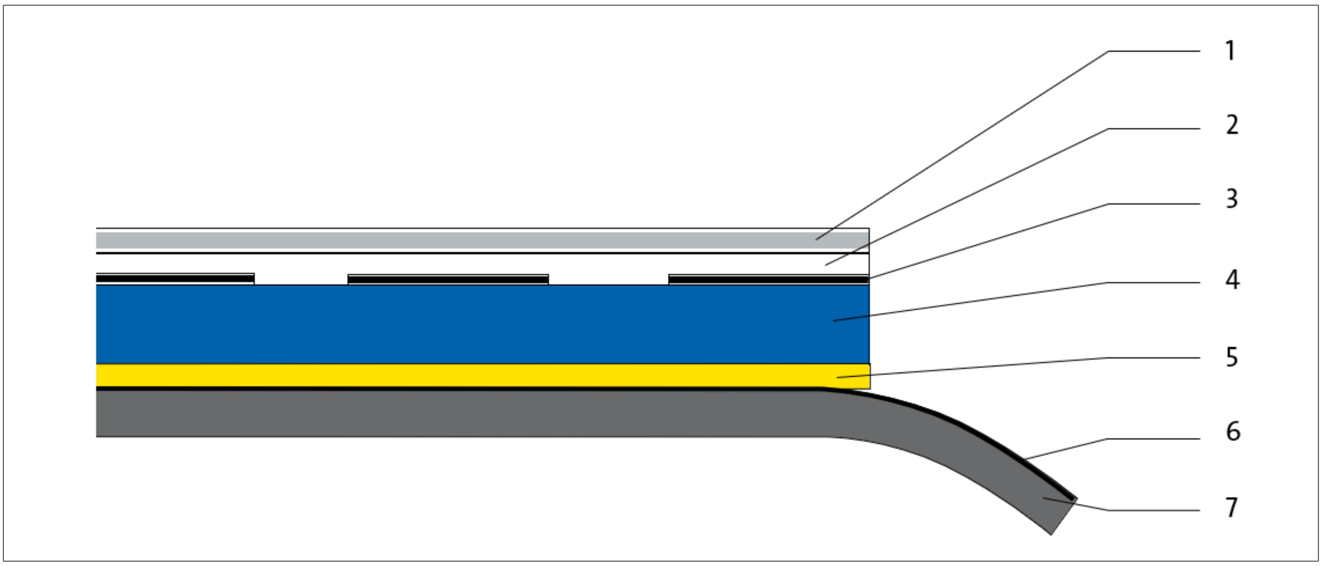


*Fig. 105:* Material build-up

1. Covering film
2. Lining/protective lacquer
3. Print design
4. Print carrier
5. Adhesive
6. Silicone
7. Label carrier (opacity according to DIN 53146)

**NOTICE**

With a deflection diameter of 40 mm, the labels must not separate from the label carrier film! Basically, the suitability of the labels must be proven under operating conditions (produce trial reels!) Label production can be approved only after successful test runs!

## Properties of label carrier film for automatic bonding (APS III + APS IV)

The splicing point must resist mechanical strains of a determined degree. As there are are large number of material and coatings possibilities, a minimum loadability of the splicing point of a tensile force of at least 30 Newtons is required.

The tensile test according to DIN ISO 1924-2 must be carried out according to the following description (see figure : Bonding labels [▸ 50]):

A 15 mm wide label carrier film strip is to be bonded with the 25 mm wide double-sided adhesive tape (KRONES No. 0-900-965-649) with 30 Newtons of contact pressure for approx. 3 seconds.

Make sure that a silicone layer is also involved in the bonding (see figure).

The subsequent tensile test must be carried out within 10 after bonding.

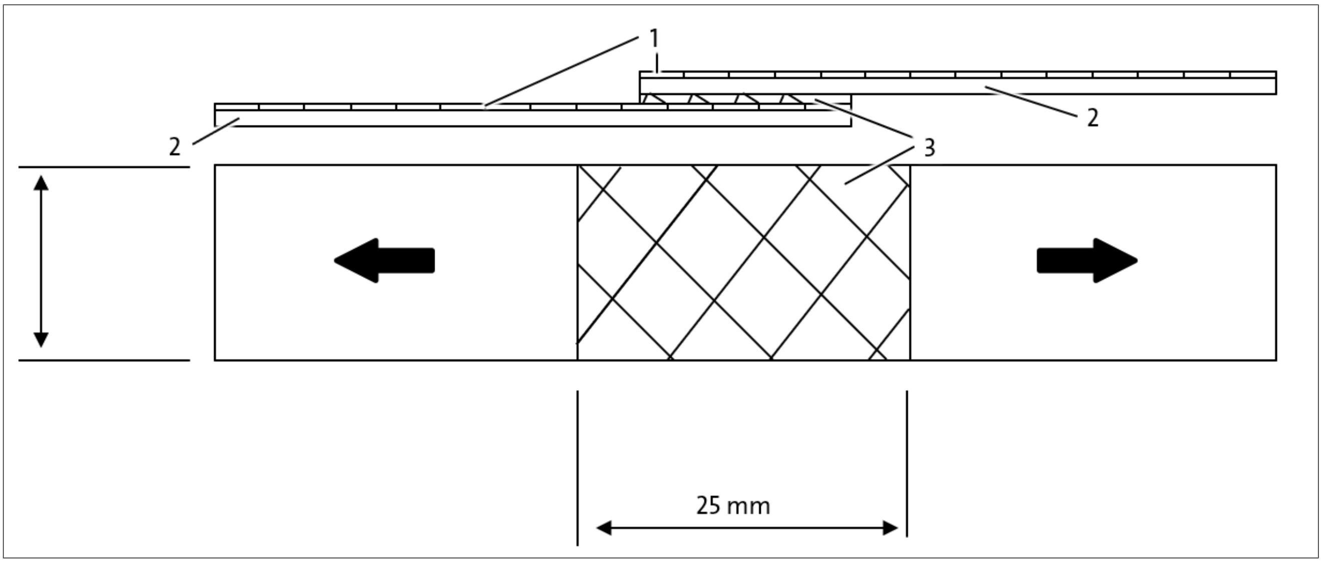


*Fig. 106:* Bonding labels

1. Silicone layer
2. Label carrier film
3. Double-sided adhesive tape (KRONES No. 0-900-965-649)

## Cut edges of the label carrier film for self-adhesive labels

The label carrier film of self-adhesive labels that has a frayed cut edge after the longitudinal cut at the label manufacturer (see following figure) can lead to processing problems. The abrasion of the carrier tape can cause contamination of the sensor system, therefore interrupting production.

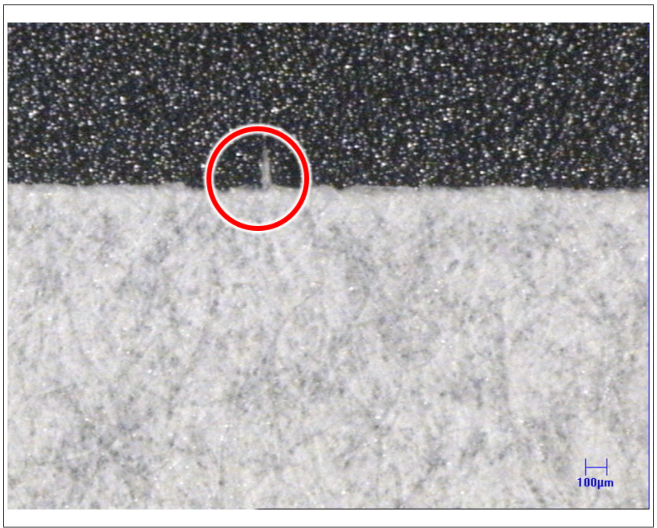


*Fig. 107:* Fringed cut edges

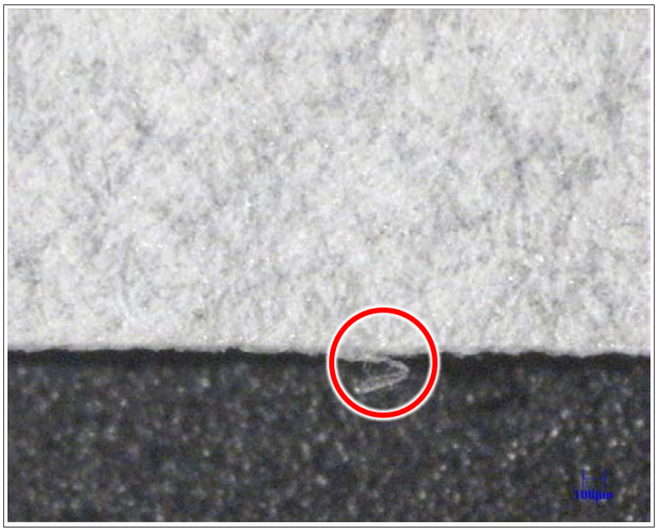

*Fig. 108:* Fringed cut edges

# 4 Sleeve labels

Basically, the suitability of the sleeve must be proven under operating conditions. Only after successful completion of the test runs can sleeve production be released.

## 4.1 Stretch sleeve

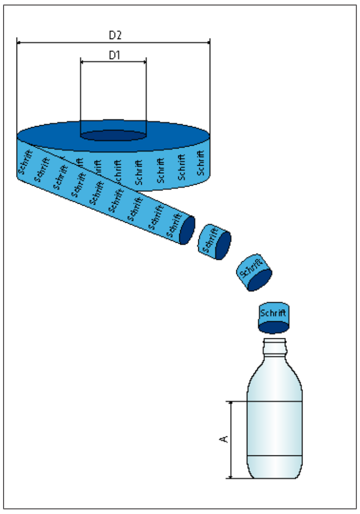


*Fig. 109:* Sleeve labels

Label reel

- D1 = Inner diameter of 76 mm
- D2 = Outer diameter (maximum) of 600 mm
- A = Application height

The sleeve reels must be wound such that they cannot telescope under their own weight and that the marking is legible as shown.

| | |
|---|---|
| Sleeve material | PE-LD (LDPE) Low Density Polyethylene |
| Film thickness | 0.05 mm ± 10 % |
| Coefficient of sliding friction: | 0.1 – 0.2 |
| Elastic elongation | > 12 % with cylindrical label seat (with curved seat only on request) |
| Longitudinal tensile strength | > 22 N/mm² |
| Transverse tensile strength | > 20 N/mm² |
| Longitudinal elongation at break | > 300 % |
| Transverse elongation at break | > 450 % |
| Seam strength | > 10 N/15 mm |
| Flat sleeve width | Inner sleeve dimension ± 0.5 mm |

**Label dimensions:**

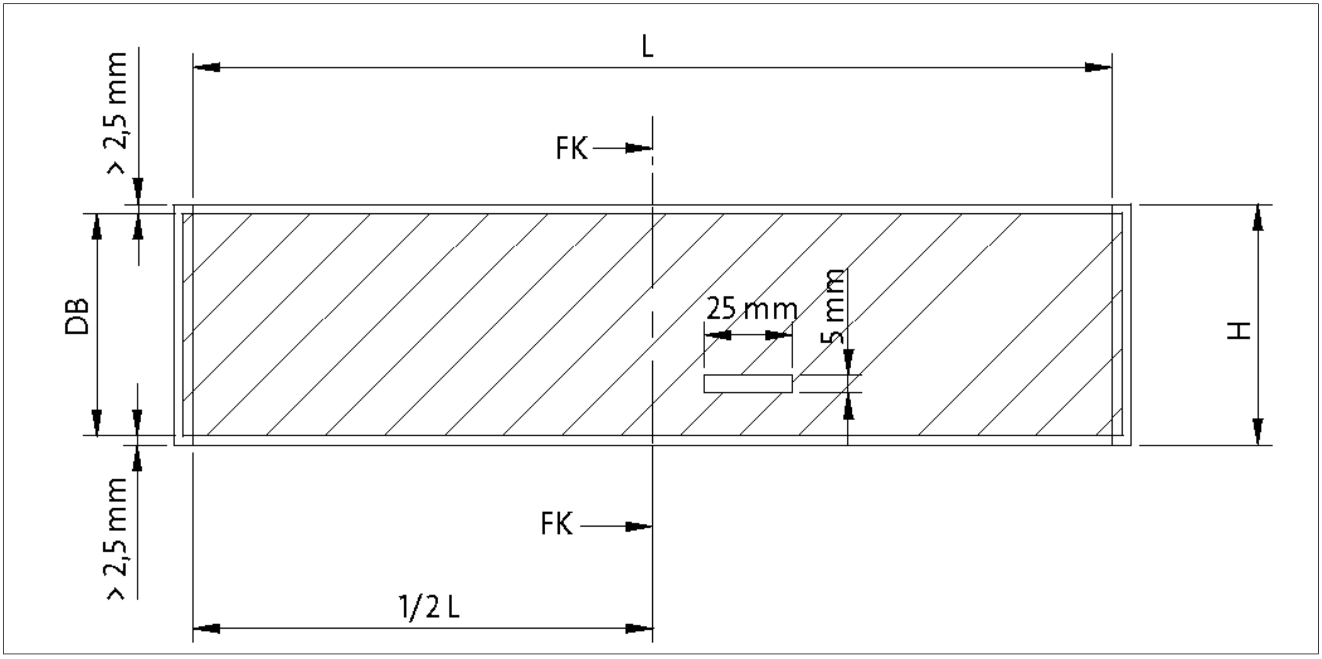


*Fig. 110:* Label dimensions

Dimensions:
- L = Label length
- H = Label height
- FK = Folding edge
- DB = Printing area

Dimensional tolerances of sleeve:
- Measured from register mark to register mark+ 0.5 %
- Sleeve width: ± 0.5 mm

## 4.2 Shrink sleeve

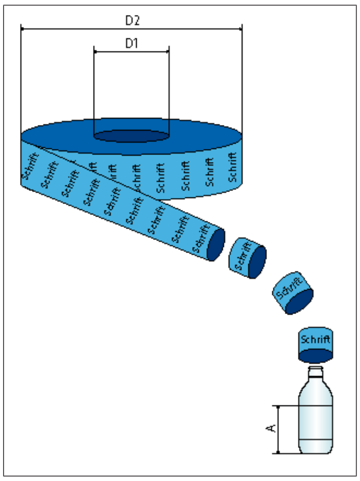


*Fig. 111:* Shrink sleeve

Label reel:
- D1 = Inner diameter of 152 mm or 254 mm
- D2 = Outer diameter (maximum) of 600 mm
- A = Application height

The sleeve reels must be wound such that they cannot telescope under their own weight and that the marking is legible as shown.

Sleeve materials:
- PVC (polyvinyl chloride), PET (polyethylene terephthalate) and OPS (oriented polystyrene)

Longitudinal shrinkage values:
- Film-dependent

Thickness:

*Fig. 112:* Layer offset (winding tolerance)

| | |
|---|---|
| Sleeve material, folding width | < 110 mm |
| PET clear film | min. 40 µm |
| PVC clear film | min. 40 µm |
| OPS clear film, expanded | min. 50 µm |
| PET barrier film, expanded | min. 55 µm |
| Bending moment TD > 0.090 Nmm | Bending moment MD > 0.185 Nmm |
| Bending stiffness TD > 0.019 Nmm | Bending stiffness MD > 0.040 Nmm |

| | |
|---|---|
| Sleeve material, folding width | > 110 – 135 mm |
| PET clear film | min. 40 µm |
| PVC clear film | min. 40 µm |
| OPS clear film, expanded | min. 50 µm |
| PET barrier film, expanded | min. 55 µm |
| Bending moment TD > 0.115 Nmm | Bending moment MD > 0.243 Nmm |
| Bending stiffness TD > 0.027 Nmm | Bending stiffness MD > 0.054 Nmm |

| | |
|---|---|
| Sleeve material, folding width | > 135 – 200 mm |
| PET clear film | min. 40 µm |
| PVC clear film | min. 40 µm |
| OPS clear film, expanded | min. 50 µm |
| PET barrier film, expanded | min. 55 µm |
| Bending moment TD > 0.140 Nmm | Bending moment MD > 0.300 Nmm |
| Bending stiffness TD > 0.034 Nmm | Bending stiffness MD > 0.068 Nmm |

## Label dimensions:

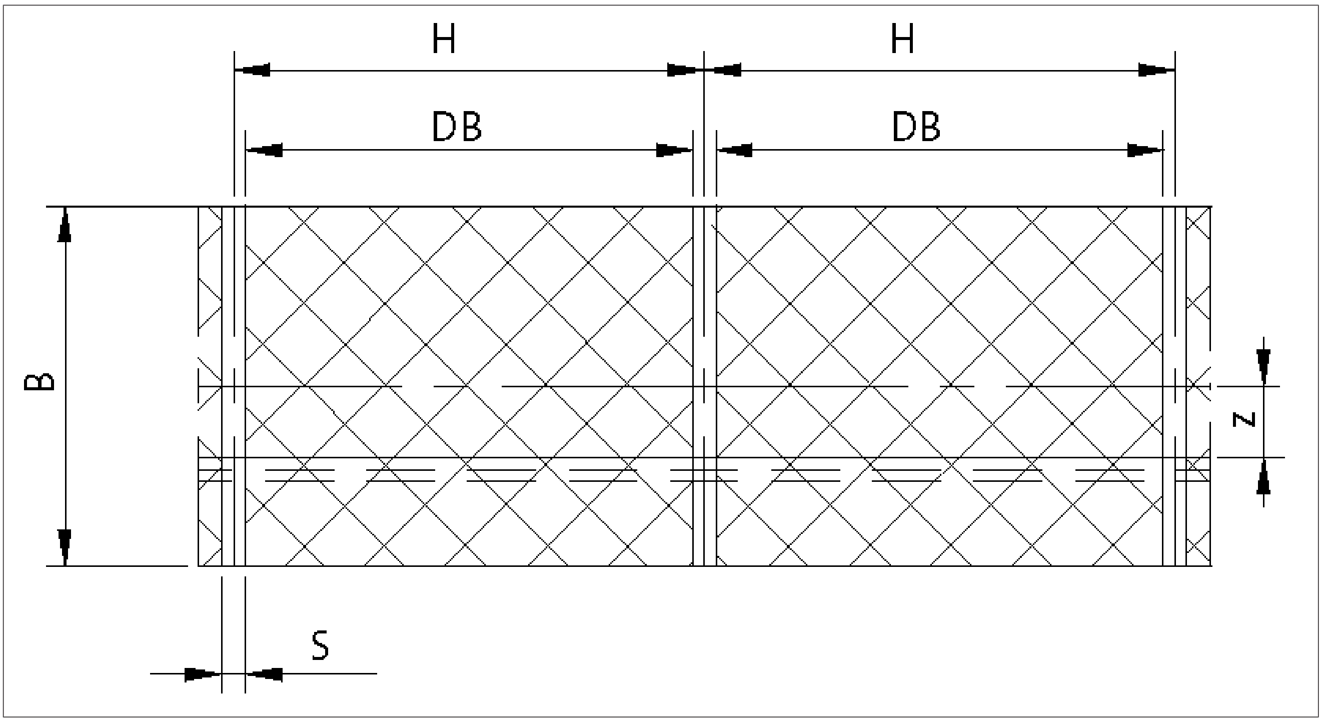

*Fig. 113:* Figure: Label dimensions

Dimensions:
- H = Label height
- B = Flat sleeve width
- DB = Printing area

- S = Transparent register mark (5 mm)
- Z = Minimum distance of the adhesive edge/sealing edge to the label centre (at least 15 mm)

Dimensional tolerances of sleeve:

- Measured from register mark to register mark: + 0.5 %
- Sleeve width: ± 0.5 mm

## 4.3 Register marks for sleeve labels

### 4.3.1 Definition

*Fig. 114:* Example of sensory scanning of a register mark

A so-called register mark is required for the precise cutting of individual labels from tubular reel material. A register mark is a clear, geometrically defined colour contrast on the label, usually in the form of a small bar, that is used to cut individual labels from the reel.

This bar serves as a recognition mark on the label, which is scanned by a colour sensor or luminescence sensor (UV sensor). The arrangement of a register mark is usually horizontal across the width of the fold.

We generally recommend sending all differently printed labels to KRONES for checking the respective contrast difference in order to have the processability of the labels confirmed. The illustration shows a register mark (here across the label as a transparent bar) and the detection sensor.

When processing labels with register marks of luminescent ink that can only be evaluated under UV light, it is essential to consult KRONES. The integration of a register mark, which should be as unobtrusive as possible, should already be taken into account during the label design in order to ensure proper functioning. The subsequent insertion of the register mark into already existing label designs often leads to less than optimal solutions. It is therefore necessary to consider the register mark at an early stage in the label design.

### 4.3.2 Luminescent register marks

The requirements listed below for a register mark offer optimum production reliability and short machine changeover times:

- Exactly one register mark per label (label length L)
- Register mark size:
  Luminescent ink: 5 mm high, 25 mm wide, spectrum 370 nm (see following figure)

The register mark must not be on the folding edge. The use of a clearly detectable register mark by means of colour contrast is also possible. It must be ensured that there is sufficient colour contrast to the register mark. Experience shows that the contrast is not always sufficient. We generally recommend sending all differently printed labels to KRONES for checking the respective contrast difference in order to have the processability of the labels confirmed.

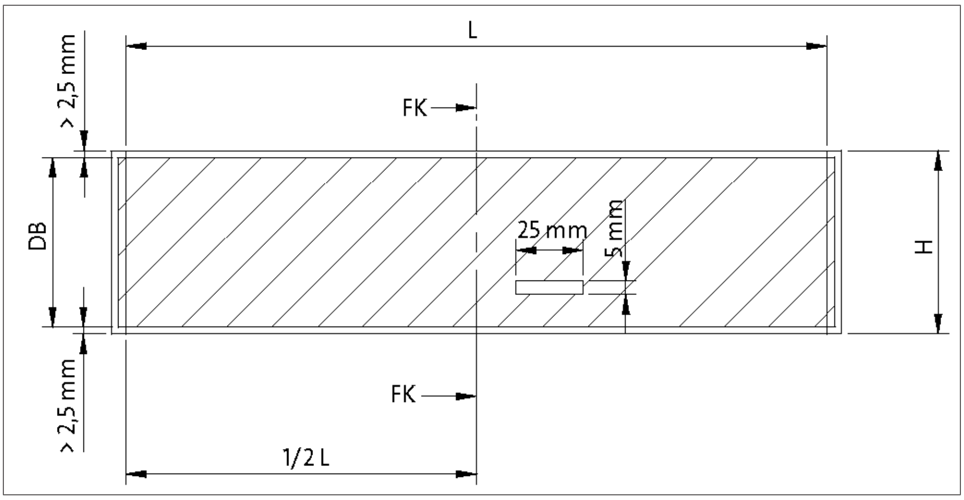


*Fig. 115:* Label drawing for register mark geometry of a sleeve label

Dimensions:

- L = Label length
- H = Label height
- FK = Folding edge
- DB = Area of graphic design

Register mark tolerance

- Measured from register mark to register mark: + 0.5 %

## Examples of readable luminescent register marks


*Fig. 116:* Readable luminescent register mark


*Fig. 117:* Readable luminescent register mark

The label is printed with an all-round strip of luminescent ink. This strip becomes visible when UV light is used (see illustration). The area above the EAN code is addressed.

## Examples for NON-readable luminescent register marks

*Fig. 118:* NON-readable luminescent register mark

*Fig. 119:* NON-readable luminescent register mark

The label is printed all over with luminescent ink. Here it is not possible to define a unique register mark.

## Examples of readable colour contrast register marks

*Fig. 120:* Readable colour contrast register mark

The transparent label is only partially printed with a graphic design. The extra black bar integrated in the label is used as the register mark.

### 4.3.3 Register mark for transparent labels

For transparent labels it is also possible to use a transparent strip as a register mark (see 4.3.3: Figure 103 [▸ 57]; SM = register mark = 5 mm). For this purpose, there must be no other transparent areas in the scanning area (see 4.3.3: Figure 103 [▸ 57]; AB = scanning area).

This variant offers the advantage that it is checked for see-through, and therefore graphic design or labelling is also possible in the scanning area (see 4.3.3: Figure 103 [▸ 57]; DB = printing area).

If possible, the position of the scanning area should be in the same position for all sleeve labels so that the colour sensor does not have to be adjusted each time.

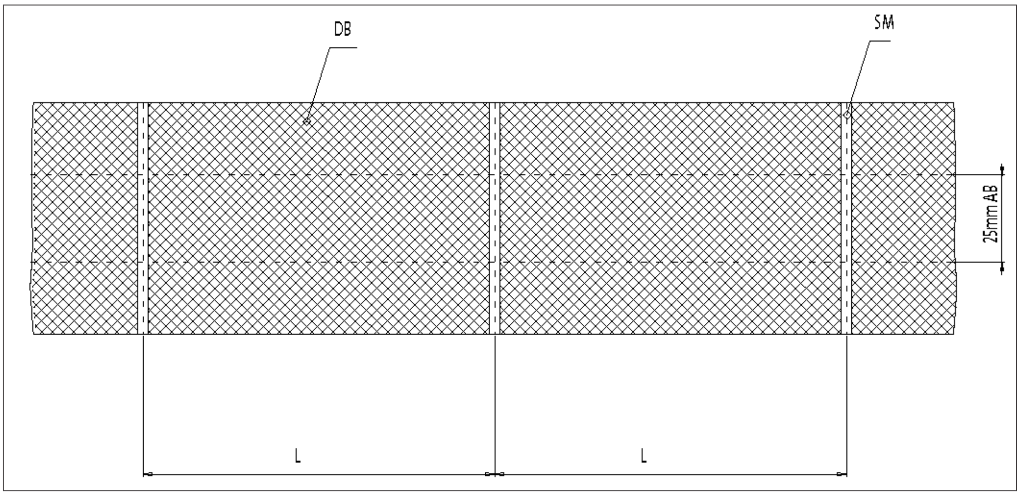


*Fig. 121:* Label drawing for register mark geometry with transparent register mark

## Examples of readable transparent register marks


*Fig. 122:* Readable transparent register mark


*Fig. 123:* Readable transparent register mark

The transparent label is printed over the entire surface, with transparent strips in the overlap area. This transparent strip is used as a register mark (see also chapter Error! Reference source could not be found.).


*Fig. 124:* Register mark

The transparent label is fully printed with a blank window above the barcode. This transparent window is used as a register mark


*Fig. 125:* Register mark

The transparent label is fully printed with a blank window above the barcode. This transparent window is used as a register mark

### 4.3.4 Examples of NON-functional register marks

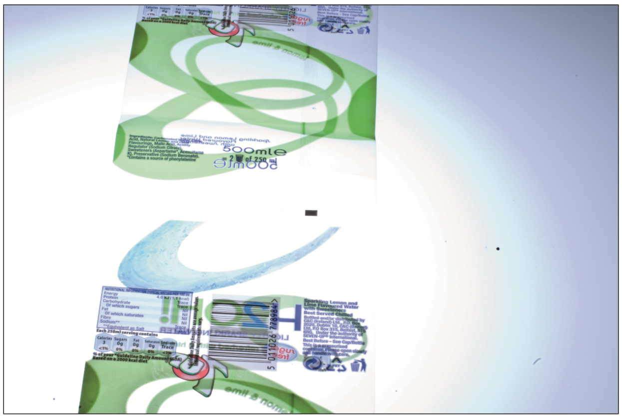

*Fig. 126:* NON-functional register mark

The transparent label contains neither a continuous printed area that could be used as a register mark, nor an extra colour inserted register mark, nor a UV register mark.

### 4.3.5 Other notes on register marks

The register mark design must be carried out according to the above specifications. The remaining design of the label printing is the responsibility of the customer.

## 4.4 Notes on printing on transparent and semi-transparent sleeves

A good, uniform coefficient of friction on the inside of the sleeve is a prerequisite for proper processability of the sleeves. To ensure this for transparent and partially transparent sleeves, unprinted transparent areas are not permitted. For sleeves that use a circumferential transparent area as a register mark or for graphics that extend downwards into the transparent area, the transparent part of the sleeve must be painted over with a suitable bonded coating.

Without painting over, malfunctions are inevitable, especially in the case of containers with adhesive container surfaces, caused for example by the use of preforms with a high recycled content. When using a Sleevematic Inline, the measured value for the bottle stickiness must not exceed the value of 5 N.

## 4.5 Reel core for sleeve labels

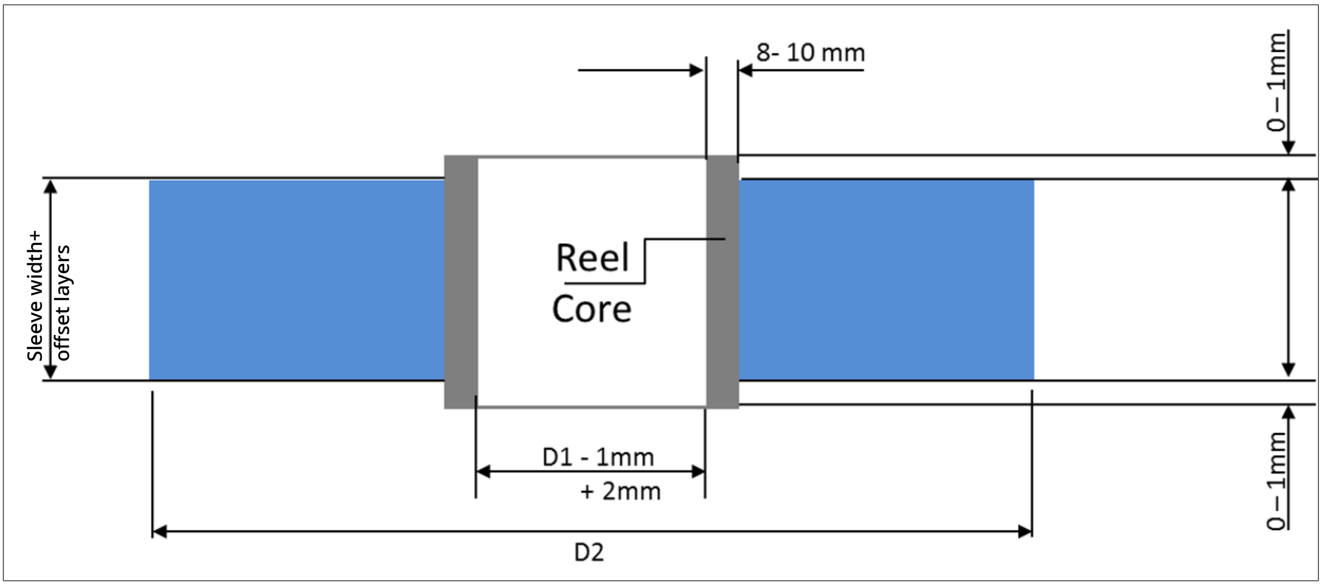


*Fig. 127:* Reel core for sleeve labels

## 4.6 Bottle stickiness

### Specification:

The measured value for bottle stickiness must not exceed 5 N for sleeve labelling.

### Measuring method:

The measuring method generally corresponds to that of the preform measurement, with the difference that only one bottle is firmly clamped due to the larger reference block (bottle).

As the sidewalls of an empty bottle do not maintain their shape when the bottle is loaded with a weight, the bottle to be tested must be pressurised inside with approx. 3 bar. To do so, the caps are provided with a rubber plug (used also for NitroHotfill), and a needle injects compressed air.

When measuring bottles, care must be taken that the bottle contour represents a suitable contact surface. It must be horizontal and sufficiently large to ensure proper sliding of the bottle on top (between two grooves there should be at least 15 mm clear surface).

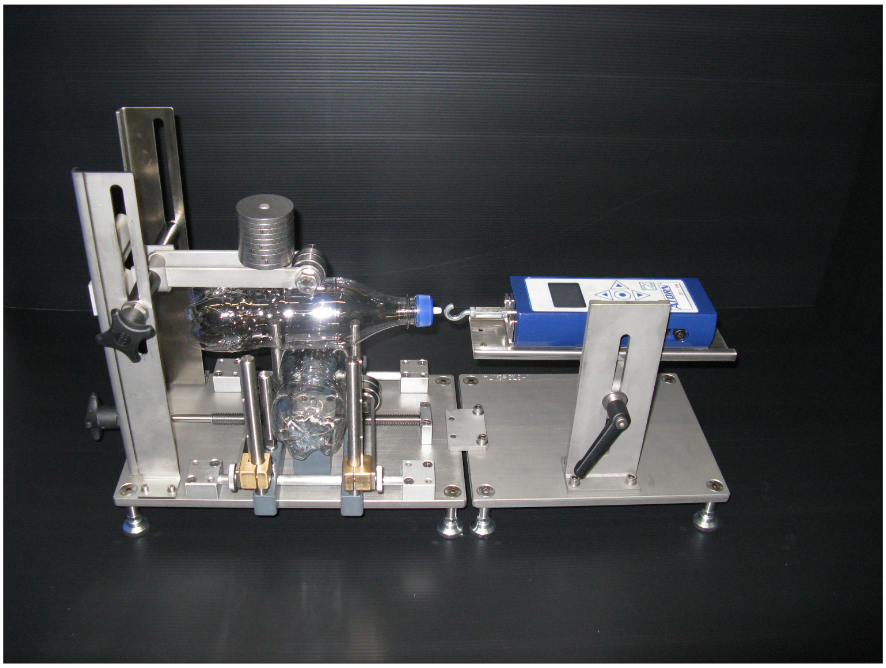

*Fig. 128:* Measuring device for bottle adhesiveness

The method of operation of the device corresponds to that of the preform measuring device. In addition to the height of the measuring slide, the height of the pivoted arm with the loading weight must be adjusted in this device to compensate the different bottle diameters. (The pivoted arm should be adjusted as horizontally as possible).

A cap with an integrated rubber plug has been devised to connect the top bottle with the dynamometer. The closure can be attached with a loop in the hook of the dynamometer.

To make it easier to transport the measuring unit, the measuring unit is connected to the receptacle unit via a plug-in connection.

## Handling, transport

When measuring, it is essential that the bottles are free from adhering dust, dirt, skin grease and other substances that can influence the stickiness.

They must therefore be protected against external influences during the period from their production or the opening of the delivery container until the measurement (packaging in a new, clean and dust-free plastic bag) and may only be touched in the area of the mouthpiece if necessary.

## Characteristic values for stickiness:

The characteristic value is defined as the force in Newtons that is required to overcome the adhesive force between the friction partners (bottles) at a contact pressure of 5 Newtons. To minimise the influence of measuring faults and aberrations, series of at least ten measurements must be performed to determine the parameter.

In addition, fresh bottles should be used for each measurement.

In order to calculate the parameter, the normally distributed measured values are used which range within the limit of the standard deviation around the average value of the population (μ ± σ).

This automatically excludes large outliers from the characteristic value formation.

## Practical example for the calculation of a parameter from a series of measurements:

| | Measured values: | | Outlier test according to 1-Sigma*: |
|---|---|---|---|
| | 4,6 | → | 4,6 |
| | 4,7 | → | 4,7 |
| | 5,7 | → | Outlier! |
| | 4,7 | → | 4,7 |
| | 3,9 | → | Outlier! |
| | 4,3 | → | 4,3 |
| | 4,6 | → | 4,6 |
| | 4,1 | → | 4,1 |
| | 4,8 | → | 4,8 |
| Average value μ: | 4,60 | | 4,54 |
| Standard difference σ: | 0,51 | | |

**) All values which are outside the range of μ - σ (4.60-0.51) to μ + σ (4.60-0.51),*
*i.e. are less than 4.09 or greater than 5.11, are considered to be outliers.*

*Fig. 129:* Practical example

From the other measured values, a mean value is again formed, which corresponds to the characteristic value for the stickiness of the measured bottles.

**Note:**
The parameter for the stickiness of bottle pairs does not correspond to the physical principle of static friction, as with a theoretical press-on force of zero Newtons between the friction partners, a value of zero must result, according to the laws of physics. However, this is not the case, as the following diagram demonstrates:

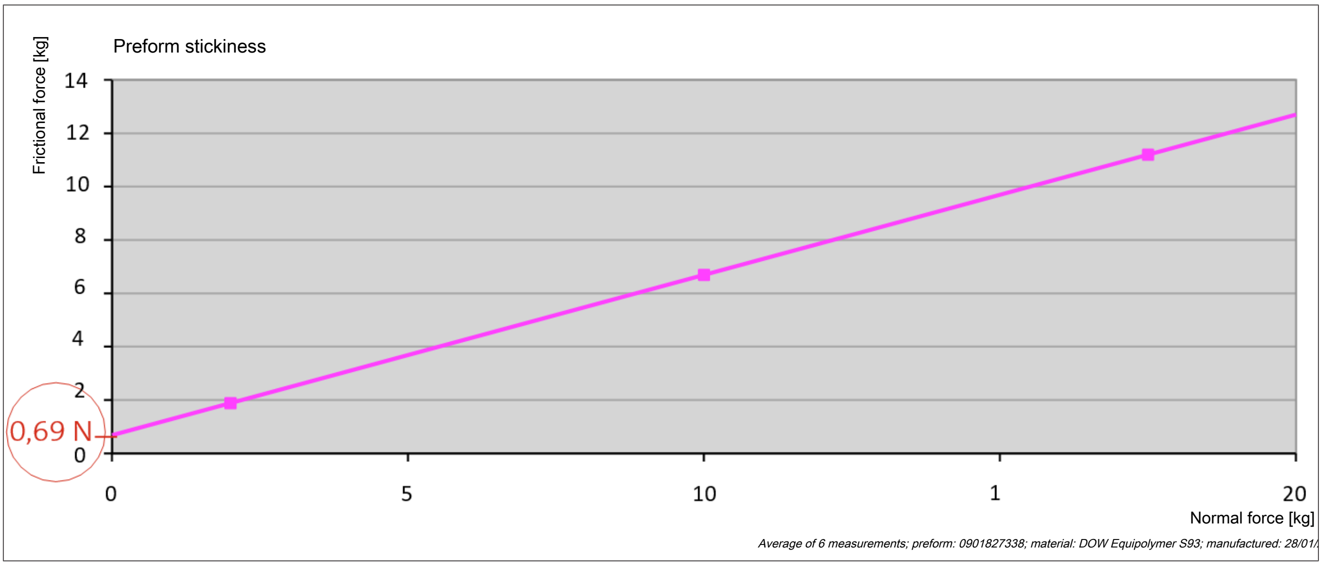


*Fig. 130:* Course of the adhesive strength over the normal force