Specification

KRONES Preform Specifications

TD10024222 EN 02

KRONES

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1 General information

1.1 Basic information

The specified dimensions and their tolerance specifications are necessary as minimum requirements for the configuration of the different machines. Deviations from this specification must be communicated in advance to the relevant specialised departments and may result in containers outside of container specifications or not being able to process the preform.

This concerns the following parameters:

- Shape/geometry and dimensional accuracy
- Physical properties
- Quality criteria

The specification applies mainly to preforms made of PET container material. Recyclate can be used by observing a suitable, constant quality. Deviations and variations in the material characteristics may cause problems in processing up to the non-compliance of container specifications.

Preform-depending parts can only be designed in connection with the original sample or a detailing drawing. The sample or the detailed drawing must be provided by the customer. This applies especially if there are different preform suppliers (each supplier must provide the sample or detailed drawing).

Despite the adherence to all the points indicated here, the preform manufacturer is not released from the obligation to manufacture the preforms acc. to the state of the art and with absolute precision.

Upon order placement KRONES must be provided with a sufficient quantity of preforms. These preforms are part of the final tests. If no original preforms are available, KRONES offers no guarantee that the blow-moulding machine will function properly or that the specification will be observed.

All information in this specification corresponds with our current knowledge. This way they do not have the meaning to assure specific properties of the products or their suitability with a certain operation purpose.

If you have any questions, please contact our product specialists in the respective product division.

1.2 Storage and processing conditions

Preforms must not be exposed to direct sunlight and must be stored at a dry place.

The preforms must not be older than 6 months, and for customer specifications concerning pressurised containers or hotfill containers not older than 2 months. Preforms should generally not be stored too long.

The maximum stacking height of the preform packs must be chosen according to the package stability (risk of deformation).

The storage temperature of the preforms must be at least 10 °C and not more than 40 °C (see also Contiform media requirements). Before processing, the preforms must be stored for at least 24 hours at the machine or under identical ambient conditions. The temperature difference between the individual preforms, which are fed to the Contiform oven, must be maximum ± 1 °C.

Maximum moisture content of preforms

	For containers designed for hot filling		For pressurised containers or CSD containers with customer-specification[4]	For Contipure systems (preform sterilisation)
	Inline [1] processing and filling temperature 3) <89°C	Offline [2] processing or filling temperature[3] ≥89°C		
For containers up to 1 l	2,500 ppm 0.25 % wt	1,500 ppm 0.15 % wt	2,500 ppm 0.25 % wt	1,500 ppm 0.15 % wt
For containers more than 1 l	2,000 ppm 0.2 % wt	1,000 ppm 0.1 % wt	2,000 ppm 0.2 % wt	1,000 ppm 0.1 % wt

1. Inline processing without intermediate storage of the containers, e.g. in KRONES blow moulder/ filler blocks or in air-conveyor systems without additional container storage systems
2. Offline processing with intermediate storage of the containers for future filling or for container conveyance outside the filling line
3. Temperature of the product at the filling unit outlet
4. Specifications outside the "KRONES non-returnable bottle specification" and "KRONES non-returnable bottle base line specification", especially if there are requirements for the stress-crack behaviour

If the preforms come directly from the injection moulder, the moisture is usually clearly below 1,000 ppm (0.1 % wt).

2 Geometry and dimensional accuracy

For basic dimensions, tolerances and designations of the preform, see drawing KRONES preform data.

Additional tolerances:

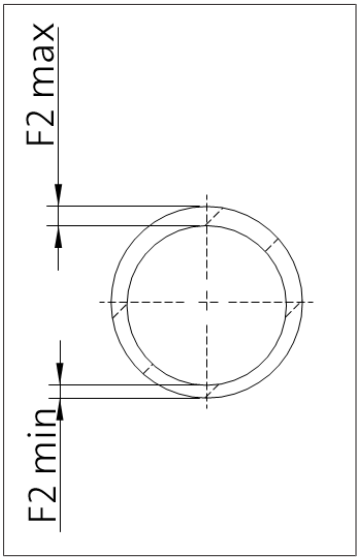
(All non-mentioned tolerances acc. to DIN 16901.)

2.1 Preform height A

A < 120 mm: ± 0.5 mm

A ≥ 120 mm: ± 0.5 %

2.2 Wall thickness variation



(F2 max – F2 min)

Fig. 1: Wall thickness variation

Preform length A	Wall thickness F2 < 3 mm	Wall thickness F2 ≥ 3 mm
< 100 mm	0.12 mm	0.10 mm
≥ 100 mm and < 120 mm	0.14 mm	0.12 mm
≥ 120 mm	0.15 mm	0.15 mm

2.3 Ovality

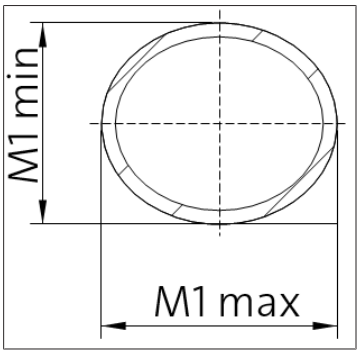


Fig. 2: Ovality

(maximum diameter M1 – minimum diameter M1)

M1 max – M1 min ≤ 0.2 mm

2.4 Axial eccentricity/perpendicularity

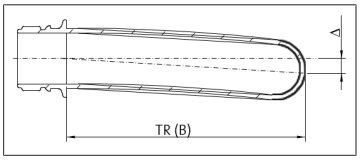


Fig. 3: Axial eccentricity/perpendicularity

Δs ≤ 0.02 B

(less 2 % of perform heigh below support ledge)

and

Δs ≤ 1.2 mm

2.5 Parting line offset

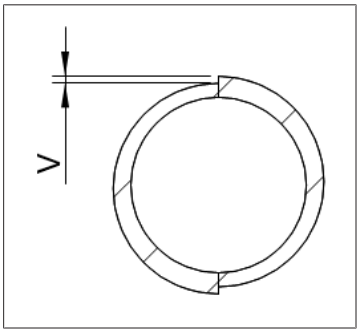


Fig. 4: Parting line offset

v ≤ 0.03 mm

The maximally determined offset is relevant in the entire thread area.

2.6 Flash

Maximum of 0.05 mm width, 0.13 mm height.

2.7 Sinkmarks

Not deeper than 0.08 mm in the body area.

Not more than 25 % of the nominal side wall thickness in the preform end cap area, and for customer specifications concerning pressurised containers, only 5 % is permissible.

3 Quality criteria

3.1 Gate nub length

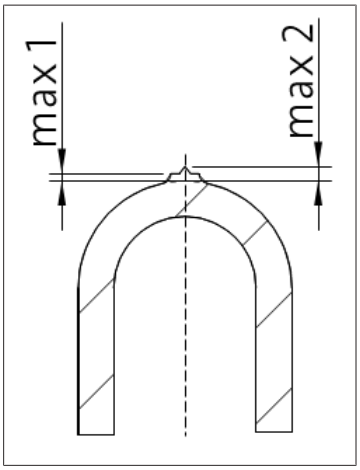


Fig. 5: Gate nub length

Maximum of 1 mm for the solid gate nub, including other overlaps of more than 2 mm

3.2 Hole formation in the gate

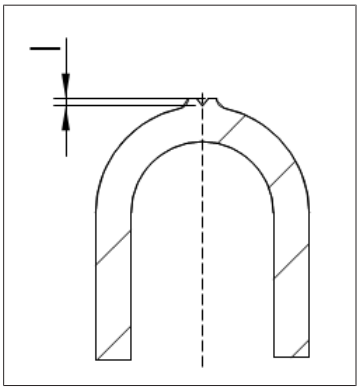


Fig. 6: Hole formation in the gate

- $l \leq 0{,}25$ F3
  (max. 25 % of the nominal wall thickness F3 in the base)
  for F3 $\leq$ 4 mm
- $l \leq 1$ mm
  for F3 > 4 mm
  At customer's specifications for pressurised containers, no hole formation is allowed.

3.3 Crystallinity of gate

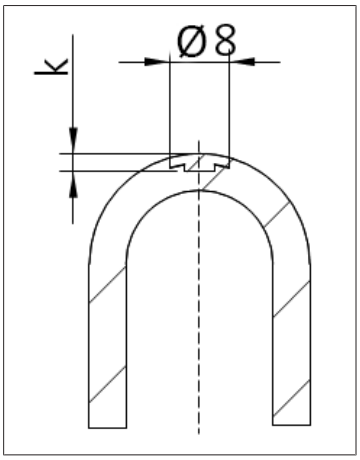


Fig. 7: Crystallinity of gate

k ≤ 0.35 F3 (the crystalline (milky) area may not be lower than 35 % of the nominal wall thickness in the preform end cap area) and it must be within a circle around the gate with a radius of 4 mm. For customer specifications concerning pressurised containers, a maximum depth of 5 % of the nominal wall thickness is permissible only (k ≤ 0.05 F3)!

3.4 Scratches

Scratches on the preform are reproduced strongly enlarged on the container. Scratches on one side of the preform are not permissible. This leads to irregular heating in the oven of the blow moulder and to a quality degradation of the containers (offcenter).

3.5 Surface cleanliness

No impurities allowed.

3.6 Weight

The preform weight must not vary by more than ±1 %, below 20 g preform weight ±0,2 g.

3.7 Not acceptable

Not acceptable:

- Foreign material in the preform, inhomogeneous areas, dull areas, gas bubbles, vacuoles, non-molten or burnt material
- Stringing on gate nub
- Cold flow
- Moisture rings
- Streaks
- Weld lines
- Damaged sealing surfaces or deviating shapes in the neck finish area (container test, sealing, container must not leak)
- Other crystallinity (except for gate)/haze (except for recrystallised hotfill threads)

4 Other relevant requirements

- Engraving of the mould number of the injection moulding tool above the support ledge for tracking upon faults
- Marking of the preform packs with preform designation, source, date of manufacture and preform material (incl. IV value and material additivation/colouring)
- No mixing of preforms from different batches (as otherwise no good container quality can be ensured)
- Preform geometry and material must be adapted to the required container (stretch ratios).
- The support ledge must geometrically be a dish-shaped ring (otherwise there is no sealing during the blowing process). Deviations such as elevations or recesses must be discussed in advance with KRONES Product Line plastics technology. No embossments are allowed below the support ledge!
- The contact area of the clamps must be free of any embossments to ensure faultless handling.
- Even if the preform (neck finish) meets all specified values, this does not imply that the combination of cap to neck finish will be compatible.
- According to the "KRONES adhesiveness measurement" method, the preform/container adhesiveness must not exceed the following values:
  - Preform: 5 N
  - Container: 15 N

5 Preform material properties

Requests on the PET resin

Application	Description	I.V. area[1], dl/g	Copolymer content[2], %
Non-carbonated	Water, non-carbonated product Container with low pressure (< 0.3 bar)	0.72 – 0.80	2 – 5
CSD	CSD, carbonated product, container highly pressurised	0.80[3] – 0.85	2 – 3.5
N_2	Non-carbonated product pressurised (< 1.5 bar) Low-carbonated product (< 4 g/l)	0.75 – 0.82	2 – 4
Heat set	Hot filling, pressurised hot filling	0.78 – 0.84	<2

1. I.V. (Intrinsic Viscosity): Measure of the viscosity and mechanic load capacity of PET (ISO 1628-5, solvent phenol/1,2 dichlorobenzene 1:1, 0.005 g/ml, 25 °C), measured at preform, the typical I.V. waste during injection moulding of preforms of about 0.02 dl/g has to be considered
2. Total of copolymers IPA and DEG
3. For customer specifications for pressurised containers the I.V. value of the preform must be minimum 0.83 dl/g

Colouring and additives, especially for opaque preforms and/or high contents of master batches (>1%), may change the processability of preforms up to the non-compliance of the container specifications and may cause heavy wear in the capper.

The tension conditions in the preform must be constant. An overpacking of the preform is not allowed, as it may lead to tension or crystallinity, therefore causing base chippings. Possible overpacking as well as tensions can be verified by scale or polarised light.

The acetaldehyde content (AA value) of the container results from the AA value of the preform. The stretch blow moulding doesn't change it.

5.1 Use of recycling material

When using recycling material, the material characteristics may fluctuate more than if virgin material is used. Higher fluctuations lead to deviating bottle quality and possibly (depending on the bottle specification) to an increased scrap rate. In the following, indications for a stable process, a stable bottle quality and a low scrap rate are given.

Black specks:

Black specks, charred material or other particles lead to locally greater heating in the IR oven and possibly to thin spots in the bottle and bottle bursts. Lower stretching rates and higher bottle wall thicknesses are to be preferred.

Size of black specks	Permissible quantity of black specks		
	In pellets	In test plates 5 g, d=45 mm, t=3 mm	In preforms
> 1 mm	0	0 %	0 %
> 0.5 mm; < 1 mm	1 piece per 10,000 g	max. 0.05 % of 5 g test plates	max. 0.2 % of the preforms at 20 g preforms (respectively 0.4 % at 40 g preforms, etc.)
< 0.5 mm	Hardly reliably detectable	Hardly reliably detectable	Hardly reliably detectable

Intrinsic viscosity

The IV value should not fluctuate more than ± 0,02 dl/g for a preform type (EN ISO 1628 – 5).

Colour value

In the visible spectrum of the light (wave length: 380 nm – 780 nm) the ΔE^*_{down} value (EN ISO 11664-4) should not deviate more than 3 from preform to preform.

Infrared value

For a safe process, the temperature of the preforms at the end of the heating section must not deviate more than +/- 2 °C from the mean value of the preform temperature.

Therefore, the transmissions T1 of a random sample of at least 5 randomly selected preforms should be determined. The maximum and minimum of the transmissions T1 should not deviate more than 1 percentage point from each other.

Therefore, the transmission T is first measured at a wave length of 1,560 nm. The measurement is carried out in the cylindrical area of the preform where you can find a constant side wall thickness d in the area of the measuring point. The measurement is also carried out vertically to the longitudinal preform axis, through two complete side wall thicknesses d and within the inner diameter of the preform. To minimise the influence of the preform geometry, the measurement includes an area as small as possible vertically to the longitudinal preform axis and, if applicable, the focus is positioned on the longitudinal preform axis.

Each transmission T determined in this way is converted to a transmission T_1 according to the following regulations:

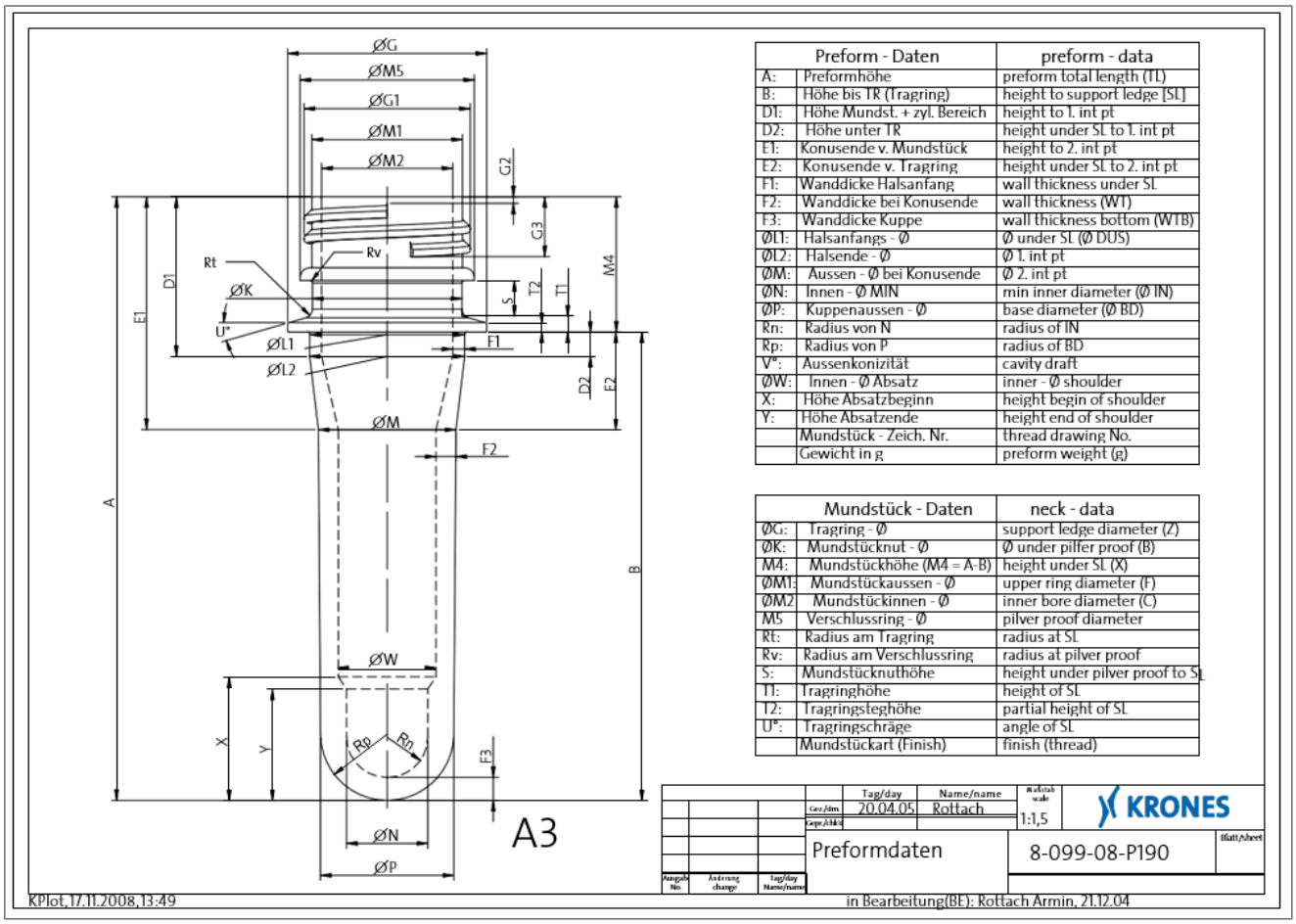
$$T_1 = \left(\frac{T}{100}\right)^{\frac{1\,mm}{2 * d}} * 100\,\%$$

T = transmission in %

d = side-wall thickness of preform in mm

6 Appendix

6.1 Relevant dimensions for preforms



Preform - Daten		preform - data
A:	Preformhöhe	preform total length (TL)
B:	Höhe bis TR (Tragring)	height to support ledge [SL]
D1:	Höhe Mundst. + zyl. Bereich	height to 1. int pt
D2:	Höhe unter TR	height under SL to 1. int pt
E1:	Konusende v. Mundstück	height to 2. int pt
E2:	Konusende v. Tragring	height under SL to 2. int pt
F1:	Wanddicke Halsanfang	wall thickness under SL
F2:	Wanddicke bei Konusende	wall thickness (WT)
F3:	Wanddicke Kuppe	wall thickness bottom (WTB)
ØL1:	Halsanfangs - Ø	Ø under SL (Ø DUS)
ØL2:	Halsende - Ø	Ø 1. int pt
ØM:	Aussen - Ø bei Konusende	Ø 2. int pt
ØN:	Innen - Ø MIN	min inner diameter (Ø IN)
ØP:	Kuppenaussen - Ø	base diameter (Ø BD)
Rn:	Radius von N	radius of IN
Rp:	Radius von P	radius of BD
V°:	Aussenkonizität	cavity draft
ØW:	Innen - Ø Absatz	inner - Ø shoulder
X:	Höhe Absatzbeginn	height begin of shoulder
Y:	Höhe Absatzende	height end of shoulder
	Mundstück - Zeich. Nr.	thread drawing No.
	Gewicht in g	preform weight (g)

Mundstück - Daten		neck - data
ØG:	Tragring - Ø	support ledge diameter (Z)
ØK:	Mundstücknut - Ø	Ø under pilfer proof (B)
M4:	Mundstückhöhe (M4 = A-B)	height under SL (X)
ØM1:	Mundstückaussen - Ø	upper ring diameter (F)
ØM2:	Mundstückinnen - Ø	inner bore diameter (C)
M5	Verschlussring - Ø	pilver proof diameter
Rt:	Radius am Tragring	radius at SL
Rv:	Radius am Verschlussring	radius at pilver proof
S:	Mundstücknuthöhe	height under pilver proof to SL
T1:	Tragringhöhe	height of SL
T2:	Tragringsteghöhe	partial height of SL
U°:	Tragringschräge	angle of SL
	Mundstückart (Finish)	finish (thread)

Fig. 8: Drawing KRONES preform data

6.2 Admissible limit values

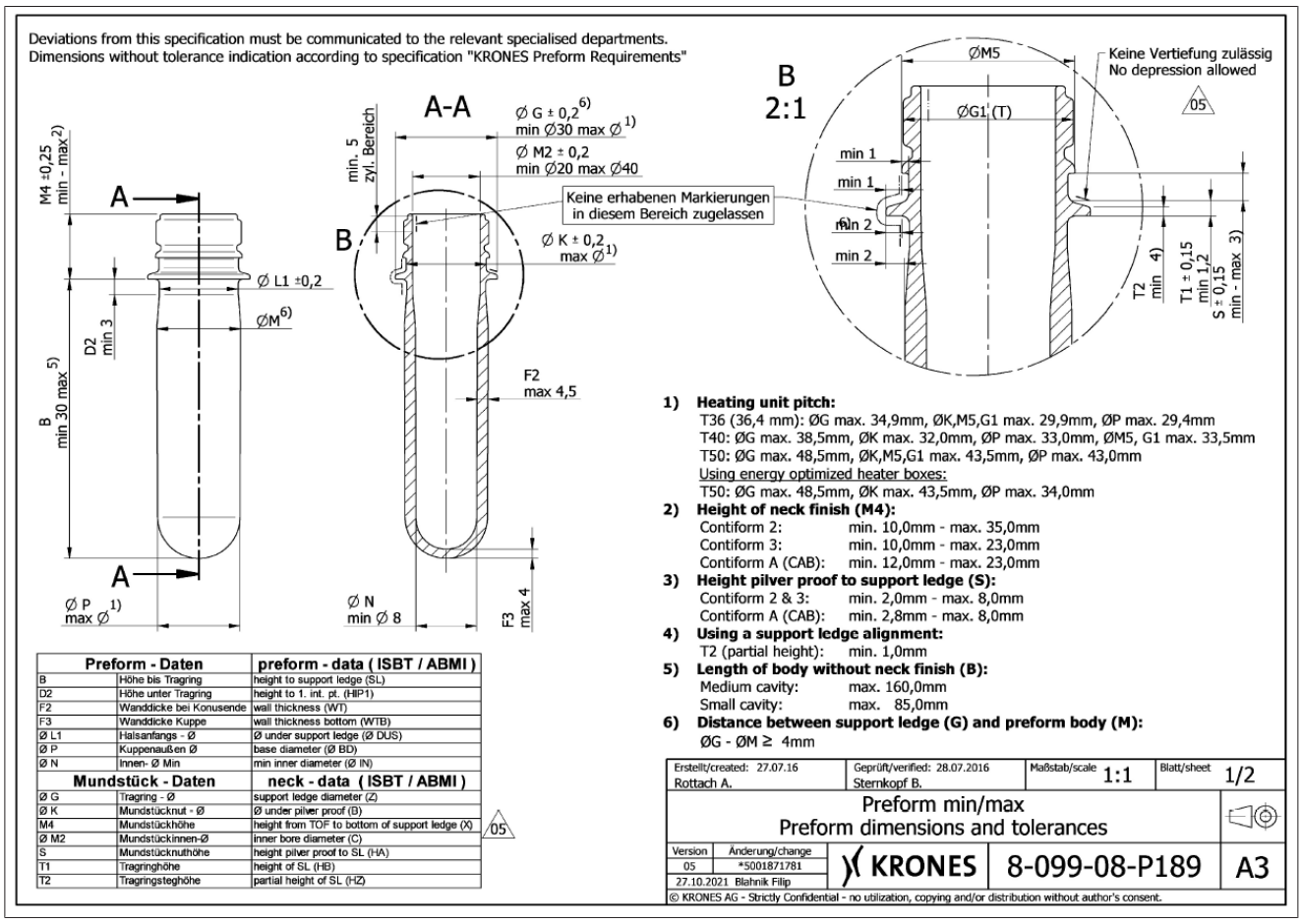


Fig. 9: Admissible limit values

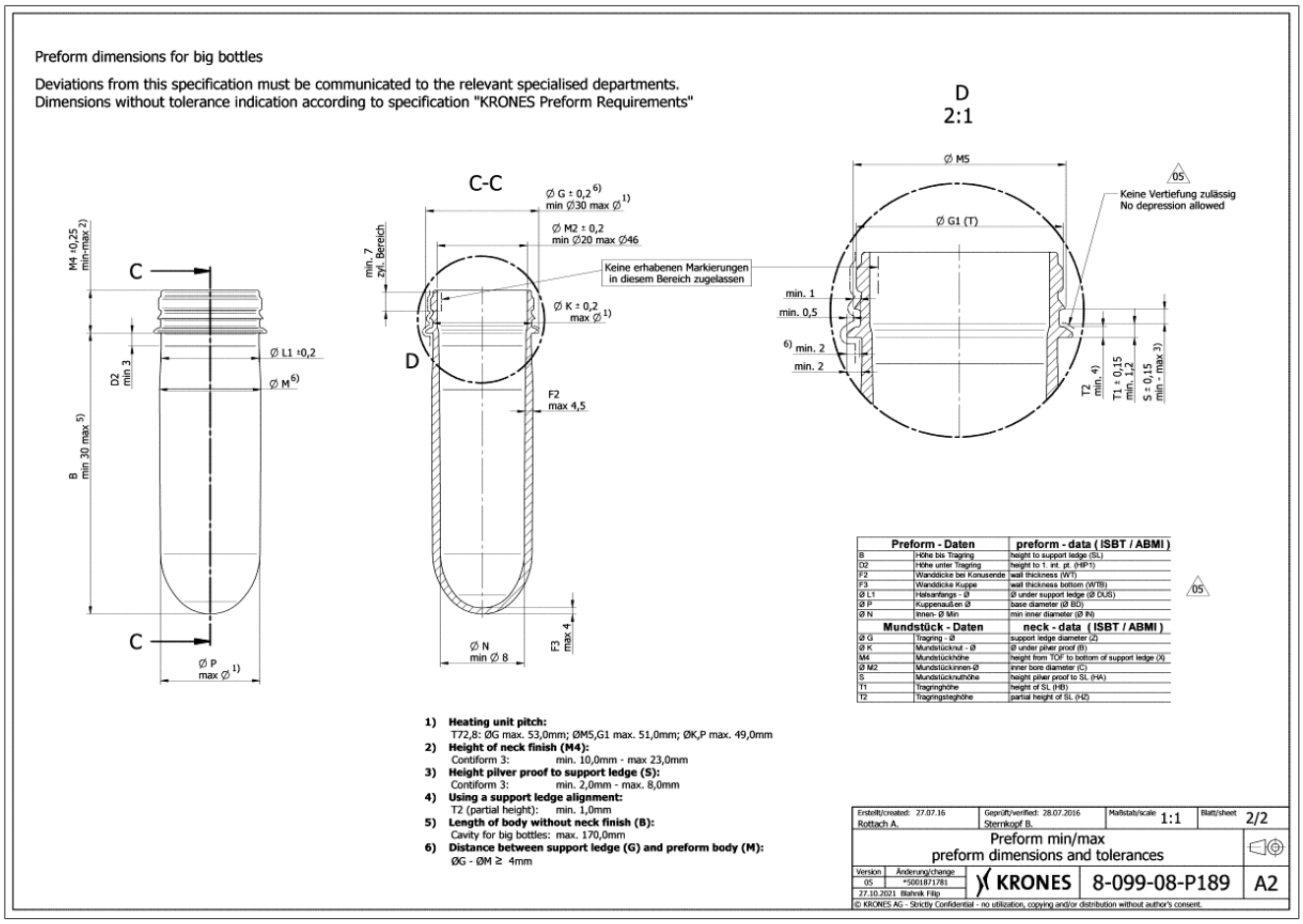


Fig. 10: Admissible limit values – Big Bottles

6.3 Preform stickiness

Specification:

The measured value for preform stickiness must not exceed 5 N.

Measuring method:

The measuring method is based on the determination of the maximum adhesive force between plastic preforms of the same material.

For this purpose, the friction pairs in the area of the preform body are brought into contact with each other and loaded with a defined supporting weight. In detail, here two preforms are clamped horizontally in a device. A third preform is laid on the preforms clamped in place at an angle of 90° to their longitudinal axis. This results in two contact points between the preforms at which the adhesive force is effective. A defined weight is laid on the preform laid on via a lever arm, which contacts the preform via a ball bearing in order not to affect its mobility and therefore the measured adhesive force.

A tensile force is applied to the moving preform in the direction of its longitudinal axis. This is then increased until the adhesive force between the preforms is overcome and the moving preform begins to slide.

This maximum adhesive force is measured between the friction pairs using a force gauge.

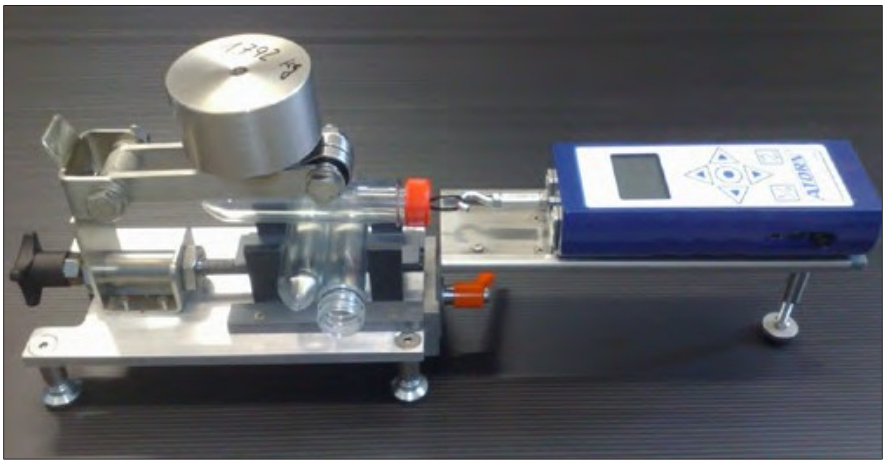


Fig. 11: Meter for the stickiness of preforms

Clamping claws are located on the base plate of the device which can be moved with the control knob on the left-hand side. The supporting weight is mounted freely rotatable with a lever arm and can be folded away to the rear. A carriage is located on the right-hand side of the device which enables free movement of the tensile force meter in the longitudinal direction of the preform axis. To obtain an aligned, horizontal pull-off direction, this carriage can be locked in its height with the locking lever in the middle of the device and the height-adjustable foot (must be adjusted according to the preform outer diameter). When doing so, it must be ensured that the preform lying on top is in contact with the two lower preforms. A fastener with an eyelet is hooked into the hook of the tensile force meter as a connection between the preform on top and the force gauge.

Handling, transport

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

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

6.4 ProShape

The ProShape neck orientation is capable of exactly aligning neck finishes with an optical system. The following parameters must be fulfilled for this purpose:

- The bottom side of the support ledge is carried out "matt". This is achieved with an unpolished, eroded surface in the injection moulding cavity.
- The alignment mark must be burr-free.
- The mark to be detected is symmetrical.
- With colourless, transparently dyed and black preforms, a notch of this kind is located on the underside of the support ledge:

Fig. 12: Notch on the underside

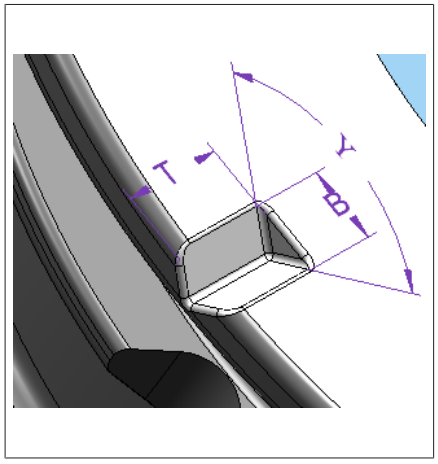


Fig. 13: Notch on the underside

Width of notch (W):	0.5 mm – 1.5 mm
Length of notch (D):	≥ 1.0 mm
Angle (Y):	60° - 120°

- For opaque preforms with little or no light-transmitting capacity, an recess of this kind must be applied on the support ledge:

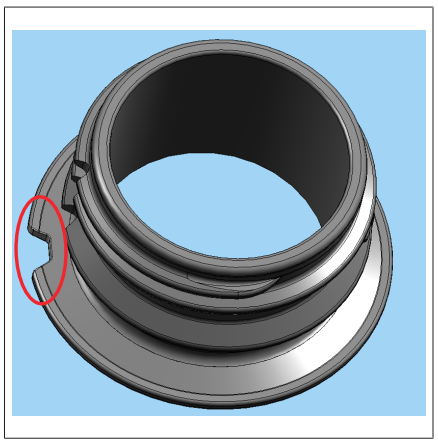


Fig. 14: Recess on the support ledge

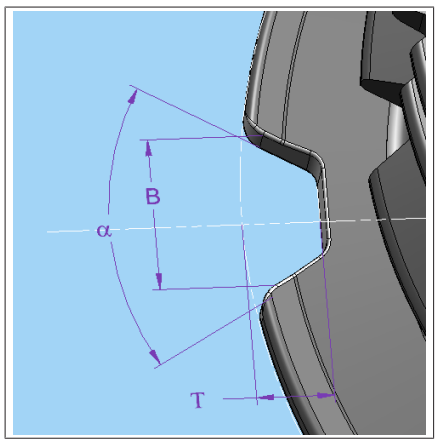


Fig. 15: Recess on the support ledge

Appendix

Opening angle (α):	≤ 50°
Width of recess (W):	≥ 1.5 mm
Depth of recess (D):	≥ 1.5 mm

Differing types of alignment marks must be checked by Krones for usability.
It is not possible to process neck finishes in which a raised marking (cam) is positioned in the area of the groove above the support ledge, as the transport grippers grip there.