Specification

KRONES Container Specifications

TD10026397 EN 02

KRONES

Table of Contents

KRONES

1 General information

1.1 Basic information

"This is to specify the demands the filling and packing line places on the container. It does not replace any other specifications. In particular the KRONES PET non-returnable container specification, which specifies the container properties of containers produced on KRONES Contiform machines is not replaced by the specification.

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

This concerns the following parameters:

- Shape/geometry and dimensional accuracy
- Physical properties
- Neck geometry/neck finish

The specification is valid for the following container types:

- Glass containers:
  rotationally symmetrical, cylindrical containers and specially-shaped bottles
- PET containers:
  rotationally symmetrical, cylindrical containers and specially-shaped bottles
- Plastic containers:
  rotationally symmetrical, cylindrical containers and specially-shaped bottles
- Cans

The specification is to be understood as a supplement and as a clarification of a container drawing. This specification does not replace the customer's container drawing!

If the weight, tolerances and other requirements of the specification are exceeded, please consult with KRONES!

Parts that depend on the containers can only be designed with the original sample material. The sample must be provided by the customer. This is especially the case when there are different container suppliers (one sample material each is to be provided per supplier).

1.2 Tilting angle of containers

The tilting angle must be indicated with k for all containers. It is defined by the centre of gravity S and the floor space radius (= footprint diameter SD/2) of the container.

→ *See the following drawings (apply as reference for all container types)*

The tilt angle k of the containers must be at least 10°.

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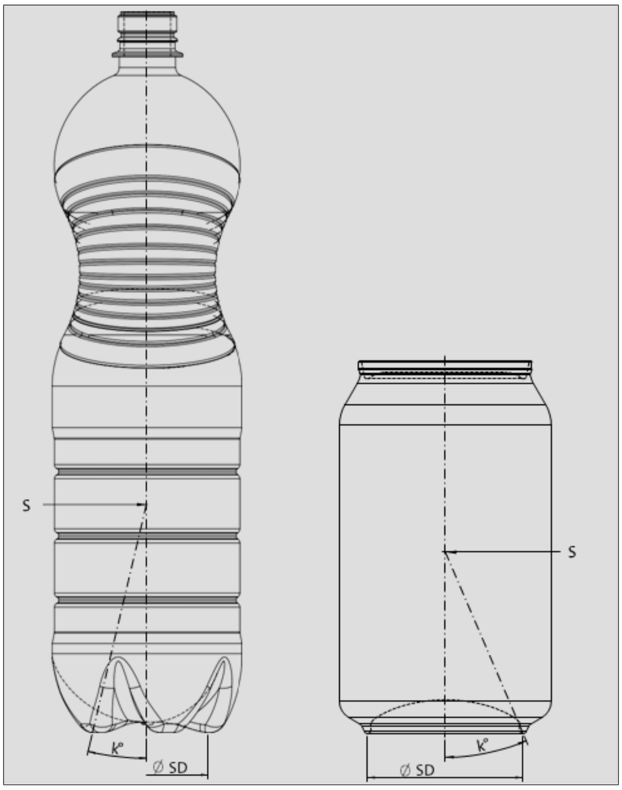

Fig. 1: Example: PET container, beverage can

S = centre of gravity

K = tilt angle

∅ SD = footprint diameter

2 Glass containers

2.1 Rotationally symmetrical, cylindrical containers

2.1.1 Sample drawing – example

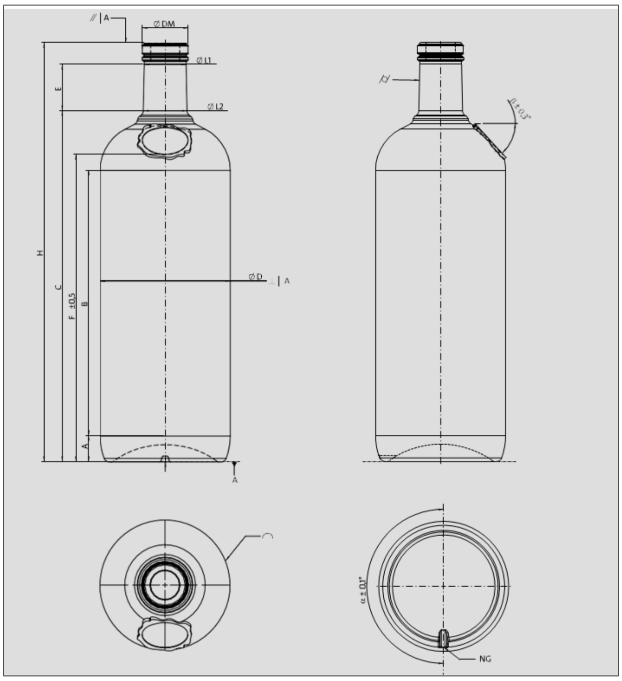

Fig. 2: Dimensioned glass bottle

⫽ = plane parallelism

∅ DM = neck finish diameter

∅ L1 = neck diameter, beginning

∅ L2 = neck diameter, end

∅ D = container diameter

H = container height

E = height of neck area

C = height of neck area, end

E = height of emblem

B = height of labelling area

A = height of labelling area, end

⊥ = perpendicularity

/o/ = cylindrical shape

β = inclination

α = spotting bar position

∩ = line shape

NG = spotting bar geometry after separate drawing

2.1.2 Shape/geometry and dimensional accuracy

Dimensional drawing based on DIN 6129-1 (all dimensions in mm)

Heights

Total height H		Permissible deviation [mm]	Total height H		Permissible deviation [mm]
above	to:		above	to:	
-	50	± 0.8	250	300	± 1.8
50	75	± 0.9	300	325	± 1.9
75	100	± 1.0	325	350	± 2.0
100	125	± 1.1	350	375	± 2.1
125	150	± 1.2	375	400	± 2.2
150	175	± 1.3	400	425	± 2.3
175	200	± 1.4	425	450	± 2.4
200	225	± 1.5	450	475	± 2.5
225	250	± 1.6	475	500	± 2.6

Calculation of the permissible deviation [mm] for H: ± (0.6 + 0.004 x H); values are always rounded up to a full 0.1 mm.

Container diameter

Container diameter D		Permissible deviation [mm]	Container diameter D		Permissible deviation [mm]
above	to:		above	to:	
-	25	± 0.8	100	108	± 1.8
25	33	± 0.9	108	116.5	± 1.9
33	41.5	± 1.0	116.5	125	± 2.0
41.5	50	± 1.1	125	133	± 2.1
50	58	± 1.2	133	141.5	± 2.2
58	66.5	± 1.3	141.5	150	± 2.3
66.5	75	± 1.4	150	158	± 2.4
75	83	± 1.5	158	166.5	± 2.5
83	91.5	± 1.6	166.5	175	± 2.6
91.5	100	± 1.7	175	183	± 2.7

Calculation of the permissible deviation [mm] for D: ± (0.5 + 0.012 x D); values are always rounded up to a full 0.1 mm. With oval and square cross-sections, the wide side of the cross-sectional dimension is used for the definition.

Neck geometry

For designing the neck guide, the beginning of the neck (dimension C) and the neck height (dimension E) are required.

Designation	Dimension	Permissible deviation [mm]
Neck-diameters – beginning	Ø L1	± 0.2
Neck-diameters – end	Ø L2	± 0.2

With deep-cone wrap-around labels, the maximum deviation from the conicity must not exceed 0.1°.

Spotting bar position

Designation	Dimension	Permissible deviation [mm]
Spotting bar position relative to emblem	α	± 0.1°

Emblem

A maximum overhang of the emblems of < 0.75 mm in the diameter is permissible in the shoulder area. This applies to emblems on the front and rear side.

Designation	Dimension	Permissible deviation [mm]
Emblem inclination	β	± 0.3°

Plane parallelism

Please note “Plane parallelism“ in Chap. 2.1.1 Sample drawing – example [▸ 6]

Neck finish diameter DM		Permissible deviation [mm]
above	to:	
-	40	2 % of diameter
40	60	0.9
60	-	1.0

Rectangularity

Please note “Rectangularity“ in Chap. 2.1.1 Sample drawing – example [▸ 6]

Total height H		Permissible axis deviation of rectangularity [mm]
above	to:	
0	120	± 0.8
120	140	± 0.9
140	160	± 1.0
160	180	± 1.1
180	200	± 1.2
200	220	± 1.3
220	240	± 1.4
240	260	± 1.5
260	280	± 1.6
280	300	± 1.7
300	320	± 1.8
320	340	± 1.9
340	360	± 2.0
360	380	± 2.1
380	400	± 2.2
400	420	± 2.3
420	440	± 2.4
440	460	± 2.5
460	480	± 2.6
480	500	± 2.7

Calculation formula for axis deviation:

H greater than 120: (0.3 + 0.01 x H) x 0.5; values are always rounded up to a full 0.1 mm. (Container height H includes the neck finish, see 2.1.1 Sample drawing – example [▸ 6])

Cylindrical shape/linear shape

In the labelling area, the cylindrical shape must not deviate from the nominal dimension of the container by more than 0.3 mm.

Additional requirements

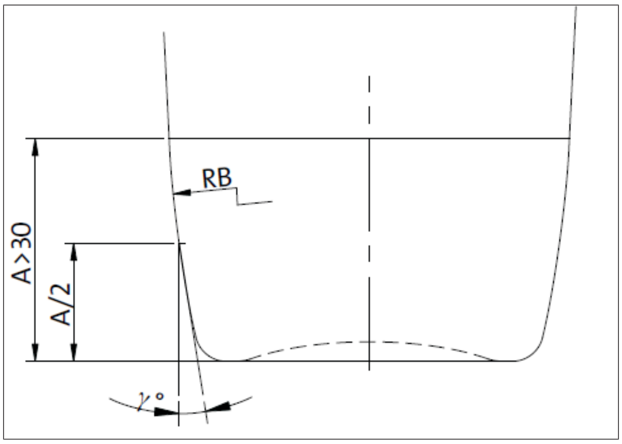

Fig. 3: Dimensioned base contour

With base heights A greater than 30 mm, the radius RB must be indicated.

With conical base contours and base heights A > 30 mm must be dimensioned at half the base height (A/2) of the angle γ°.

Surface and surface condition

For coated glass containers or diffuse surfaces (also embossing or debossing in the glass), this note is required for performing possible tests. In addition, the colour of the container is relevant as a design criterion.

Neck finishes

The shape and tolerances of the neck finishes are standardised acc. to DIN 6094. Deviations from this standard must be specified separately.

If customer-specific neck finishes are used, enclose the appropriate drawings.

Base geometry

For containers with base and/or side-spotting bars (raised/recessed) (also embossing or debossing in the base area), they must be separately dimensioned and specified with the corresponding tolerances (see Chap. 6 Spotting bar geometry [▸ 40]).

Other requirements

With tamper-evident labels, the Labelling Technology Division must be consulted for dimensions E + height of neck finish M < 40 mm. The KRONES specialist department must be consulted if the label protection is missing. Damage to the label must be expected if the label protection is missing.

2.2 Not rotationally symmetrical containers (specially-shaped containers)

2.2.1 Sample drawing – example

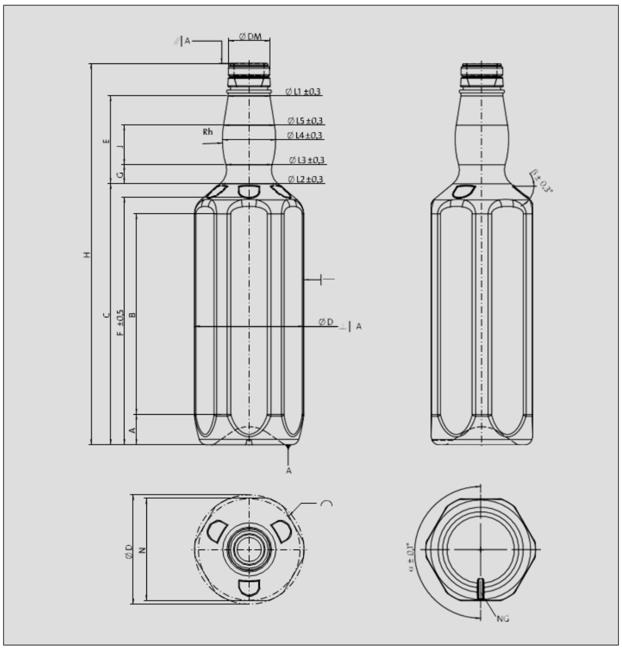

Fig. 4: Dimensioned glass bottle (specially-shaped container)

⫽ = plane parallelism

∅ DM = neck finish diameter

∅ L1 = neck diameter, beginning

∅ L2 = neck diameter, end

∅ L1 – L5 = relevant neck diameter

Rh = relevant neck radius

G, J, E = relevant neck height dimension

∅ D = container diameter

N = inside container diameter

H = container height

C = height of neck area, end

E = height of emblem

B = height of labelling area

A = height of labelling area, end

_ = straightness

⊥ = perpendicularity

β = inclination

α = spotting bar position

∩ = line shape

NG = spotting bar geometry after separate drawing

2.2.2 Overview matrix

The following overview shows the various specially-shaped containers schematically:

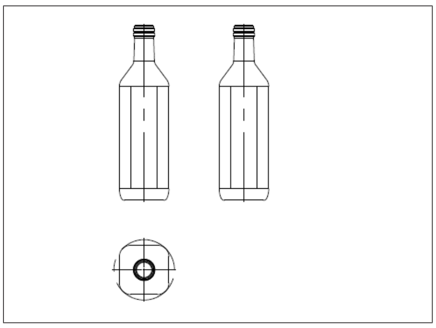

Fig. 5: Container shape – square

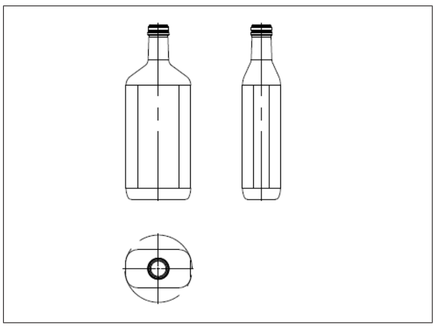

Fig. 6: Container shape – rectangular

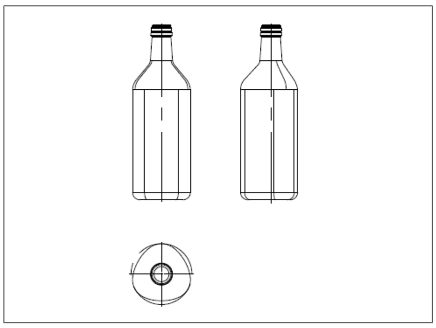

Fig. 7: Container shape – triangular

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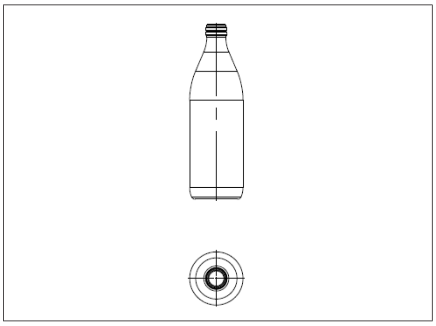

Fig. 8: Container shape – circular

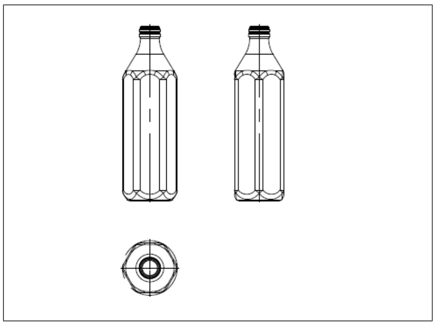

Fig. 9: Container shape – hexagonal

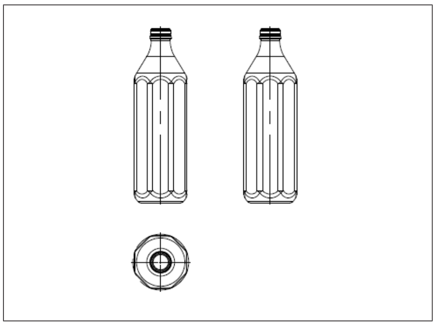

Fig. 10: Container shape – octagonal

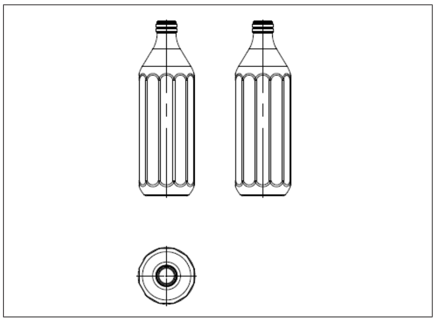

Fig. 11: Container shape – polygonal

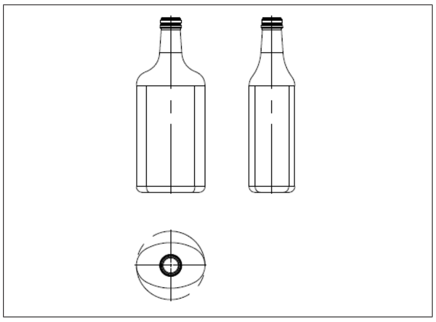

Fig. 12: Container shape – oval

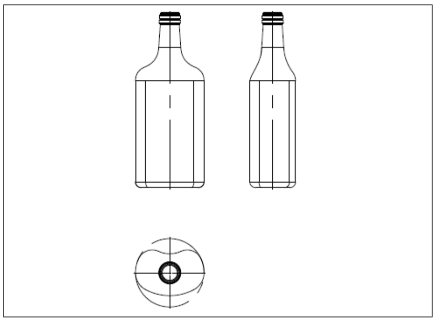

Fig. 13: Container shape - kidney-shaped

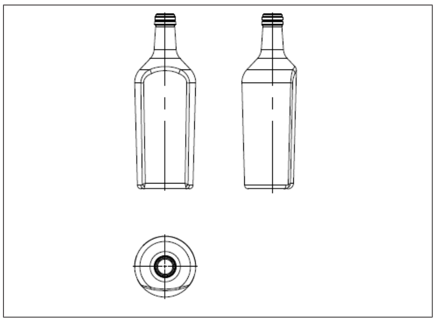

Fig. 14: Special shape and Others

2.2.3 Shape/geometry and dimensional accuracy

Dimensional drawing based on DIN 6129-1 (all dimensions in mm)

Heights

Total height H		Permissible deviation [mm]	Total height H		Permissible deviation [mm]
above	to:		above	to:	
-	50	± 0.8	250	300	± 1.8
50	75	± 0.9	300	325	± 1.9
75	100	± 1.0	325	350	± 2.0
100	125	± 1.1	350	375	± 2.1
125	150	± 1.2	375	400	± 2.2
150	175	± 1.3	400	425	± 2.3
175	200	± 1.4	425	450	± 2.4
200	225	± 1.5	450	475	± 2.5
225	250	± 1.6	475	500	± 2.6

Calculation of the permissible deviation [mm] for H: ± (0.6 + 0.004 x H); values are always rounded up to 0.1 mm.

Container diameter

Container diameter D Inside container diameter N		Permissible deviation [mm]	Container diameter D Inside container diameter N		Permissible deviation [mm]
above	to:		above	to:	
-	25	± 0.8	100	108	± 1.8
25	33	± 0.9	108	116.5	± 1.9
33	41.5	± 1.0	116.5	125	± 2.0
41.5	50	± 1.1	125	133	± 2.1
50	58	± 1.2	133	141.5	± 2.2
58	66.5	± 1.3	141.5	150	± 2.3
66.5	75	± 1.4	150	158	± 2.4
75	83	± 1.5	158	166.5	± 2.5
83	91.5	± 1.6	166.5	175	± 2.6
91.5	100	± 1.7	175	183	± 2.7

Calculation of the permissible deviation [mm] for D: ± (0.5 + 0.012 x D); values are always rounded up to a full 0.1 mm. With oval and square cross-sections, the wide side of the cross-section is used for defining the dimension limits.

Neck geometry

For designing the neck guide, the beginning of the neck (dimension C) and the neck height (dimension E) are required.

Designation	Dimension	Permissible deviation [mm]
Neck-diameters – beginning	Ø L1	± 0.3
Neck-diameters – end	Ø L2	± 0.3

With deep-cone wrap-around labels, the maximum deviation from the conicity must not exceed 0.1°.

Spotting bar position

Designation	Dimension	Permissible deviation [mm]
Spotting bar position relative to emblem	α	± 0.1°

Emblem

A maximum overhang of the emblems of < 0.75 mm in the diameter is permissible in the shoulder area. This applies to emblems on the front and rear side.

Designation	Dimension	Permissible deviation [mm]
Emblem inclination	β	± 0.3°

Plane parallelism

Please note “Plane parallelism“ in Chap. 2.2.1 Sample drawing – example [▸ 10]

Neck finish diameter DM		Permissible deviation [mm]
above	to:	
-	40	2 % of diameter

Neck finish diameter DM		Permissible deviation [mm]
above	to:	
40	60	0.9
60	-	1.0

Rectangularity

Please note “Rectangularity“ in Chap. 2.2.1 Sample drawing – example [▸ 10]

Total height H		Permissible axis deviation of rectangularity [mm]
above	to:	
0	120	± 0.8
120	140	± 0.9
140	160	± 1.0
160	180	± 1.1
180	200	± 1.2
200	220	± 1.3
220	240	± 1.4
240	260	± 1.5
260	280	± 1.6
280	300	± 1.7
300	320	± 1.8
320	340	± 1.9
340	360	± 2.0
360	380	± 2.1
380	400	± 2.2
400	420	± 2.3
420	440	± 2.4
440	460	± 2.5
460	480	± 2.6
480	500	± 2.7

Calculation formula for axis deviation:

H greater than 120: (0.3 + 0.01 x H) x 0.5; values are always rounded up to a full 0.1 mm. (Container height H includes the neck finish, see 2.2.1 Sample drawing – example [▸ 10])

Straightness/linear shape

In the labelling area, both the straightness and the linear shape must not deviate from the ideal state of the container by more than 0.3 mm.

Additional requirements

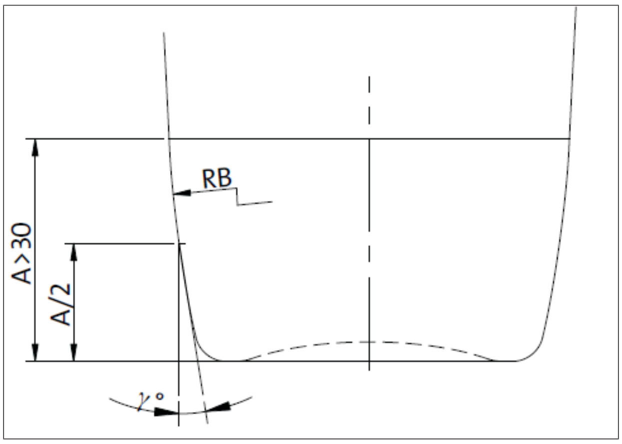

Fig. 15: Dimensioned base contour

With base heights A greater than 30 mm, the radius RB must be indicated.

With conical base contours and base heights A > 30 mm must be dimensioned at half the base height (A/2) of the angle γ°.

Surface and surface condition

For coated glass containers or diffuse surfaces (also embossing or debossing in the glass), this note is required for performing possible tests. In addition, the colour of the container is relevant as a design criterion.

Base geometry

For containers with base and/or side-spotting bars (raised/recessed) (also embossing or debossing in the base area), they must be separately dimensioned and specified with the corresponding tolerances (see Chap. 6 Spotting bar geometry [40]).

Other requirements

With curved geometries (see neck geometry in Chap. 2.2.1 Sample drawing – example [10]), the dimensions must be specified so that the outer geometry is completely determined (reproducibility of the geometry).

Designation	Dimension	Permissible deviation [mm]
Neck geometry	Ø L1	± 0.3
	Ø L2	± 0.3
	Ø L3	± 0.3
	Ø L4	± 0.3
	Ø L5	± 0.3

With tamper-evident labels, the Labelling Technology Division must be consulted for dimensions E + height of neck finish M < 40 mm. The KRONES specialist department must be consulted if the label protection is missing. Damage to the label must be expected if the label protection is missing.

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3 PET containers

3.1 Rotationally symmetrical, cylindrical containers

3.1.1 Sample drawing – example

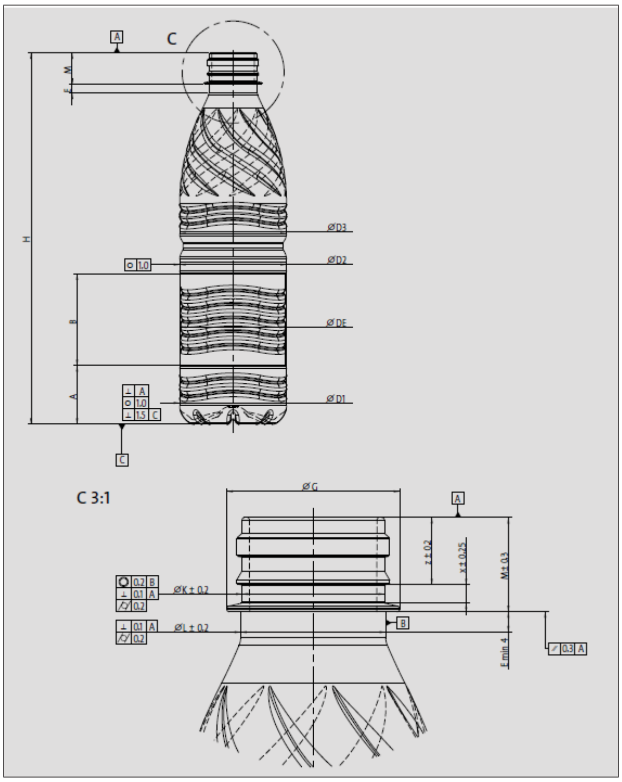

Fig. 16: Dimensioned PET container

⫽ = plane parallelism

∅ DM = neck finish diameter

∅ L1 = neck diameter, beginning

∅ L2 = neck diameter, end

∅ D = container diameter

H = container height

E = height of neck area

C = height of neck area, end

E = height of emblem

B = height of labelling area

A = height of labelling area, end

⊥ = perpendicularity

/o/ = cylindrical shape

β = inclination

α = spotting bar position

∩ = line shape

NG = spotting bar geometry after separate drawing

3.1.2 Shape/geometry and dimensional accuracy

Heights, containers and label diameter

Rated volume [l]		Height (H) [mm]	Container diameter D3, label diameter D [mm]
above	to:	Permissible deviation [mm]	
0	0.5	± 0.8	± 0.4
0.5	1.0	± 1.0	± 0.6
1.0		± 1.3	-0.7 | +0.8

The specified tolerances refer to an unfilled container.

The container diameter must be at least 45 mm. When a container diameter > 108 mm is exceeded, KRONES must be consulted to ensure processability on neck handling starwheels and rejection units.

In the area of the filling technology, the following PET container heights can be processed for all applications outside aseptic:

- **≥ 150 mm: Minimum PET container height**

- **≤ 350 mm: Maximum PET container height**

Measured in each case from the top edge of the neck finish to the bottom edge of the container base. The span from the smallest to the largest container must not exceed a height difference of 200 mm.

If the minimum or maximum container height is exceeded, then processing can be checked in individual cases with regard to the design up to the following values:

- **≤ 370 mm or**
- **≥ 105 mm (for non-returnable PET in neck-handling system) or**
- **≥ 140 mm (for returnable PET in base-handling system)**

Processability is no longer ensured outside these values.

Neck geometry and neck finish

For designing the neck guide, the beginning of the neck (dimension C) and the neck height (dimension E) are required.

Neck height E [mm]	Permissible deviation [mm]
< 4	not permissible
> 4	+ 0.3

If these tolerances are exceeded in the neck/neck finish area, consultation with KRONES is required.

When different neck finishes are used (other height, other support ledge diameter), it is necessary to check for mixed processability by KRONES. Consultation with the specialist department Engineering Department/Packaging Division is required when using clip inserters.

Guide diameter

The container guide diameter must always be the largest diameter on the container - even when all tolerances are exhausted. The container requires a constant guide diameter.

The height of this guide diameter must be between 40 and 50 mm. At special expense, this can also be a height between 30 and 40 mm (it is sufficient when at least one contact point with the maximum container diameter is within a range of 10 mm).

Consultation with the specialist department Engineering Department/Packaging Division is required in case of deviation from the specifications.

Plane parallelism

Please note “Plane parallelism“ in Chap. 3.1.1 Sample drawing – example [▸ 15]

Diameter of neck finish recess K		Permissible axis deviation from the plane parallelism [mm]
above	to:	
-	40	2 % of diameter
40	50	0.9

Rectangularity

Please note “Rectangularity“ in Chap. 3.1.1 Sample drawing – example [▸ 15]

Rated volume [l]		Permissible deviation of rectangularity [mm]
above	to:	
0	1.5	3.0
1.5	2.5	4.0
2.5		5,0

Cylindrical shape/linear shape

In the labelling area, both the cylindrical shape and the linear shape must not deviate from the ideal state of the container by more than 0.3 mm.

Additional requirements

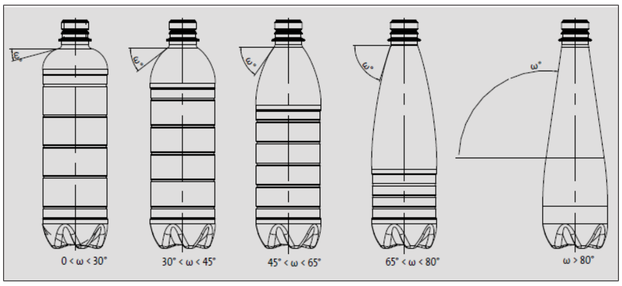

Fig. 17: Container types

Container shape and dimensional accuracy

The transportability of containers in an air conveyor or a packer is mainly dependent on the container shape, especially characterised by the shoulder angle ω. The following areas are differentiated:

Shoulder angle ω [°]		Transportability
above	to:	
0	30	greatly limited
30	45	good
45	65	very good
65	80	limited
80		greatly limited

Tab. 1: With regard to an air conveyor:

Shoulder angle ω [°]		Processability
above	to:	
0	30	Special approval + test for divider inserter
0	30	Special approval for clip inserter
80		Visually defective shrink-wrapped packs
80		Special approval for wrap-around pack

Tab. 2: With regard to the Variopack/Varioline packer:

Contact: Engineering Department/Packaging Division specialist department

With shoulder angles ω < 30° or ω > 65°, KRONES must be consulted.

Depending on the shoulder angle ω, the neck radius Rh and the neck height E must have the following minimum values:

Shoulder angle ω [°]		Neck radius Rh [mm]	Neck height E [mm]
above	to:		
	20	not permissible	
20	25	> 1.0	> 6.0
25	35	> 1.0	> 5.0
35		> 1.0	> 4.5
35		> 1.5	> 4.0

Stability

Especially for light-weight containers, sufficient stability of the empty and filled containers is important. Even if lateral forces act on the containers, they must not be strongly deformed.

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Thermostability

The following percentage dimensional deviations of the nominal dimensions are permissible for closed containers filled with carbonated water (8.0 - 0.5 + 0 g/l CO_2) after 24 h storage at 38°C (any desired humidity).

Further processing of containers with machine stop:

Due to dimensional changes of the containers, further processing after > 30 minutes is not possible or only with major restrictions. This applies to the entire system line. This specification does not apply to grip recesses, etc.

Rated volume [l]		Height H	Container diameter D, Label diameter DE [mm]
above	to:		
0	1.5	3.0	4.0
1.5		3,5	5,0

Beads

Dimension T1, T2, T3	Minimum dimension
T1, T3	10 mm
T2	8 mm

The beads must be designed so that two bottles cannot become interlocked with each other.

Axial pressure load (Top Load)

The measurement of the vertical load capacity (Top Load) of the empty container up to buckling (maximum load capacity, 'peak load'). In the process, the movement speed of the piston is to be 510 mm/min to ensure the comparability of several measurements. The containers must bear an average load of k x 140 N.

Usually the container wall thickness is less if a non-carbonated product is to be filled. The top load for these applications is reduced. The containers must therefore bear an average load of k x 90 N, and the factor k is calculated as follows:

Carbonated product	Top Load = k x 140 N	
Non-carbonated product	Top Load = k x 90 N	
Calculation k	k =	$\dfrac{\text{weight of sample bottle - neck finish weight}}{\text{Preform weight according to table – 6 g}}$

Other requirements

- With PET containers with carbonated product, the ambient temperature must also be specified.
- With tamper-evident labels, the Labelling Technology Division must be consulted for dimensions E + height of neck finish M < 40 mm.
- KRONES must be provided with the geometry of a PET container before and after filling the container so that the container handling parts can be adapted accordingly.

Factors which influence the fill level:

- Filler type, output, bottle neck geometry, machine pitch, size of discharge and capping starwheel, carbonation or nitrogen injector, bump formation during shrinking process
- The requirements for the fill level are very heterogeneous for the various machines, i.e. the fill level must be as high as possible and as low as necessary. A balanced fill level must be ensured in the process.

Adhesiveness

According to the "KRONES adhesiveness measurement" method, the preform/PET bottle adhesiveness must not exceed the following values:

- Preform 5 N
- Bottles 15 N

Residues on the containers may not have a negative effect on the unwinding behaviour. Sticking together of the bottles must be prevented.

Definition of adhesiveness: See preform specifications, adhesiveness supplement sheet

Base mould

Each individual contact surface (footprint) of the container must have a diameter ≥ 6 mm.

If the contact surface is < 6 mm, processing in the shrinking tunnel is not possible.

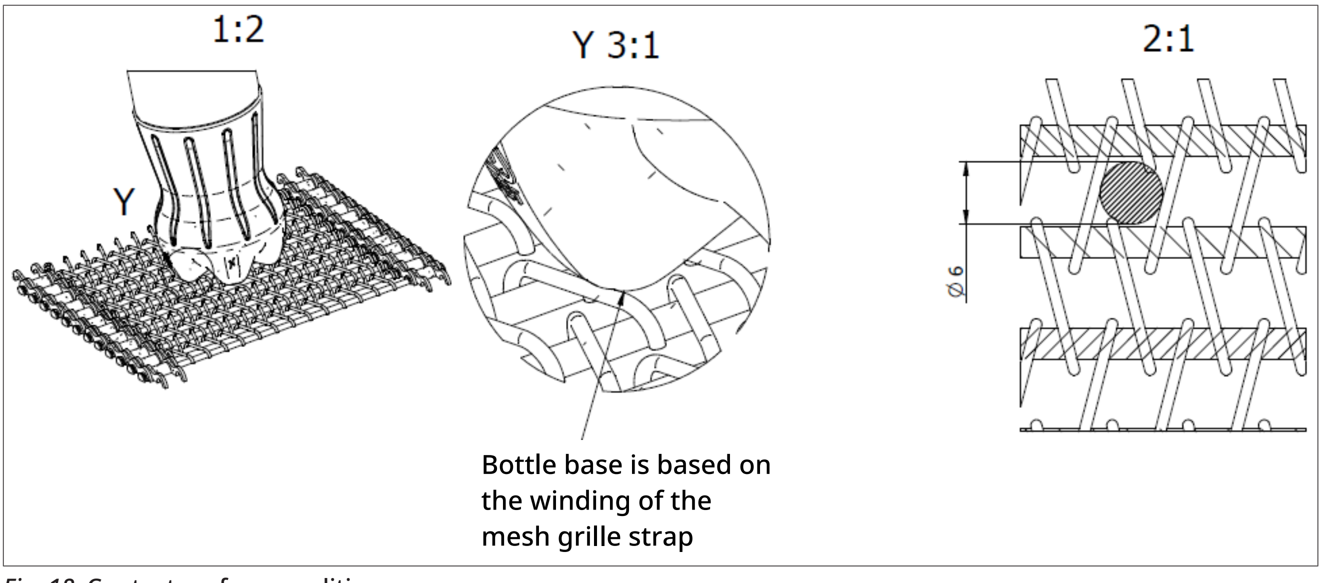

Fig. 18: Contact surface condition

Definition of adhesiveness: See preform specifications, adhesiveness supplement sheet

3.2 Not rotationally symmetrical containers (specially-shaped containers)

3.2.1 Overview matrix

The following overview shows the various specially-shaped containers schematically

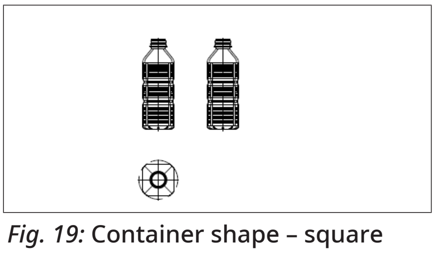

Fig. 19: Container shape – square

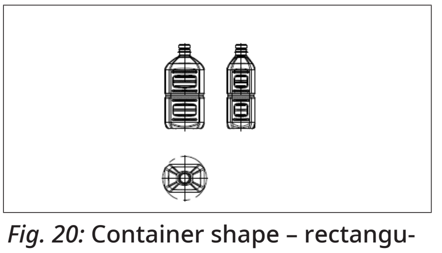

Fig. 20: Container shape – rectangular

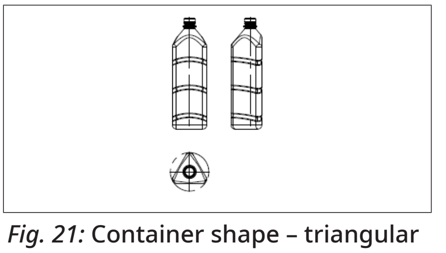

Fig. 21: Container shape – triangular

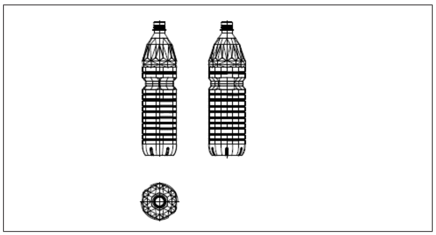

Fig. 22: Container shape – hexagonal

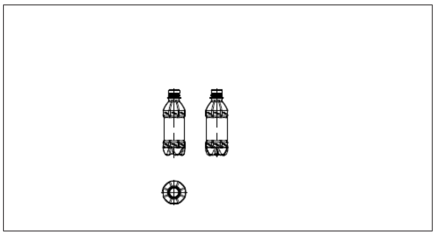

Fig. 23: Container shape – octagonal

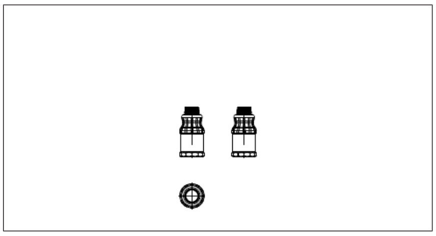

Fig. 24: Container shape – polygonal

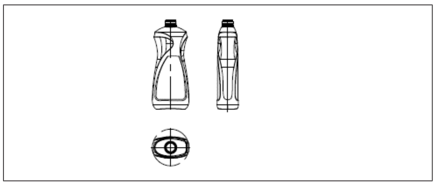

Fig. 25: Container shape – oval

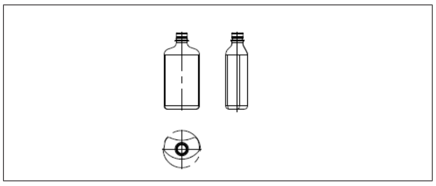

Fig. 26: Container shape - kidney-shaped

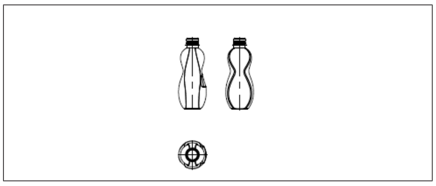

Fig. 27: Special shape and Others

3.2.2 Sample drawing – example

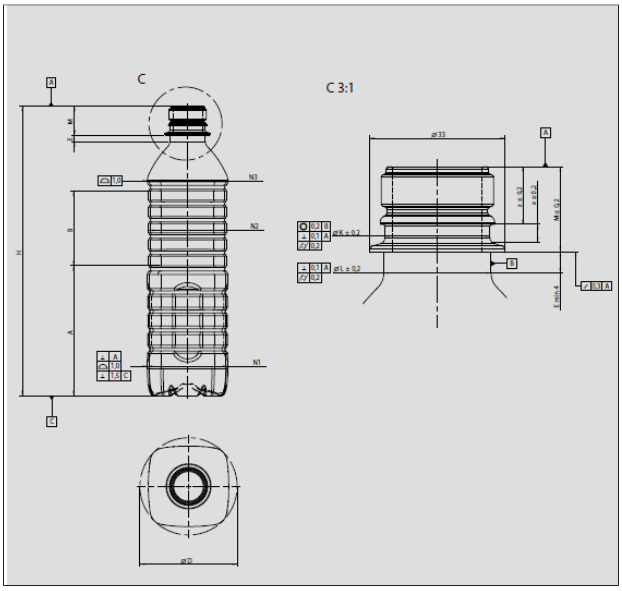

Fig. 28: Dimensioned PET container (specially-shaped container)

∥ = plane parallelism

∅ G = support ledge diameter

∅ K = diameter, neck finish recess

∅ L1 = neck diameter, beginning

∅ L2 = neck diameter, end

∅ D = outside container diameter

∅ D = inside container diameter

H = container height

E = neck height, support ledge

C = height of neck area, end

B = height of labelling area

A = height of labelling area, end

∩ = line shape

M = height of neck finish

_ = straightness

⊥ = perpendicularity

T1 – T3 = beads

S = neck finish recess height Rh, radius at neck transition

Rv = Radius at cap ring

RT = Radius at support ledge

3.2.3 Shape/geometry and dimensional accuracy

Heights, containers and label diameter

Rated volume [l]		Height (H) [mm]	Outside container diameter D, Inside container diameter N [mm]
above	to:	Permissible deviation [mm]	
0	0.5	± 0.8	± 0.4
0.5	1.0	± 1.0	± 0.6
1.0		± 1.3	-0.7 | +0.8

The specified tolerances refer to an unfilled container.

The container diameter must be at least 45 mm. When a container diameter > 108 mm is exceeded, KRONES must be consulted to ensure processability on neck handling starwheels and rejection units.

In the area of the filling technology, the following PET container heights can be processed for all applications outside aseptic:

- **≥ 150 mm (minimum PET container height)**
- **≤ 350 mm (maximum PET container height)**

Measured in each case from the top edge of the neck finish to the bottom edge of the container base. The span from the smallest to the largest container must no exceed a height difference of 200 mm.

If the minimum or maximum container height is exceeded, then processing can be checked in individual cases with regard to the design up to the following values:

- **≤ 370 mm or**
- **≥ 105 mm (for non-returnable PET in neck-handling system) or**
- **≥ 140 mm (for returnable PET in base-handling system)**

Processability is no longer ensured outside these values.

Neck geometry and neck finish

For designing the neck guide, the beginning of the neck (dimension C) and the neck height (dimension E) are required.

Neck height E [mm]	Permissible deviation [mm]
< 4	not permissible
> 4	+ 0.3

If these tolerances are exceeded in the neck/neck finish area, consultation with KRONES is required.

Consultation with the Engineering Department/Packaging Division specialist department is required before using clip inserters.

When different neck finishes are used (other height, other support ledge diameter), it is necessary to check for mixed processability by KRONES.

Guide diameter

The container guide diameter must always be the largest diameter on the container - even when all tolerances are exhausted. The container requires a constant guide diameter. The height of this guide diameter must be between 40 and 50 mm. At special expense, this can also be between 30 and 40 mm. (It is sufficient when at least one contact point with the maximum container diameter is within a range of 10 mm).

Consultation with the specialist department Engineering Department/Packaging Division is required in case of deviation from the specifications.

Plane parallelism

Please note “Plane parallelism“ in Chap. 3.2.2 Sample drawing – example [▸ 20]

Diameter of neck finish recess K		Permissible axis deviation from the plane parallelism [mm]
above	to:	
-	40	2 % of diameter
40	50	0.9

Rectangularity

Please note “Rectangularity“ in Chap. 3.2.2 Sample drawing – example [▸ 20]

Rated volume [l]		Permissible axis deviation of rectangularity [mm]
above	to:	
0	1.5	± 3.0
1.5	2.5	± 4.0
2.5		± 5.0

Straightness/linear shape

In the labelling area, both the straightness and the linear shape must not deviate from the ideal state of the container by more than 0.3 mm.

Additional requirements for container shape and transportability

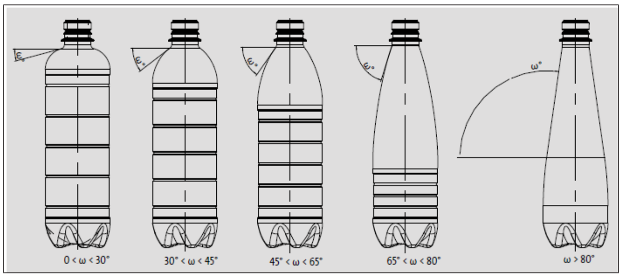

Fig. 29: Container types

Container shape and dimensional accuracy

The transportability of containers in an air conveyor or packer is mainly dependent on the container shape, especially characterised by the shoulder angle ω. The following areas are differentiated:

Shoulder angle ω [°]		Transportability
above	to:	
0	30	greatly limited
30	45	good
45	65	very good
65	80	limited
80		greatly limited

Tab. 3: With regard to an air conveyor:

Shoulder angle ω [°]		Processability
above	to:	
0	30	Special approval + test for divider inserter
0	30	Special approval for clip inserter
80		Visually defective shrink-wrapped packs
80		Special approval for wrap-around pack

Tab. 4: With regard to the Variopack/Varioline packer:

Contact: Engineering Department/Packaging Division specialist department

With shoulder angles ω < 0° or ω > 65°, KRONES must be consulted.

Depending on the shoulder angle ω, the neck radius Rh and the neck height E must have the following minimum values:

Shoulder angle ω [°]		Neck radius Rh [mm]	Neck height E [mm]
above	to:		
	20	not permissible	
20	25	> 1.0	> 6.0
25	35	> 1.0	> 5.0
35		> 1.0	> 4.5
35		> 1.5	> 4.0

Corner radius

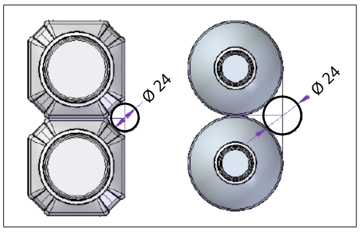

Fig. 30: Corner radius

For the processability of the containers in the Variopac packer, the corner radius must be designed as shown in the draft. Otherwise, please consult the Engineering Department/Packaging Division specialist department.

Stability

Especially for light-weight containers, sufficient stability of the empty and filled containers is important. Even if lateral forces act on the containers, they must not be strongly deformed.

Thermostability

The following percentage dimensional deviations of the nominal dimensions are permissible for closed containers filled with carbonated water (8.0 - 0.5 + 0 g/l CO_2) after 24 h storage at 38°C (any desired humidity). Further processing of containers with machine stop: Due to dimensional changes of the containers, further processing after > 30 minutes is not possible or only with major restrictions. This applies to the entire system line. This specification does not apply to grip recesses, etc.

Rated volume [l]		Height H	Outside container diameter D, Inside container diameter N
above	to:	Permissible deviation [%]	
0	1.5	3.0	4.0
1.5		3,5	5,0

Beads

Dimension T1, T2, T3	Minimum dimension
T1, T3	10 mm
T2	8 mm

The beads must be designed so that two bottles cannot become interlocked with each other.

Axial pressure load (Top Load)

The measurement of the vertical load capacity (Top Load) of the empty container up to buckling (maximum load capacity, 'peak load'). In the process, the movement speed of the piston is to be 510 mm/min to ensure the comparability of several measurements. The containers must bear an average load of k x 140 N.

Usually the container wall thickness is less if a non-carbonated product is to be filled. The top load for these applications is reduced. The containers must therefore bear an average load of k x 90 N, and the factor k is calculated as follows:

Carbonated product	Top Load = k x 140 N
Non-carbonated product	Top Load = k x 90 N
Calculation k	$k = \frac{\text{weight of sample bottle - neck finish weight}}{\text{Preform weight according to table – 6 g}}$

Other requirements

- With PET containers with carbonated product, the ambient temperature must also be specified.
- With tamper-evident labels, the Labelling Technology Division must be consulted for dimensions E + height of neck finish M < 40 mm.
- KRONES must be provided with the geometry of a PET container before and after filling the container so that the container handling parts can be adapted accordingly.

Factors which influence the fill level:

- Filler type, output, bottle neck geometry, machine pitch, size of discharge and capping starwheel, carbonation or nitrogen injector, bump formation during shrinking process
- The requirements for the fill level are very heterogeneous for the various machines, i.e. the fill level must be as high as possible and as low as necessary. A balanced fill level must be ensured in the process.

Adhesiveness

According to the "KRONES adhesiveness measurement" method, the preform/PET bottle adhesiveness must not exceed the following values:

- Preform 5 N
- Bottles 15 N

Residues on the containers may not have a negative effect on the unwinding behaviour. Sticking together of the bottles must be prevented.

Base mould

Each individual contact surface (footprint) of the container must have a diameter ≥ 6 mm.

If the contact surface is < 6 mm, processing in the shrinking tunnel is not possible.

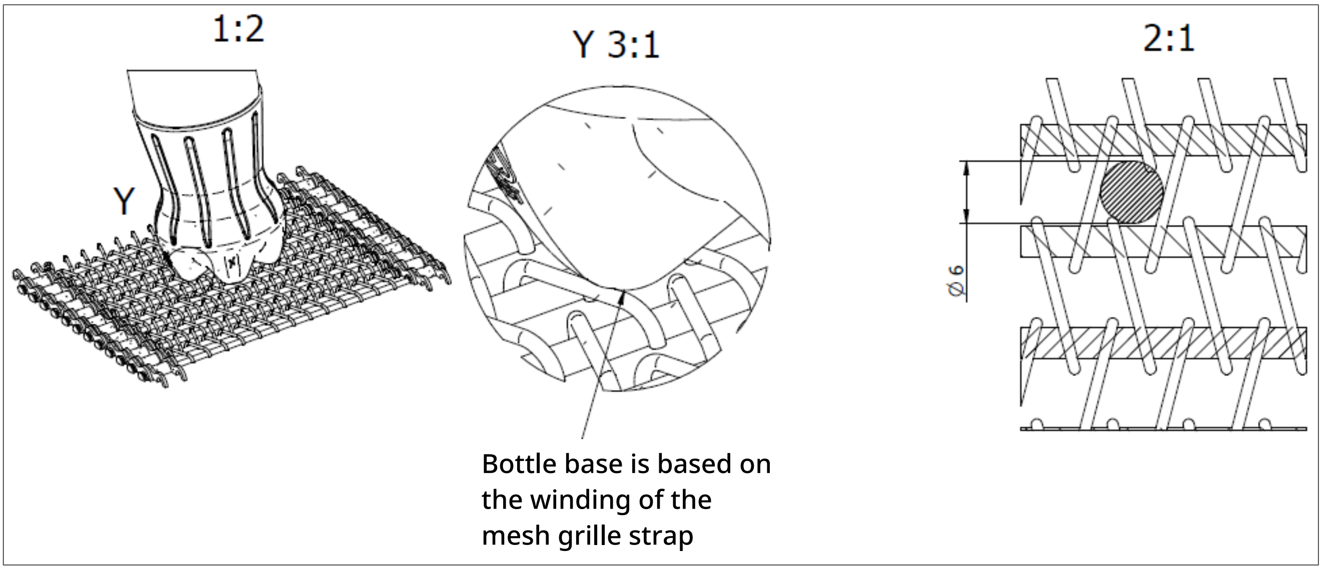

Fig. 31: Contact surface condition

Definition of adhesiveness: See preform specifications, adhesiveness supplement sheet

4 Plastic containers (without PET)

4.1 Rotationally symmetrical, cylindrical containers

4.1.1 Sample drawing - Example 1

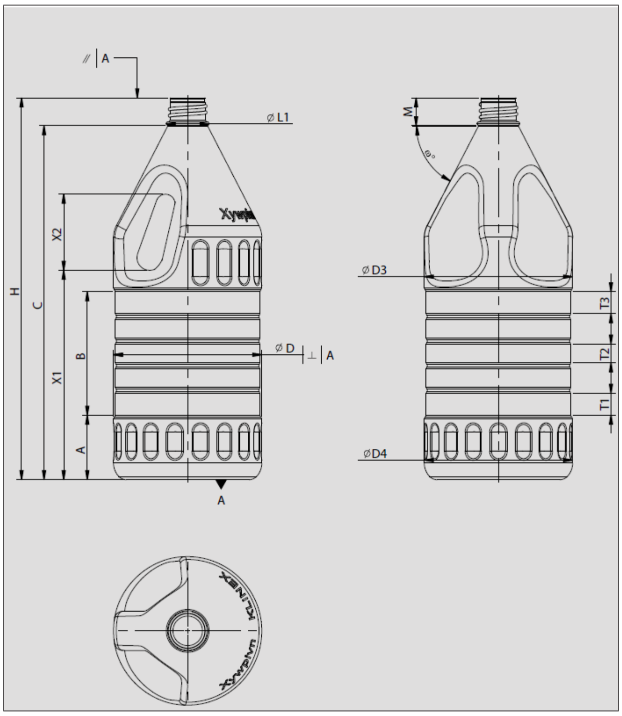

Fig. 32: Example: Plastic container (1)

// = plane parallelism

∅ L1 = neck diameter, beginning

H = container height

C = height of neck area, end

X1 = handle height

X2 = height of handle through-passage area

B = height of labelling area

A = height of labelling area, end

⊥ = perpendicularity

M = height of neck finish

ω ° = shoulder angle

∅ D3/D4 = container diameter

∅ D = container diameter

T1 – T3 = beads

4.1.2 Sample drawing - Example 2

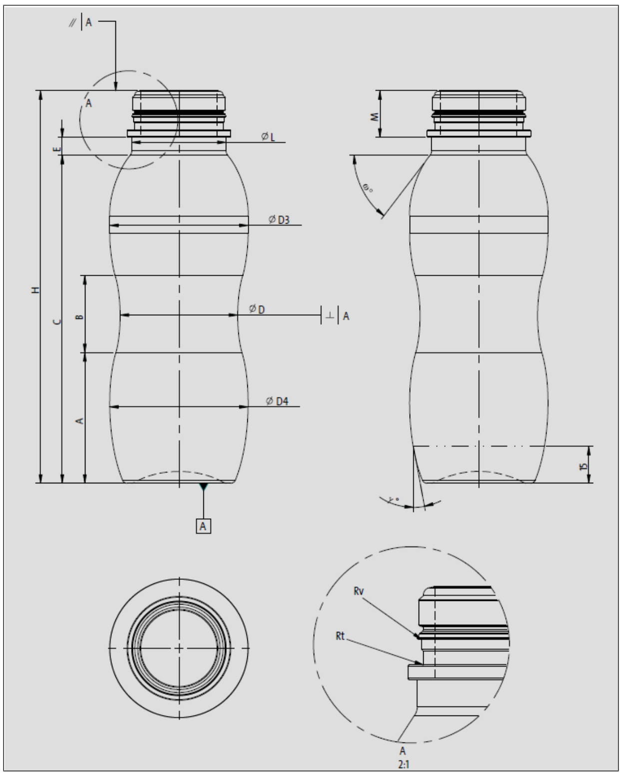

Fig. 33: Example: Plastic container (2)

⫽ = plane parallelism

∅ L1 = neck diameter, beginning

∅ L2 = neck diameter, end

∅ D = container diameter

∅ D3 = container diameter

∅ D4 = container diameter

⊥ = perpendicularity

H = container height

E = neck height, support ledge

C = height of neck area, end

B = height of labelling area

A = height of labelling area, end

M = height of neck finish

ω ° = shoulder angle

R3 – R6 = relevant container radii

Y ° = base tapering angle

Rv = Radius at cap ring

RT = Radius at support ledge

4.1.3 Shape/geometry and dimensional accuracy

Heights, containers and label diameter

Rated volume [l]		Height (H) [mm]	Container diameter D, D3, D4 [mm]
above	to:		
0	0.5	± 0.8	± 0.4
0.5	1.0	± 1.0	± 0.6
1.0	1.5	± 1.0	-0.7 | +0.8
1.5	2.5	± 1.3	-0.7 | +0.8
2.5		± 1.3	-0.7 | +0.8

Neck geometry and neck finish

For designing the neck guide, the beginning of the neck (dimension C) and the neck height (dimension E) are required.

Designation	Dimension	Permissible deviation [mm]
Neck diameter - beginning	Ø L1	+ 0.2
Neck diameter - end	Ø L2	+ 0.2

Plane parallelism

Please note “Plane parallelism“ in Chap. 4.1.1 Sample drawing - Example 1 [▸ 26]

Diameter of neck finish recess K		Permissible axis deviation from the plane parallelism [mm]
above	to:	
-	40	2 % of diameter
40	50	0.9

Rectangularity

Please note “Rectangularity“ in Chap. 4.1.1 Sample drawing - Example 1 [▸ 26]

Rated volume [l]		Permissible axis deviation of rectangularity [mm]
above	to:	
0	1.5	+ 2.0
1		+ 3.0

Additional requirements

Stability

Especially for light-weight containers, sufficient stability of the empty and filled containers is important. Even if lateral forces act on the containers, they must not be strongly deformed.

Beads

Dimension T1, T2, T3	Minimum dimension
T1, T3	10 mm
T2	8 mm

The beads must be designed so that two bottles cannot become interlocked with each other.

Axial pressure load (Top Load)

With regard to Top Load, the minimum value may not drop below 120 N for empty and full containers. Always contact KRONES when the Top Load is lower than the above!

Surface condition

Residues which occur as a result of the container production process must be presented to and known at KRONES.

If the containers are not flamed, special glues are to be used. Dirt, splattered glue, etc. are also disadvantages. In addition, glue strings often occur when the machine operates at higher speeds.

Furthermore, it must be determined here with tests which glue rollers and pallets (pairing) can be used.

Other requirements

KRONES must be provided with the geometry of a HDPE container before and after filling a container so that the container handling parts can be adapted accordingly.

4.2 Not rotationally symmetrical containers (specially-shaped containers)

4.2.1 Overview matrix

The following overview shows the various specially-shaped containers schematically

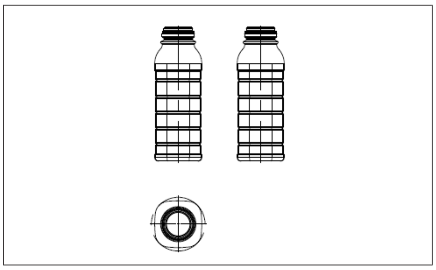

Fig. 34: Container shape – square

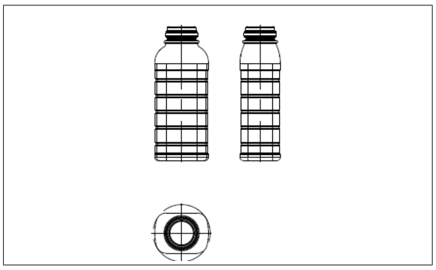

Fig. 35: Container shape – rectangular

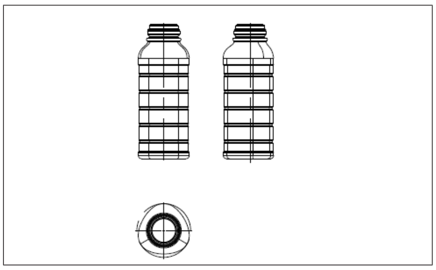

Fig. 36: Container shape – triangular

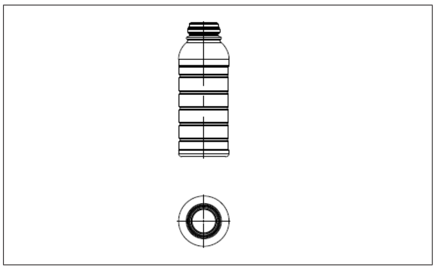

Fig. 37: Container shape – circular

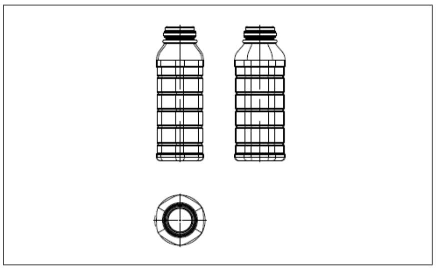

Fig. 38: Container shape – hexagonal

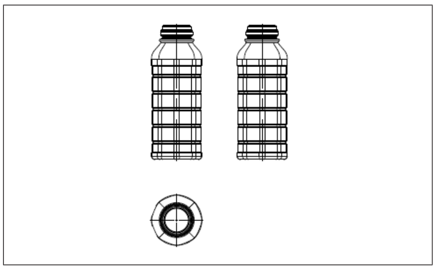

Fig. 39: Container shape – octagonal

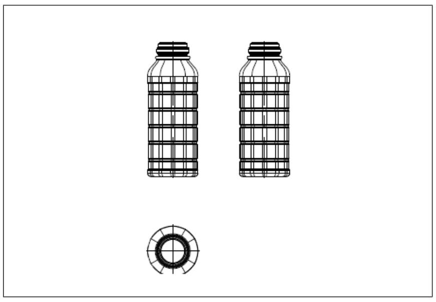

Fig. 40: Container shape – polygonal

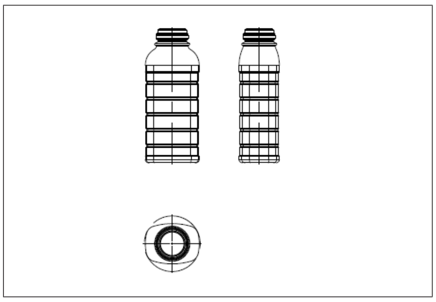

Fig. 41: Container shape – oval

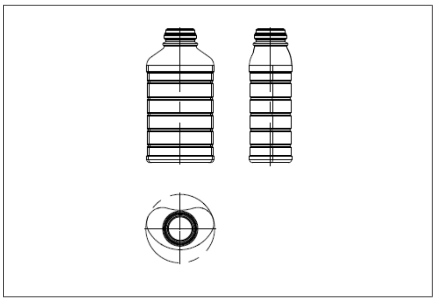

Fig. 42: Container shape - kidney-shaped

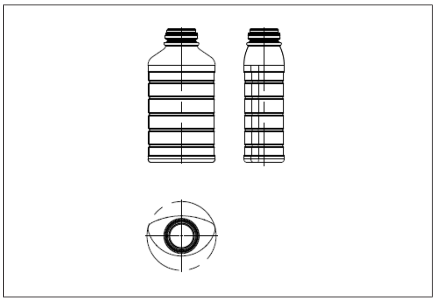

Fig. 43: Special shape and Others

4.2.2 Sample drawing - Example 1

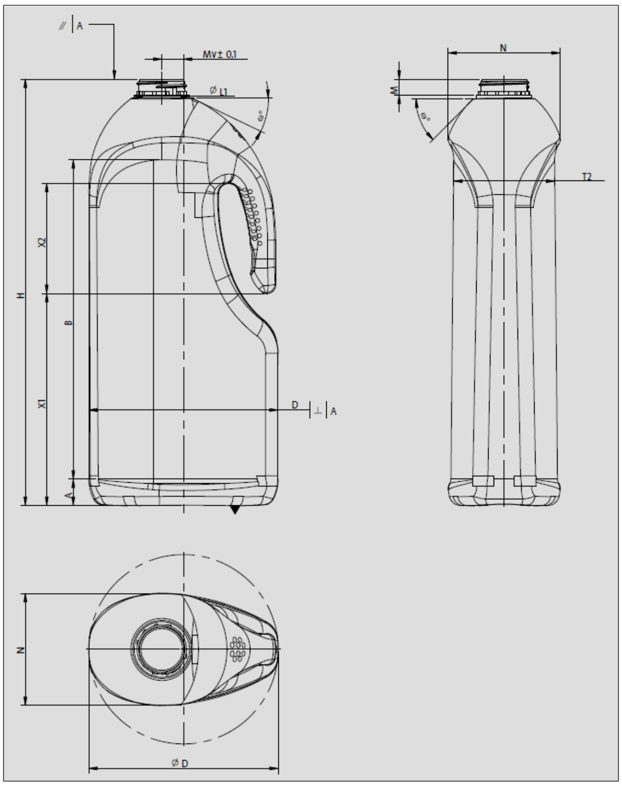

Fig. 44: Example: Plastic container (3, specially-shaped container)

⫽ = plane parallelism
Mv = neck finish offset to centre of container
∅ L1 = neck diameter, beginning
Ra = shoulder radius - front view
Rb = handle radius
H = container height
X1 = handle height
X2 = height of handle through-passage area
B = height of labelling area
A = height of labelling area, end
⊥ = perpendicularity
Rc = outer radius
Rd = inside recess radius
M = height of neck finish
Rf = shoulder radius - side view
ω ° = shoulder angle
T2 = beads
Ra - Rf = relevant container radii
∅ D = relevant outside container diameter

4.2.3 Sample drawing - Example 2

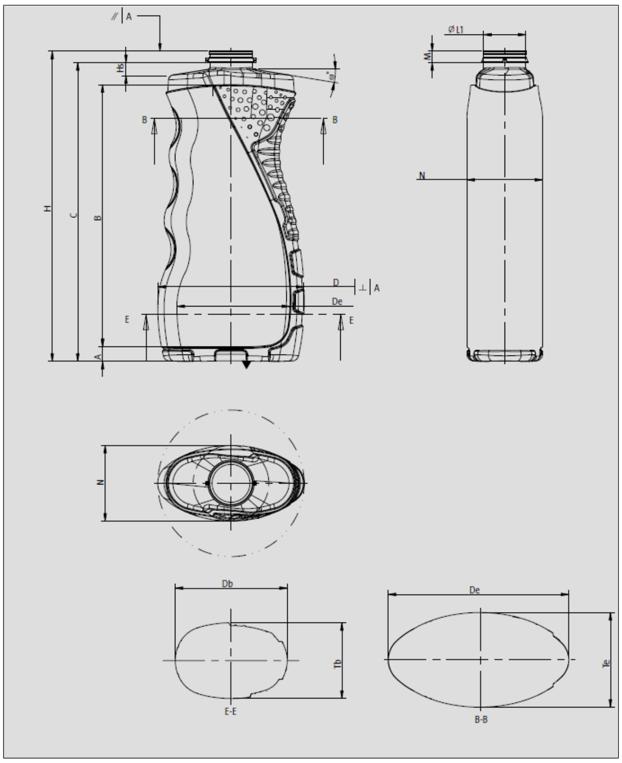

Fig. 45: Example: Plastic container (4, specially-shaped container)

⫽ = plane parallelism

H = container height

C = height of neck area, end

Hs = shoulder height

B = height of labelling area

A = height of labelling area, end

ω ° = shoulder angle

⊥ = perpendicularity

∅ D = outside container diameter

Da – De = relevant container lengths

∅ K = diameter, neck finish recess

M = height of neck finish

∅ L1 = neck diameter, beginning

T – Te = relevant container widths

4.2.4 Shape/geometry and dimensional accuracy

Heights and container diameter

Rated volume [l]		Height (H) [mm]	Outside container diameter D, Inside container diameter N
above	to:		
0	0.5	± 0.8	± 0.4
0.5	1.0	± 1.0	± 0.6
1.0	1.5	± 1.0	-0.7 | +0.8
1.5	2.5	± 1.3	-0.7 | +0.8
2.5		± 1.3	-0.7 | +0.8

Neck geometry

For designing the neck guide, the beginning of the neck (dimension C) and the neck height (dimension E) are required.

Designation	Dimension	Permissible deviation [mm]
Neck diameter - beginning	Ø L1	+ 0.2
Neck diameter - end	Ø L2	+ 0.2

Plane parallelism

Please note “Plane parallelism“ in Chap. 4.2.2 Sample drawing - Example 1 [▸ 30]

Diameter of neck finish recess K		Permissible axis deviation from the plane parallelism [mm]
above	to:	
-	40	2 % of diameter
40	50	0.9

Rectangularity

Please note “Rectangularity“ in Chap. 4.2.2 Sample drawing - Example 1 [▸ 30]

Rated volume [l]		Permissible axis deviation of rectangularity [mm]
above	to:	
0	1	+ 2.0
1		+ 3.0

Additional requirements

Stability

Especially for light-weight containers, sufficient stability of the empty and filled containers is important. Even if lateral forces act on the containers, they must not be strongly deformed.

Beads

Dimension T1, T2, T3	Minimum dimension
T1, T3	10 mm
T2	8 mm

The beads must be designed so that two bottles cannot become interlocked with each other.

Axial pressure load (Top Load)

With regard to Top Load, the minimum value may not drop below 120 N for empty and full containers. Always contact KRONES when the Top Load is lower than the above!

Surface condition

Residues which occur as a result of the container production process must be presented to and known at KRONES.

If the containers are not flamed, special glues are to be used. Dirt, splattered glue, etc. are also disadvantages. In addition, glue strings often occur when the machine operates at higher speeds.

Furthermore, it must be determined here with tests which glue rollers and pallets (pairing) can be used.

Other requirements

KRONES must be provided with the geometry of a HDPE container before and after filling a container so that the container handling parts can be adapted accordingly.

If the neck finish is offset relative to the container centre (Mv), the offset must be indicated in mm. For this, please note dimension “Mv“ in Chap. 4.2.2 Sample drawing - Example 1 [▸ 30].

5 Cans

5.1 Rotationally symmetrical, cylindrical containers

5.1.1 Sample drawing - Example 1a closed beverage containers

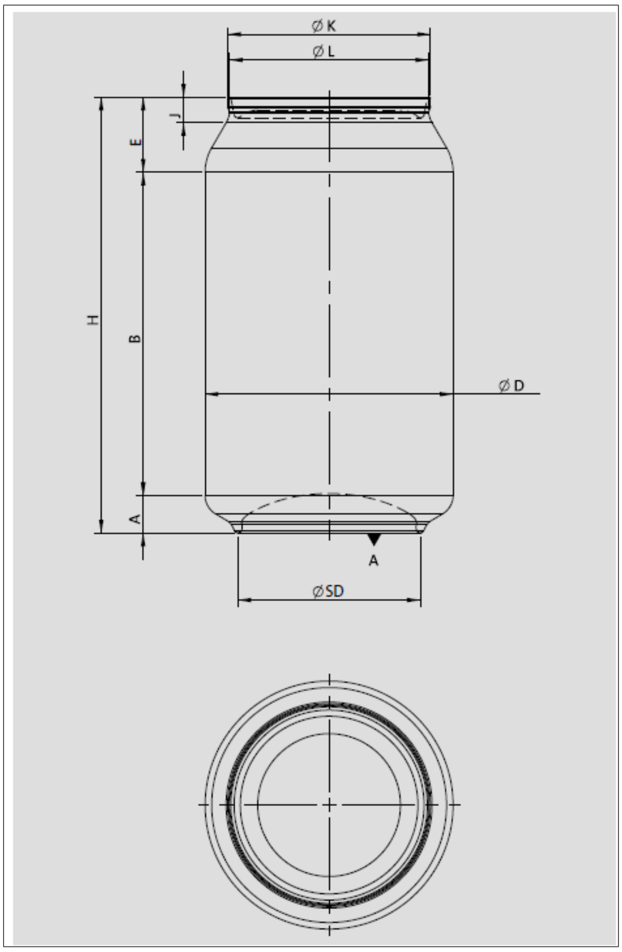

Fig. 46: Example: Beverage can (closed)

∅ K = flare diameter

∅ L = neck finish diameter

H = container height

E = height of neck area

J = flare edge height

B = height of labelling area

A = height of labelling area, end

/O/ = cylindrical shape

∅ D = container diameter

∅ SD = footprint diameter

∩ = line shape

R1 – R4 = relevant can radii

5.1.2 Sample drawing - Example 1b open beverage containers

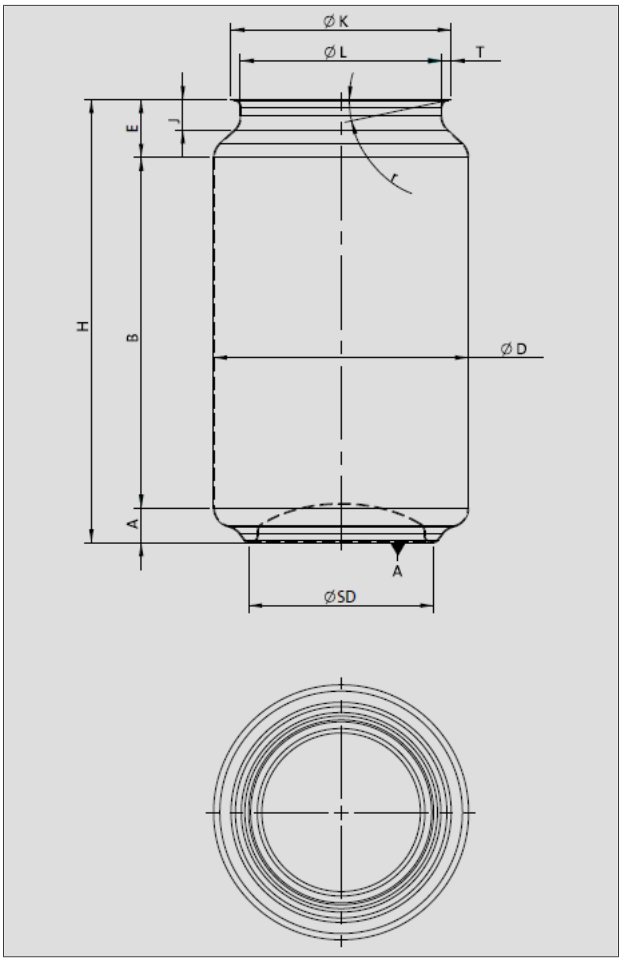

Fig. 47: Example: Beverage can (open)

∅ K = flare diameter

∅ L = neck finish diameter

T = flare width

H = container height

E = height of neck area

J = flare edge height

B = height of labelling area

A = height of labelling area, end

/O/ = cylindrical shape

∅ D = container diameter

∅ SD = footprint diameter

∩ = line shape

R1 – R4 = relevant can radii

5.1.3 Sample drawing - Example 2a closed food can

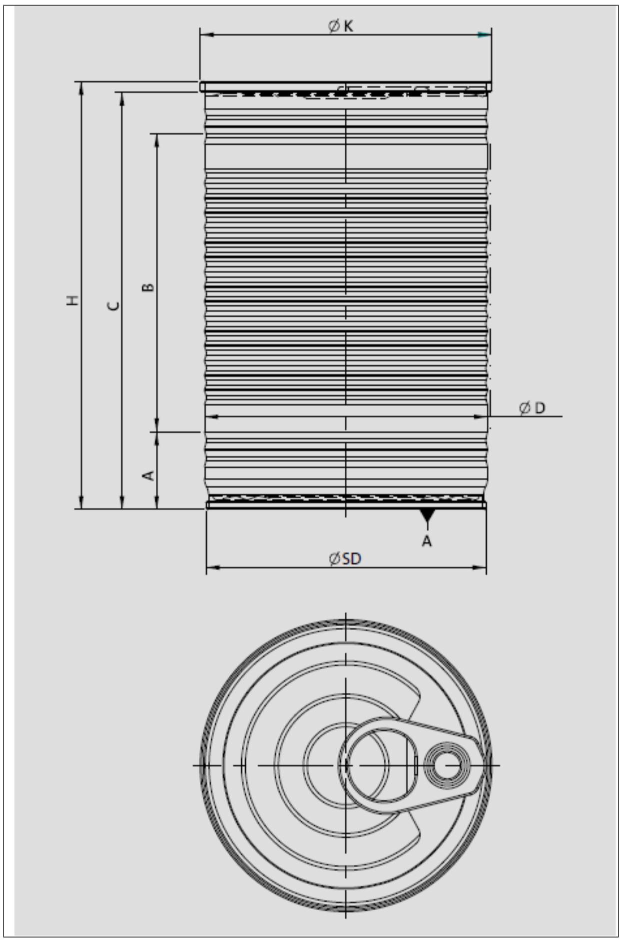

Fig. 48: Example: Food can (closed)

∅ K = flare diameter

H = container height

C = height of neck area, end

B = height of labelling area

A = height of labelling area, end

/O/ = cylindrical shape

∅ D = container diameter

∅ SD = footprint diameter

∩ = line shape

5.1.4 Sample drawing - Example 2b closed food can

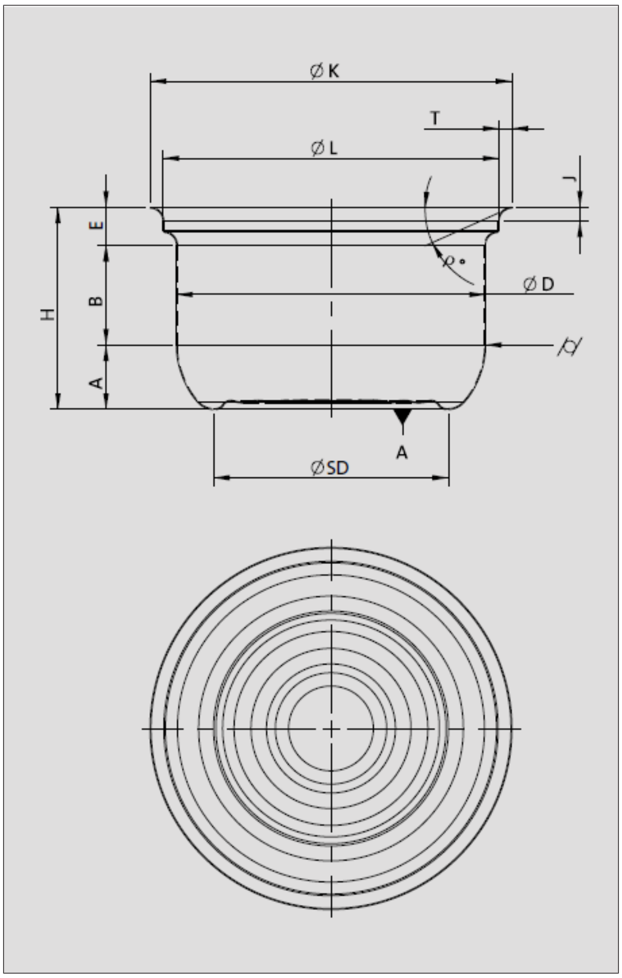

Fig. 49: Example: Food can (closed)

∅ K = flare diameter

∅ L = neck finish diameter H

H = container height

E = height of neck area

B = height of labelling area

A = height of labelling area, end

T = flare width

J = flare edge height

P°= flare angle

∅ D = container diameter

/O/ = cylindrical shape

∅ SD = footprint diameter

∩ = line shape

R1 – R2 = relevant can radii

5.1.5 Sample drawing - Example 3: Other cans

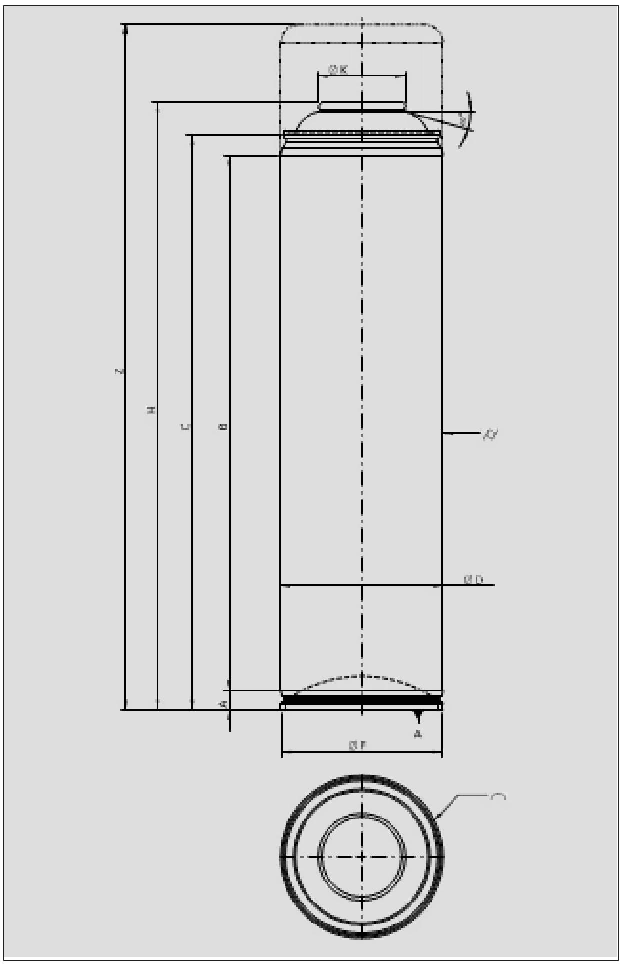

Fig. 50: Example: Other cans

∅ K = flare diameter

Ω ° = shoulder angle

Z = container height incl. closure

H = container height

C = height of neck area, end

B = height of labelling area

A = height of labelling area, end

/O/ = cylindrical shape

∅ D = container diameter

∅ F = footprint diameter

∩ = line shape

5.1.6 Shape/geometry and dimensional accuracy

Height

Rated volume [l]		Dimension	Permissible deviation [mm]
above	to:		
0	3.0	H	± 0.4

The following applies for beverage cans:

The can height must be within the following values to ensure processability in the can filler and seamer:

- **≥ 87 mm: minimum can height**
- **≤ 250 mm: maximum can height**

Measured in each case from the top edge of the can rim to the bottom edge of the can base.

Processability is no longer ensured outside these values. When these can height values are not reached and/or exceeded, KRONES must be consulted.

Container and label diameter

Rated volume [l]		Dimension	Permissible deviation [mm]
above	to:		
0	3.0	Ø D	± 0.2
Designation		Dimension	Permissible deviation [mm]
Footprint diameter		Ø F	± 0.3

The ovality is included in this deviation. With oval and square cross-sections, the wide side of the cross-section is used for defining the dimension limits.

The following applies for beverage cans:

The can diameter must be within the following values to ensure processability in the can filler and seamer:

- **≥ 52 mm: minimum can diameter**
- **≤ 85 mm: maximum can diameter**

Measured in each case at the largest can diameter.

Processability is no longer ensured outside these values. When these can diameter values are not reached and/or exceeded, KRONES must be consulted.

Neck/flare geometry

Designation	Dimension	Permissible deviation [mm]
Flare diameter	Ø K	± 0.3
Flare width	Compliance	± 0.3
Neck height	E	± 0.3

Surface condition

The surface condition of the cans must always be indicated. The following factors are necessary:

- Finish: yes (smooth or matt and/or with haptic elements)/no
- Brush-on: yes (type of brush-on)/no
- Colour
- To ensure proper inspection, the colour and the degree of gloss of the surfaces for each product tape must be uniform and consistent.
- The body area of the can must have a continuous layer of paint.

General mechanical requirements

- The can must withstand an internal pressure of at least 6.2 bar.
- The empty can must withstand an axial force of at least 800 N.
  Cans with top load values > 675 N and < 800 N are defined as lightweight cans and can be confirmed only after they have been released individually.
  Cans with a top load < 675 N cannot be processed.

Requirements for pasteurisation processes

- The customer object (can, lid, paints and internal coating) must be suitable for running through the steps necessary for the pasteurisation process without negative effects on the geometry or the contents.
- This refers, in particular, to the water properties (pH values, ingredients), disinfectants used, temperature, compressive strength (at least 6.2 bar and/or adapted to the saturation pressure of the finished product at the individually required pasteurisation temperatures), as well as the duration.

- The specifications and limits for process water specified by KRONES for the basis for the requirements. The pH value is an exception to this. In deviation from the current process water specifications, the pasteurisers for cans are usually operated with a slightly acid pH value (pH 6-7).
- The head space in the can must be at least 4 % of the nominal volume.
- A painted flap is urgently recommended to avoid the occurrence of well blackness.

Other requirements

- For smooth processing, the height H and the diameter D must not exceed the tolerances during the entire filling and packaging process! (Otherwise, malfunctions including on the rinser, can inverter and other format-dependent components are to be expected.)
- If the flare diameter K or the neck finish diameter L > diameter D, separate information must be provided (if necessary, problems/damage in the empty can area and/or rising up of the cans in the full can area).
- The cans must have a corrosion resistance.
- The material type (aluminium or tin) must also be specified.
- The dimensions of the empty can including the tolerance specifications (in grammes) must also be indicated.
- The manufacturer and the manufacturer-specific type designation must also be stated.
- The type/designation of the internal coating must also be specified.
  The internal coating must be suitable for the product to be filled and must not react with it in any way (e.g. foaming, oxygen reaction, air reaction, turbulences).
- The can base must have an undamaged and homogeneous paint coating over the entire base ring in order to enable sufficient sliding properties.

Partially or completely missing base paint affects the container handling and can lead to increased product loss, damage and scratches on the container and to an increased conveyor lubricant concentration/consumption.

6 Spotting bar geometry

Neither writing nor a relief may be applied to the container diameter of the spotting bar.

6.1 Side-spotting bars

6.1.1 Recessed side-spotting bar

For the side-spotting bar tolerances, see the following schematic. The specified dimensions are necessary to be able to design the centring spotting bar.

Designation	Dimension	Permissible deviation [mm]
Start of spotting bar above base	NBH	–
Spotting bar width	NB	+ 0.5
Spotting bar height	NH	+ 0.5
Spotting bar depth	NT	+ 0.5
Spotting bar head radius	Ra	- 0.3
Spotting bar base radius	Rb	- 0.3
Outer radius	Rc	- 0.3
Inside recess radius	Rd	- 0.3
Spotting bar inclination angle	δ	+ 2°
Recess inclination angle	φ	+ 2°

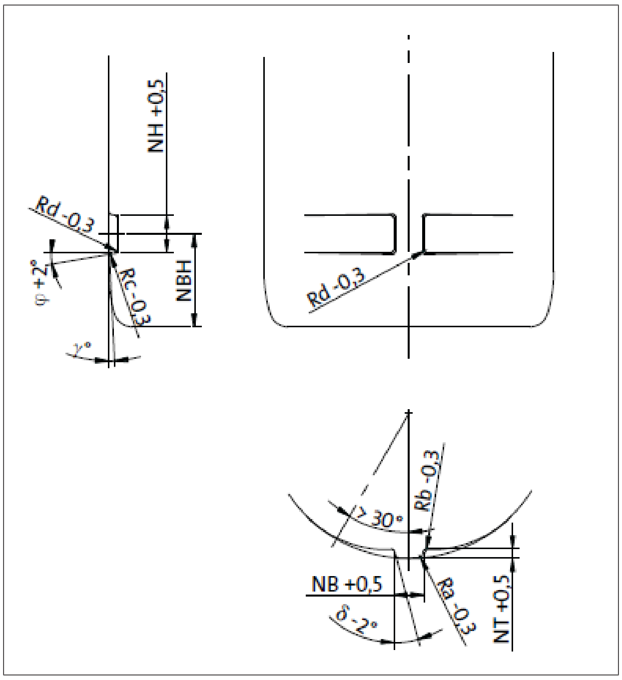

Fig. 51: Dimensioned deepened (negative) side-spotting bar

The machine running direction depends on the symmetry of the side-spotting bar. The start of the spotting bar above the base (NBH) should not be less than 15 mm. With cone-shaped base contours, the angle γ must not exceed the value 10°.

6.1.2 Raised side-spotting bar

For the side-spotting bar tolerances, see the following schematic. The specified dimensions are necessary to be able to design the centring spotting bar.

Designation	Dimension	Permissible deviation [mm]
Start of spotting bar above base	NBH	–
Spotting bar length	NL	+ 0.5
Spotting bar width	NB	+ 0.5
Spotting bar height	NH	+ 0.5
Spotting bar head radius	Ra	- 0.3
Spotting bar base radius	Rb	- 0.3
Spotting bar head radius	Rc	- 0.3
Spotting bar base radius	Rd	- 0.3
Spotting bar width inclination angle	δ	+ 1°
Spotting bar length inclination angle	φ	+ 2°

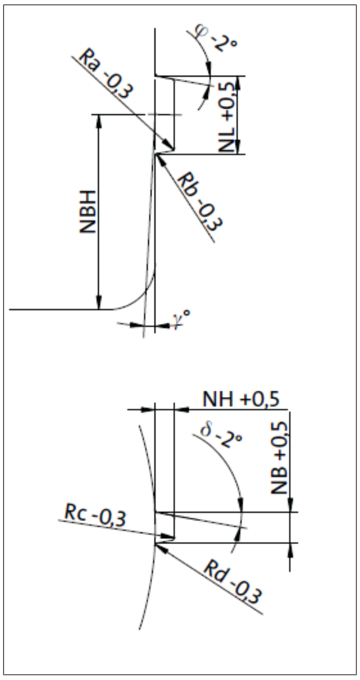

Fig. 52: Dimensioned raised (positive) side-spotting bar

The start of the spotting bar above the base (NBH) should not be less than 15 mm. With cone-shaped base contours, the angle γ must not exceed the value 10°.

6.2 Base spotting bars for glass containers

For the base spotting bar tolerances, see the following schematic. The specified dimensions are necessary to be able to design the centring spotting bar.

Designation	Dimension	Permissible deviation [mm]
Spotting bar height	NH	+ 0.5
Exterior spotting bar width	Na	+ 0.5
Interior spotting bar width	Ni	+ 0.5
Exterior spotting bar radius	Ra	- 0.3
Spotting bar side radius	Rb	- 0.3
Interior spotting bar radius	Rc	- 0.3
Spotting bar width inclination angle	δ	+ 1°

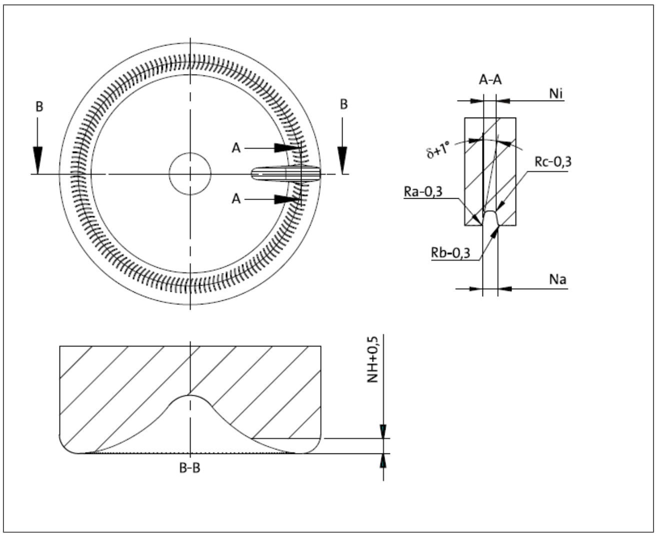

Fig. 53: Dimensioned base-spotting bar - glass container

6.3 Base spotting bars for plastic containers

For the base spotting bar tolerances, see the following schematic. The specified dimensions are necessary to be able to design the centring spotting bar

Designation	Dimension	Permissible deviation [mm]
Spotting bar length	NL	+ 0.5
Spotting bar width	NB	+ 0.5
Spotting bar height	NH	+ 0.5
Spotting bar eccentricity	NE	± 0.2
Exterior spotting bar radius	Ra	- 0.3
Interior spotting bar radius	Rb	- 0.3
Spotting bar side radius	Rc	- 0.3
Spotting bar width inclination angle	δ	+ 1°
Spotting bar length inclination angle	φ	+ 2°

Spotting bar geometry

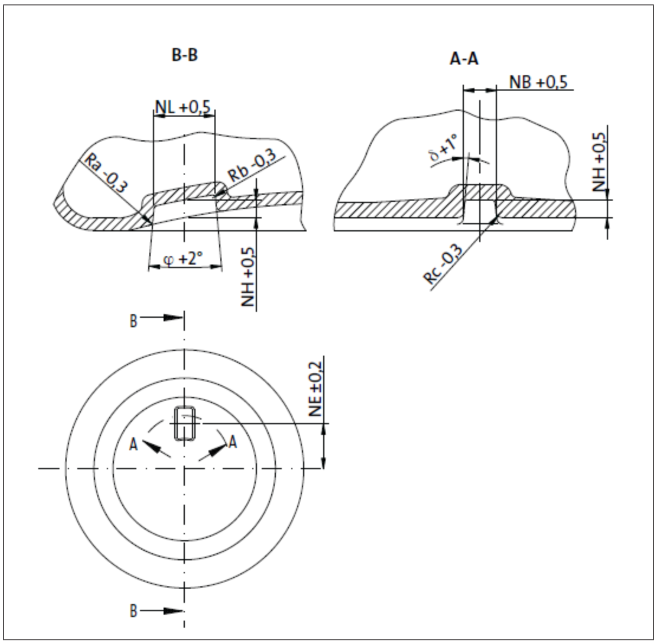

Fig. 54: Dimensioned base-spotting bar - plastic container