Specification

Depalletising New Container Stacks

TD10027156 EN 00

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1 General information

This specification addresses the requirements for new containers and their stacking and processing conditions for unloading or destacking a stack of new containers, either via pusher or lifter functions.

The following topics will not be covered:
- Processing of full containers or empties
- Palletiser or loader functions
- General outer packaging, e.g. cluster trays or interlocked packs

Containers

- Containers are produced from a wide variety of shapes and a wide variety of materials, such as cylindrical, square, custom-shaped, free-form, glass, tin, aluminium or plastic. Concrete examples are glass bottles, cans, plastic containers, oil cans or decorated containers. These containers are filled with the final product.
- Round PET containers are mostly transported by the customer directly from the company's own stretch blow moulder to the filler, in which case there is usually no need for new container stack transport. A challenge is posed by the low stability of the PET containers (especially with petaloid or star bases) and the low empty weight. In individual cases, new PET stacks only need to be fed if no blow moulder is integrated. In general, the rules as described for other types of containers also apply here. In specific cases, PET new container stacks should be checked for processability in the design.
- This specification deals mainly with containers which are most commonly used; special shaped containers may approximate in their properties the containers mentioned in this specification. As the variety in moulded containers is often unlimited, it proves difficult to address the entire range.

New container handling

The following points must be observed with regard to the handling of new containers:
- After delivery, the stacks of new containers are depalletised. In this process, the packaging or transport protection material, such as the strapping, the foiling or the top frame or plate, is first removed and then the containers are either pushed off or lifted off the pallet layer by layer.
- Lines that fill non-returnable containers require a continuous supply of new containers. If, on the other hand, filling is geared to returnable containers, new containers are only supplied as required. The new containers added always compensate for the system's needs or the losses of damaged returnable containers.

→ Relevant definitions of terms can be found in the glossary.

1.1 Requirements for stacks of new containers

To handle new container stacks easily, they must meet certain requirements. Consequently, the requirements for a new container stack must be observed for proper processing. The following table summarises the most important requirements for a new container stack.

Requirements for new container stacks and their handling	Reason	See
Storage		

Requirements for new container stacks and their handling	Reason	See
New container stacks must be stored in a dry environment and at low humidity. They must not be stored outdoors	Cardboard layer pads, inverted trays and bottom trays soften when the humidity is too high and the container bases can press trough depressions into the layer pad, see definition "Lego effect".	4.2 Ambient conditions during storage and transport [▷ 17]
Protect the stack from sunlight	Direct sunlight can negatively affect the properties and the appearance of the containers.	4.2 Ambient conditions during storage and transport [▷ 17]
Do not store new container stacks near exhaust gases, chemicals or oils	Otherwise, parts of the stack may absorb substances that do not comply with food law.	4.3 Proper return [▷ 18] 6 Packaging and packing materials [▷ 25]
If you do not finish processing a new container stack entirely and have to put it back into storage, wrap it completely in film again	Otherwise, the containers will become dirty. Wrapping the stack in film also restabilises it.	6 Packaging and packing materials [▷ 25]
New container stack		
The stack of new containers should not be too large or too small in relation to its pallet area	▪ Overhang: Edge containers can fall down very easily after removing the film. ▪ Undersize: Protruding layer pads can be bent by wrapping in film. The stack centring unit cannot approach the stack because the layer is smaller than the pallet dimension.	5.2 Undersize and overhang [▷ 19]
There must not be a distance greater than 20 mm between the real and theoretical stack height	The real layer accumulation (stack height) must match the sweep-off level.	5.3 Stacking accuracy [▷ 20]
The individual layers of the stack must be stacked exactly on top of each other and vertically aligned	Layer overhangs would destabilise the stack.	5.3 Stacking accuracy [▷ 20]
The sweep-off depalletiser stacks must have at least six layers.	If the stack has too few layers, a loss of performance is to be expected.	6.3 Bottom tray/inverted tray [▷ 30]
Pallets		
Pallets must be even. The maximum difference in height across the pallet surface must be within specified limits	In the case of larger height differences, containers cannot be lifted or pushed off properly	5.4 Pallets [▷ 21]
Pallets must not be significantly damaged	Otherwise, machines cannot handle them	5.4 Pallets [▷ 21]
Films		
Completely remove the film from the new container stack. If necessary, provide a pallet lifting device at the unwrapping station.	Residual foil pieces on the pallet can incorrectly fix a loose bottom pad to the pallet base. Remaining pieces of film may erroneously trigger the detection sensors.	6.1 Packaging films [▷ 25]
Layer pads and bottom pads		
The corner radius of the layer pads should be adapted to the radius of an edge container	If the corner radiuses of the layer pads are too small, the bottles at the corners and edges of the layer tend to fall off when the film is removed. If the corner radius is too small, the film bends the corner downward -> corner containers fall off	6.2 Layer pads [▷ 26]
Transporting the new container stack		

Requirements for new container stacks and their handling	Reason	See
When transporting the stack by means of an industrial truck, the stack must not be touched from the side by the approaching stacking truck.	If the forklift collides with the stack of new containers when approaching from the side, the edge containers can be deformed, broken or the stack can be taken out of its permitted tolerance range.	8 Transporting new container stack [▷ 42]
Moderate acceleration especially of the unsecured/unwrapped new container stack	If the transport acceleration is too fast, the stack may shear, bend or skew.	8 Transporting new container stack [▷ 42]
Ensure that the new container stack does not tilt	Risk of the layers shifting relative to each other	8 Transporting new container stack [▷ 42]
Unusual container shapes		
Conical outer shapes of containers are to be checked at an early stage	Conical (or cone-shaped) containers are not continuous in their outer surface; they only touch at one point at a certain height. Therefore, they can become misaligned when they are depalletised. In addition, the point load causes greater surface abrasion on the conical container. Conical containers must be checked by the Krones design department.	10.3 Bottles [▷ 47]
If your containers have a special shape, contact us to clarify the requirements	Special container types have individual shapes. The KRONES engineering department must check the container shape.	10.3 Bottles [▷ 47]

1.2 Exchange of information on relevant topics

This specification describes the special features of new container stacks and their containers.

The following table lists the most important special features which require consultation of our customers with the Krones Sales or Engineering Department to ensure smooth order processing.

No.	Client - Krones communication is consistently required when the following is used:	Reason	See:
1.	PET new containers in stack	For cost reasons and due to their low stability, they are usually stretch blow-moulded directly before filling.	1 General information [▷ 4]
2.	Chapatex layer pad	Two different surfaces and greater weight of the layer pad influence the gripping tool	Glossary
3.	Lego [interlocking] effect	Conditions of transport, storage and type of packaging aids must be optimised.	Glossary
4.	Conical outer shapes of containers	Conical containers can tip over, rise up against each other or jam when being pushed off or on the discharge table. With lift-off grippers, the conical container necks cannot be gripped securely on uneven pallets	1.1 Requirements for stacks of new containers [▷ 4] 5.4 Pallets [▷ 21] 10.3 Bottles [▷ 47]
5.	Special container shapes	Due to their individual shape, they must be checked for processability via drawings or hand samples.	1.1 Requirements for stacks of new containers [▷ 4] 10.3 Bottles [▷ 47]
6	Use of a lift-off depalletiser gripper head (bar gripper, inflated-bar gripper or cup gripper head)	When using a lift-off gripper head, it is imperative that the relationship between the bottle body diameter and the bottle neck diameter is checked by Design so that the gripper units can dip between the container necks.	2 Differentiation of sweep-off and lift-off depalletisers [▷ 9]
7	Method of stacking new container pallets on top of each other	It is better to find a shelving solution to protect stacks from damage.	4.1 Storage of stacks of new containers [▷ 17]

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No.	Client - Krones communication is consistently required when the following is used:	Reason	See:
8	Undersize or overhang of the layer on the pallet	In case of deviations due to undersize or overhang and layer size deviation of the layer pad relative to the pallet, Krones Engineering must be consulted.	5 Output palletising [▹ 19]
9	New container stacks with a circumferential x-y layer deviation of more than 25-50 mm offset	Centring device could run against container and damage it. In addition, the stack would stand unstably	5.3 Stacking accuracy [▹ 20]
10	Pallets with layer unevenness with a deviation of more than 5 mm	Sweep-off depalletiser: Sweep-off device stops on collision with an uneven pallet and outputs a fault message. Remover: Depending on the gripping tool design, it may no longer be possible to grip the lower containers with conical container necks.	5.4 Pallets [▹ 21]
11	Electrostatic charging of films and containers	The friction caused during the removal of the film can lead to electrostatic charging of the film and the containers.	6.1 Packaging films [▹ 25]
12	Returning layer pads to the new container stack manufacturer	If layer pads to be reused are used, they should be pre-sorted by the user to the extent that only layer pads in perfect condition may be reused.	6.2 Layer pads [▹ 26]
13	Use of bottom trays/inverted trays for sweep-off or lift-off depalletiser mode	In the case of the pushers, preference is not given to processing **bottom trays** because of special layer centring, sweep-off station, intensive software adjustment and reduced performance. However, if these are nevertheless to be processed, the Krones Sales department must be consulted about significant additional costs. In contrast, **inverted tray** processing is common practice with lift-off depalletisers. For lift-off depalletisers, it must be checked whether the selected inverted wall height can be processed for all container heights.	6.3 Bottom tray/ inverted tray [▹ 30]
14	Request for an automated destrapper	A destrapper can be purchased, which takes over the removal of the straps. However, Krones Engineering must be consulted in advance about the additional costs to be determined.	6.6 Strapping bands [▹ 34]
15.	Use of cardboard insert dividers for linearly lined up containers	It must be checked whether the cardboard insert dividers can be lifted out of the linearly lined up container layer with the help of a gripping tool. The position of lifting out and disposal must be clarified.	7.2 Packing patterns with containers lined up linearly [▹ 41]
16.	If possible, sample containers are to be physically provided before a design is laid out	Hand samples are important to better take into account the tolerances, special features and processability of the containers when designing the machine. The customer should check whether the nominal drawing dimensions of the containers correspond to the actual layer dimensions.	10.1 Container tolerances [▹ 46] 10.2 Tilting angle of containers [▹ 47]
17.	Complete data sheets of the new containers and the layer patterns	Provision of complete data sheets regarding all elements of the new container stack are always necessary. In order to speed up the preparation of an order, it would be advantageous if the customer would provide corresponding drawings of layer pack images and the containers at an early stage. If this is the case, we ask the customer to clarify in advance with the new container stack supplier whether certain changes are still possible in principle. This would make it possible to influence critical new container stacks and therefore to prepare them optimally for processing by the customer.	10 Containers [▹ 46] 10.4 Beverage and food cans [▹ 52]
18.	Tilting angle of containers	This effect of tilting usually occurs when sweeping off or transporting on the bottle table. If the customer is aware that the stability of the container is too low, Krones Design must be informed.	10.2 Tilting angle of containers [▹ 47]
19	Satined or coated containers	With satined or coated bottles, special care is needed to avoid damaging the too-sensitive surfaces.	10.3 Bottles [▹ 47]

No.	Client - Krones communication is consistently required when the following is used:	Reason	See:
20	Special features for can stacks	For the calculation of layer and stack weights, as well as for lifting devices, it is important that corresponding data sheets are made available to the Krones Design Department. Flanged rims of cans must remain below the can diameter.	10.4 Beverage and food cans [▸ 52]

2 Differentiation of sweep-off and lift-off depalletisers

2.1 Sweep-off depalletiser

Push-off depalletisers are machines that sweep containers horizontally in layers off a stacking level of a pallet. They are used to depalletise container stacks. The container formations are surrounded by means of circumferential sweep-off bars and pushed on at the so-called sweep-off point on one side on a level sweep-off table. The sweep-off point (sweep-off bar contact point with the container) can be varied depending on the container shape. For standard glass bottles, for example, this is at least 10 mm above the container base. With cylindrical container shapes, sweeping off is not a problem, as these containers can support each other. In the case of special container shapes, problems can arise if, for example, no mutual support can be achieved or there are no two vertical points of contact with the neighbouring container.

For the most part, no additional handling parts are required for the sweep-off depalletisers in order to process different pack formations. Only the length-adjustable handling parts of the sweep-off frame are adjusted to the new layer dimensions, which encompass the layer on four sides.

Fig. 1: Fully automatic sweep-off depalletiser with containers in nested container formation

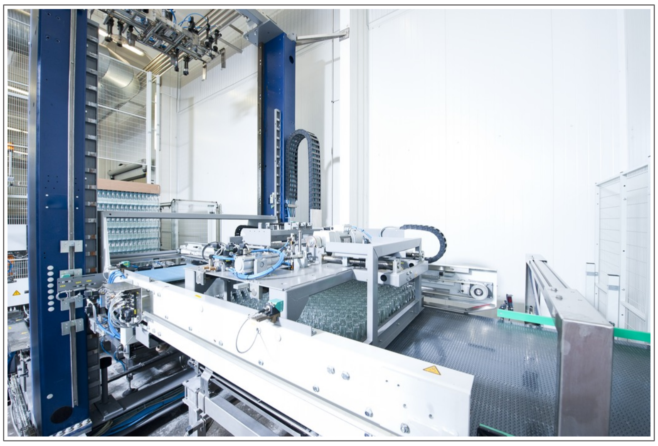

Fig. 2: Fully automatic sweep-off depalletiser during the sweep-off process

2.2 Lift-off depalletiser

Lift-off depalletisers are machines that lift the current top layer of a stack of containers upwards with the help of a gripping tool. The two most widely used gripper variants are the inflated-bar gripper and the bar gripper. For very small container diameters, tools with gripper cups can also be provided within a specified size range. All gripping tools grip their containers at the container neck. In the case of a lift-off depalletiser, there are usually only rigidly mounted layer centring devices on the edge of the actual gripping tool with attached distributing wedges to increase the gripping area. Unlike the automated sweep-off depalletiser, a lift-off depalletiser can either be operated manually (gantry lift-off) or automatically via robot handling.

Before the rows of containers can be picked up by a lift-off depalletiser, it must be ensured that they are in straight and parallel rows to each other in the catching area of the pick-up bars. This means that these containers can be easily picked up with, for example, a bar or hose ridge gripper. If the rows of containers are not parallel in a straight line or break out alternately, the gripper bars can collide with the processed material, as the bars can no longer thread into the free space between the necks of the containers. Additional pre-centring units could be a remedy here. This matter should be assessed by Krones Design.

In order to stabilise the edge containers of a layer in particular, it is best to use bottom trays as packing aids when using lift-off depalletiser functions. With flat layer pads carriers without a support and containment effect, there is a correspondingly high risk that edge containers of the packing layer are already missing or can still fall out during open stack transport.

Fig. 3: Semi-automatic gantry lift-off depalletiser with manually controlled bar gripper

Fig. 4: Fully automatic lift-off with bar or inflated-bar grippers

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Vertical alignment of the containers with lift-off depalletiser

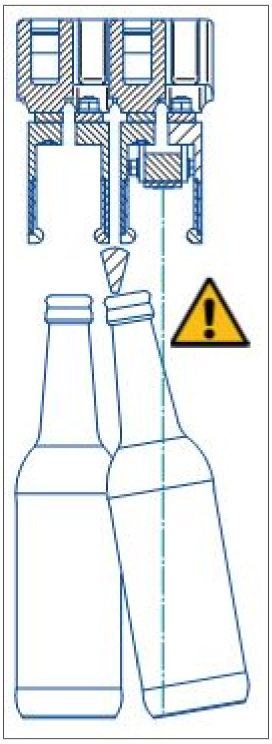

Fig. 5: Collision - The tilted position of a bottle prevents the retraction of the space pre-centring unit

Single and entire rows of containers should be vertical to avoid problems when lifting off upward. If this is not the case, problems can occur within the catch area. If the bottle rows have considerably shifted or tilted, the operator must check the bottle formation. The slant must not decrease the gap between the bottle necks too much. Otherwise, the bar gripper/inflated-bar gripper cannot move into the gap between the bottle necks. New container stacking packaging, which is often secured with retaining and tensioning straps, can prevent individual containers or entire rows from slipping and tipping. It is therefore best to only remove the packaging at the destacking station. Especially in the case of manual gantry lift-off depalletisers, it is best to only provide for layer-by-layer removal of the packaging.

3 Quality levels and performance grade for packing materials and new container stacks

The condition of the packing materials and customer objects can be divided into different quality levels. The examples below are intended to illustrate the classification of levels Q1 to Q3 in order to provide information on the processability of different quality levels of new container stacks.

The classification into quality levels can also support decisions on whether to reuse or dispose of packing materials.

New container packing materials	Possible reuse after processing of new container stacks
Inverted trays and bottom trays	Inverted trays and bottom trays are usually deformed, damaged or soiled after delivery, transport and storage. Therefore, a return to the supplier and reuse (inspection effort and hygiene) would not be considered in most cases. Storage would be very space-intensive because of the upright tray edges. After flat forming of the inverted blanks, it would be advisable to recycle them via a material recycling system.
Layer pads	Layer pads can be reused as long as they are in proper condition. In the case of functional in-house reuse or return to the supplier, particular care must be taken with regard to the hygienic value. Otherwise, recycling is possible.
Packaging films	Packaging films are not suitable for direct reuse. Recycling is possible if the type of plastic is known.
Top frame	Top frames are usually reused several times as long as they are in proper condition. Functional machine malfunctions may indicate defective top frames. Manual condition inspections and repairs of the top frames are advisable, especially after irregularities. If damaged, initiate repair or send to material recycling.
Load distribution plates	Load distribution plates can be used several times as long as they are in proper condition.
Strapping bands	Strapping bands are not suitable for repeated reuse. Recycling is possible if the type of plastic is known.
Pallets	Pallets are usually reused several times as long as they are in proper condition. Functional machine malfunctions may indicate defective pallets. Manual condition inspections and repairs are advisable, especially after irregularities. If damaged, initiate repair or dispose of.

Tab. 1: New container packing materials

Quality level 1:

Packing materials and new container stock from the first quality level can be unstacked without further problems. They are to be classified as being in an almost new condition. Characteristics are a straight stack and an exact position of the containers. In most cases, plastic layer pads provide a stable level and ensure stacking quality.

Fig. 6: Optimally aligned new container stack with plastic layer pads

Fig. 7: Optimally aligned new container stack with bottom trays

Fig. 8: Optimally aligned new container stack with strapping bands

Quality level 2:

At the second quality level, the containers and packing materials may show slight damage and deformation, but these should not yet pose too many challenges for the reliable depalletising process. Small deviations in the container positions and pitches are possible. The stacks brought in are within the limits of the catching areas and the centring systems. Only minor malfunctions are to be expected. Due to possible damage to a few new containers, isolated containers can cause partial malfunctions in processing. The smaller and more numerous the container layers are, the greater the resulting effects of malfunctions. Defective containers that have been lifted or pushed off and have already entered the system must be removed from the system with the corresponding effort. At this quality level, medium additional effort and slightly fluctuating performance losses must be expected.

Fig. 9: New container stack with pressed-in inverted tray corners

Fig. 10: Stack of new cans with slightly bent-down layer pads in the edge area

Fig. 11: Stack of new containers with slightly offset inverted trays (manual removal required) and bent-down layer pads

Fig. 12: Stack of new containers with torn packaging film

Quality level 3:

This quality level shows packing materials that have major damage and deformations. Here, continuous machine processing is usually impossible, as the packing materials no longer support the new container stack or make it destackable.

Fig. 13: New container stack with slipped container rows

Fig. 14: Damaged cans in a new can stack

Fig. 15: New container stack with greatly slipped container layers

Fig. 16: New container stack with fallen container row in the top layer

Fig. 17: New container stack with fallen containers

Fig. 18: New container stack with first layer greatly shifted to the left

Fig. 19: New container stack with severely deformed bottom trays and slipped containers

Fig. 20: Deformed inverted tray

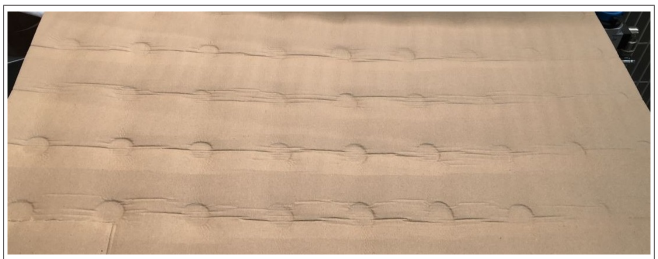

Fig. 21: Heavy container imprints on the underside of the layer pad, which make sweep-off more difficult, as an example of the "Lego effect".

Influence on the efficiency of the machines

The possible influence of the various quality levels on the efficiency of the machines is explained in the following table. The data are empirical values from machine operators and therefore without a guarantee of absolute accuracy.

New container stack quality	Efficiency of depalletisers
1: optimal	Standard efficiency, e.g. 98.5 %
2: medium	-10 % reduction of efficiency
3: poor	-30 % to not processable

Tab. 2: New container stack quality

4 Stack delivery and storage

The stacks of new containers are usually delivered to their processing site by truck. The condition at delivery has a substantial influence on the quality of subsequent processing. Deviations from the perfect condition can affect the efficiency and the functioning of the line. Before feeding to the destacking processing, the condition of the stack of new containers must be checked again by the operator.

4.1 Storage of stacks of new containers

- In order to use the space in the warehouse more effectively, the stacks can ideally be stored upwards in compartments of a shelf storage system. It is critical if stacks of new containers are directly stacked on each other. The most heavily loaded containers in the lower layers must be able to withstand the weight of the container layers placed on top of them.
  A better distribution is achieved if each stack to be loaded is provided with a sufficiently large load distribution plate at the time of storage, thereby allowing the weight to be distributed evenly among the stacks.
- The stacks of new containers should be placed vertically on top of each other and straight in relation to each other.
- If new container stacks are stored side by side, an appropriate gap distance should be maintained between the columns of the new container stacks to ensure that the stacks can be stored and retrieved without colliding with each other.

As new container pallets stacked on top of each other can result in corresponding damage, this storage handling must be reported to the Krones specialists so that appropriate measures can be taken. The processing performance of the machine may be reduced accordingly due to damage resulting from this storage system.

4.2 Ambient conditions during storage and transport

Fig. 22: Do not expose new container stacks to moisture

NOTICE

Do not expose new container stacks to moisture

Exposing new container stacks to moisture can cause serious damage.

- ▶ Ensure that the new container stacks are always transported and stored in a dry environment with low humidity outside of processing times.
- ▶ Under no circumstances should a new container stack be exposed to moisture, especially in the base area.

Paper fibre-like layer pads, inverted trays and bottom trays can quickly absorb corresponding moisture and soften as a result. Moisture also arises from major temperature changes due to condensation forming (e.g. change between day/night). In the worst case, hollow-base containers (e.g. bottles with champagne bases) can sink in particularly heavily when the layer pads are softened, creating strong unevenness there and causing the stack to tilt (see partial Lego [interlocking] effect). If the measured height of a stack no longer corresponds to the calculated height (see 5.3 Stacking accuracy [▷ 20]), the respective cardboard layer pads have already collapsed into each other. This will already have an effect on the stack quality in the wet state as a loss of strength. Subsequent drying of the layer pads leaves an irreversible hardened and fissured surface unevenness on the paper fibre-based packing materials which is irreversible.

Krones cannot guarantee the proper functioning of its machines with regard to moisture damage to dependent packing materials, which is the responsibility of the customer and its supplier. If, however, damp or dried stacks are inserted in the meantime, corresponding malfunctions and performance losses must be expected because, for example, the layer pads cannot be lifted off as a result. In order to minimise disruptions in advance, it is imperative that defective top carton layers that can no longer be sucked on are removed manually before they are introduced into the system. However, if a top layer pad is programmed to be removed by machine, a new, layer pad in proper condition must be placed manually on the relevant stack, otherwise the sweep-off depalletiser will report a fault.

In addition to the humidity, sufficient attention must also be paid to the right climate at the storage location of the container stacks. To prevent the outer colours or the (can) inner coatings of the containers from discolouring or dissolving due to solar radiation, direct sunlight and extreme delta temperatures at the storage location of the new container stacks should be avoided as far as possible. The stacks should also not be stored near unhygienic exhaust fumes, chemicals or oils, as the layer pads, films or the containers could absorb these substances and their properties could change. In addition, regularly check the storage place for infestation with animals or insects. Pest infestation is to be avoided by all means. The time spent in storage should also be limited, as containers can change in their physical properties over time. The "first in - first out" principle applies here.

4.3 Proper return

Some manufacturers also use returnable packing materials for the new container stacks. These materials are returned and used several times. Elements of reusable packing materials can include pallets, top frames and layer pads. To ensure proper multiple use of packing materials, they should be in perfect condition and stacked flat and straight on top of each other again when being returned. Care must also be taken to ensure that the returned packing materials are stored appropriately.

→ See 4.1 Storage of stacks of new containers [▷ 17]

Do not mix returnable packing materials from different manufacturers as in most cases, their dimensions and tolerance deviations differ.

Sort out bad packing materials at an early stage and dispose of them.

Do not use damaged, deformed or unhygienic packing materials, as they can directly affect efficiency.

→ Observe the following information for returning in order to avoid malfunctions during processing: 3 Quality levels and performance grade for packing materials and new container stacks [▷ 12]

The customer has the option of either returning the packing materials already used to the manufacturer of the new container stacks or, for example, continuing to use layer pads on a downstream palletiser.

5 Output palletising

5.1 Capacity factor of a container layer

The capacity factor (CF) of a container layer is determined by the ratio of the layer area to the pallet area. If the two areas have the same size, this is referred to as 100 % utilisation. If the layer area is below the pallet area, this is referred to as undersize (CF < 100 %), if it is above, it is referred to as overhang (CF > 100 %). In the event of excessive deviations due to undersize or overhang, Krones Engineering must be specifically consulted.

5.2 Undersize and overhang

Undersize

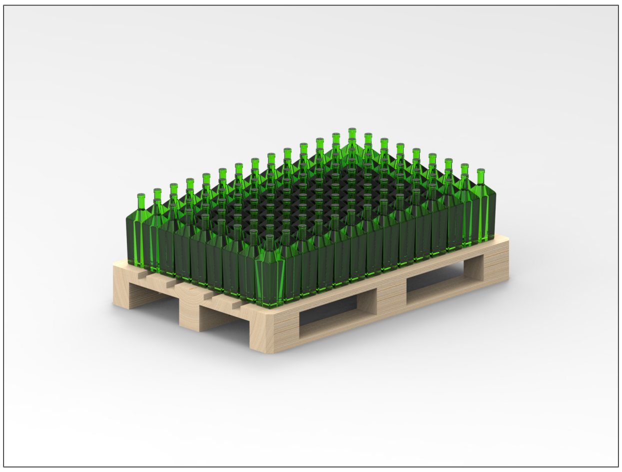

Fig. 23: Slight undersize of a new glass container stack

If the layers are smaller than the pallet, this is referred to undersize. If the palletising surfaces are not fully filled, the relative pallet output of the machine also decreases, because fewer containers can be removed from the layer per sweep-off operation. Furthermore, compared to an optimally fully loaded pallet, more pallet changes per time unit must be carried out on the machine. If their size differs too much from the normal pallet size, the stack may become more unstable with increasing height, compared to a stack that uses the entire pallet space. When transporting, e.g. pallet stacks that are not fully utilised in a truck on the road, the stacks cannot support each other in case of lateral forces. The layer position can vary more within the pallet area. If the pallet guide rail is adjusted too generously, the layer position can be shifted further out of its ideal position in an unfavourable way.

Overhang

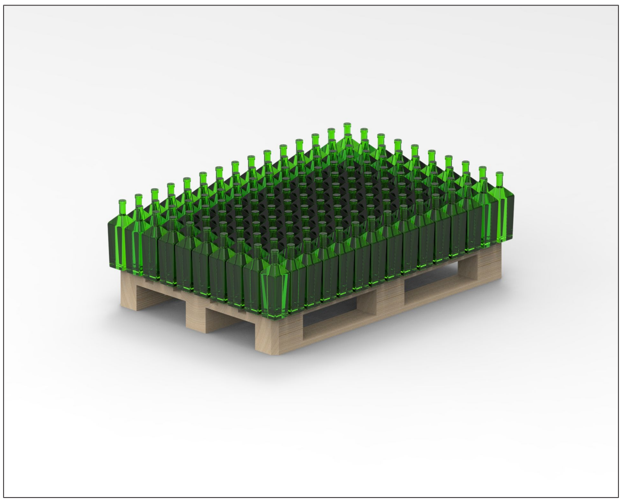

Fig. 24: Overhang of a new glass container stack

Overhang is when the layer is larger than the pallet and the containers standing at the edge protrude beyond the edge of the pallet with a reduced standing area. The larger the overhang, the higher the risk that individual containers and rows can fall off in the edge area during processing. As the stack must cover a distance unsecured on the pallet conveyor after the new container stack has been stripped of film, there is a higher risk of the edge containers falling due to minimal vibrations in case of an overhang, for example due to acceleration, braking and the transition to the next driven segment during pallet transport. Furthermore, in the case of truck transports, for example, the pallet edges set back in the bottom area due to overhang cannot offer a stack stop against each other, whereby the pressure is now passed on via the soft stack walls. This can cause container shifting and external damage to the stack.

5.3 Stacking accuracy

Fig. 25: Vertical stack with high stacking accuracy

To obtain maximum stability when stacking the layers, the stack manufacturer must make sure that the layers are precisely positioned. The stack must be straight in the vertical direction. If the layers are not placed exactly on the respective lower layers, the stacking accuracy and with it the stability of the stack will decrease. In the worst case, a stack that is placed too inaccurately threatens to become increasingly unstable as the height increases.

The theoretical sweep-off level must correspond to the actual height level of the respective layer. If an entire layer or partial parts of it have sunk deeper, depending on the container shape, damage to containers cannot be ruled out outside a certain height range (supported by 20 mm transition slope at the bottle table transition).

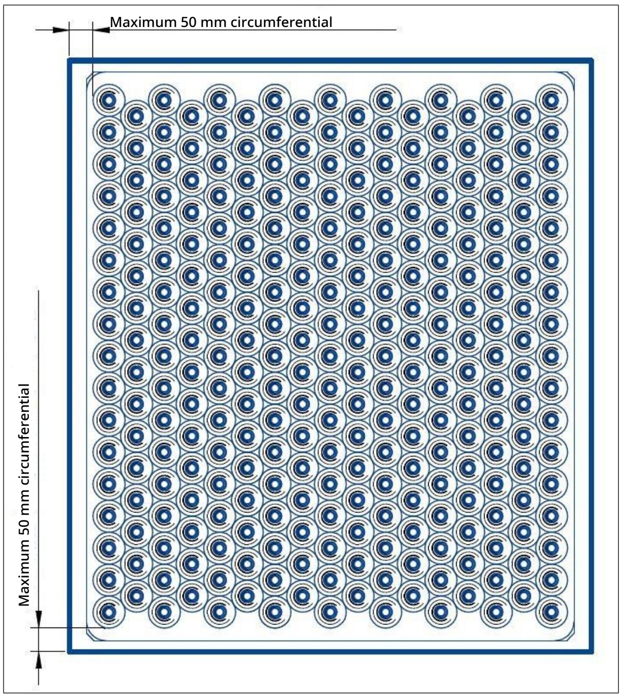

Fig. 26: Maximum vertical deviation of a new container stack

An excessively slanted stack or imprecise stacking can work against good processing or even lead to non-processability. Therefore, the position tolerance of a continuous stack inclination must not be more than 50 mm (to the ideal stack) all around, otherwise the stack fixation of the sweep-off depalletiser would collide with the containers when entering the stack. The "self-propelled centring" used in lift-off depalletisers also creates a centring frame on 4 sides that travels in height and would also collide with the containers if the height were to exceed 50 mm. In the case of a circumferential offset deviation of more than 50 mm to 100 mm, processing is optimally only possible with additional costs to be clarified. If stacks with these deviations are known to occur, this must be communicated to Krones Design prior to receipt of the order. In this way, it is possible to check in advance which additional components would be necessary on the machine. New container stacks with a stack offset tolerance deviation of more than 100 mm cannot be processed; moreover, they would hardly be transportable due to their instability when unpacked.

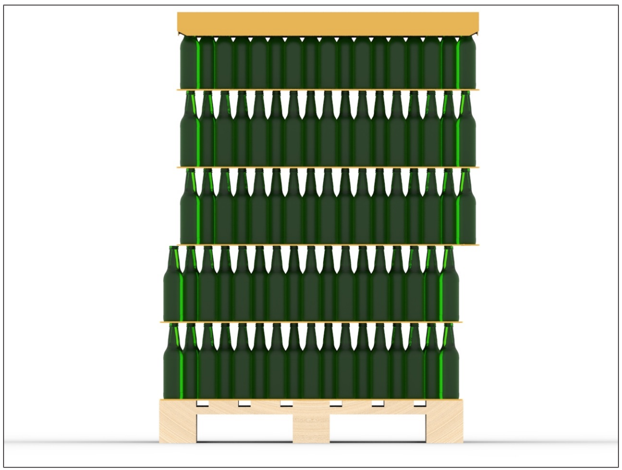

Fig. 27: New container stack with abruptly offset layer

New container stacks with layers offset abruptly from one another or in groups of layers are more difficult to process than continuously offset layers. A new container stack with abrupt offsets could have a maximum possible deviation within just two layers. Due to the edge instability of the individual containers, it is hardly possible any more to bring greatly protruding layers into a processable position with a stack fixation system or a self-propelled centring system.

5.4 Pallets

In the case of a stack with a bulging carrier pallet, there is a risk that containers in the upper stack layers in particular will be more unstable due to layer accumulation. The following illustrations show the two basic types of so-called "bulging" pallets. For optimal processing, however, the top of the pallet must always be flat.

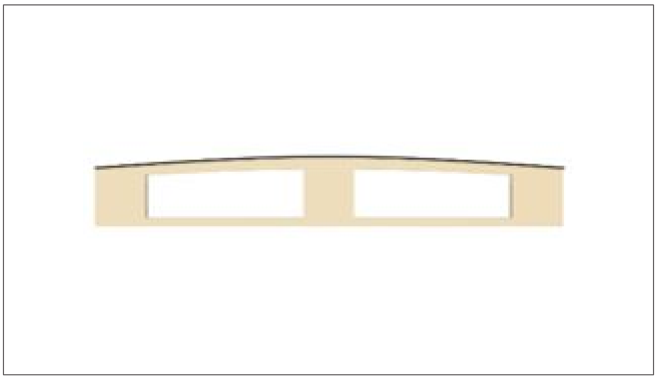

Fig. 28: Bulging pallet facing upwards (convex surface)

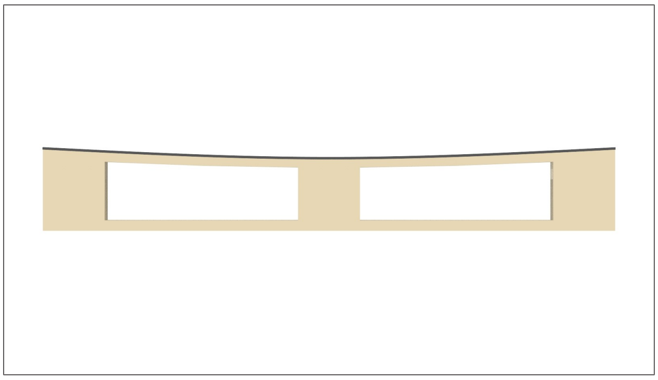

Fig. 29: Bulging pallet facing downwards (concave surface)

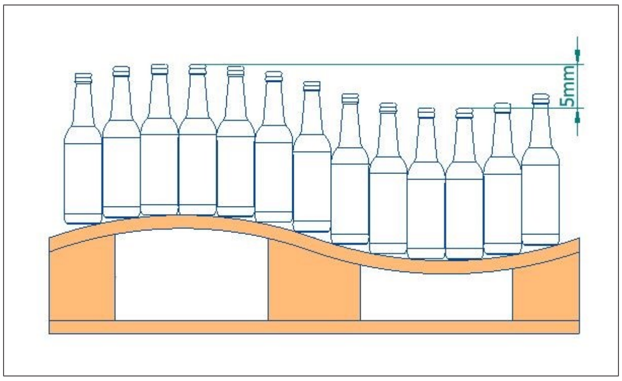

Fig. 30: Wavy pallet surface

If the pallets bulge, it is more difficult for a lift-off depalletiser to pick them up. This is because the lift-off depalletiser uses the highest bottle of the respective layer as a reference to determine where to grip the containers. Depending on the shape of a conical container neck or the type of gripping tool, a layer should not have more than 5 mm height difference in its container plane.

A sweep-off depalletiser may also have problems with a bulging pallet if the bottom sweep-off point of the sweep-off unit is too close to the bottle base. In this case, the sweep-off depalletiser could collide with a bulging spot on a pallet and cause damage.

On the other hand, for lift-off depalletisers with container gripping tools in the case of bulging pallets, appropriate lateral edge-supporting bottom trays are recommended. Edge containers that want to tilt outwards can be kept straight in this way. Should the layer unevenness of a pallet exceed a deviation of 5 mm, regardless of whether it is a sweep-off depalletiser or a lift-off depalletiser, the Design department must be consulted.

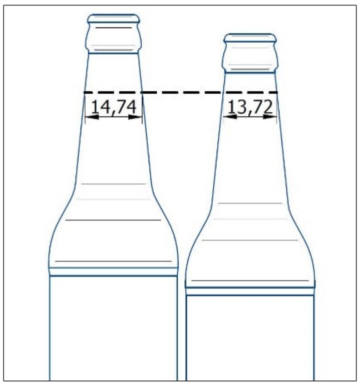

Fig. 31: Neck diameter differences only due to stand height differences of the conical areas

In lift-off depalletiser processing in connection with conical bottle necks and bulging pallets, some containers may be picked up more poorly by the gripping tools. Due to the height difference of the pallet and the resulting different standing heights of the containers, there are different diameter sizes at the container neck within the same gripper level, which must first be compensated.

For information on pallet conditions, see the official website of "EPAL – The pallet system". The product data sheet there specifies the permissible deviations and describes the types of damage to pallets that must be repaired so that they can be exchanged.

Some examples are described in the following in which there is damage that requires the pallets to be repaired:

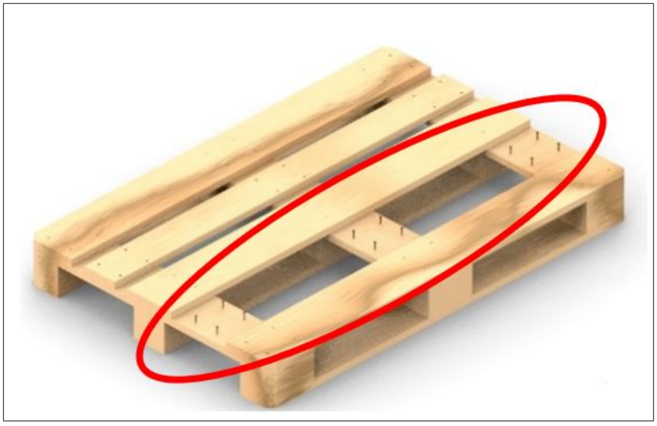

Fig. 32: As soon as a board is missing, it should be replaced

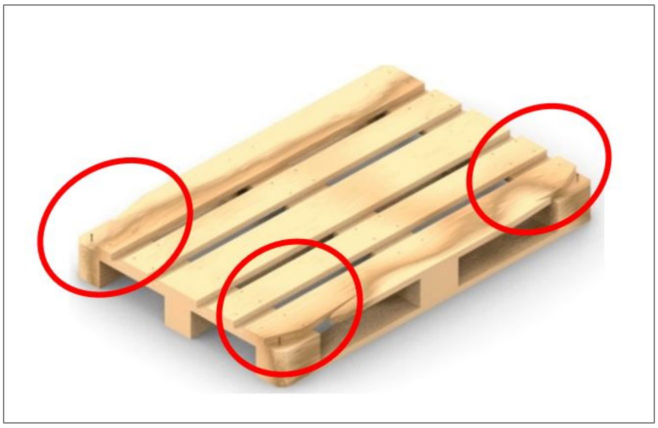

Fig. 33: If more than two bottom or top boards are splintered in such a way that more than one nail shank is visible

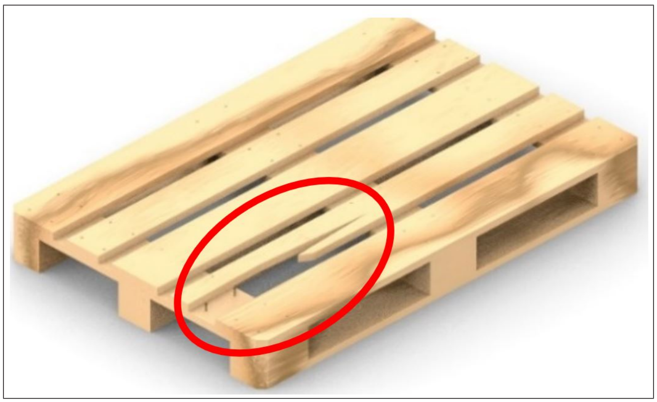

Fig. 34: If a bottom or top board is splintered in such a way that more than one nail or screw shank is visible.

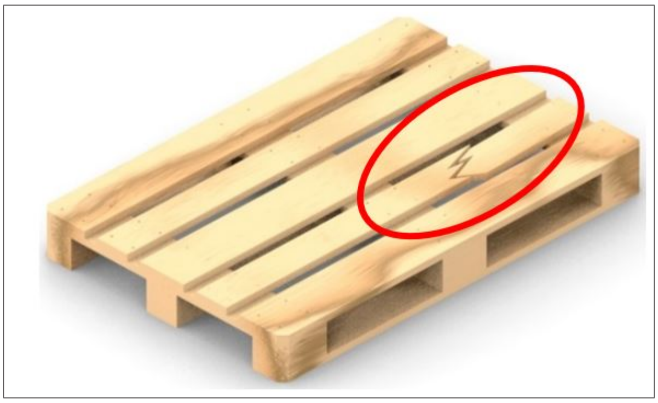

Fig. 35: A board is broken transversally or diagonally.

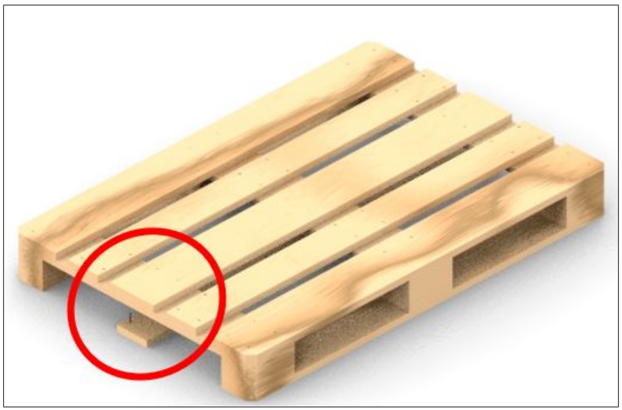

Fig. 36: If a block is missing or split in such a way that more than one nail shank is visible

Further exclusion features for a pallet no longer fit for use:

- The load-bearing capacity is no longer guaranteed.
- The loads are contaminated by soiling of the pallet.
- There is severe chipping on several blocks.
- Unauthorised components were used for the repair.

5.5 Discharge tables

The discharge table is the first station after a sweep-off depalletiser or lift-off depalletiser. From the discharge table, the new containers are transported onwards for processing. The table works similarly to a conveyor. The discharge table consists of hinged-belt chains that have different surfaces depending on the type of container. For PET and plastic containers, plastic flush-grid belts are used in most cases. Metal hinged-belt chains are mainly used for glass containers. The decisive factors are stability, durability and the required friction, matching the container.

5.6 Separation at discharge tables

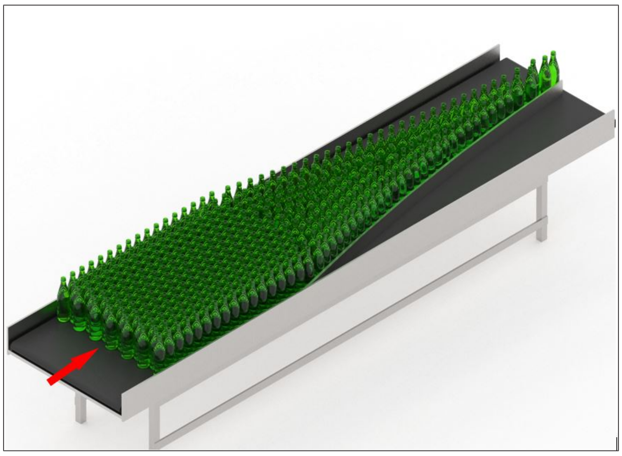

Fig. 37: Separation using tapering units

The term "separation" refers to the integration of the container flow into the container transport. Round containers are accumulated here on the discharge table and then serially separated with the aid of several tapering stages. Different speeds are run at the tapers of the discharge tables to prevent the containers from accumulating too heavily.

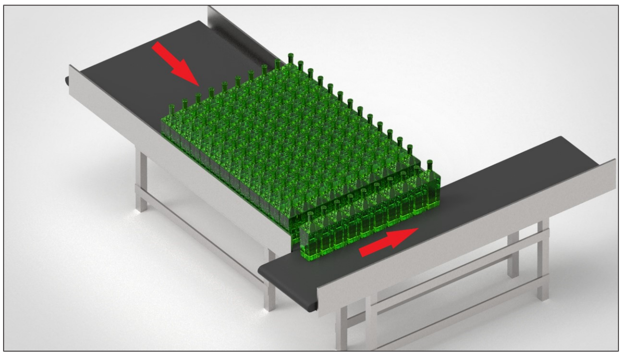

Fig. 38: Row by row separation of a layer with rectangular new glass bottles

In addition to tapering separation, there is also row-by-row 90° separation of new container layers. This type of separation is also used for rectangular containers, for example. The container rows are first separated and then passed on for further processing using a discharging container lane.

6 Packaging and packing materials

Fig. 39: Repacked new container stack

Most damage to the containers can occur during improper transport of the new container stacks. During transport, acceleration forces can cause complete layers to be offset or deformed at an angle. Furthermore, containers can also fall out of the divided layers. Stacking several stacks can also cause problems, e.g. if the bottom stack cannot bear the weight of the top stack.

The correct packing of a new container stack also plays a major role in a stack that has been started. Each new container stack that has been started must be repacked and stored again after partial use, unless it is processed again shortly afterwards. If this is not done, the layer pads may absorb moisture and swell. Furthermore, in the absence of packaging, the stack would no longer be protected against dust and dirt.

It is recommended that gas and electric powered forklifts be used for bottling plants, as they emit little pollution to their environment compared to diesel powered forklifts.

6.1 Packaging films

Fig. 40: Stack of new glass containers wrapped in stretch film

In order to protect the new containers from damage or dirt during transport from the stack manufacturer to the destination, the stack must be packed externally. In most cases, stretch films are used for packaging. These films are wrapped around the stack to stabilise it and to protect it from foreign objects. In addition to stretch films, there are also heat-active shrink hoods, among other things, which are slipped over the stack and reduce in size when heat is absorbed in order to fit snugly against the new container stack. In case of large temperature differences between the place of manufacture and the destination, it is recommended that the packaging film be removed only after an adjustment period (temperature and humidity adjustment for cardboard) to the climate of the place of processing.

Removing the film

In order to be able to depalletise the new containers, they can be partially or completely stripped of film. The now unsecured new container stack stripped of film should be driven to the depalletising station at reduced speed, otherwise there is a risk of falling edge containers or unstable stacks may collapse. Especially during jerky movements, braking and acceleration or during an EMERGENCY STOP, the unbound stacks are exposed to heavy loads. In sweep-off depalletiser operation, the stacking film should always be completely removed, as a three-sided stack fixation on the sweep-off depalletiser fixes the stack vertically on the reverse side. The lateral surfaces hold the layer in the current position and at the same time prevent the stack stripped of film from tilting.

Partial film removal in layers is a special feature. With the semi-automatic lift-off depalletisers, the film should only be manually removed layer by layer if the intermediate layers are flat layer pads. This means that the stability of the rest of the stack towards the bottom is still maintained. If, on the other hand, bottom trays/inverted trays are used that serve as lateral centring walls, the film can always be completely removed from the new container stack, because the bottom tray walls gives the stack greater stability. However, film removal should always preferably be done directly at the destacking station in order to maintain the quality of the stack.

Note that all residual pieces of a stretch film must be completely removed by the operator during film removal. It is possible that residual pieces of film on the pallet can retain the lowest bottom layer pad, causing a malfunction during layer pad lift-out, or that P.E. sensor signals can be unintentionally impaired or triggered.

The use of plastic new containers in conjunction with packaging films can lead to a considerable hazard when the stack is stripped of film. The friction caused during the removal of the film can lead to electrostatic charging of the film and the containers. Unlike glass bottles, the empty plastic containers further promote this effect. Adverse conditions can cause electric current to flow. In this case, deionisation devices and earthing can provide a possible remedy. Plastic friction points should therefore be avoided. A significant reduction is achieved with conductive foil coating or with the use of metallic discharge brushes. If the customer has already had negative experiences with electrostatic charging in its new container stack processing operations, it should contact Krones Engineering for advice.

6.2 Layer pads

Layer pads are made of a wide variety of materials, such as plastics, corrugated cardboard or cardboard packaging. The layer pads are placed between the individual layers when stacking a new glass pallet, for example, in order to stabilise the stack. This enables a stable flat surface for the next layer. In addition, the layer pads make it easier to sweep off the layers from the stack as they provide a sliding surface. This means that the swept-off containers can no longer come into contact with the bottom layer.

Plastic layer pads demonstrate good properties in stack processing. Ideally, they can also be used in tropical areas where humidity is too high. Cardboard layer pads, on the other hand, would absorb the high humidity and soften accordingly. Plastic layer pads are more expensive, but they are usually permanently reusable.

As the layer pads are usually lifted off with a vacuum-based suction gripper, the following characteristics must be observed:

- The material of the layer pads must not be absorbent.
- The surface should be continuous, smooth on both sides and not textured or uneven.
- No damp, wet or torn material may be used.

→ Also see the Krones layer pad specification.

Recommendations:

If, for example, a stack is to be transported to a different climatic region (change in temperature and humidity for the layer pad cardboard), then it is recommended that the packaging film only be removed after a period of climate adjustment. Depending on the processing requirements, the optimum climate for cardboard insert materials is usually between approx. 15-20°C and an adjusted average humidity.

If, for example, when the layer pad is lifted off by machine, the suction cups of the gripper cannot lie tightly against the surface due to unevenness, or if they suck through the cardboard material, no vacuum can be created and the layer pad cannot be lifted off. A consideration for improved transport and storage conditions would be necessary here.

Fig. 41: Layer pad bent downwards

If, for example, the corners of the layer pads protrude too far during the production of the stack, the corners of the layer pads can bend or buckle due to the high tensile force of the film (see illustration). As soon as the film packaging is opened, the corner and edge containers tend to fall off the layer. This can lead to a domino effect and destabilise the entire stack. Optimum adaptation of the layer pad corner radii to the container diameters and packing patterns used would be a sensible measure to prevent excessive buckling of the layer pad corners. The conflict of objectives when designing smaller or larger layer pad corner radii is that, on the one hand, as many containers as possible should fit stably on the layer pads and, on the other hand, the possibly protruding layer pad corners should not bend down when wrapping with film. This is because if there are bent corner areas, the corner bottles located there would immediately fall down after removing the film. On the other hand, layer pads with small corner radii all the way up to sharp corners can also cut the film if the film is tight.

To make good use of a container layer, the corner radius of the layer pads should be optimally adapted to the containers. A compromise between an optimally utilised container layer and the shortest possible protruding corner flaps of the layer pad should be chosen in this case.

It has been shown that suitable layer pad corner roundings are usually indirectly related to the container diameter. The rounding radius of a layer pad corner may vary between the single container radius and twice the value.

From this context, simple findings for the corner radii of staggered packed (formed in a nested container pattern) round container layers can be established, which should only be seen as a recommendation for the corner rounding characteristics of layer pads without any guarantee.

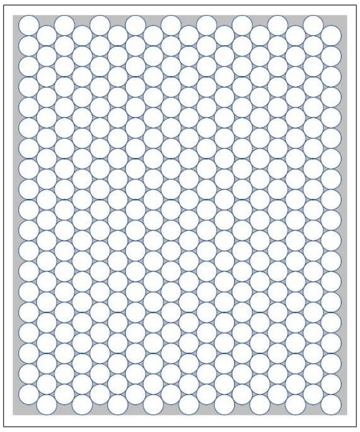

Fig. 42: Top view of a container layer with an even number of container rows and different corner container arrangement

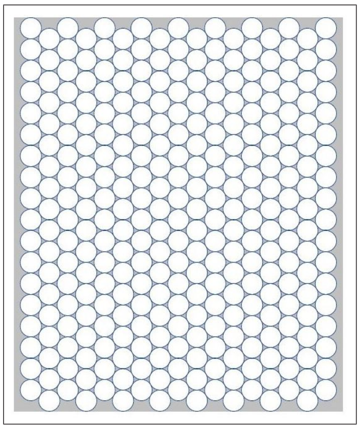

Fig. 43: Top view of a container layer with an odd number of container rows and the same corner container arrangement

1. Containers should not be placed outside the edge of the layer pad for stability reasons. They should also not protrude above the curves in the corner area of the layer pad. The layer pad and its 4 corner radii should always be at least large enough for the container layer to stand completely on it.
2. With an **even number of container rows** on the layer pad, there are always two different corner formations of the containers facing each other. But the corner radii of the layer pads should not be chosen differently. The handling of such asymmetrical layer pads requires complex logistics, as they must always be placed in the correct position. As this requires a corresponding additional effort, it is usually avoided for this reason.
   If a corner bottle is allowed in two of the corners, then the container radius for all 4 curves can be selected as the radius size. If at least two bottles are in the corner formation, then experiment with choosing twice the radius of the container.
3. If there are an **uneven number of container rows** on the layer pad, there will always be two different corner formations of the containers facing each other due to an equal number of containers in the first two edge rows. If there are at least two bottles in the corner formation, try choosing the twice the container radius as the radius size.
   However, if there is one bottle less in the second edge row, the same arrangement of a single corner bottle results in each corner. In this case, try selecting the container radius once as the radius size for the corner rounding.
4. If several container sizes are provided for one layer pad size, the corner radius is usually based on the smallest radius of the containers.

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Further information and dependencies:

Fig. 44: Corner containers that have fallen down after film removal

If, for example, the corner radii of the layer pads are very small, the rounding or corner tongues are usually correspondingly long. A smaller rounding looks sharper-edged and the projecting corner tongues cannot be supported as well by the containers, so long corner tongues tend to bend more easily when wrapping with film. On the other hand, the corner containers tend to fall from their position more quickly if the corner radius is too large, as this corner offers less standing space for the corner containers here.

If, for example, despite suitable corner radii, the corner tongues of the layer pads are pressed down by the film, this may mean that either the film shrinkage process or the tightening force of the film banding has been adjusted too high. In principle, the stiffness of the layer pad could be increased as a remedy to solve the problem. Instead of increasing the thickness or stiffness of the layer pad, the first measure should be to adjust the film wrapping process, which may have been adjusted too high. Another measure against a bent corner would also be the use of more elastic, thinner films or less film tension by the pallet wrapper.

If, for example, different packing patterns with layer pads of the same size are to be used, care must be taken to ensure that a good compromise is chosen here for the different container sizes and different packing patterns when determining a constant corner radius. If necessary, the packing patterns can be superimposed during planning using CAD in order to iteratively determine the appropriate corner radius for all packing patterns.

Furthermore, it would be important that the layer pad has a constant thickness in its surface, so that no slanted stacks can arise in the summation. The typical thickness of layer pads lies in the range of 2 to 5 mm. For new can stacks, the typical layer pad thickness is 0.6 to 1 mm according to a new can manufacturer.

→ See the Krones layer pad specification

Layer pads should be at least the same size as the respective packing pattern size; if there is a shortfall in the packing pattern, Krones Design must be notified. Larger round containers still allow tolerances here, while smaller round containers have less leeway due to their smaller pitch.

If layer pads are supplied by several suppliers, they should also have identical processing characteristics so that the machines can handle them without having to differentiate between them. Layer pads must be suction-tight, 90°-angled rectangular or square, flat throughout and must not have any holes or other cut-outs, unless otherwise agreed.

Some customers magazine their destacked layer and bottom pads to return them to the new container manufacturer for reuse (See 4.3 Proper return [▸ 18]). However, it must be noted that, depending on the type of application, reuse of layer pads must be communicated to the Design and Sales departments. The condition of the reused layer pads must be flawless in terms of dryness, cleanliness and integrity (as new).

According to the Krones layer pad specifications, layer pads must comply with the permissible dimensional tolerance for layer pads is ± 0.25 %, bases on the nominal dimension of the length and width dimensions. As a prerequisite, however, there is always the requirement for a complete support surface for the container layer. Deviations of up to +/- 5 % are permitted for the thickness.

6.3 Bottom tray/inverted tray

For processing new containers, inverted trays or lids made of cardboard offer the advantage of a permanent qualitative position retention of the packing layers, provided that they have been correctly dimensioned for the layer sizes they contain. However, with regard to sweep-off depalletiser or lift-off depalletiser operation, there are different evaluations for these packing materials. For lift-off depalletiser functionalities, the precise positioning of the container rows offers a great advantage by picking up the containers exactly with a suitable gripping tool. In contrast, bottom trays and/or inverted trays are more expensive to process for with the sweep-off functions. Therefore, when sweep-off depalletisers are used, flat layer pad systems are usually preferred for processing. However, inverted tray systems can still be processed adequately and bottom tray systems at a significantly higher cost.

Fig. 45: Inverted tray

Fig. 46: Bottom tray

Bottom trays and/or inverted trays can be placed between each layer in a similar way to the flat layer pads to ensure the stability of the stack. They are preferred for containers with a low dead weight, small footprint, conical/ball-shaped, particularly high-quality or very tall containers with a low tipping angle, as well as for specially-shaped containers. The special features compared to layer pads are the four downward or upward facing side walls, which enclose the layer all around.

Inverted trays are placed on top of the container layer with the opening facing downwards to protect the containers well from dirt. The walls of the inverted trays must extend down in each layer at least as far as the main body or cylindrical main part of the containers to support them. If layer-sized inverted trays have flaps that are too short vertically and as a result do not extend downwards beyond the neck area of a container, the walls of the inverted trays do not make final contact with the outer areas of the containers and cannot support this layer laterally all the way around (see illustrations).

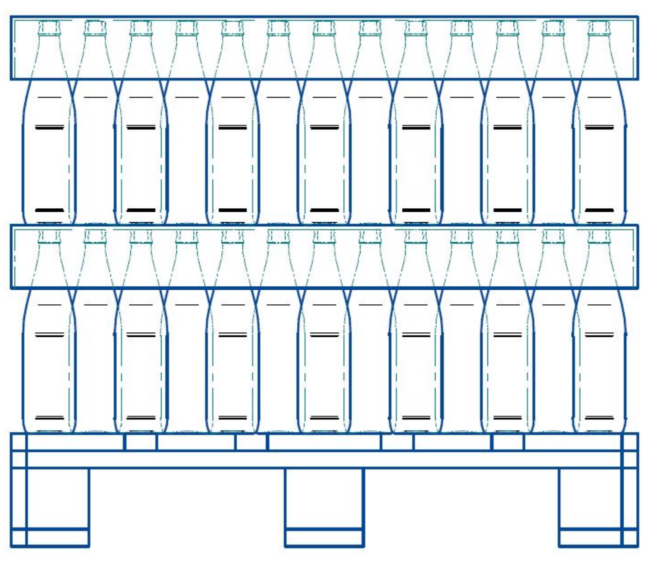

Fig. 47: Inverted tray depth too short, the inverted walls do not touch/support any containers laterally

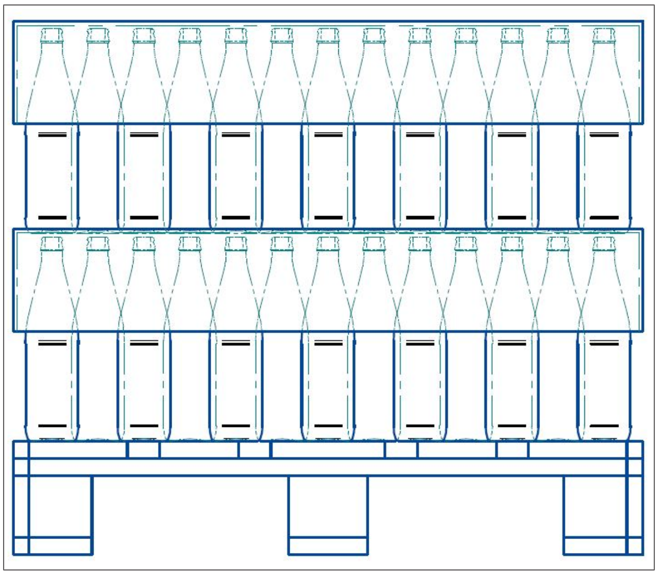

Fig. 48: Optimum inverted tray depth, the inverted trays rest against the outer walls of the new containers and support them against lateral movement

If the inverted tray does not reach down to the shoulder of the bottle, it has a purely layer pad function. In case of vibrations, the container position can shift; if, on the other hand, the flap reaches at least up to the shoulder of the bottle, the position is better secured against slipping.

The following illustrations show the different possible variants in the use of bottom trays and inverted trays for new container stacks.

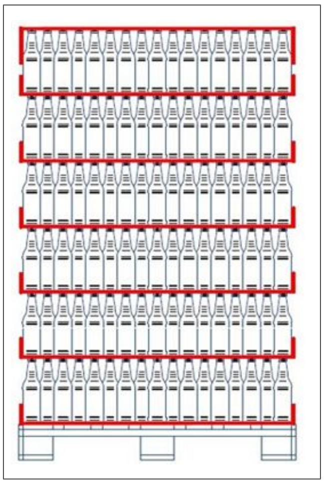

Fig. 49: Bottom tray system with an inverted tray as top layer; functionally good for lift-off depalletisers

Fig. 50: Inverted tray system with flat bottom pad; functionally good for sweep-off depalletisers

Fig. 51: Inverted tray system with a bottom tray as bottom pad; functionally good for lift-off depalletisers

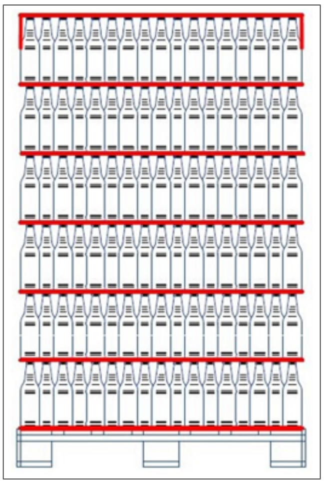

Fig. 52: Layer pad system with no or only one inverted tray as top layer; functionally good for sweep-off depalletisers

The sweep-off depalletiser stacks are to have at least six layers.
If the stack has too few layers, a loss of performance is to be expected.

Fig. 53: Stack of new glass containers with inverted trays that are too large and shifted bottles

In the case of bottom trays and inverted trays, care must be taken to ensure that the internal surfaces are not designed too large or too small in relation to the container packing pattern. If the inverted trays are designed too large, the stabilisation effect is not fulfilled and the container formations can slip within the layer. This can cause massive problems for a lift-off depalletiser, as the containers are no longer lined up true to size and so it cannot be guaranteed whether the specified distance between the containers is available for lifting. The illustration shows a stack of inverted lids that are too large. Unfortunately, the containers have already moved there. This makes processing with a lift-off depalletiser more difficult. If, on the other hand, the bottom trays or inverted trays are too narrow, the lifting off of the inverted cartons or containers can be disturbed if, for example, the inverted trays to be lifted off want to pull the edge bottles located below or the bottles picked up want to pull along the bottom tray located underneath.

In addition, if the inverted tray selected by the manufacturer is too small, this can cause unfavourable deformation of the container layers during film shrinkage of the pallet (tilting of the containers and tipping out at the container base).

When lifting off with a gripping tool, the use of bottom trays is usually more practical, as it provides additional support for the container layers with its walls. The bottom tray can be removed as easily as a layer pad and therefore does not require any significant additional effort in the processing of a lift-off depalletiser function.

The situation is different with sweep-off depalletisers, where bottom trays have to be processed with additional effort. This is because, among other things, a corner-opening device (with wedges or cutting edges) is needed to open and prepare the corners for sweeping off. After sweeping off, the opened bottom tray can be lifted off and, for example, thrown off onto a slide. If it was necessary to open the corners of the bottom trays, they can be stored in a more space-saving way, but can only be recycled. In addition to material disposal, it is also conceivable to return proper inverted trays to the manufacturer of the new container stacks. However, as more space is required for the return of proper inverted cartons than for flat layer pads, a return is carried out less frequently.

The inverted trays can be easily lifted out upwards due to their position with the opening facing downwards. This applies to the lift-off depalletiser as well as to the sweep-off depalletiser function. If necessary, the inverted trays of the sweep-off depalletiser can also be pushed off, but must then be removed from the layer on the discharge table. When disposing of entire inverted trays, they can be turned 180° (walls upwards) with an auxiliary function in fully automated mode, if desired, so that they can then be transported away, e.g. with a V-belt conveyor. However, this requires an additional special expenditure, as an extra turning device has to be provided for this purpose. Inverted trays are usually avoided in sweep-off depalletisers due to space constraints and additional costs.

Depending on the type of inverted cartons, a special magazine with a flattening device can also be requested as a special function in the technology for space-saving, flat storage.

In the sweep-off mode, bottom tray walls in the layer centring unit can alternatively also be split open with mechanical wedge action. However, this only works as long as the attached transport strapping bands have not previously deformed the cardboard inverted walls too severely. When severing strongly deformed cardboard wall corners, large tensile stresses could possibly result in an unfavourable manner, which would draw corresponding folds into the cardboard push-off surface, making it uneven. The higher the carton wall and the tighter the strapping has been tensioned, the more often this so-called unevenness effect occurs.

The walls of bottom trays should not be higher than the shoulder height of the containers. The corner tab connections of the bottom trays should not be stapled, but should instead be glued due to possible opening devices. A perforation at the corners of the bottom tray would be ideal to facilitate tearing it open at the intended points. In summary, the processing of bottom trays with sweep-off depalletisers is not recommended, however if these are nevertheless to be processed, the additional costs must be discussed with the Krones Design department.

6.4 Top frame

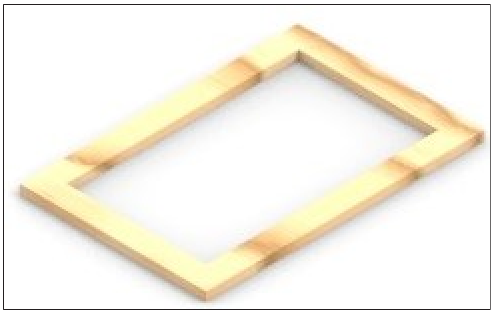

Fig. 54: Wooden top frame

Top frames can be made of plastic, wooden boards, flat or L-shaped metal angles. They are placed on top during the production of a stack as the last layer of a new container stack. With the exception of the L-section top frame (inner dimension usually larger than outer dimension of the processing pallet), they have the same outer dimensions as the associated pallet on which the new container stack is placed. The top frame serves as the top edge protection of the stack and protects it from being cut by the tensioning straps, which are used to stabilise the stack. In particular, the L-section top frame protruding slightly outwards at the top is suitable in combination with attached blocks on the lower bottom boards of the pallet for mutual positive support during truck transport and therefore offers optimum stability and spacing of the stacks during transport.

For top frames, the stackability, material, weight, board width, cross-section and surface are decisive for further processing. Therefore, the permissible deviations of the top frames must be observed for optimal processing (see 6.7 Permissible deviations of packing materials [▸ 35]). Top frames are usually returned to the stack manufacturer and reused. They are therefore gently deposited on a separate storage location; if necessary, they can also be deposited mixed together with the empty pallet. L-section metal angle frames are usually placed directly back onto the associated empty pallet after the complete stacking process; this requires additional re-centring of the empty pallet in the chute.

6.5 Load distribution plates

Fig. 55: New container stack with load distribution plate

Load distribution plates are required if new container stacks are to be stacked over each other. Place the load distribution plates between the stacks to distribute the weight of the top stack more evenly across the bottom stacks. Load distribution plates can sometimes be as large as the footprints of two pallets side by side. This can provide additional stability for higher stacks. Load distribution plates with single pallet size are also used for single stacks where there are no top frames or they are too weak.

See also 4.1 Storage of stacks of new containers [▷ 17].

6.6 Strapping bands

Fig. 56: Green strapping bands with top frame on a new glass stack

Strapping bands secure the stack during transport. These are usually stretched over the complete stack in pairs, vertically offset by 90°, to prevent the layers from slipping. However, in special cases (with compression-resistant containers), strapping may have been stretched horizontally once over one of the upper layers to further stabilise the stack. However, such bindings should always be pressure-adjusted so that the layer pattern is not changed.

To remove the straps, the tensioned straps can be removed manually at the film removal station or an automated "destrapper" on the container table can be purchased to assume the removal of the straps. However, the Krones Engineering Department must be consulted beforehand. When delivered, always check whether the strapping bands are too tight or too loose. If the strapping bands are too tight, they can damage containers. If the strapping bands are not tight enough, the containers can shift within the layer.

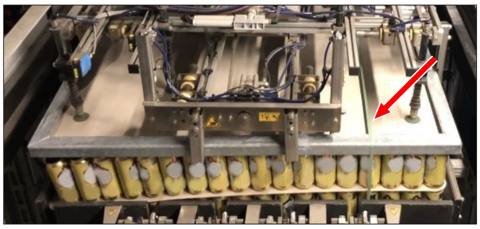

Fig. 57: Malfunction when lifting off the top frame. Reason: Forgotten, circumferential strapping band on new container stack not removed

Vertical strapping bands on the new container stacks must always be completely removed before the depalletising process, as otherwise damage to the containers may occur. If the removal of the bands is even partially missed, a malfunction will immediately occur during the next processing step of lifting off the uppermost top layer pad or top frame. For example, if only one strapping band is still attached to the container stack, the stack would be lifted on one side and the containers would fall out of the slanted layers. In these cases, this new container stack would no longer be machine-processable.

6.7 Permissible deviations of packing materials

In order for the packing materials to be processed correctly, their dimensions and material properties must correspond to the specifications of the respective machine type. The following table shows the special features for processing the packing materials using a sweep-off depalletiser.

Packing materials	Criteria	Information/Values
Top frame	Length/width	To fulfil its function of protective edge trim: +0.4 % tol. deviation conceivable. No falling short of necessary functional dimensions
	Board width	To be checked by the Krones Design Department depending on the manufacturer's specifications
	Height	
	Contour	Whenever a contour change takes place (perforated, angled top frame), the processability must be rechecked.
	Material	As long as the contour/stability remains the same, the material is of limited relevance.
	Surface	Determines the processability (absorbent or not)
Layer pad	Length/width	Approx. as large as pallet size (max. 10 mm smaller than pallet size)
	Starch	Depends on the weight of the new container layers
	Material	As soon as customer-specific material (e.g. Chapatex, wooden board, hard plastic plate, rough surfaces) is to be processed, a special gripping tool is necessary.
	Weight	From approx. 2 kg, two independent systems are recommended for suction. Depending on the weight, additional undergripping may be necessary.
Bottom tray, inverted tray	Material	Preferred disposal by means of V-belt conveyor, if necessary also cardboard baler

Packing materials	Criteria	Information/Values
	Wall height and design	Bottom tray not lower than 60 mm and inverted tray not higher than 200 mm. The use must be tested by Design
Pallets	Length/width	Permissible deviation approx. 5 mm
	Height	By arrangement up to 50 mm

Tab. 3: Special features in the processing of the packing materials

7 Structure of packing patterns

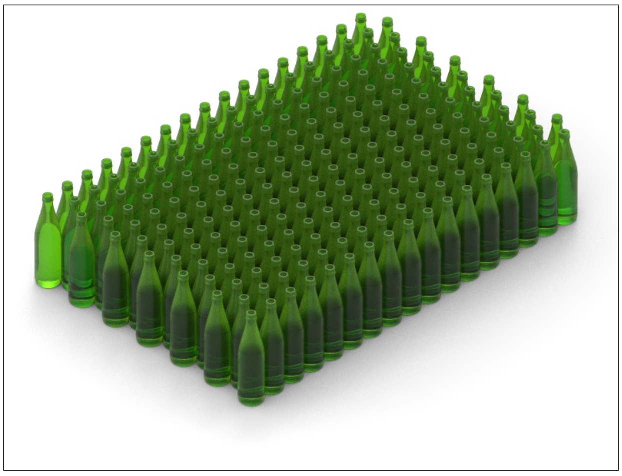

Fig. 58: Representation of a row nesting or also called a ball-packed arrangement (nested containers)

The layers are located in the individual levels of the stack. These are referred to as packing pattern layers, layer patterns or new container patterns. The packing pattern shows whether the containers are placed next to each other in a linear row or whether the rows are nested.

7.1 Nested packing patterns (nested containers)

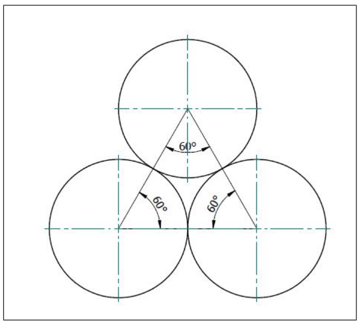

Fig. 59: Simplest representation of a nested container pattern

To make optimum use of the space in a layer of round containers, the containers in a nested container pattern are arranged offset or nested at 60° to each other. In this formation, round containers stand closest together in the area. The individual container rows are alternately offset by half the diameter and shifted into each other (so-called nested container pattern with 60° container offset or a compressed-compacted container packing pattern layer).

7.1.1 Packing patterns for lift-off depalletiser function

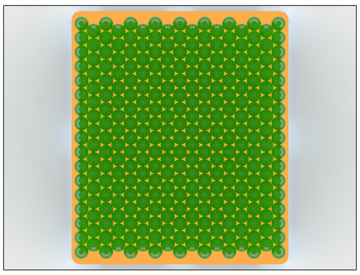

Fig. 60: Top view of a ball-packed new container stack in lengthwise row arrangement

As a recommendation and also for greater customer advantage, the rows of containers should ideally be arranged in lengthwise row arrangement on a pallet. In most cases, this arrangement allows for the largest number of containers on the pallet. Threading a semi-automatic gantry lift-off depalletiser gripping tool in a lengthwise row arrangement is also much easier, as the gripping devices must to be threaded in on far fewer rows. The semi-automatic bar gripper is shown in Fig. 3: Semi-automatic gantry lift-off depalletiser with manually controlled bar gripper [▸ 10]. The installation should be chosen so that the operator's line of sight at the operating switches travelling with the unit can be through the longitudinal axis of the terminal strips or hoses. This means that the bar gripper or the inflated-bar gripper can be optimally inserted between the rows of containers.

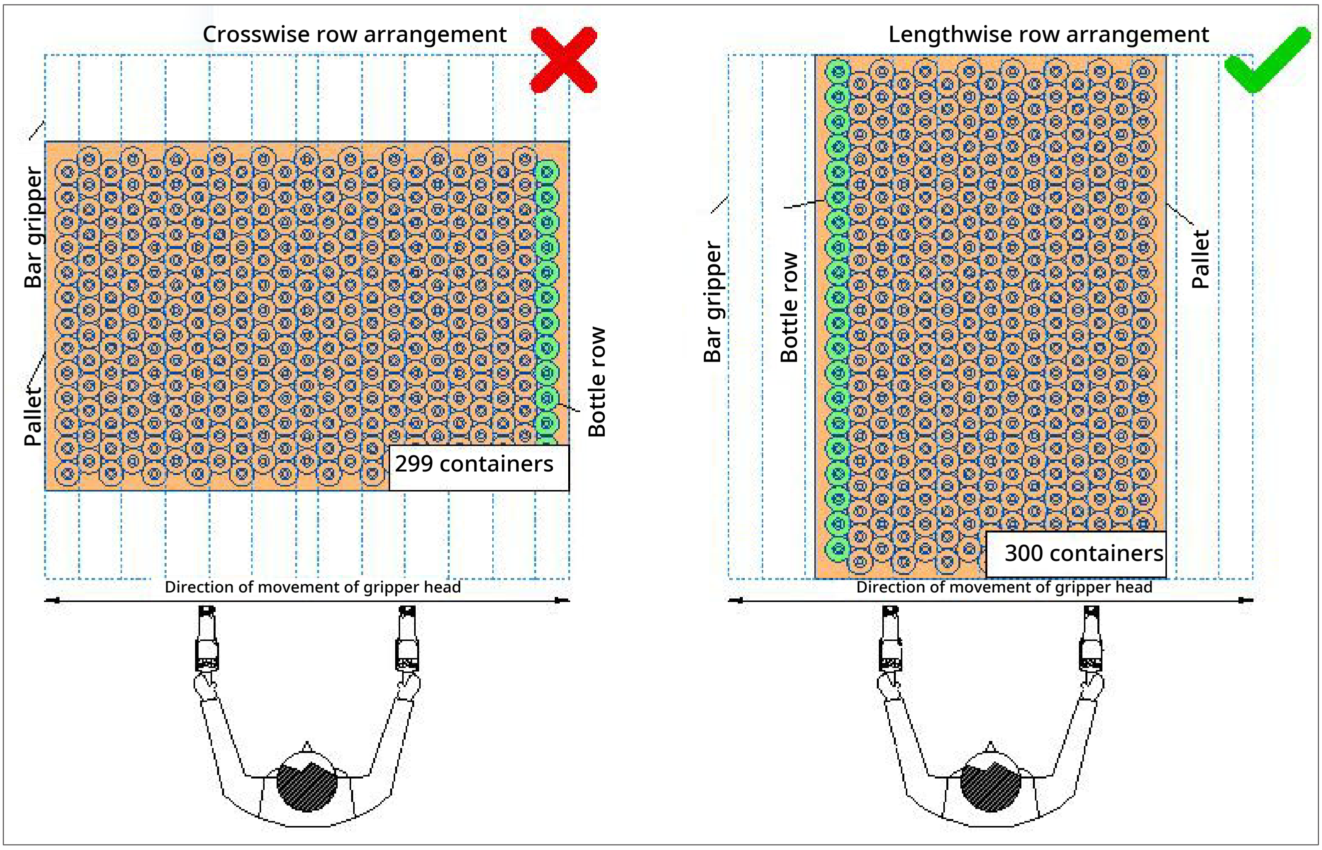

Fig. 61: Left: Packing layers lined up crosswise on a pallet; Right: Packing layers lined up lengthwise on a pallet

7.1.2 Packing patterns for sweep-off depalletiser function

In the case of sweep-off depalletisers, crosswise sweeping off is preferred in terms of the layer format, as it provides performance-relevant advantages. Longitudinal sweeping off extends the sweep-off time, as the sweep-off depalletiser must travel a longer distance.

Furthermore, within the layer format, the packing patterns can be lined up crosswise or lengthwise. This is relevant for the jaw grippers acting at the rear in the sweep-off direction, which are intended to retain the layer pad during the sweep-off process. If the container packing rows are arranged crosswise on the pallet surface (Fig. 62: Crosswise sweep-off direction of the layer with containers in crosswise row arrangement [▸ 39]), the jaw grippers arranged at the rear only have enough space between the offset containers to avoid colliding with the containers. If the stack is tilted or a container has shifted, the grippers for retaining the layer pad could collide with the containers in this case.

However, in the case of a packing pattern lined-up lengthwise, the area for the lateral jaw grippers is only sufficient if there is still a sufficiently wide layer pad edge strip after the containers for gripping. The more different packing patterns are to be processed, the more difficult it becomes to find an optimum position for the jaw grippers in relation to individual layer patterns. With smaller packing patterns, the edge strip of the layer pad is usually correspondingly larger and therefore easier to grip without coming into contact with a container.

Situation 1: Container layers lined up crosswise pushed off in crosswise direction of pallet

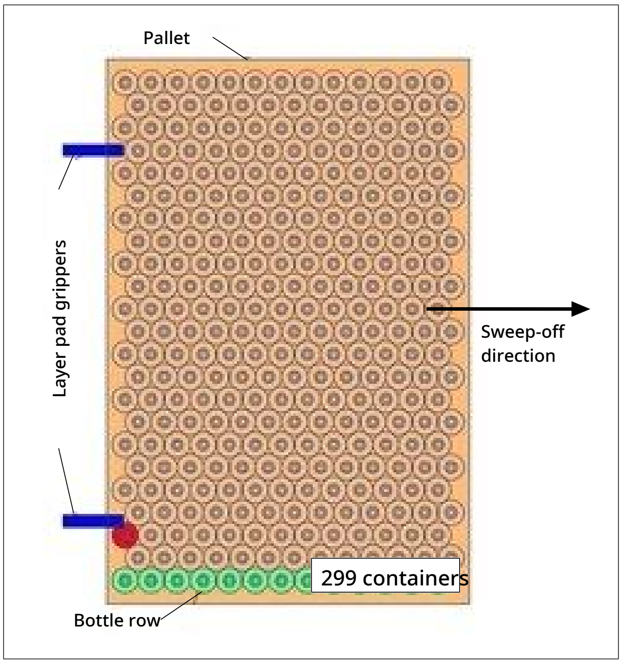

Fig. 62: Crosswise sweep-off direction of the layer with containers in crosswise row arrangement

Advantages:
- Fast sweep-off times, due to short distances
- Partial free segments for gripper positions for layer pad retention, but these must be set in advance for each container formation

Disadvantages:
- Not the maximum possible number of containers
- If the stack is not exact or the containers are shifted, the grippers come into contact with the containers.
- In the case of stacks inserted rotated by 180° (e.g. due to operator error), there is corresponding contact between the grippers and the containers in special packing patterns (see 9.1 Sweep-off depalletiser and its specific challenges [▶ 43])

Situation 2: Container layers lined up lengthwise pushed off in crosswise direction of pallet

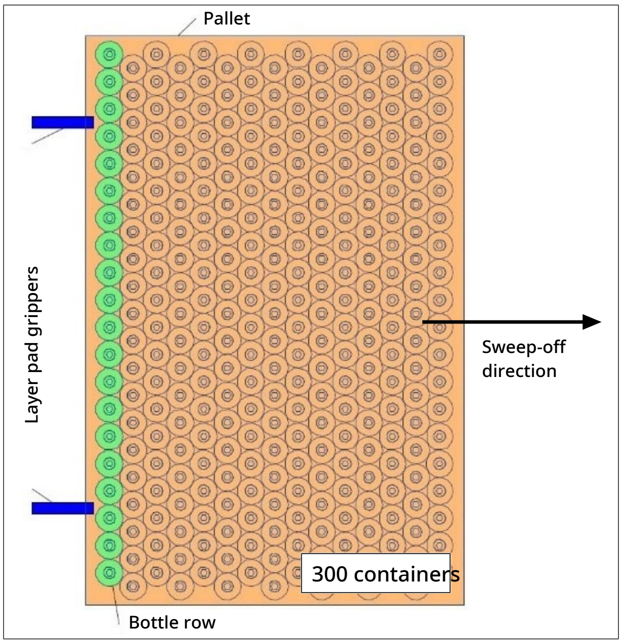

Fig. 63: Crosswise sweep-off direction of the layer with containers in lengthwise row arrangement

Advantages:
- Maximum possible number of containers
- Fast sweep-off times, due to short distances, grippers can be positioned over the entire side length during design if free edge strip available

Disadvantages:
- If the edge strip is too short, the grippers can collide with containers and shift the formation of the container layer. This could possibly cause containers to tip over
- Fewer free segments for gripper positions for layer pad retention

Situation 3: Container layer lined up lengthwise pushed off in longitudinal direction of pallet

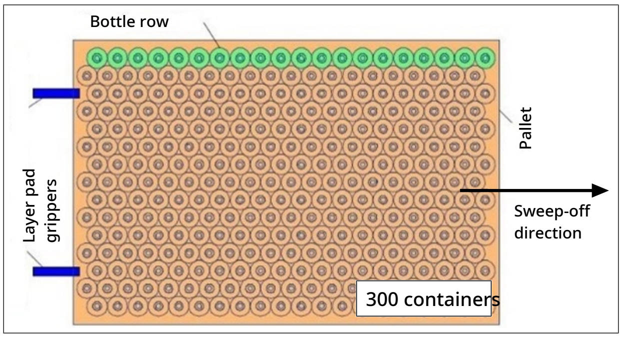

Fig. 64: Lengthwise sweep-off direction of the layer with containers in lengthwise row arrangement

(Type of processing is not preferred for performance reasons)

Advantages:

- Partial free segments for gripper positions for layer pad retention, but these must be set in advance for each container formation.
- Maximum possible number of containers

Disadvantages:

- Slower sweep-off times, due to longer distances
- If the stack is not exact or the containers are shifted, the grippers come into contact with the containers
- Releasing the containers during sweeping off requires more force (greater static friction)
- In the case of stacks inserted rotated by 180° (e.g. due to operator error), there is corresponding contact between the grippers and the containers in special packing patterns (see 9.1 Sweep-off depalletiser and its specific challenges [▷ 43])

Situation 4: Container layer lined up crosswise pushed off in longitudinal direction of pallet:

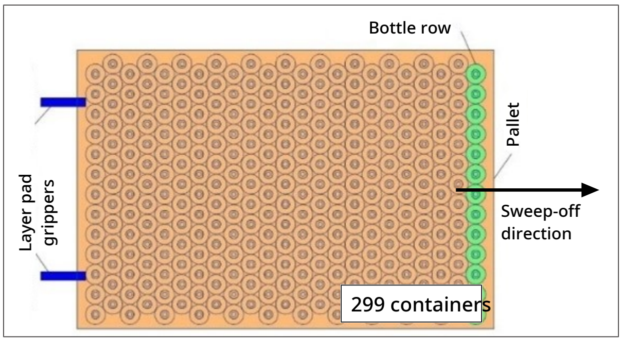

Fig. 65: Container layer lined up crosswise in lengthwise direction of pallet

(Type of processing is not preferred for performance reasons)

Advantages:

- Grippers can be positioned over the entire width length during design

Disadvantages:

- If the edge strip is too short, the grippers can collide with containers
- Slower sweep-off times, due to longer distances
- Releasing the containers during sweeping off requires more force (static friction)
- If there is no corner container, the formation of the container layer can shift and containers could possibly tip over as a result.

7.2 Packing patterns with containers lined up linearly

In addition to the nested container pattern, there is also the in-line layer pattern. Here the containers are arranged in rows, and are not offset in contrast to the nested container pattern. This row arrangement needs more space but is the simplest layer pattern. This packing pattern is mostly used for rounded rectangular, square, oval and specially-shaped containers, as well as for "Bocksbeutel" (flattened ellipsoid) and pocket or breast bottles.

If appropriately configured, the lift-off depalletiser could pick up the containers with an in-line arrangement both lengthwise and crosswise, provided that the distance between the bottle necks is large enough in each direction. However, for the crosswise lift-off, more gripper bars are needed, which is disadvantageous. However, with round containers with an in-line arrangement, there can be a risk of this layer pattern shifting into one another in the event of vibrations, which is why linear row arrangements of round containers are usually not considered very stable.

In this case, the use of an inserted cardboard divider (upright in a grid shape) can increase the stability sufficiently again, but any processing would have to be checked by the Krones Design Department. In the case of rectangular containers, the result is usually a stable linear arrangement when the containers are fully adjacent to each other.

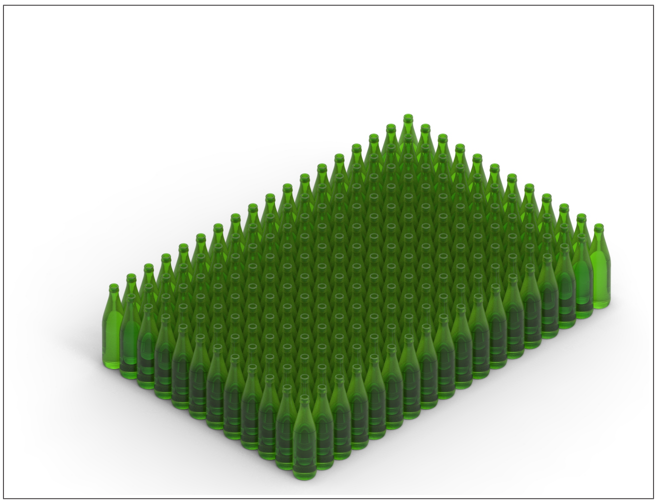

Fig. 66: Pallet with in-line container arrangement

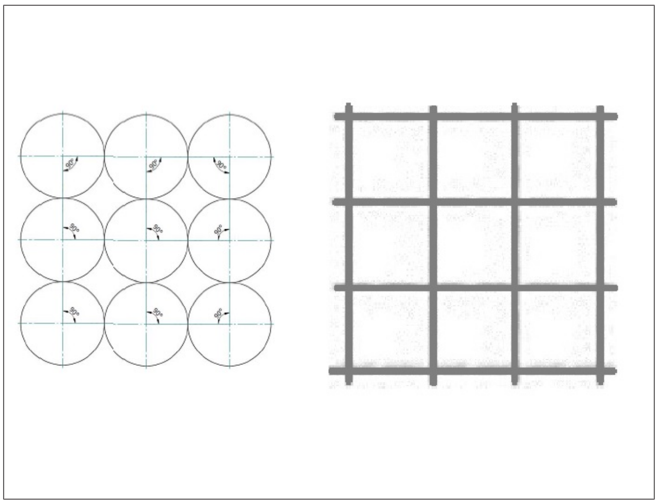

Fig. 67: Left: Orientation of containers in in-line row
Right: Top view of erected cardboard divider insert

8 Transporting new container stack

To prevent damage to the containers and the pallet, forklifts must approach the stack in the middle and parallel. The forks should already be brought to the correct height before approaching in order to avoid a collision of the forklift forks with the pallet. To protect the packaging of the new container stack and the pallet, the stack should not be pushed or pulled across the floor. You can also fit spacers onto the top edge of the fork to prevent damage to the containers. The spacer is used to maintain a minimum distance between the fork holders and the containers so that the forks only come into contact with the pallet. If this were not the case, the fork holder would press in the containers that are at the edge of the pallet and, in the worst case, damage them.

Fig. 68: Forklift fork with and without spacers

The start-up accelerations and braking decelerations that occur during new container stack transport must be adjusted to maintain the strength and quality of the stack being transported. Otherwise, the individual container layers can slip among each other in both the film-wrapped state and with the film removed when accelerated too greatly. If a stack has become misaligned during transport, the edge containers can slip off after film removal or the stack can become so unstable that the containers or entire sections of them can fall off the stack at the edge of the layers.

9 Positioning new container stacks on destacking station

Ensure that the new container stacks are always positioned in the same orientation at a designated stacking or destacking station. In order to be able to run through the processing procedure without any malfunctions, an inaccurate positioning of the stack or an accidental rotation by 90° or 180° should be avoided as far as possible. Especially in the case of a stack rotated by 180°, the orientation of the layer may vary depending on the number of container rows (see Fig. 69: Top: Predefined acceptable container arrangement; Bottom: Same, but rotated 180°, unsuitable container arrangement [▸ 44]).
To avoid this, it should be ensured that the positioning of the new container stacks at the stacking or destacking station is always carried out with the same orientation. Operators and forklift drivers should be instructed accordingly. The operating personnel should be encouraged to document corresponding findings on the correct stacking of new container stack and to communicate them to the next team at the end of the shift. For example, this could be illustrated with a cross-layer information book and/or with photo examples at the placement location of the new container stacks.

9.1 Sweep-off depalletiser and its specific challenges

In a sub-function of the sweep-off process, corresponding gripper systems are used to retain individual layer pads on the stack. For this purpose, two to four grippers can be used on a layer pad; these must fit into the free space at the edge between the containers. The position of the grippers can be changed within certain limits depending on the layer patterns used. It is also possible to switch the gripper positions variably between the different packing patterns in order to always use a free clamping position for the grippers depending on the packing pattern. The layer pad grippers require a horizontal gripping depth of approx. 20 mm to build up sufficient grip to hold the layer pads. The further a gripper can engage with a layer pad, the more securely the layer pad can be retained during the sweep-off process.

Especially with sweep-off depalletisers, it is important to pay attention to the correct orientation of the new container stacks during the feeding process. What matters here is the specified stack positioning and the correctly oriented loading of the stack.

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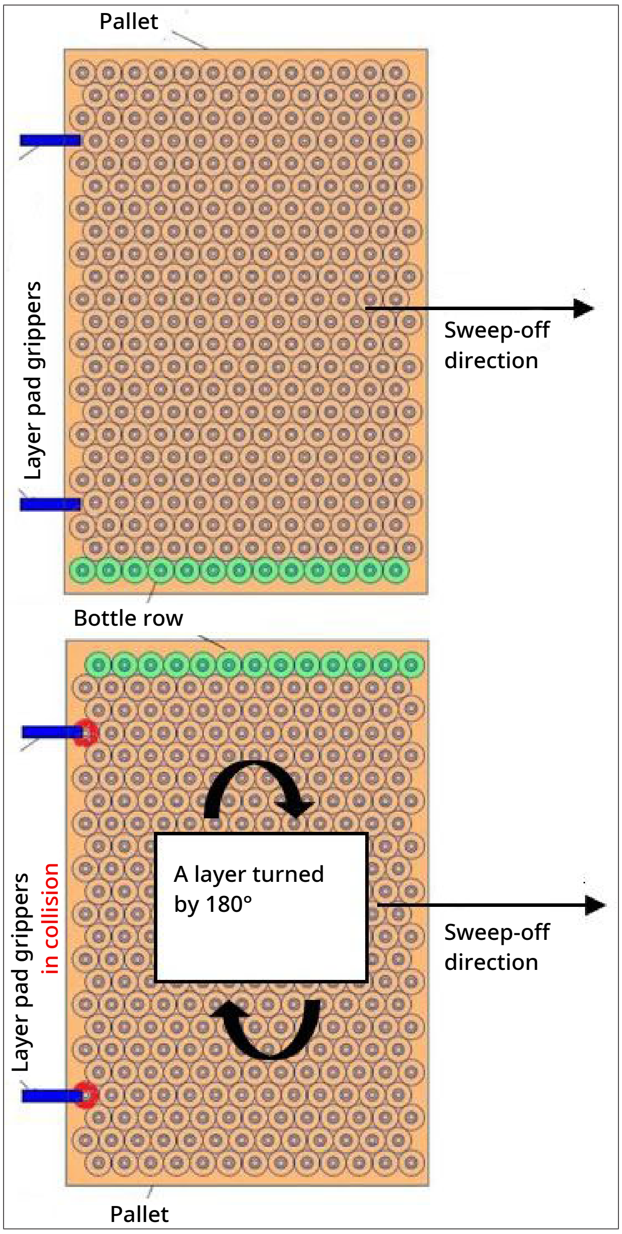

Fig. 69: Top: Predefined acceptable container arrangement; Bottom: Same, but rotated 180°, unsuitable container arrangement

In the case of non-uniform insertion of a stack of new containers rotated alternately by 180°, it can be seen that the free jaw gripper positions can be free on one side of the same stack and occupied by containers on the other side in the case of a rotated orientation (see Fig. 69: Top: Predefined acceptable container arrangement; Bottom: Same, but rotated 180°, unsuitable container arrangement [▷ 44]). Depending on the specified packing pattern, the grippers can then collide with the containers, as a result of which the layer pads may not be gripped properly or retained.

In summary, it can be said that new container stacks should only ever be pushed off from the same side, as otherwise the containers would stand differently and the layer pad grippers cannot thread into the gaps provided on them.

There is also a challenge for gripper applications due to the interaction of unfavourable influences above a certain level of undersize.

If the packing pattern has a low degree of utilisation (undersize), the container layer may assume an unfavourable position. Smaller layer patterns can, for example, be positioned centrally offset and asymmetrically at the respective edge side of the pallet and thus have a maximally unfavourable position at the pallet edge and the layer corner. To make matters worse, the necessary clear width of the railing guide of the pallet conveyor creates further inaccuracies due to the usual pallet size tolerance. It is also becoming increasingly difficult to find suitable, optimised positions for the layer pads when processing different layer patterns or different container diameters.

Furthermore, the ratio of layer pad to pallet size should always be taken into account in the case of undersize. The following cases and their effects must be distinguished here:

1. There is a certain degree of undersize of the container layer. All layer pad sizes correspond to the pallet size.
   Advantages:
   - Layer pads can be gripped with grippers; little contact with the containers is to be expected if there is a slight undersize.
   - A loose bottom layer pad lying directly on the pallet in each case can be clamped well against the pallet during the sweep-off process with the "upper part of the grippers" facing downwards.

   Disadvantages:
   - Layer pads can be bent downwards or deformed by film wrapping at the stack manufacturer if the packing layer is considerably smaller than the layer pad (see 6.2 Layer pads [▸ 26]).
   - The stack fixation of the sweep-off depalletiser can only be closed to the layer pad size (corresponds to the pallet size here).

   Conclusion: This is the more favourable case for processing

2. There is a certain degree of undersize of the container layer. All layer pad sizes correspond at least to the container layer size smaller than the pallet.
   Advantages:
   - Layer pad edges are less likely to be bent or deformed by film wrapping at the stack manufacturer (see 6.1 Packaging films [▸ 25]), as the corners protrude less.

   Disadvantages:
   - The stack fixation or grippers can only be moved up to the pallet size; a free area is created between the stack edge and the lateral stack centring unit
   - It may no longer be possible to grip layer pads with grippers; this can be a knock-out criterion.

   Conclusion: This is the less favourable case for processing

9.2 Lift-off depalletiser and its specific challenges

With lift-off depalletisers as well, it is especially important to pay attention to the correct orientation of the new container stacks. As already described above, what matters here is a straight stack and correctly oriented loading. The quality of processing is particularly dependent on the adapted shape of the gripper head to the agreed packing patterns.

→ See 7.1 Nested packing patterns (nested containers) [▸ 37] on this topic

10 Containers

There are a large number of different new containers that can be stacked on a pallet. The most common are glass bottles, metal cans or special plastic containers. The containers must be stable and capable of bearing loads to form a loadable new container stack. Otherwise, there is no guarantee for the stack's stability. Depending on the shape of the container and the applied performance limits, different destacking devices (sweep-off depalletiser or lift-off depalletiser) may be necessary for depalletising.

10.1 Container tolerances

For a timely design of the machines, the nominal dimensions and tolerances of the containers for the calculation of the layer patterns must be provided by the customer well in advance. If possible, corresponding sample containers are to be provided to Design in advance.

Containers can show corresponding dimensional differences with increasing wear of the container manufacturing machine. One reason for this, for example, is that moulds for glass bottle production burn out from the inside with increasing age and the glass moulds expand. Consequently, this effect also makes the nominal size of the glass bottle correspondingly larger.

The +/- tolerances, e.g. of a bottle, always refer to the specified nominal dimension. The disadvantage of a dimensional shift is that the centre of the +/- tolerance deviation also moves with the increasing nominal dimension, which can now also lead to higher maximum deviations for some bottles. Statistically, it is assumed that the tolerance deviations in the production of bottles mostly follow a normal distribution, i.e. the bottles with the current nominal dimensions occur most frequently. The greater the nominal deviations in production, the rarer the occurrence of these bottles in the statistical rule. In order to get a good picture of the real nominal dimensions that occur in practice, it would be possible to measure the length and width of one or better several complete-layer container packing patterns in a nested container pattern as a whole and extrapolate this with the calculated nominal dimensions of the container drawing and compare it with practice. As the container tolerances usually cancel each other out in these measured positions, it can be assumed that the measurement result can be used to infer the actual nominal container diameter. If a tendency towards a change in nominal dimensions is detected, this can now be communicated to Krones Engineering so that, for example, a perfectly adapted gripping tool can be designed for lift-off depalletiser processing.

In the following table, rough tolerance zones of various container types are given without any claim to completeness:

Container type	Dimensional accuracy of tolerance zone	Possible later dependence	Weight trend
Glass bottles	Half to several millimetres	Age of the mould	Container weight approximately equal to the weight of the contents Share of total weight 1/2
Plastic bottles	Usually in the half-millimetre range	Hotfill dimension decreases during cooling CO_2 or gas pressure filled cylinders become larger Due to back pressure on the container table, they appear to be smaller in size there in the direction of the container lane.	Container weight significantly lighter than contents

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Container type	Dimensional accuracy of tolerance zone	Possible later dependence	Weight trend
Beverage cans and tins	Few tenths of a millimetre	Hardly any difference in diameter between a full can and an empty can filled with CO_2.	Can weight significantly lighter than contents

Tab. 4: Tolerance fields according to container type

10.2 Tilting angle of containers

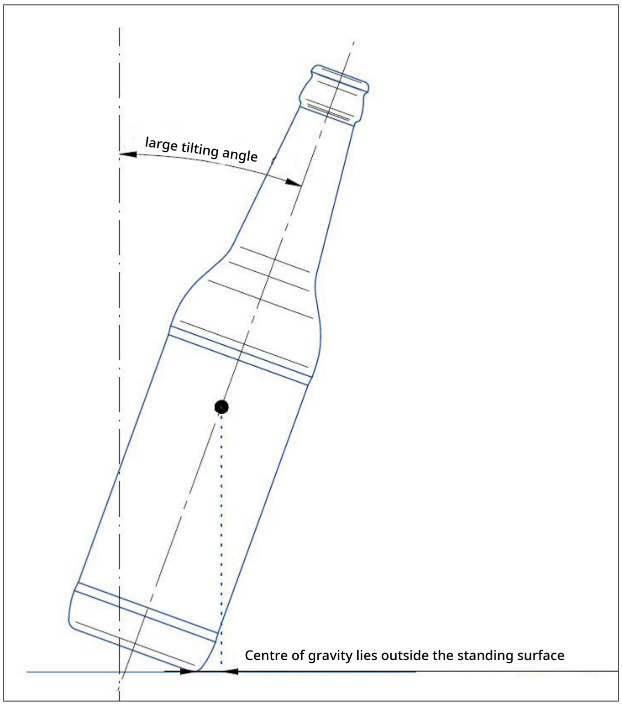


Fig. 70: The container is in danger of tilting because the tilting angle has been exceeded

A tilting angle is an angle at which the container begins to tilt when it is in an inclined position. This effect usually occurs when the centre of gravity of the container extends beyond the footprint of the container base. The tilting angle is usually 12° to 15°. If it is smaller, the containers can tilt even at a slight angle. This effect of tilting usually occurs when sweeping off or transporting on the bottle table. If the customer is aware that the tilting angle is problematically small, the Krones Design Department must be informed.

10.3 Bottles

There are different types and designs of bottle-like containers. A widely used container shape would be the cylindrical glass bottle. This is the most common bottle shape that is used to form new container stacks. The shape of a bottle also plays an important role in processing. Cylindrical bottles can usually be processed well with standard machines.

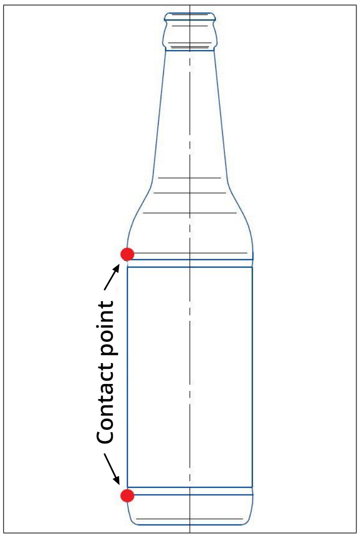


Fig. 71: Bottle with two shifting points (contact points). Optimal for the sweep-off process.

With satin-finished or lacquered bottles, special care is needed to avoid damaging the extremely sensitive surfaces. In this case, a reference and corresponding samples would be necessary for evaluating the bottles in order to have Krones check processing.

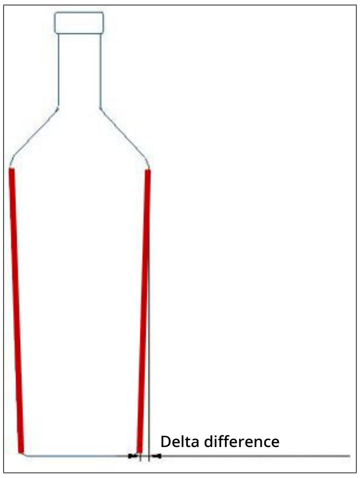


Fig. 72: Conical bottle

Special shapes, such as a conical bottle shape where the diameter changes continuously with the bottle height, can lead to special effects in processing. These conical bottles can quickly tip over during sweeping off or on the discharge table, they can rise up against each other under back pressure or they can even tilt towards each other. Even small lateral forces in a new container stack can cause conical bottles to rapidly tilt within the layers and push each other away. For this reason, the KRONES engineering department must check the processability of conical bottles. As usual, customer samples are required promptly.

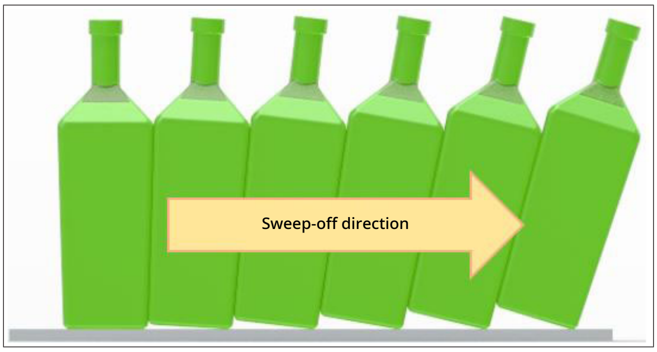
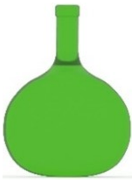


Fig. 73: Tilting problems when sweeping off conical containers

Glass bottle shapes	Illustration	Special features	Use
Beaded bottle		Have a cylindrical body and a waisted bottle neck for gripping the bottle better. There are also small nub-like structures on the onion-shaped bottle neck area.	Mineral water, soft drinks
Wide and narrow-neck bottles		With wide-neck bottles, the contents are easily accessible through their large opening and they can be used well for food. Narrow-neck bottles are used for spice liquids or spirits, for example, because of their easy-to-use bottle opening for dosing.	Spices, juices, food, soft drinks
Special shapes (e.g. slanted neck)		Bottles in special shapes cannot all be described in this specification due to the many design possibilities. They must always be fundamentally checked for processability by the Krones Design Department.	Wine, spirits, beer, soft drinks, spices, juices, food and more
Square bottles		Due to their angular shape, they are only suitable for in-line row arrangement.	Oils, spirits
Cylindrical bottles		Have an almost straight bottle neck and a cylindrical body, which is why they can be used for ball-packed and linear packing patterns.	Wine, spirits
Euro bottle		Suitable for nested container patterns and in-line row arrangements due to their cylindrical shape. They are mostly used by breweries for bottling beer. Conical bottle necks should receive attention	Beer, soft drinks
Stone bottles		Have a lower centre of gravity due to their lower height. Suitable for nested container patterns and in-line row arrangements due to their cylindrical shape. Conical bottle necks should receive attention.	Beer, soft drinks

Glass bottle shapes	Illustration	Special features	Use
"Bocksbeutel" (flattened ellipsoid)		Have a small bottle neck and a large round flattened bottle body. Mostly linear packing pattern. The orientation of the container (short-side-leading or long-side-leading) decides on the subsequent row arrangement and container transport.	Wine, spirits
Vichy bottle		Have a conical bottle neck and cylindrical body.	Beer, soft drinks
Bottle with bail		The body of the bottle is usually cylindrical. There is a wire bail on the bottle that can be used to close the bottle again. New glass bottles of this type are usually still missing the wire bails.	Beer
Pocket bottle		The pocket bottle is usually a smaller narrow bottle, in a classic hip flask shape. Usually linear structure in the packing pattern. The orientation of the container (short-side-leading or long-side-leading) decides on the subsequent row arrangement and container transport.	Spirits, food

Tab. 5: Bottle shapes and special features

10.3.1 Base types

Straight container base

Fig. 74: Bottle base with a straight base shape

The most commonly used base shape for glass bottles is the straight container base. The edge of the container base serves as a standing surface for the container. The diameter of the bottom footprint can be slightly smaller than the diameter of the outer surface.

Champagne bases (punt)

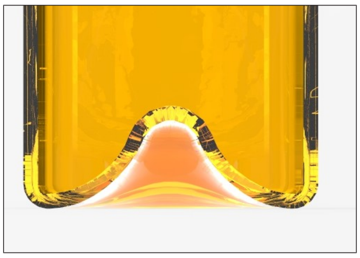


Fig. 75: Cross section of a champagne bottle base

Champagne bottle bases have an indent as shown in the adjacent illustration. Champagne bottles need this punt to withstand the high internal pressure resulting from the CO_2 in the bottle. The indent strengthens the base and distributes the pressure more evenly to the bottle wall. A flattened base would not withstand this pressure in comparison. For new container stacks using this type of bottle, it is important to use a thicker and more moisture-resistant layer pad. Otherwise, with a flexible layer pad, bottles on top of each other could sink into each other. This would result in the sunken bottles blocking the position during horizontal sweeping off (Lego [interlocking] effect).

Slight punt

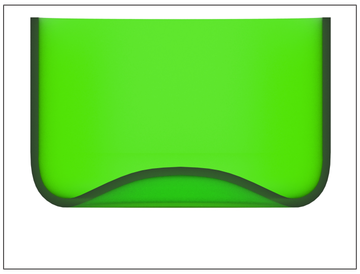


Fig. 76: Sectional view of a bottle with a slight punt

Containers with a slight punt, similar to champagne bottles, are suitable for beverage fillings with high internal pressure. The slight indent strengthens the base and distributes the pressure more evenly to the bottle wall. Similar to the champagne bottles, a more rigid layer pad is recommended.

10.3.2 Bottle neck

Bottle necks come in various designs, such as the long neck, the beaded bottle necks, the neck ring bottle necks, the conical necks and the rather rare slant-neck bottle. The shape of the bottle neck is just as important for processing as the shape of the bottle body itself. If the bottle neck is too conical, for example, processing with a lift-off depalletiser may no longer be possible.

Longneck bottles

Fig. 77: Glass bottle with a long neck

Long-neck bottles have a long bottle neck that decreases conically from the bottom to the top. With the lift-off depalletiser, problems arise here when the neck diameter slopes too steeply. Therefore, for conical bottles, a review of the slope ratio should be carried out to ensure the design of the appropriate lift-off depalletiser.

Beaded bottle neck

Fig. 78: Beaded bottle

Beaded bottles have a waisted bottle neck with nubs. The special shape and the nubs are intended to offer the end user more ergonomics and grip. The bottle neck diameter decreases conically towards the mouth-piece and should therefore be treated similarly to the long-neck bottle when designing with suitable lift-off depalletiser gripping tools.

Slant-neck bottles

Fig. 79: Marketing example: Change to slanted neck

Bottles in which the direction of the bottle neck does not overlap with the vertical axis of symmetry of the body are called slant-neck bottles. Lift-off depalletiser tools can cause problems here, as they usually want to grip the bottles by the neck. Due to the inconsistent slanting of the neck, the catching range of a gripper may no longer be sufficient. In this case, it can be more useful to sweep off the bottle layer.

10.4 Beverage and food cans

Fig. 80: Stack of new cans

There are different types of cans, for example: food, oil and beverage cans. In most cases, they are made of aluminium, tinplate or a combination of these materials.

10.4.1 Beverage can

The can is lightweight in its construction, and therefore its total stacking weight is much less than the new containers of other types. When comparing the weight of light aluminium beverage cans to heavier tin vegetable cans, large differences can easily occur. Therefore, for the calculation of layer and stack weights as well as for lifting devices, it is important that corresponding data sheets are made available to the Krones Design Department.

For space reasons, some customers place their stacks of cans on top of each other. However, if stacks of cans are stacked directly on top of each other, there must be no damage to the can containers or marks in the layer pads. Despite the relative light weight of a stack of cans, appropriate shelving systems should always be used for storing the stacks on top of each other. If depression-shaped impressions have been created in the layer pads, problems may arise when the layer is swept off due to containers jamming (Lego effect). Therefore, when stacking stacks on top of each other, at least one load distribution plate is advisable between the individual stacks (see 6.5 Load distribution plates [▸ 34]).

Fig. 81: Side view of a can with still unseamed crimping rim

In their composition, cans consist of either two or three pieces. Two-piece cans are mostly the well-known beverage cans, whereas three-piece cans are mostly food cans. A beverage can consists of the can body and a lid, which is placed on the can body after filling and then seamed to it. The unseamed crimping rim of the beverage can is sharp-edged and may have a larger outer diameter than the base diameter. Therefore, it cannot be ruled out that at high weight pressures and with moist or very thin layer pads, the upper cans of a layer sink into the lower can layer and get caught at this point during the sweep-off process (Lego effect). This could result in individual cans being damaged when the layer is cleared. In order to keep this negative effect to a minimum, the stacking of new container stacks in storage should be avoided as far as possible.

If the unseamed crimping rims of a new container unfavourably extend beyond the diameter of a can, this can lead to non-uniform spacing between the cans in a new container layer. If the capacity factor of the pallet is also very high, there can be unintentional contacts at the three-sided shaft walls of a sweep-off depalletiser (stack fixation), in the sweep-off device, the subsequent railing guides on the container table and on the container conveyor, therefore possibly resulting in damage to the crimping rims. Therefore, the Krones Design Department must be informed if these conditions occur.

To prevent new cans from being damaged during sweeping off, the layer-pad retaining grippers are arranged so that they retain the layer pad in the space between the cans during sweeping off. To be able to reliably guarantee this position, the pallet conveyor settings must be made in such a way that the pallet stacks are always centred in relation to the infeed into the sweep-off machine.

Fig. 82: Heavily damaged new can pallet

Cans are more prone to damage during transport than glass bottles, as they can be dented relatively easily. For this reason, pay special attention to transporting them gently. Stacks of new cans with dented cans are difficult to process further, as the can contours are no longer clearly in the desired position. Moreover, they can no longer be marketed. Damaged cans must be sorted out in the next step of processing.

Empty cans can either be pushed off via a sweep-off depalletiser or lifted off using a lift-off depalletiser with a layer-independent gripping tool (e.g. magnetic/suction plate). Depending on the design and type of material, there are corresponding magnetic or suction grippers for the can layers with which the cans can be lifted off.

If there are any unusual characteristics on can stacks, the customer should inform the Krones Sales Department so that appropriate solutions can be found and measures can be prepared.

10.4.2 Food can

Fig. 83: Food can

As already mentioned, food cans are predominantly three-piece cans, which are usually manufactured from tin. As a rule, food cans are significantly larger and heavier than beverage cans.

Common food cans usually have a cylindrical can body in the middle section, which has a lid and a base. These are flanged onto the cylindrical can body at the bottom and top. The material of food cans is mostly made of magnetic steel, and therefore, as an alternative to sweeping off, it could also be possible to process tin cans with a magnetic or suction plate gripper.

11 Summary

In summary, the quality of a new container stack arriving for processing always affects the performance of destacking. The responsible implementation for a proper stack quality lies primarily with the stack manufacturers. The maintenance of important quality characteristics must be ensured for all further step chains that the produced new container stack still has to pass through (e.g. for internal/external transports, warehousing and provisioning).

In particular, the following points play a role here:

- Early notification of special features
  If there are any special features, it is important to contact Krones at an early stage to prevent complications later on when designing the system. An early favourable influence on the individual processing steps can save a great deal of technical effort and financial expense. We ask that it be clarified in dialogue with our customers and the new container stack suppliers whether certain changes are still possible in principle. In this way, the new container stacks can be optimally prepared for processing at the customer's site.
- Early provision of drawing materials
  In order to further accelerate the preparation of an order, it is advantageous for the customer to obtain the corresponding drawing material of the layer packing patterns and the containers from the new container manufacturer at an early stage and to confirm the conformity in writing. Haptic samples of individual containers are also very useful. Undersize and overhang of a layer should be avoided as far as possible to ensure optimum processing of a stack.
- Selection of suitable packaging materials
  The packaging materials used should be selected by the new container manufacturer to provide the new container stack with sufficient stability during transport or processing.

If all parties involved in the discussion (e.g. suppliers, new container manufacturers, filling companies and equipment providers) jointly coordinate the requirements listed in this specification, efficient, successful cooperation can be ensured and economic success achieved.

Glossary

Catch area

The catch area is the area in which a processing device can still actively compensate for certain position inaccuracies of the object to be gripped during the approach process. The maximum possible catch area results from the effectiveness of, for example, a rigid catch slope or a mechanical centring device. A catch slope is usually measured by the length of the attached distributing wedges. A container layer must be within this catch area so that a lift-off depalletiser, for example, can subsequently pick up the containers exactly at the neck. In sweep-off processing, on the other hand, inclined stacks are pressed into the narrow catch area of a stack centring unit.

CF

Capacity factor, e.g. of a pallet surface

Chapatex

Chapatex is the name given to special thin reusable layer pads made of pressed wood fibres. During production, the wood structure is dissolved down to the individual fibres and pressed again by activating the wood's own constituents and possibly adding synthetic resins. They have a uniform density with a smooth water-repellent surface and a more water-sensitive screen structure on the underside. The thickness of the plate is on average three to five millimetres. The weight is usually in the range of 2-4 kg per Chapatex layer pad. Because of the two different surfaces, always make sure that the side that is less sensitive to water is facing upwards. Chapatex layer pads are mostly reused while they are still in proper condition. Due to Chapatex warped by moisture and structurally damaged characteristic, these characteristics can make destacking difficult. When lifting off with (vacuum-based) vacuum suction systems, the system should always be designed to handle the poorer (rougher) side with the screen structure, as it can never be ruled out that a Chapatex layer pad lies the wrong way round. If a Chapatex layer pad is used, Krones Design must be informed separately.

Conical bottles/conical bottle necks

In the case of conical bottle external contours, the diameter changes continuously along the bottle height or neck. There are also containers in the shape of a cone. Here, the container's outer shape changes continually in diameter.

Crosswise row arrangement

The term crosswise row arrangement describes an alignment of a container packing pattern on a rectangular pallet. The container lines, lined up in a linear fashion, are aligned perpendicular to the pallet. This means that the direction of the rows is parallel to the shorter side of the pallet.

Exchangeability of pallets

This means the possibility of exchanging standardised empty pallets with, for example, various new container stack manufacturers for newly filled new container stacks. Specially made pallets, on the other hand, can only be returned to the respective manufacturer or are not intended for reusable consumption. Defective empty pallets are also no longer exchangeable.

Layer

Layers are the individual levels of a new container stack. The so-called packing pattern layers define the arrangement of the containers in the individual layer.

Lego effect

A so-called Lego effect stands for a behaviour when approximately concave surface elements* overlap with convex surface shapes** in the same place, causing a "sinking into each other" or entering into a kind of interlocking seen in the surface. This changes the relative height of the stack downwards, which in turn could cause an undesired change in the height of a stack of containers. Separating these container layers (e.g. by sweeping them off to the side) can be very difficult when the effect occurs. Therefore it is also called the "Lego [interlocking] effect" in the following. Here, Krones Engineering should be consulted to reduce this effect. *e.g. hollow bottle bases cause a convex surface on the surface of a layer pad that is too thin or moist **e.g. Bottle neck finishes cause a concave surface underneath a layer pad that is too thin or moist

Lengthwise row arrangement

The container lines, lined up in a linear fashion, align themselves lengthwise to the pallet. This means that the direction of the rows are aligned parallel to the longer side of the pallet.

Lift-off depalletiser

Lift-off depalletisers are machines that lift off the current top layer of a stack of containers upwards with the help of a gripping tool. The two most widely used gripper variants are the inflated-bar gripper and the bar gripper.

Nested container

Nested containers are the narrowest arrangements of circular containers in which linear rows of containers are each offset by half the diameter and shifted into one another.

New container stack

Loaded pallets loaded with brand new empty containers. These usually come directly from the container manufacturer.

Normal/optimal palletising

Normal/optimal palletising describes a stacking of layers which is free of gaps and optimally occupied with objects in terms of space in each layer.

Overhang

Overhang is when the layer is larger than the pallet and the containers standing at the edge protrude beyond the edge of the pallet with a reduced standing area.

Packing materials

The packing materials belong to the stacking or stabilising aids of the new container delivery. These are, for example, layer pads, bottom trays/inverted trays, cover plates/frames and stretch films.

Packing pattern layer

The so-called packing pattern layers define the arrangement of the containers in the individual levels of a new container stack.

Row separation

Integration of the container flow into the container conveyor

Scuffing

Scuffing occurs, among other things, with repeated reuse cycles of containers. This is the wear on the guide rails or on the surface of containers in contact with each other, resulting from the abrasive movement towards each other. This wear and tear occurs in particular with rounded or cylindrical glass and PET bottles, which are repeatedly subject to the abrasion stresses of container transport due to their return to the reuse cycle. The surface loads mostly run in points or lines along the highlighted contours of the containers (mostly partial annular circumferential rubbing lines). It is advantageous for containers to have "contact points" at the bottom and top for mutual support (sweep-off point and height point are subject to scuffing), at which the containers can stabilise each other during the sweep-off process.

Self-propelled centring unit

The self-propelled centring unit can be assigned to lift-off depalletiser processing. It places a 4-sided centring frame, which travels along at the processing height, around the new container stack in order to bring the containers close to the layer to be lifted into the catch area of the gripper tool.

Stack fixing unit

Stack fixation is the term used for the sweeping-off depalletiser to describe the application of a three-sided safety wall by means of stack-sized, wide-area and parallel-closing shaft walls over the entire height of the new container stack. The three-sided stack fixing unit can only be adjusted to the pallet size and not to the position in case of undersize.

Stacking accuracy

Stacking the individual layers and containers as precisely as possible to achieve the highest possible quality.

Sweep-off depalletiser

Push-off depalletisers are machines that sweep containers horizontally in layers off a stacking level of a pallet. They are used to depalletise container stacks.

Sweep-off point

Is the height point at which the sweep-off depalletiser contacts the containers for sweeping. This is below the centre of gravity of the containers, as the containers could otherwise tip over during sweeping off. With (non-cylindrical) specially-shaped containers, there may also be problems with guiding the containers.

Tilting angle

The tilting angle of a container is the angle from the centre axis of a container to the standing surface at which a container begins to tilt when placed at an angle.

Top layer pad

A top layer pad is an uppermost layer pad that is placed last on a new container stack to protect the stack from dust and dirt.

Undersize

If the layers are smaller than the pallet, this is referred to as undersize.