Processing Guideline for Twist-Off® closures

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Warranty note

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Preface

The current guideline forms part of Silgan White Cap's TOTAL SYSTEM SOLUTION, which, apart from the manufacture of closures, the technical specification of Twist-Off® and PT glass finishes and the technical support of the capping process through capping machines and test equipment, also contains recommendations for the user's processing conditions.

The recommendations and data of the current guideline relate to the correct processing of Twist-Off® lug closures on glass containers. This includes the process filling and capping, as well as any successive heat treatment and the storage of the final packages.

The information contained herein has been kept general enough to fit all Twist-Off® lug closures. For certain closure diameters or special processing conditions, there may be recommendations, which differ from those described in this document.

Particular notes

Marking of particular notes

Information

Information note

- **Note or remark for your information.**

Warning

Warning note!

- **Important note which may have an effect on the quality as well as the functionality of the final package.**

CONTENT

DESCRIPTION OF THE CLOSURE SYSTEM

Vacuum safety closure

Twist-Off® lug closures belong to the group of metal vacuum closures, which form a hermetical seal on a suitable container immediately after the capping process. In the case of Twist-Off® closures, apart from the method of hot filling, an additional **pre-vacuum** is obtained during the capping process by the injection of steam into the headspace of the container. By means of the **vapour-vacuum method**, a higher final vacuum and an additional **expulsion of air oxygen** from the headspace of the package is obtained. The latter helps to maintain product quality and taste, as well as improving the shelf life of the packaged food product.

Package originality

As an additional benefit, the vacuum enables the visual and acoustic **testing** of the originality of the final package via a **button feature** (embossed part of the inner closure panel) converting the Twist-Off® into a genuine **vacuum safety closure**. On first opening, there is, apart from the acoustically noticeable ingress of air, a distinct **crackling sound**, as a result of the mechanical spring back of the inner closure panel.

Robust packaging system

Silgan White Cap offers **Twist-Off® lug closures** in a wide range of diameters and different **closure geometries**. Depending on the shape and diameter, there are normally **3 to 8 lugs,** which are formed into the closure curl. The associated glass finishes, whose technical specification is the responsibility of the closure manufacturer, have the same number of threads under which the lugs are positioned. Due to the glass thread pitch, a **defined spring tension forms in the closure lug** of the final package, which ensures a **firm conjunction** between the closure and the glass. This spring tension, as well as the mechanical properties of the sealant, provides a **very robust packaging system**. It withstands the most varied requirements related to heat treatment, as well as storage and transport and provides the **highest possible degree of safety** for the end-user.

Easy opening and re-sealing

Twist-Off® closures are easily opened **by a quarter turn** and simply **re-sealed** liquid tight. The convenient opening of the package is decisively co-influenced by the converter himself. The applied tension of the closure lug on the glass thread, as well as the level of the vacuum achieved in the final package, are two important variables for the resultant **opening torque**. Both parameters are adjustable by means of the sealing machines **within technical limits**.

Information

- Further information concerning available Twist-Off® closure types as well as diameter ranges can be found in the brochure „Metal Closures”.

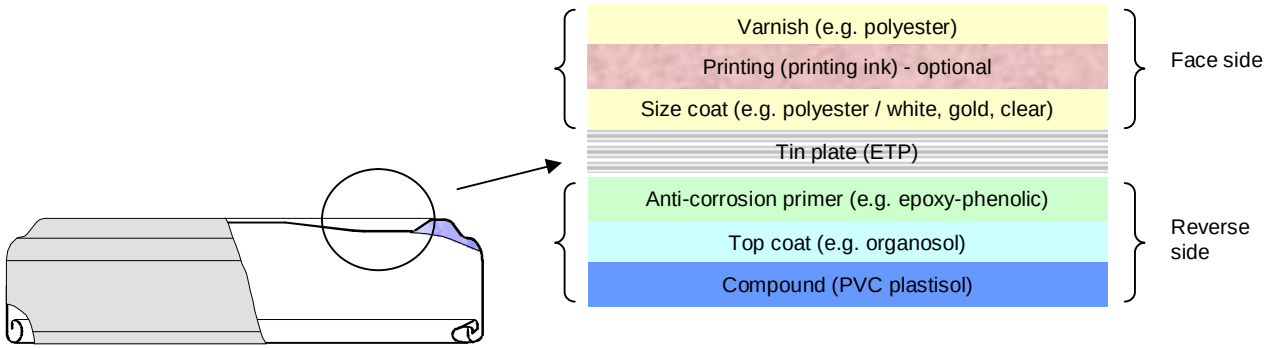
Ø Please direct your inquiry to the nearest sales office.

01 CLOSURES

01-1 CLOSURE MATERIALS

Twist-Off® closures are primarily made from double-sided **tinplate**. In respect of the intended food product contact, sheets are lacquered on the reverse side with anti-corrosion **primer**, as well as an adhesion-promoting **top coat**. Depending on the decorative aspects, the sheets are printed on the face side with one or more layers of **printing ink** and finished with a **clear varnish**. Circular blanks are then stamped out of the finished plate. The cut edges produced are open and unpainted. In the **forming process** that follows, these edges are carefully curled, lugs are formed and the closure receives its final geometry. In the last manufacturing step, the **sealant,** which produces the **gas- and liquid-proof packaging system,** is injected into the closure and finally dried in a curing oven.

Fig 01-1 / Twist-Off® closure detail



Information

- The material specifications used for the closure are provided in the relevant product data sheets (PDS).
- A declaration of conformity for the used materials in food contact (Declaration of Complains - DoC) as well as a global migration simulation for different food type categories (Closure Migration Simulation – CMS) is available on request.

Ø Please direct your inquiry to the nearest sales office.

01-2 TINPLATE

The **tinplate** applied is of varying **thickness** and **hardness** according to the closure type and its intended application. Closure types with the requirement to withstand high mechanical stress during heat treatment are generally specified with thicker material. Usually, the thickness of sheets used for Twist-Off® closures is in the range between **0.13mm – 0.24mm**. For increased **corrosion resistance tin coated sheets** are used.

01-3 COATING / PRINTING

REVERSE SIDE COATING

– For the **protection** of the **inside** of closures from **corrosion** in case of acidic or otherwise **aggressive foodstuff**, various coating systems with **anti-corrosion lacquers** are available. For food products with high protein content and for highly acidic or SO_2-

containing foodstuffs, the proper choice of the reverse coating system in relation to the food product is of particular importance. The **general resistance** against corrosion of the available coating systems is designed as a **minimum of 2 years after initial use** of the closures. For highly corrosive food products as well as for **increased closure durability** against inside corrosion, the **suitability** of the system needs to be **demonstrated** via **appropriate package testing**.

– Possible **colour shade differences** of the reverse system are either **manufacturing process related** or depend on the applied coating module itself. The visual aspects are not colour tolerated and have **no influence** on the **general resistance** of the closures.

Warning

Resistance to inside corrosion

- The choice of the suitable coating system relating to the food product requirements is done via an Silgan White Cap internal application key (Cap Application Number - CAN).
- Under correct application of the above selection criteria metal closures have a durability of a minimum of 2 years after initial use. In the case of increased requirements, suitability must be demonstrated via appropriate package testing.

Information

- Possible colour tolerances on the reverse side of the closures are process related and have no influence on the general resistance of the coating system.
- For coordination and assessment of package tests please direct your enquiry to the nearest sales office or directly to Silgan White Cap Deutschland GmbH / Department Packaging Performance via E-mail : cap.application@Silganwhitecap.com

FACE SIDE PRINTING

– **Printing** and **decoration** of the **face side** is carried out according a customer approved design. Technical restrictions on the lithography related to closure geometry are laid down in a customer information document (**Customer litho information sheets - CLI**). These restrictions and the drafted **closure decoration** need to be **aligned** and **mutually agreed** prior to final approval.

– For **protection** of the printed decoration **clear over-varnish** is used, which produces brilliance and shows high abrasion resistance in the presence of mechanical stress.

Warning

Application of new closure decorations

- Prior to new applications, closure decorations must be aligned with the technical lithography restrictions of the closure laid down in the customer litho information (CLI).

Information

- Customer litho information (CLI) is available for each closure type.

Ø Please direct your inquiry to the nearest sales office.

01-4 SEALANT / COMPOUND

Closures are equipped with **sealants aligned** to the requirements of the respective sealing and thermal **treatment conditions**. These compounds differ substantially in their **mechanical properties**, as well as in the amount of **lubricant**, which contributes to the **opening torque** of the final package.

Fig 01-2 / Twist-Off® closure

The sealant is introduced into a **ring-shaped channel** in the closure seal area.

Warning

Selection of compound

- The choice of the suitable compound in relation to the closure diameter as well as the treatment conditions is made via an Silgan White Closure internal application key (CAN / WCP-CSU).
- The correct interpretation of the above application key and observation of the recommendations in the current processing guideline ensures the optimum required level of mechanical strength during the heat treatment and the resulting opening torque of the final package.

Information

- As for the migration behavior of PVC-based sealants in food contact, external examination reports as well as a migration simulation (Closure Migration Simulation – CMS) are available on request.

Ø Please direct your inquiry to the nearest sales office.

02 CONTAINERS

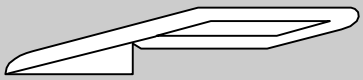
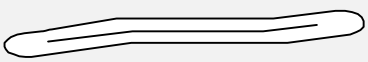
02-1 GLASS FINISH

For the various diameters and types of Twist-Off® closures, the closure manufacturers have developed and specified glass finishes.

Silgan White Cap has published a **glass finish manual**, in which current **glass finish specifications** for Twist-Off® closures, as well as quality assurance **test methods** for finishes are summarised. In addition to these finish standards; there are also **standards** for the **design** of the **glass bottom**, in order to provide good **stackability** of the final packages in alignment with the closure profile. The present manual forms the basis of an almost worldwide collaboration with the glass industry and hence a substantial **part of** the **system alignment between container and closure**.

Twist-Off® compatible glass finishes are divided into several **groups:**

Table 02-1 / Twist-Off® Glass finish types

Glass finish type	Schematic design	Description
Helix		• Helical thread without stop function • Closure lugs are positioned by means of a twisting motion under the thread (see chapter 03-2 SEALING PROCESS).
Flat		• Thread with inlet slope and horizontal ending with stop function • Closure lugs are positioned under the straight part of the thread by means of a twisting motion (see chapter 03-2 SEALING PROCESS).
Helix (special)		• Helical thread (special slope) without stop function • Only for closure diameter 43mm - 48mm • Closure lugs are positioned by means of a twisting motion under the thread (see chapter 03-2 SEALING PROCESS).

Information

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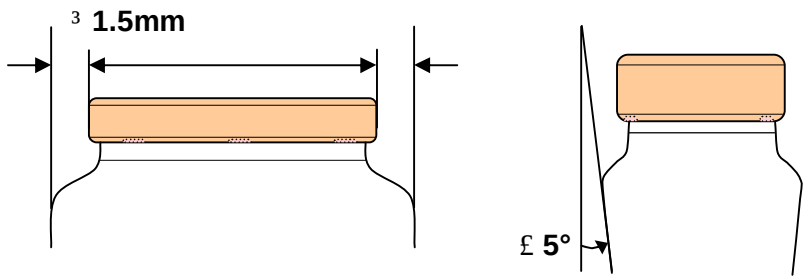
02-2 GLASS CONTAINERS

Design of the glass container

– For secure **guidance** through the sealing machine, **glass containers** are held by my means of side belts. In order to avoid any slippage of the glass containers during the capping process, the **glass body** needs to have **suitable contact surfaces**. In addition, it must be ensured, by the design of the glass container, that the created impact pressure of a filling line in operation is not directly transferred to the closure and so possibly damage it. This means that the **glass body diameter** should always **exceed** the **diameter of the closure** by a few millimetres.

Fig 02-1 / Restriction of glass body design



Warning

Specification of glass body design

- In order to avoid contact between the closures of sealed packages during filling line operation, the minimum outside container diameter should exceed the outside closure diameter by some 3 mm.
- In the case of a conical container body, in order to ensure safe guidance through the sealing machine, a negative surface slope of 5° should not be exceeded.

Possible effects of the glass container on processing behaviour

– In the manufacture of **glass containers** the application of various **coatings** to the glass surface is an important step to achieve various properties of the container, such as increased **stability / strength** (through the use of **hot end coating**) and **reduced friction** (by the use of **cold end coating**):

Ø **Hot end coating** produces a very dull, gloss-free glass surface. In the case of high coating quantities, **effects** on the **sealing** as well as the **opening behaviour** of the package can be noticed. An excessive deposit quantity of hot end coating in the finish area may lead to irregular / rising **opening torques**, as well as increased **corrosion proneness** of the **closure lug** in the presence of residual moisture. The quantity of **hot end coating** in the finish area for Twist-Off® is limited to a **maximum** of **30 CTU** (Coating Thickness Unit).

Ø **Cold end coating** produces a smooth, glossy glass surface. An excessive deposit quantity of cold end coating may lead to slipping of the glass container during its passage through the sealing machine. This endangers a proper twist-on operation and security measurements may vary widely. Cold end coating in the finish area may also adversely affect the **opening torque** behaviour. Coverage of hot end coating by **cold end coating** needs to be in proportion to the applied quantity of hot end coating.

–

– In case of the use of **multiple-trip containers**, the **glass finish** as well as the **coating quality varies** with the number of trips. Both factors may adversely affect the sealing process. Multi-trip glass varies extremely in dimensional aspects (e.g. height tolerance due to several supplier specifications, glass lots, etc.). Hence it is necessary to work with an **increased number of controls** during the filling and sealing process and possibly to react with **adjustments to sealing machine settings**.

– Admissible **tolerances** of **glass finish measurements** as well as those of the total container (such as for example the overall height, axial divergence, etc.) may result in **different processing behaviour** in the capping process, which may also lead necessarily to an adaptation of the sealing machine setting. In order to **minimise these additional adjustments**, it is recommended that a **batch-related**, or, in the case of several suppliers of glass containers, a separate **manufacturer-related processing of glass containers** be carried out.

The inspection and **compliance** to **specifications** of glass finishes according to requirements outlined in the glass finish manual belong to the **glass manufacturers** operation and should form part of the **supply agreement with** the **filler**.

Warning

Requirements for glass containers and processing

- The deposit quantity of hot end coating in the area of the finish for Twist-Off® is limited to a maximum of 30 CTU.
- The coverage of hot end coating by cold end coating must be in proportion to the hot end coating applied.
- In order to minimise the need of adaptations of the sealing machine, it is recommended to carry out a batch-related processing of glass containers and closures.

Information

Ø Please direct your enquiry to the nearest sales office or directly to Silgan White Cap Deutschland GmbH / Department Packaging Performance via E-mail : cap.application@Silganwhitecap.com

03 PROCESSING CONDITIONS

In the **filling process four important areas** can be distinguished, which from the point of view of the packaging system, have a **decisive effect** on perfect visual appearance as well as on the safety of the final package: these are the **filling process**, the **sealing process**, the **treatment process** and the **handling** of the final packages. A **sub-chapter** will be dedicated to each of these areas, in order to explain in more detail the **restrictions** and **limitations** of the packaging system in relation to the work steps used in each of them.

03-1 FILLING PROCESS

The **result of filling** foodstuffs into glass containers is very dependent on the properties of the food product itself (paste, pieces, low viscosity or readily poured). The **target** of the **filling process** is to **meet** the **tolerances** of the **declared fill weight**. From the point of view of the **packaging system,** the **requirements** of **clean filling** as well as those of maintaining a **stable headspace** at a **constant filling temperature** are additional to the requirements mentioned earlier.

Filling

- **Excess product** during filling may lead to **capping problems** or to **embedding** of the compound, increasing the risk of **integrity loss** or subsequent microorganism growth (e.g. mould growth) in the vicinity of the glass finish.

- **Oily contamination** of the glass finish or glass body may adversely affect **sealing behaviour** in the capping machine, as well as the **opening torque** of the final package.

- Products containing high percentages of **starch** or **sugar** tend, in the case of excessive filling levels, to have high **opening torques**.

- **Strongly acidic food products** can, in case of overfilling, contribute to **corrosion problems** in the area of the **closure curl** and **lugs**.

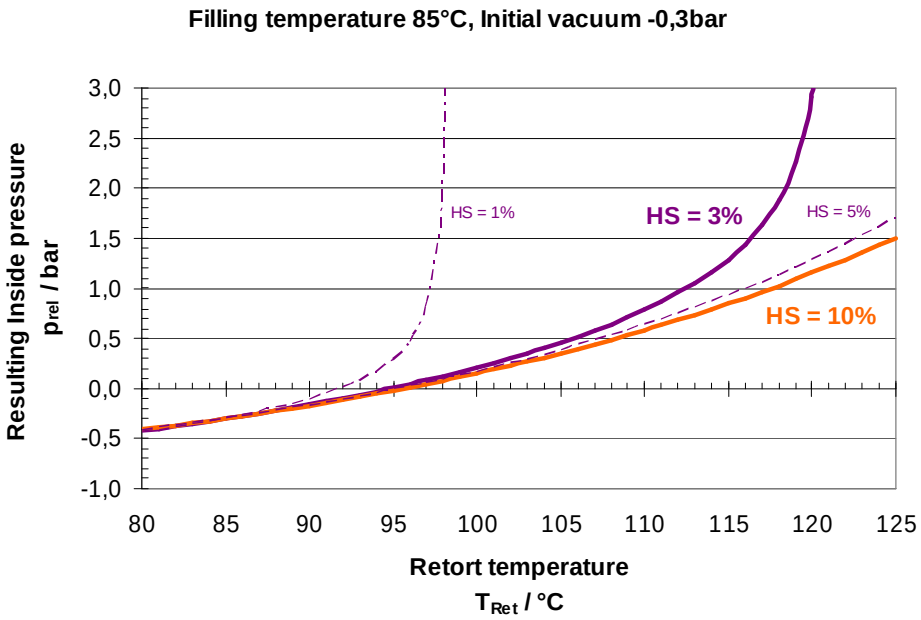
Headspace

- The **filling process** should be as **stable** as possible, since the resulting **headspace** (**HS** / percentage brimful jar capacity) has a **strong influence** on inside **pressure development** during **heat treatment** as well as on the **vacuum** of the final package. A very **small headspace volume** results in an **extreme progression of inside pressure** (see Fig 03-1 / Headspace - Inside pressure dependency).

- **Filled product pieces** should not protrude the surface of the filling liquid, since this may disrupt **vapour distribution** and may result in a change of **headspace volume** and vacuum of the final package. In addition, **discolouration of product** as well as product adhesion to the closure after heat treatment can happen and may have an **adverse effect** on the **visual appearance** of the product during first opening.

- **Trapped air** in the product or the **formation of foam** during the filling process may also adversely affect the vacuum and possibly lead to **blow-off phenomena** during heat treatment or to a **lower** than expected **final vacuum**.

Fig 03-1 / Headspace - Inside pressure dependency

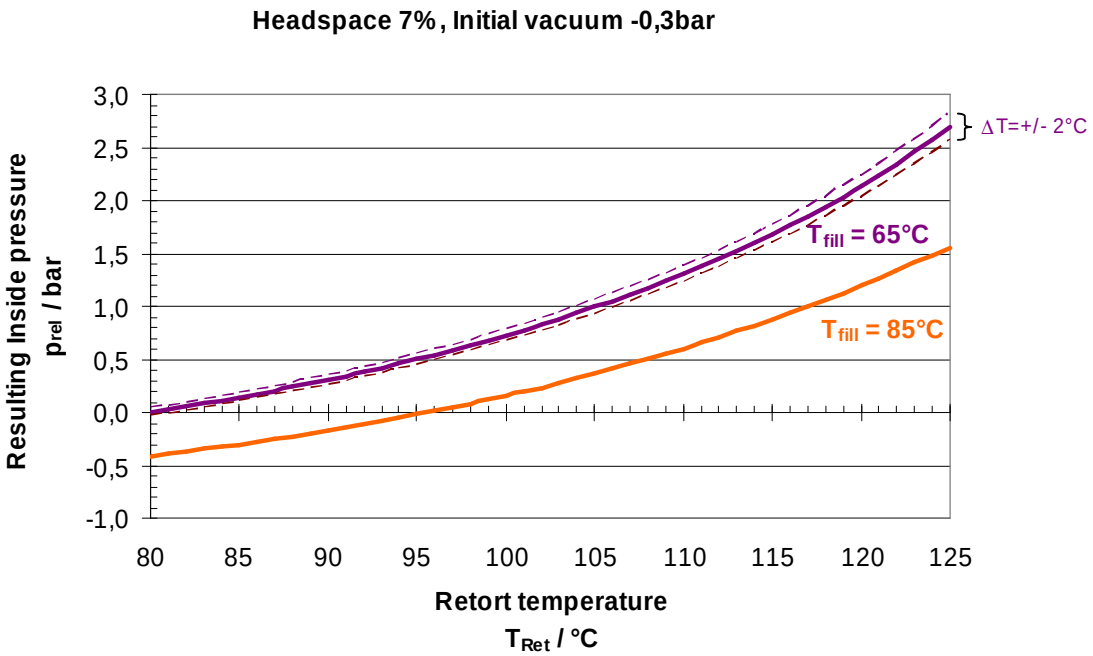


Filling temperature

- The **filling temperature** (T_{Fill} / C) has a decisive effect on the progression of the **inside pressure** during **heat treatment**. The **lower** the chosen **filling temperature**, the **stronger** the **rise** of container **inside pressure**. (see Fig 03-2 / Filling temperature - Inside pressure dependency). In a hot fill process (65°C, HS=7%) with successive sterilisation, temperature fluctuations of **±2°**C may result in a **change** of container **inside pressure** during processing of about **0.2bars**.

- The fill temperature is also **directly linked** to the final **vacuum** in the package and the related **opening torque**.

Fig 03-2 / Filling temperature - Inside pressure dependency



Warning

Filling process requirements

- Clean fill: No overfilling / protrusion of product over the glass container finish.
- Stable headspace: Compliance with filling tolerances. Avoidance of foam formation during filling. De-aeration of paste products. Alignment of headspace volume with requirements for the heat treatment process.
- Even - adaptation to the treatment process - filling temperature (see chapter 03-3HEAT TREATMENT / HANDLING OF FINISHED PACKAGES).

03-2 SEALING PROCESS

Fig 03-3 / Silgan White Cap sealing machine

After filling, the containers should be moved to the **sealing process** by the **shortest route**, in order to avoid unnecessary **loss of temperature** and to minimise the risk of **contamination** of the filled product by foreign substances or any airborne bacteria. Apart from **manual capping**, which is hardly used on an industrial scale, Twist-Off® closures are mostly capped automatically by means of **straight line sealing machines**.

After entry of the filled containers into the sealing machine, the container and the closure are brought together in the **machine head** in a **controlled steam atmosphere** and mechanically combined by a **composite press and twist-on operation**. The **closure lugs** are positioned under the thread of the container finish and tightened according to the preset **capping momentum**.

Initial vacuum

– The **steam**, which under optimum conditions has virtually expelled about ¾ of the **air** in the container **headspace**, **condenses** and forms an **initial vacuum** ($\mathbf{P_{vac}}$ / bar), which once more influences the inside pressure development of the container. The **stronger** the **vacuum** after the capping process, the **lower** the **resulting inside pressure** in the container during the heat treatment. Fluctuations of the initial vacuum of ± 0.1bar result in a change of inside pressure during sterilization of 0.4bar (see Fig 03-4 / Initial vacuum – Inside pressure dependency).

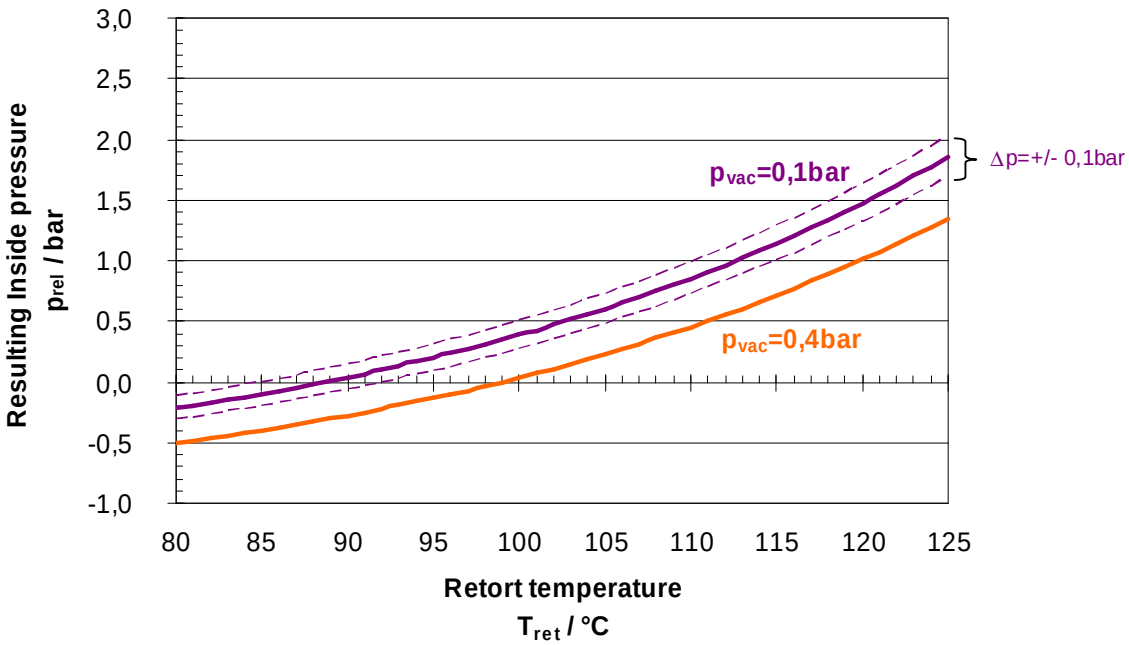
– The low container pressure results in a depression of the **closure panel** (height difference) and makes it possible, with few exceptions (e.g. extreme hot fill) for it to be controlled both visually and by technical means. Any sealing faults can be immediately noticed.

– In addition, the steam brings about a time and temperature dependent **softening** of the closure **compound**, which after sealing and re-opening becomes visible as a **permanent impression** of the **glass container finish**. This embedding of the finish into the compound over the whole circumference guarantees the **seal integrity** of the packaging system over its whole shelf life. For more details of compound pre-heating, please refer to the closure related PDS (Product Data Sheet).

– In case of **insufficient vacuum** after the sealing machine, it is recommended to install a **vacuum detector** at the line, to recognize and lock out **insufficiently sealed containers** or containers without closure. By this method it is possible to prevent defective packages running through the subsequent processes with standard products and having an ad-

verse effect. In addition, the method of ejection of defective packages after the sealing operation allows an **analysis** of **failures**, to recognize **root causes** and to take **corrective actions** early in the process.

Fig 03-4 / Initial vacuum – Inside pressure dependency



Some food products with **high gas content** are **vacuum sensitive** and, under large vacuum levels tend to float and/or to lose consistency (e.g. fish, dressing, fruit and marmalade with pieces). For these products it is recommended to restrict the **final vacuum to not more than -0.4bar**. With the use of button closures however, the final vacuum level is determined by the required vacuum of the closure to ensure a proper button flip function.

During a **production line start-up**, as well as during changes of glass or closure batches, it is necessary to carry out **controls** of **capping results** (see chapter 06-2 CONTROL OF CAPPING RESULT). Possibly identified divergences need to be corrected by means of adjustments to the sealing machine. In the case of **lines stops** and simultaneous continuous steam flow into the sealing machine, any **residual glass containers** and **closures should be removed** before restarting the production line. Alternatively, an automated steam shut-off function could be integrated into the sealing machine.

Glass containers entering the sealing machine must be at an **even distance** from one another, in order to ensure that **uniform capping results** are achieved. The minimum recommended distance is about one utilized cap diameter or one glass body, whichever results in a wider distance.

Sealing faults which occur immediately after the capping machine may have **multiple causes**. Apart from **filling conditions,** the **machine setting parameters** should be considered, as should the **dimensional aspects** of the **container** and the **closure**. To eliminate sealing faults which are due to faulty settings of the sealing machine, please consult the manufacturer's manual. A description of the most common **faults** can be found in the appendix of this document (see appendix 06-2 FAILURE DESCRIPTION).

Information

- For sealing machine settings please refer to the manufacturer's manual.

Ø Please direct your enquiry to the nearest sales office or directly to Silgan White Cap Deutschland GmbH / Department Technical Customer Service.

03-3 HEAT TREATMENT / HANDLING OF FINISHED PACKAGES

After the sealing process, the finished packages usually pass through a **heat treatment process**, in order to **preserve** the packaged foodstuff. Current methods as well as the **suitability** and **limitations** of the **Twist-Off® closure system** are explained in the following chapters.

The **general suitability** of the various closure diameters and their geometries for different treatment methods depend on the related glass finishes. A corresponding **overview** list, which links **closure type**, **glass finish** and suitable **treatment method,** is given in appendix 06-1 SUITABLE TREATMENT METHODS FOR TWIST-OFF® CLOSURE SYSTEM .

03-3.1 METHODS / SYSTEM BOUNDARIES / SPECIALTIES

Methods of heat treatment

Twist-Off® treatment processes are generally classified according to **temperature ranges** and the **methods** used:

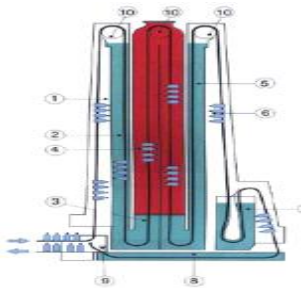
Table 03-1 / Methods of heat treatment

Type of treatment	Description
No treatment	– **Cold fill** / **hot fill** – Sealing with / without initial vacuum – Cooling / **no thermal treatment**
Pasteurisation without system pressure	– **Cold fill** (with restrictions) / **hot fill** – Sealing with **initial vacuum** – **Pasteurisation** in **open system**
Pasteurisation with system pressure	– **Cold fill** / **hot fill** – Sealing with **initial vacuum** – **Pasteurisation** in **closed system**
Sterilisation in batch autoclave / hydrostat with system pressure	– **Cold fill** (with restrictions) / **hot fill** – Sealing with **initial vacuum** – **Sterilisation** in **closed / continuous system**

Fig 03-5 / Examples of apparatus types for heat treatment

Tunnel pasteurizer
Open system

Batch autoclave
Closed system

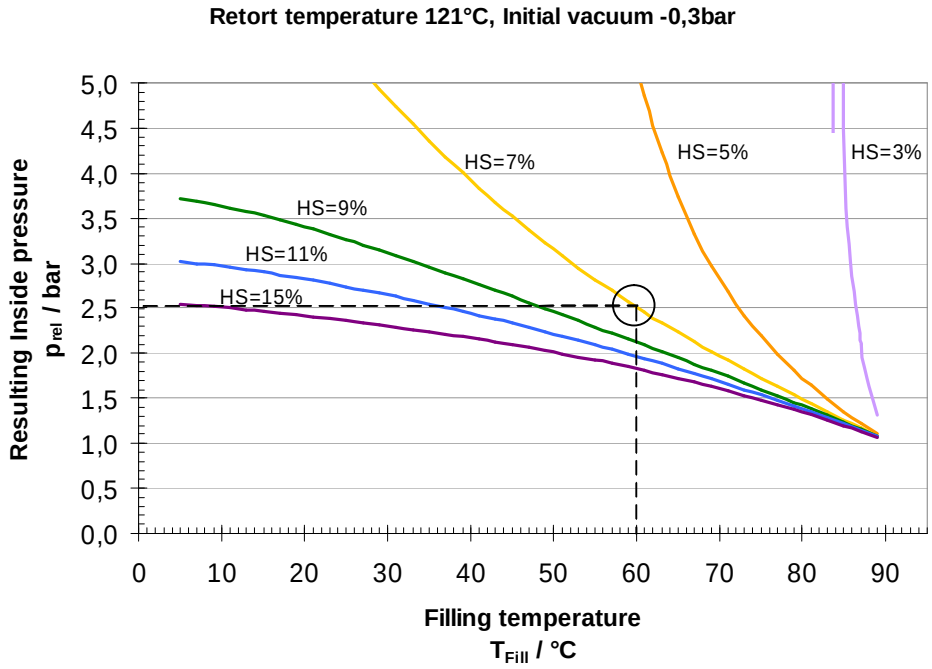


Hydrostat
Continuous system

Heat treatment – Container inside pressure

– As already described in chapter 03-1 FILLING PROCESS, apart from **filling temperature**, **headspace** and **initial vacuum**, the **heat treatment temperature** is decisively responsible for the **pressure build-up** inside a closed container. As an example the following graph demonstrates the dependency of the single filling and sealing parameters (T_{Fill}, HS, P_{vac}) relating to the resulting maximum inside pressure (p_{rel}) at an assumed sterilization temperature of 121°C:

Fig 03-6 / Filling temperature and headspace – container inside pressure dependency



Example: - - - - - -

Filling temperature Tfill=60°C, headspace HS=7%, vacuum P_{vac}=-0.3bar, sterilisation temperature T_{ster}=121°C.

Resulting container inside pressure p_{rel} =2.5 bar.

– **The smaller** the chosen **headspace** and **filling temperature**, **the higher** the **resulting pressure** inside the container, at sterilization temperatures of 121°C. Therefore special attention needs to be paid in most thermal treatment processes, that **adequate system pressure** is applied, to prevent **closures** from **ventilation** during heating and holding time phases. **Temperature variations** during sterilization of about **± 2°C** may result, in the given example, of a **change** in **container inside pressure** of about **0.5bar**.

System boundaries – closure restrictions

– The above context results in boundaries for the closure system. For Twist-Off® sealed packages special care needs to be taken so that during the entire process the **pressure differences** between **system pressure** (p_{Ret})and resulting **inside pressure** (p_{rel}) does not exceed certain **values**:

Ø **Over-pressure situation p_{Ret} >> p_{rel}:** If the system pressure is distinctly above the pressure inside the container (**generally higher than 0.7bar**), cut-through of the sealant may occur in the holding - / start of cooling phase of the sterilisation process or the **functionality** of the **closure button** may be impaired.

Ø **Excessive inside pressure p_{rel} >> p_{Ret}**: If the container inside pressure is distinctly above the system pressure (**generally higher than 0.3bar - 0.5bar**), **changes** of the closure seat (backward rotation), up to **blow-off phenomena** (product over boiling) may occur. This **blow-off** situation holds the risk, that the **vacuum** in the final pack-

age changes unexpectedly and product **unsterility** may occur, because of a possible **sucking up** of **process water** during the cooling phase of the treatment.

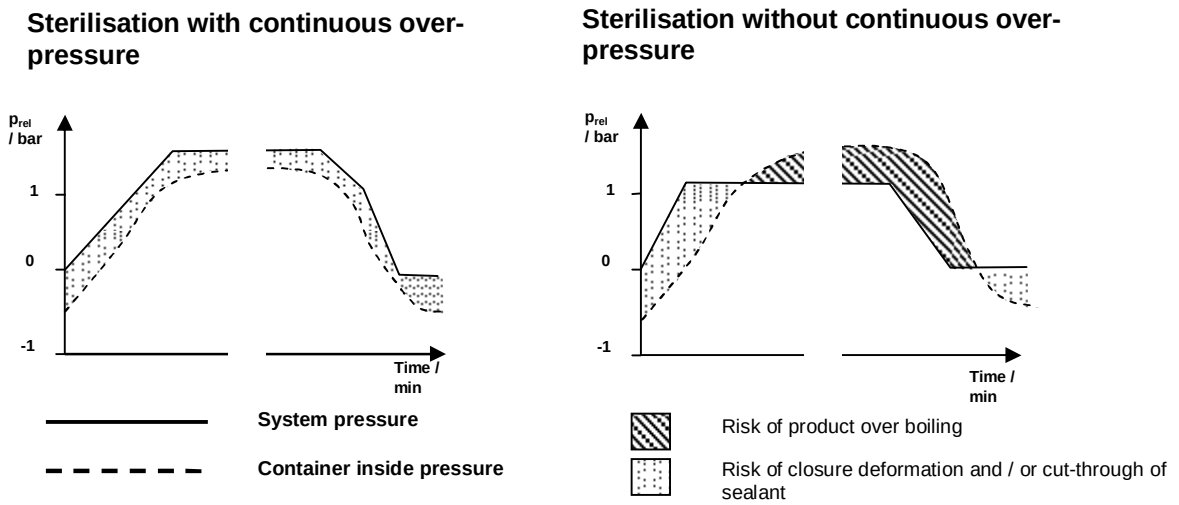
– The quoted **differential pressure values** vary according to the type of closure, the dimensional accuracy of the glass container finish, the capping result and the applied treatment conditions. **Generally small closure diameters** are **less sensitive** to exceeding the inside pressure > system-pressure, i.e. they are more resistant to inside pressure conditions.

– For security reasons, the **blow-off values** (p_{vent}) for lug closures are **generally** clearly **below** the **burst pressure of the glass container,** to ensure a safe **ventilation** of the package inside pressure, in case of product unsterilities in combination with gas development.

– In the event of extreme **pressure change stresses** due to inadequate alignment of filling and treatment conditions, **permanent deformations** in the area of the closure panel may arise, particularly in the case of large closure diameters (53mm - 110mm).

– **Generally** an **over-pressure situation** during heat treatment is **preferred** for **Twist-Off® closures** (see Fig 03-7 / Retorting - over pressure situation).

Fig 03-7 / Retorting - over pressure situation



System boundaries – Limitations of heat treatment conditions

– Because of **container inside pressure** dependency on the applied **filling** and **treatment conditions,** there is an **operating window** for the packaging system with regard to the inside pressure resistance of Twist-Off® closures. This means in general terms that the inside pressure of a container **must not exceed** the **difference** of maximum **0.5bar** in relation to the applied pressure of the retorting system.

The subsequent **table** summarizes the **system boundaries for Twist-Off® closures** under the previously mentioned aspects:

The **minimum filling temperature** is directly **linked to** the **minimum headspace**. This means that in case of a change in headspace volume, other values for the minimum filling temperatures automatically become feasible. In general, initial vacuum values above -0.3bar are assumed to be reached after capping. **Treatment processes outside** the **mentioned system boundaries** must be addressed to and agreed with **Silgan White Cap before application**.

Table 03-2 / System boundaries - Treatment conditions

Type of treatment	Recommended system pressure	Maximum treatment temperature	Holding time	Minimum filling temperature	Minimum headspace
Pasteurisation in open system	Not applicable	85°C	15min	50°C - 55°C	5% - 7%
Pasteurisation in open system	Not applicable	98°C	15min	70°C - 75°C	5% - 7%
Pasteurisation in closed system	1.0 ± 0.2bar	105°C	15min	55°C - 60°C	7% - 9%
Sterilisation in closed system Low temperature	1,6 ± 0.2bar	115°C	60 min.	65°C - 70°C	7% - 9%
Sterilisation in closed system High temperature	1.8 ± 0.2bar	121°C	60min	65°C - 70°C	7% - 9%

Corresponding values underlined

In APPENDIX B - INSIDE PRESSURE IN SEALED CONTAINERS - *of this processing guideline* ***graphs*** *of* ***inside pressure calculations*** *for* ***closed containers*** *are included and put in relation to the mentioned system boundaries. From these graphs exact values for a computed inside pressure can be derived. These calculations are based on an* ***analytical model*** *for the expansion of water and steam in closed containers. Based on these graphs the experienced user can carry out* ***first estimates*** *of the expected* ***inside pressure*** *and the* ***required system pressure****.*

Warning

Requirements for heat treatment conditions

- To protect the integrity of the packaging system from extreme pressure differentials between the container interior and the autoclave overpressure, an alignment of the process parameters is obligatory.
- General standard values for heat treatment are listed in Table 03-2 / System boundaries - Treatment conditions . Process parameters outside the specified system boundaries require verification by Silgan White Cap to ensure the protection of the system.

Particularities

– In the case of batch autoclaving special attention must be paid to the **tidy condition** of the **divider mats** before stacking finished packages into the cages. These must be free from lime deposits or extraneous particles (such as rust, sand or pieces of broken glass) to minimize the **risk of damaging** the closure **face coating** by **mechanical scratches** during the treatment process.

– To avoid additional load to the face coating system, it must be ensured that only **suitable additives** are used for the adjustment of **process water hardness**, which do not raise the alkalinity of the water during sterilisation above an ordinary **pH-value range of pH 7.0 - pH 8.5**. In addition, excessive **chlorination** of the cooling water should be avoided, since this increases the tendency of metals to corrode, in general.

– In the case of **container breakage** in the autoclaves**,** replacement of the process water must be made, since for certain products such as tomatoes, apart from the rising **degree of soiling, colour divergences** / stains (particularly on white closures) may become visible. In general, a **regular control** and **regeneration** of the **process water** is required.

Information

- Silgan White Closure offers assistance on all questions of correct and safe thermal treatment of glass packages under Twist-Off®.

Ø Please direct your enquiry to the nearest sales office or directly to Silgan White Cap Deutschland GmbH / Department Packaging Performance via E-mail : cap.application@Silganwhitecap.com

03-3.2 DRYING

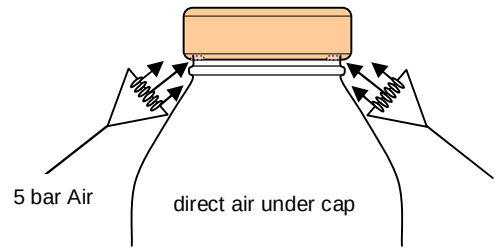
Following successful heat treatment, the packaging systems passes through a **cooling phase**, in which the product is brought to a temperature which has no further effect on the destruction of microorganisms. In selecting the **average cooling temperature** of the product it must be ensured, that this is **adequately low** to **prevent** any **resumption** of **growth** of **thermophilic germs**, yet high enough to ensure an **adequate post-drying** of the package. **Generally**, it is recommended not to drop below an **average product temperature** of **30°C - 35°C**.

Since the **lug closure** consists of tinplate and due to its manufacturing process has an **open cut edge** in the area of the **closure curl**, in the event of **residual moisture** in this area as well as in the highly stressed spots on the **lugs**, there is an implied **risk of corrosion**. The latter can bring about rust particles possibly present being sucked into the package when it is being opened and thus **contaminate the product**, or cause the formation of **rust stains** on the glass thread.

It is therefore **essential** to adopt suitable **drying steps**, in order to remove residual process moisture from the area between the glass container finish and the closure curl. **Finished packages** must not be allowed to remain in the autoclave cage for drying. Placing the cages *a slant* after the process makes it possible for the water to run off the closures and also reduces the risk of formation of lime deposits.

The **most effective method** of **removing** the **residual moisture** is with compressed air directed upwards by an **air knife system**, blowing simultaneously from both sides into the annular space between the closure curl and the container finish, **vaporising** remaining major collections of **water droplets** (see Fig 03-8 / Post process moisture removal for finished packages).

Fig 03-8 / Post process moisture removal for finished packages



The **efficiency** of the **moisture removal** system should be **tested** on a routine basis, as follows:

1. Remove consecutive packages exiting the moisture removal system.
2. Dry the package body and exterior of the closure.
3. Grip the container and shake firmly over a dry surface or your free hand, or use compressed air to blow into the gap between closure and glass.
4. If water droplets are detected, the moisture removal system should be adjusted until the trapped water in the curl/finish area of the package is eliminated.

In order to support the process of drying by means of the residual heat in the product, it is advisable to observe a short **length of time** on the conveyor belts of about **2 minutes before further processing**.

Neck bands applied over the closure/finish area of the package should have adequate **perforations** to allow sufficient airflow to **evaporate** any residual **moisture** or **condensation**.

Shrink-wrapped trays should have **openings** that allow for the **circulation of air** necessary to **evaporate** any residual **moisture** or **condensation** on the body of the packages.

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Warning

Requirements for drying

- Finished goods must be adequately dried before storage.
- Re-cooling is required after heat treatment to an average product temperature not lower than 30°C - 35°C, in order to attain adequate post-drying of the finished goods.
- No liability can be accepted in respect of corrosion phenomena, which indicate a disregard of the quoted drying steps.

03-3.3 HANDLING OF FINISHED PACKAGES

Prior to storage, **damaged** and incorrectly closed **finished packages** must be **removed**. Packages with **contaminated content** must be immediately **replaced** in order to avoid the danger of gaseous fermentation.

Prior to stacking, **adequate cooling** of the end product must be ensured, in order to avoid a **cutting through** of the still warm closure sealant because of excessively heavy stacking weight. In the case of **warm-stacked product,** there is also a long term risk of **increased opening torque behaviour**. Thus, the average product **temperature should not exceed 30°C** prior to stacking**.**

Prior to **labelling,** it is necessary to carry out **drying** of the closure surfaces, in order to achieve **adequate adhesion** of the often used **casein based glues**. In isolated cases, it may be necessary to carry out **surface activation** using suitable additional measures (e.g. plasma treatment) or to select a stronger type of adhesive (e.g. **epoxy-based adhesive**).

It is recommended that after labelling or before stacking on trays or pallets, the finished goods receive a **final control** using a **vacuum testing device**, in order to document that the individual **glass containers** are in **perfect condition**.

Finished packages need to be handled with due **care**. Horizontal or vertical **impact** must be **avoided**. This applies especially to packages whose closures project the dimensions of the container.

Warning

Requirements for finished product handling

- Prior to stacking, adequate cooling of the finished product is required (average product temperature below 30°C).
- Prior to stacking, visibly damaged glass containers need to be removed.
- In general finished packages need to be handled with due care, impact needs to be avoided.

Information

- Silgan White Closure offers assistance on all questions of correct handling of glass packages under Twist-Off®.

Ø Please direct your enquiry to the nearest sales office or directly to Silgan White Cap Deutschland GmbH / Department Packaging Performance via E-mail : cap.application@Silganwhitecap.com

04 STORAGE CONDITIONS

04-1 STORAGE CONDITIONS FOR TWIST-OFF® CLOSURES

Silgan White Cap closures of the Twist-Off® type are generally supplied in **cartons** with optional polybag on **single** or **multi-way pallets**. The cartons stacked on a pallet are covered with a plastic shield and with shrink-wrap film for additional protection from environment-related effects.

The following **storage conditions** must be observed for all deliveries of closure goods in standard cartons:

- The **condition** of the **floor** in the warehouse must be even and horizontal to ensure a firm **base** for the **pallets**. Floor deformation due to excessive stacking weight must not occur. The transport path into and around the warehouse must be even and free from potholes.
- The warehouse must be **dry** and well **ventilated**. Extreme fluctuations of storage temperature must be avoided in order to prevent condensation on the closures. The recommended **warehouse temperature** is between **5°C to 30°C** and an air **humidity** of **maximum 70%**. Exceeding the specified humidity over a longer period may lead to a **loss of stability** of the carton and a **crumpling** of individual layers or pallets. For work safety reasons, the **stacking height** of cartons should not exceed **two pallets**.
- There must be no **corrosive substances** in the **immediate vicinity** of the stored closures.
- **Pallets** with already **opened outer packing** are **to be processed first**. Open **single cartons** need to be **re-closed** in a **dustproof** way. Before feeding already opened cartons into the line systems, a **visual check** of the content is to be carried out.
- In case of **extremely cold storage conditions**, particularly during winter as well as during short-term delivery of recently manufactured goods, it is recommended that closures be stored for a minimum of **24 hours** at a **temperature** around **20°C** prior to actual processing.
- In general, there is **no basic restriction** on the **storage life** of unused closures. Nevertheless, it is recommended that in the case of the **storage time exceeding 2 years** the closures are subject to a **spot check** in **processing** before final use.

Warning

Restriction for storage conditions

- The permissible stacking height of the closure cartons must not exceed a maximum of two pallets.
- The recommended storage temperature is between 5°C - 30°C with a maximum air humidity of 70%.
- During cold storage, (minimum 5°C), a warm up of the closures for a minimum of 24 hours at around 20°C is recommended prior to their use.
- In case of the storage time exceeding 2 years a spot check on the application behaviour of the closures is recommended prior to their use.

04-2 STORAGE CONDITIONS FOR FINISHED PACKAGES

The specifications for the correct **storage** of **glass containers** are based on the recommendations of the **Centre Technique International de l'Embouteillage et du Conditionnement** (CE.T.I.E, Fact Sheet FS 05^{E}, Edition 2/99) and will be completed by marginal notes from the side of the closure manufacturer.

04-2.1 STORAGE CONDITIONS AND TRANSPORT ROUTES

- The **condition** of the **floor** in the **warehouse** must be even and horizontal to **ensure** a **firm base** for the **pallets**. Floor deformation due to the stacking weight must not occur. The **transport path** into and around the warehouse must be **even** and free from potholes. Spontaneous axial stress on the glass containers, which may occur during transport due to a pothole, may cause breakage of glass, which cannot be seen from the outside of the package.
- The warehouse must be **dry** and well **ventilated**. Strong fluctuations of warehouse temperature must be avoided, in order to prevent condensation on the finished goods, in particular on the metal closures.
- No corrosive substances, which could adversely affect the appearance of the metal closures, may be present in the **immediate vicinity** of the finished goods.

04-2.2 PALLET MATERIAL CONDITION

- The **pallets** used should be in **perfect condition**, i.e. no missing support bars, no broken, wet or rotten parts on the pallet. **Damaged pallets** must be **removed**.
- The **pallets used** must possess adequate **strength** and **resistance to deformation**. In addition, the surface must be even and free from any protruding nails. The distances between individual planks should correspond to the size of packages so that **no tilt** of the glass containers occurs.
- For the **stacking** of pallets, the use of stable, **load-distributing dividers** or the use of **double-sided pallets** is required.

04-2.3 RULES FOR STACKING OF FINISHED PACKAGES

- The stacking of the finished packages on the pallets must follow a **suitable packing scheme**. An exact and constant arrangement of the packages must be ensured. The packing schemes of a pallet layer should be displaced with respect to one another so as to achieve the highest degree of **stability**.
- The **dimension** of a pallet layer should be **smaller** as the **bearing surface** of the **pallet** itself (no protrusion of the packaging beyond the pallet).
- In case that several layers of finished packages are introduced into a single carton tray, **separators** from the **paper carton** should be used to protect the packages underneath.
- The pallets should be **stacked one on top of the other** in order to achieve an **even load distribution** on the finished packages beneath.
- The **total weight** of a **pallet** should not exceed **9.5KN** (**969 kg**). As a rule, the **stacking height** including the base pallet should be limited to **3 pallets**. Divergences from this stacking height are admissible (e.g. the stacking of residual pallets), as long as the **total weight** of **28.5KN** (**2907kg**) is not exceeded.
- Stacking and the related inclination of pallets must comply with **national regulations**. It is recommended that a maximum **stacking inclination** of **2%** should not be exceeded.
- An **overlapping of staked units** (e.g. through the displacement of the uppermost pallet in a row) **should be avoided**. The initially localised collapse of a stack might trigger a chain reaction, which would be transferred to other stacks in a row. Such a chain reaction

would primarily be helped by the absence of dividers, as well as by large distances between individual rows.

– The **displacement** of pallets must take place **carefully**, in order to **avoid** the occurrence of **extreme forces** and abrupt movements. These mostly occur during the putting down of pallets. In general, **impacts** on the pallets should be avoided. At **low temperatures of < 10°C**, these can adversely affect the integrity of the packages since the **flexibility** of the **sealant** in this range of temperatures markedly **decreases**.

04-2.4 OUTER PACKAGING

– The **outer packaging** must be aligned in size with the finished packages. It should be right-angled and should possess adequate **stability**. Moisture-resistant cardboard qualities are preferred.
– In the case of **shrink-wrapping**, an **additional** and suitable **support** of the packaging unit should be given and either cardboard trays or another stiff material should be used. To **avoid** an **accumulation of moisture**, an **air circulation** in and out of the packaging unit must be ensured.
– **Finished packages** must stand **vertically** in the **outer packaging**. Excessive tightness of the shrink film in the tray or the stretch film of the pallet may expose individual parts of the total package to **extreme stress, (**mostly those near edges), and may have an adverse effect on the package integrity.
– The **coating of cardboard cartons** in direct contact with the closure should be free from **surface treatment with adhesive properties**, in order to prevent lasting transfer or the sticking of pieces of paper onto the closures.

Warning

Requirements for the storage of finished packages

- The warehouse must be dry and well ventilated. To avoid condensation, temperature and humidity should remain constant.
- Only pallets in perfect conditions should be used.
- The transport and stacking of finished products/pallets should be done with due care.
- Stacking of pallets takes place on top of one another with use of load-distributing dividers.
- The total pallet weight must not exceed the maximum of 9.5kN/969kg.
- The pallet stacking height is restricted to a maximum of 3 pallets (including base pallet) with a total weight of maximum 28.5kN/2907kg.
- In case of additional shrink film packaging of the pallet, air circulation must be ensured to prevent the accumulation of moisture.

Information

- Silgan White Closure offers assistance on all questions of correct storage conditions of finished packages under Twist-Off®.

Ø Please direct your enquiry to the nearest sales office or directly to Silgan White Cap Deutschland GmbH / Department Packaging Performance via E-mail : cap.application@Silganwhitecap.com

05 LABELLING OF DELIVERED GOODS

05-1 CARTON LABEL

Silgan White Cap closures are supplied in **one-way cartons**. Information concerning the content of the carton is attached at least on one side. In the event of a **complaint**, please pass on the **left strip** of the **carton label** or the information thereon to the closure manufacturer for onward processing. Only on the basis of this information can an early and complete answer to questions concerning **traceability** of, for example, materials, be made. For an **easy transfer** of the carton information to the related **quality data** on the filling line, the **label** is designed as a two-layer **self-adhesive** one.

Fig 05-1 / box label for traceability

Nr.	Description
01	**TIME OF PRODUCTION: HHMM)**)
02	**DATE OF PRODUCTION: DDMMY)**)
03	**SWCEA MATERIAL NUMBER OF CAP**
04	**RUNNING BOX NUMBER OF PRODUCTION ORDER UNTIL ORDER CHANGE + BLANK + NUMBER OF SWCEA PRODUCTION LINE,**, length 4+1+3
05	**INTERNAL BARCODE: TYPE INTERLEAVED 2 OF 5, CODED NUMBER OF PRODUCTION ORDER+LINE NUMBER+PACKING SYSTEM CONTROL,LENGTH 8+3+3**|
06	**CLEAR TEXT OF BARCODE DATA: AUTOMATICALLY GENERATED BY BARCODE**
07	**DESIGN TEXT: NAME OF DECORATION, ENGLISH CAPITAL LETTERS IN GENERAL, REPETITION OF TEXT AT POINT 16**
08	**OPTIONTEXT: OPTIONAL TEXT FREE OF CHOICE BY CUSTOMER, GENERAL CAPITAL LETTERS, REPETITION OF TEXT AT POINT 17**
09	**SWCEA MATERIAL NUMBER OF CAP**
10	**BOX CONTENTS IN PIECES**
11	**FIXED TEXT "CAPS"**
12	**CAPCODE: CAP DESIGNATION WITH SPECIFICATION OF NOMINAL SIZE+CAPTYPE+COMPOUND TYPE**
13	**SHIPPING UNIT: CODE OF USED BOX, POLYBAG YES/NO, PALLET RETURNABLE/NON RETURNABLE, # OF BOX LAYERS ON PALLET**
14	**SURFACE SYSTEM: CODE OF REVERSE COATING SYSTEM+FACE COATING SYSTEM+PRINTING SYSTEM (# OF COLOR LAYERS)**
15	**CAN/CAP APPLICATION NUMBER: CODE OF GUARANTEED APPLICATION SUITABILITY**
16	**DESIGNTEXT: NAME OF DECORATION, ENGLISH CAPITAL LETTERS IN GENERAL**
17	**OPTIONTEXT: OPTIONAL TEXT FREE OF CHOICE BY CUSTOMER, ENGLISH CAPITAL LETTERS IN GENERAL**

06 APPENDIX A

06-1 SUITABLE TREATMENT METHODS FOR TWIST-OFF® CLOSURE SYSTEM

The following table provides information about the general **suitability** of the different closure diameters and geometries for certain **methods of heat treatment**.

Table 06-1 / Suitable treatment methods for Twist-Off® closures

Closure diameter	Closure type	Glass finish drawing	Treatment method						
			NDS	NFC	NFH	PPN	PPY	STL	STS
027	RT REGULAR	WGF-146 A	+	+	+	+	o	o	o
030	DT DEEP	WGF 145 D	+	+	+	+	o	-	-
030	MT MEDIUM	WGF 169 S	+	+	+	+	-	-	-
033	MT MEDIUM	WGF 169 S	+	+	+	+	-	-	-
038	DT DEEP	WGF 145 B	+	+	+	+	o	-	-
038	MT MEDIUM	WGF 145 E	+	+	+	+	-	-	-
038	RU REGULAR	WGF 146 S	+	+	+	+	o	o	o
043	RS/RT REGULAR	WGF 157 A	+	+	+	+	+	-	-
048	RS/RT REGULAR	WGF 157 A	+	+	+	+	+	-	-
053	RA/RS/RT REGULAR	WGF 136 S	+	+	+	+	+	o	o
058	DW DEEP	WGF 136 A	+	+	+	+	+	+	+
058	RA/RS/RT REGULAR	WGF 136 S	+	+	+	+	+	+	+
063	DW DEEP	WGF 138 B	+	+	+	+	+	+	+
063	RA/RS/RT REGULAR	WGF 138 S	+	+	+	+	+	+	+
066	DW DEEP	WGF 138 B	+	+	+	+	+	-	-
066	RA/RS/RT REGULAR	WGF 138 S	+	+	+	+	+	+	+
070	DW DEEP	WGF 138 B	+	+	+	+	+	+	+
070	RA/RS/RT REGULAR	WGF 138 S	+	+	+	+	+	+	+
070	TN TALL	WGF 138 D	+	+	+	+	+	+	+
077	RA/RS REGULAR	WGF 138 E	+	+	+	+	+	+	+
082	RA/RS REGULAR	WGF 130 S	+	+	+	+	+	+	+
089	RS REGULAR	WGF 122 S	+	+	+	+	+	+	+
100	RS REGULAR	WGF 165 S	+	+	+	+	+	+	+
110	RS REGULAR	WGF 140 S	+	+	+	+	+	+	o

Table 06-2 / Explanation for abbreviations used

Abbreviation	Description
NDS	No heat treatment, dry sealing without vacuum
NFC	No heat treatment, cold fill
NFH	No heat treatment, hot fill and re-cooling
PPN	Pasteurisation without system pressure, max. 98°C
PPY	Pasteurisation with system pressure, max. 105°C
STL	Sterilisation low temperature, max. 115°C
STS	Sterilisation standard temperature, max. 121°C
Suitability	+ approved o conditional / process verification required - Not approved

Warning

Limits of the Twist-Off® closure system

- Compliance with Table 06-1 / Suitable treatment methods for Twist-Off® closures is obligatory for Twist-Off® closure application.
- Different or conditionally approved treatment methods need verification by Silgan White Cap prior to their use.

06-2 FAILURE DESCRIPTION

Table 06-3 / Type of capping faults

Notion	Description	Appearance of fault
Cocked caps	Closures, which do not sit **horizontally** on the finish.	• The fault is recognised by the fact that whilst one or more lugs were correctly positioned under the thread, others were crushed. The lugs on the closure are in general bent to a greatly differing extent. • The compound impression is deep on the sides of the intact lug(s), weakly impressed on the sides of the crushed lug(s). The crushed lugs are markedly scratched.
Crushed lugs	Closures, which have not been screwed on, but **pressed on** the finish.	• This fault is recognised by the fact that all the lugs are on the thread, or were partly pressed over it and so were crushed. • The compound impression is only weakly marked. The crushed lugs are markedly scratched.
Loose caps	Closures, which were not **adequately tightened**.	• This fault is recognised from the inadequate security values or the required opening torque and/or an inadequate closure seat, often accompanied by vacuum loss.
Stripped caps	Closures, which were **turned beyond** the **end of** the **thread**.	• This fault is recognised by the markedly bent lug and the stripped, mostly loose closure seat. • The compound impression is weak and, based on the general closure deformation, slightly oval. The lugs are markedly scratched.

06-3 CONTROL OF CAPPING RESULT

For the **control** and documentation of a faultlessly performed sealing process and the correct condition of the closed packages there is the possibility of various **visual** and **measurement checks**.

06-3.1 CLOSURE LUG SEAT

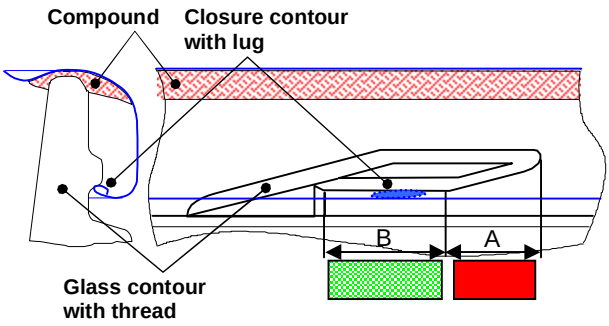
Visual check, measurement - **assessment**, whether the lugs are positioned under the thread and not deformed or the closure lug was adequately tightened on the thread (see also Fig 06-1 / Correct cap seat).

– In the case of **FLAT** type **finishes**, for a correct **cap seat** it has to be assessed whether the **closure lug** is positioned **under** the **horizontal part of the thread** of the glass container finish. If the closure lug is not under the horizontal part of the thread (e.g. a closure hanging at the start of the thread), the closure seat is not in accordance with the requirements.

– In the case of **HELIX** type **finishes** (TO53 - TO110) the position of the lugs is determined by the **distance between** the **parting line** on the **finish** and the **start of the closure lug** (**parting line - lug distance**). On every finish there are two visible vertical lines (parting line = form seam). If the closure lug is to the left of the parting line, a stripped closure with excessively extended closure lug is possible. The package is then not securely closed. A proper closure seat is reached, if the **closure lugs are to the right of the parting line** and the directives for the security values referred to in chapter **06-3.3 Security Measurement** are followed.

Fig 06-1 / Correct cap seat

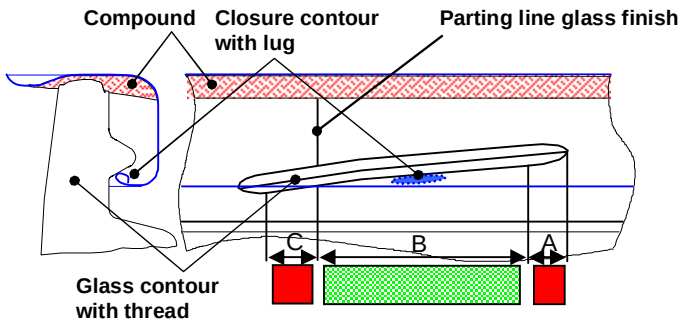
FLAT finish



A: Incorrect cap seat
Inadequate lug tension.
Risk of vacuum loss due to loose cap seat.

B: Correct cap seat
Closure lug under horizontal thread part

HELIX finish TO 53-110mm



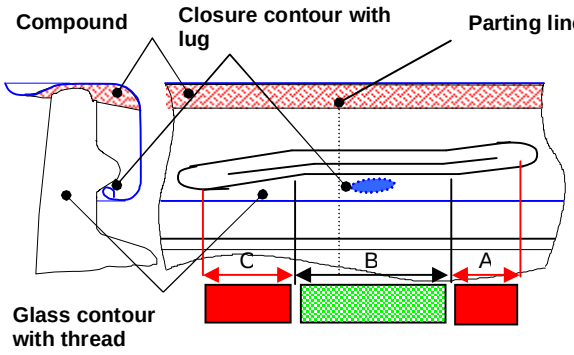
A: Incorrect cap seat
Inadequate lug tension.
Risk of vacuum loss due to loose cap seat.

B: Correct cap seat
Closure lug under part of thread with inclination. Security (lug tension) must be adequate.

C: Stripped (over stretched) closure. Area left from parting line.

– In the case of the **special HELIX** type **finish** WGF-157A (TO43, TO48) in principal the same approach is valid. The lugs must neither be in the entry nor exit part of the finish thread.

HELIX finish (specialty only for TO 43mm & 48mm - Finish drawing FD 157A)



A: Incorrect cap seat
Lug is positioned under the inclined part of the thread. Inadequate lug tension. Risk of vacuum loss due to loose cap seat.

B: Correct cap seat
Lug is positioned under the almost horizontal part of the thread.

C: Incorrect cap seat
Lug is positioned under the inclined part of the thread. Risk of stripped (over stretched) closure.

Information

- Silgan White Closure offers assistance on all questions of correct assessment of finished packages under Twist-Off®.

Ø Please direct your enquiry to the nearest sales office or directly to Silgan White Cap Deutschland GmbH / Department Packaging Performance via E-mail : cap.application@Silganwhitecap.com

06-3.2 OPENING TORQUE

Measurement – **assessment**, where the **opening torque** depends on the **surface condition** of the glass, the **filling**, **sealing**, **treatment** and **storage conditions** (in particular time and temperature), the final **package vacuum** and the **security measurement**. Because of the number of the various influencing factors, no universal values for the opening torque of a final package can be laid down. Generally speaking, there is a **rule of thumb** that the **opening torque** of a package, which has been **stored** for a considerable length of time, results in a figure of about **50%** of the **closure diameter** (measured in inlbs). For small diameters, the values are normally lower, for larger diameters the values are higher.

Information

- Due to the problem of laying down general limits for opening torque values, the measurement is not compulsory but recommended and requires drawing up values under stable processing conditions at the customer.

06-3.3 SECURITY MEASUREMENT

Measurement - assessment of the present **lug tension** after the capping or treatment process in the case of finishes of the **HELIX** type (Twist-Off® 53mm – 110mm).

The package to be measured is marked with a felt-tip pen by drawing a **vertical line** on the **closure** and on the **glass**. The closure is then turned anticlockwise, until the vacuum is broken, without lifting it off the container. The **closure** is then **re-tightened finger-tight** until first resistance is felt.

The **distance** between the now displaced halves of the **marking line** is the **security measurement** (mm). The security measurement is expressed as a **positive** value, when the marking line on the closure is to the **right** of the marking line on the glass. The security measurement is expressed as a **negative** value, if the marking line on the closure is to the **left** of the marking line on the glass.

Fig 06-2 / Evaluation of cap security

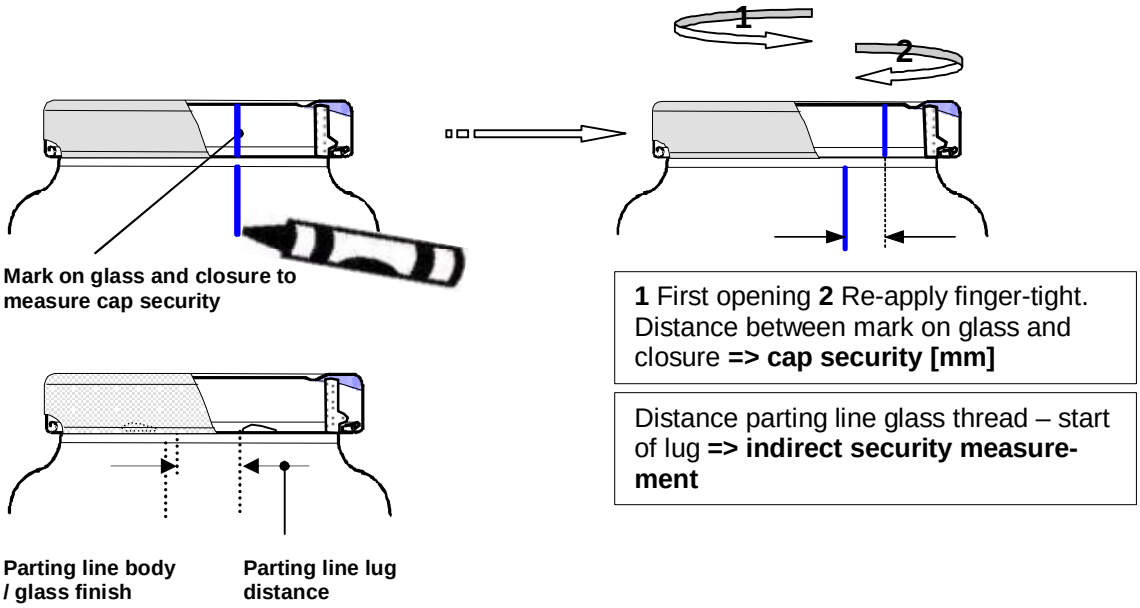


Table 06-4 / Standard values for cap security under standard processing conditions

Processing conditions	Standard values for cap security after sealing process	Standard values for cap security of the final package
Cold fill / hot fill and re-cooling / Pasteurisation without system pressure	**4,0 mm +/- 2,0 mm**	**2,0 mm +/- 2,0 mm**
Pasteurisation and sterilization with system pressure	**6,0 mm +/- 2,0 mm**	**2,0 mm +/- 2,0 mm**

Warning

Requirements for assessment of cap seat and security

- The assessment of the closure lug seat as well as of the security measurement should be carried out at regular intervals after the sealing process as well as after the cooling cycle, as compliance with the standard values is essential for a correct capping result.

Information

- Silgan White Closure offers assistance on all questions of correct sealing of finished packages under Twist-Off®.

Ø Please direct your enquiry to the nearest sales office or directly to Silgan White Cap Deutschland GmbH / Department Packaging Performance via E-mail : cap.application@Silganwhitecap.com

06-3.4 COMPOUND IMPRESSION

Visual test - assessment of adequate **embedding of the glass finish surface** in the closure sealant, or complete **embedding over the entire 360°**.

In case of **cold-/** or **dry sealed packages** a **visual check** is meaningful only **after** an adequate **short period of relaxation** (>5min).

06-3.5 BUTTON FUNCTION / VACUUM

Visual test and measurement – assessment of a perfect **button function** of flip closures. The closure button serves as **tamper evidence proof**.

The basic condition for the perfect functioning of the button is the availability of the required **functional vacuum** within the **final package**. Compliance with the predetermined vacuum values ensures the drawing down of the closure button (flip-in). A **control** is carried out via the **measurement** of the **vacuum** in the **final package** using a manometer. A visual-acoustic check follows on opening the package via the **change** of the **button position** from the **flip-in** to the **flip-out** position, with the simultaneous acoustic perception of a **cracking noise**.

Excessive mechanical load during the sealing process, the heat treatment or subsequent handling (e.g. labelling), may result in a **remaining deformation** of the **closure panel**, which may **impair** the proper **button function**.

Warning

Requirements for proper button function

- Correct functioning of the button is only possible when the functional vacuum values are reached.
- Excessive mechanical stress to the closure panel can have an adverse effect on the proper button function.

Information

- Closure diameter-dependent functional vacuum values appear in the technical drawing of the closure (Customer Cap Information - CCI).

Ø Please direct your enquiry to the nearest sales office.

06-4 TEST PROTOCOL TWIST-OFF® < EXAMPLE TEMPLATE >

The control of the sealing parameters serves the early recognition of faulty sealed packages. Documentation should take place during each line start, during running processes at regular time intervals, as well as during changes of glass and closure lots. In case of deviations from the internally defined settings, appropriate corrective action needs to be taken. A minimum quantity of six finished packages should be assessed per spot check. In addition, to meet the requirements for traceability, documentation of used glass and closure lots should be ensured.

Line		Product		Glass volume [ml]		Date	

Time	**Filling temperature**	**Headspace**	**Vacuum**	**Cap seat**	**Cap security**	**Remarks**	**Assessor**
hh-mm	¨ °C ¨	¨ % ¨ mm	¨ [-mbar] ¨	ok / n.ok	¨ [mm] ¨		
	Min	Min	Min	A / B / C	Min		
	Max	Max	Max		Max		

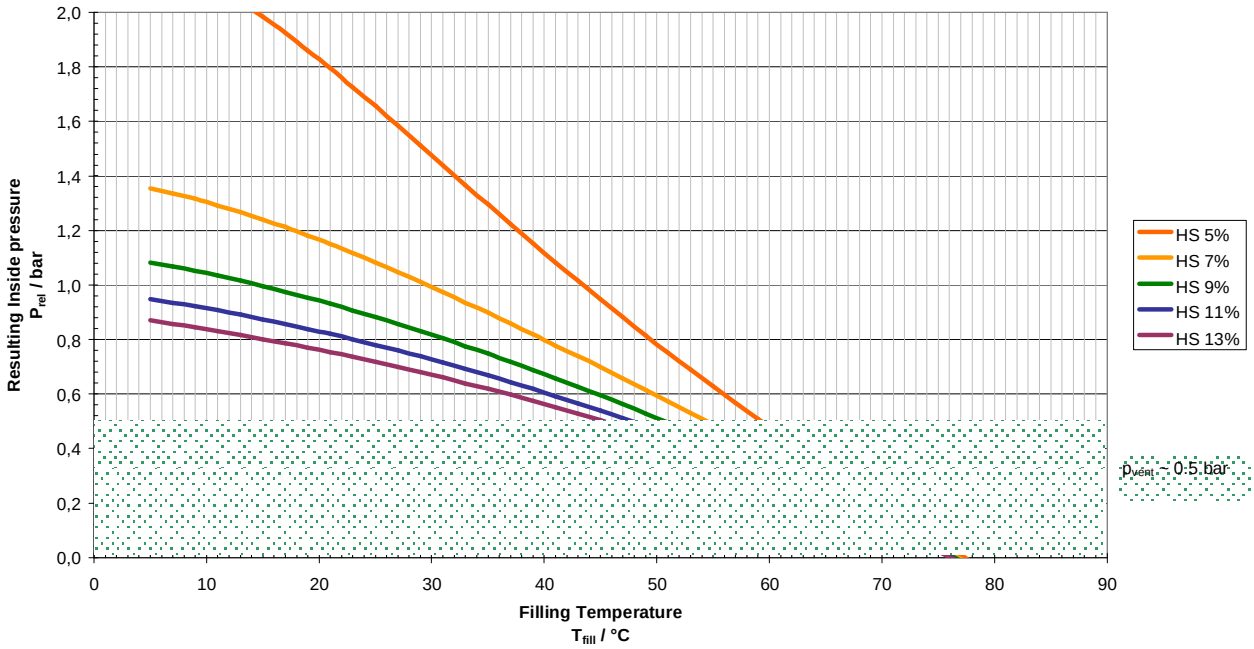
07 APPENDIX B

07-1 INSIDE PRESSURE IN SEALED CONTAINERS

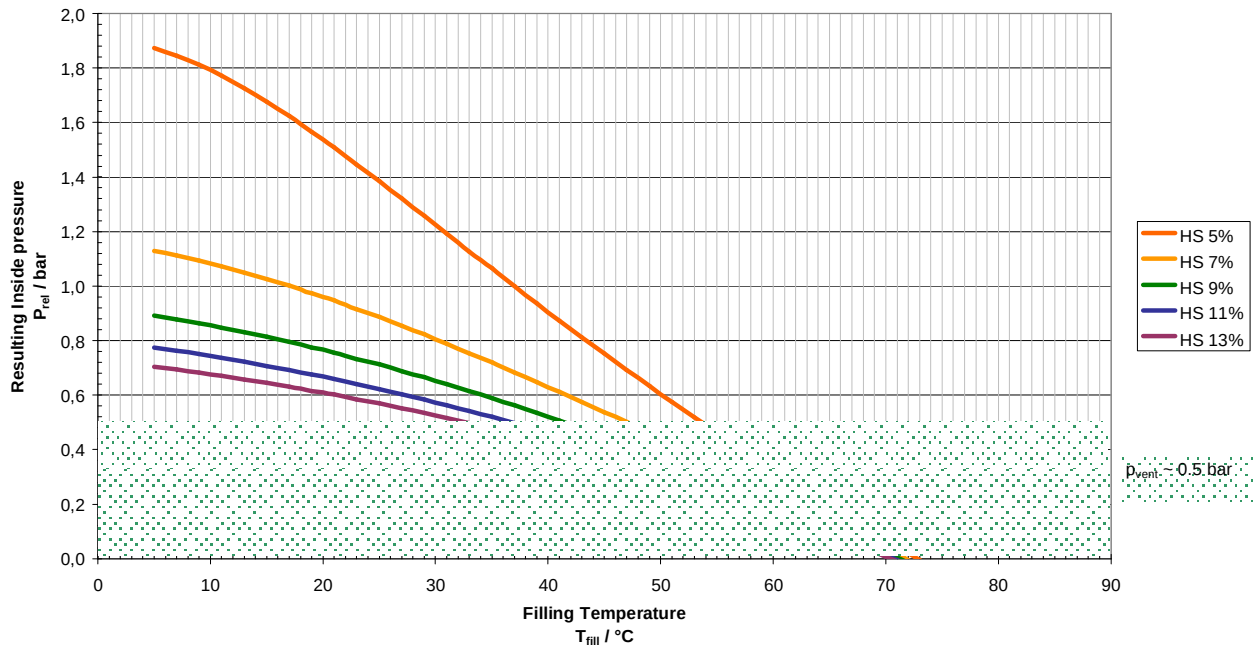
07-1.1COLD- AND HOT FILL PASTEURISATION 85°C

The inside pressure graphs used in this guideline are based on a mathematical model of steam and water in sealed containers; therefore the computed values can deviate from the actual inside pressure in a package filled with real food product. Consequently, the graphs shown can only be used as starting a point for an assessment of the correct system pressure settings and do not replace the actual measurement of the pressure and temperature curves in a heat treatment process.

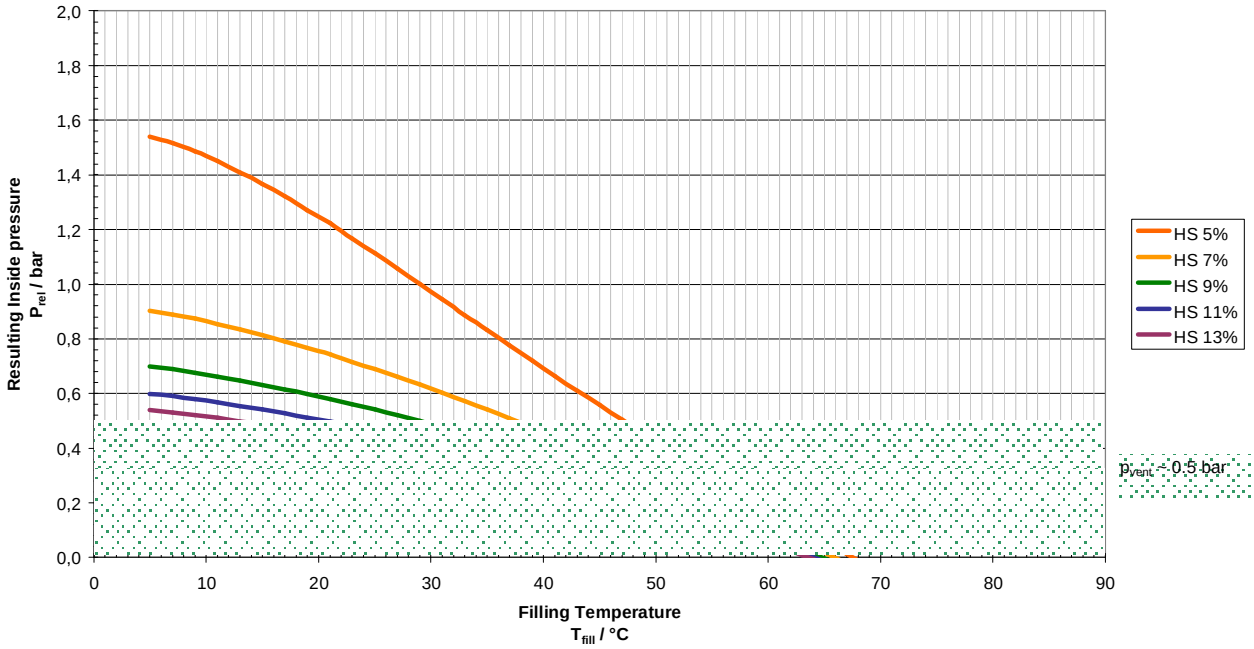
Cold-/hot Fill Pasteurisation 85°C
p_{vac} -0.2 bar



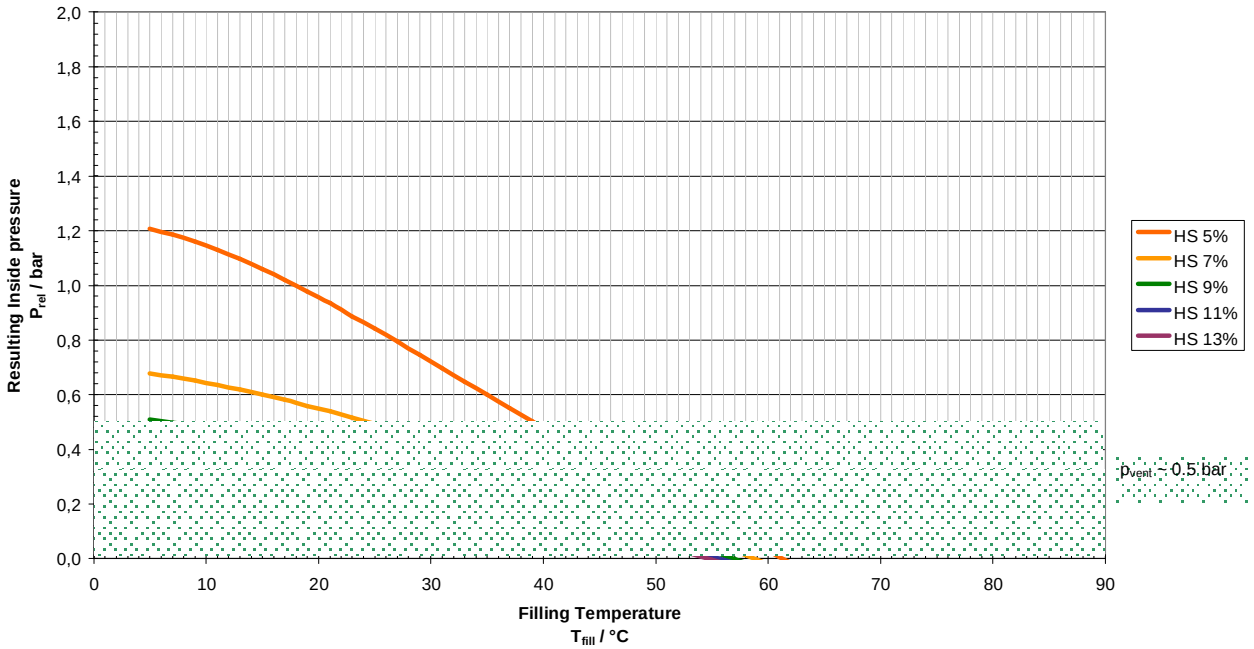
Cold-/hot Fill Pasteurisation 85°C
p_{vac} -0.3 bar



Cold-/hot Fill Pasteurisation 85°C
p_{vac} -0.4 bar

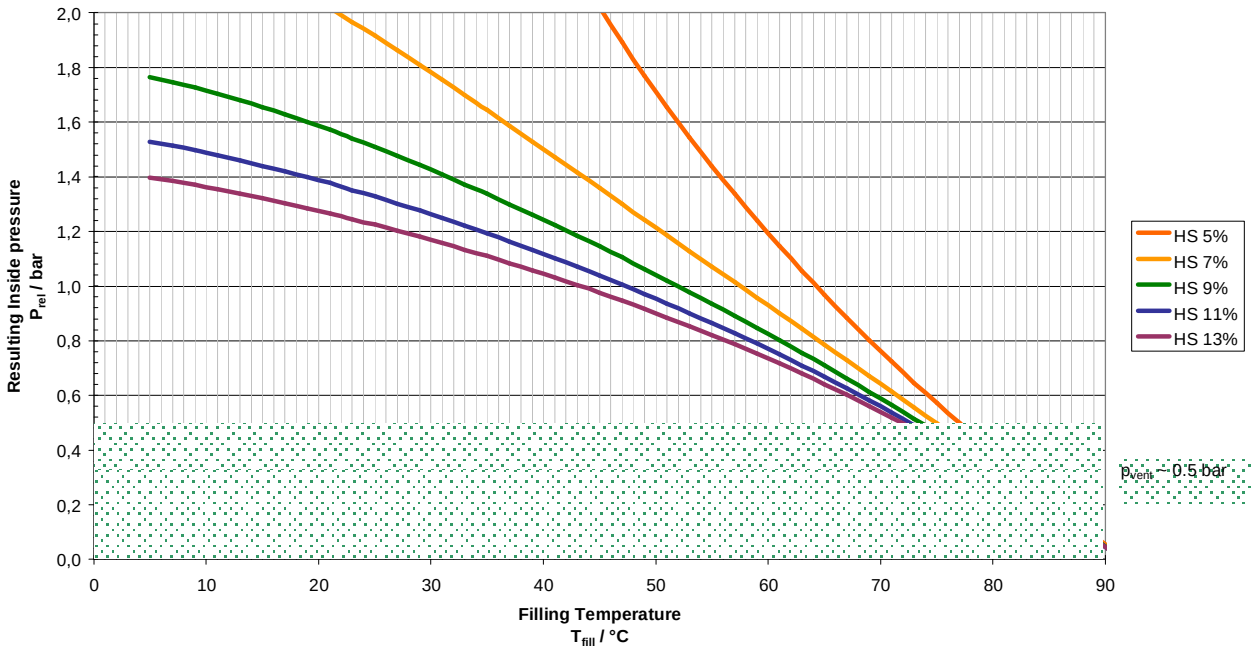


Cold-/hot Fill Pasteurisation 85°C
p_{vac} -0.5 bar

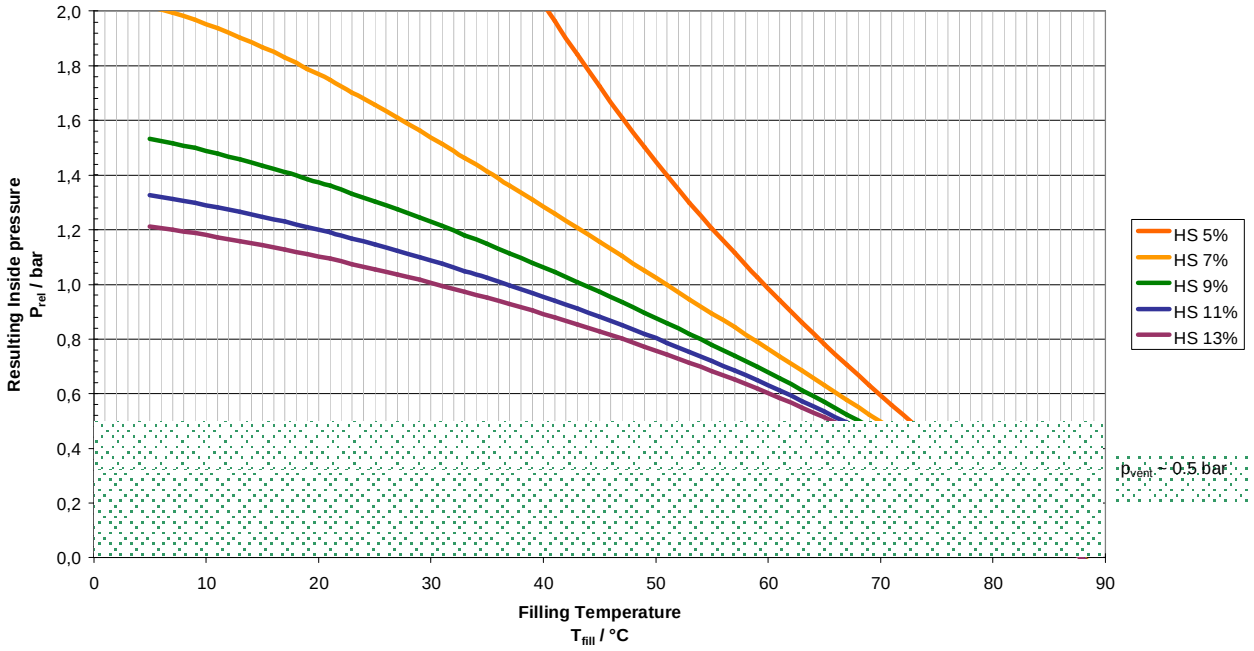


07-1.2 HOT FILL PASTEURISATION 98°C

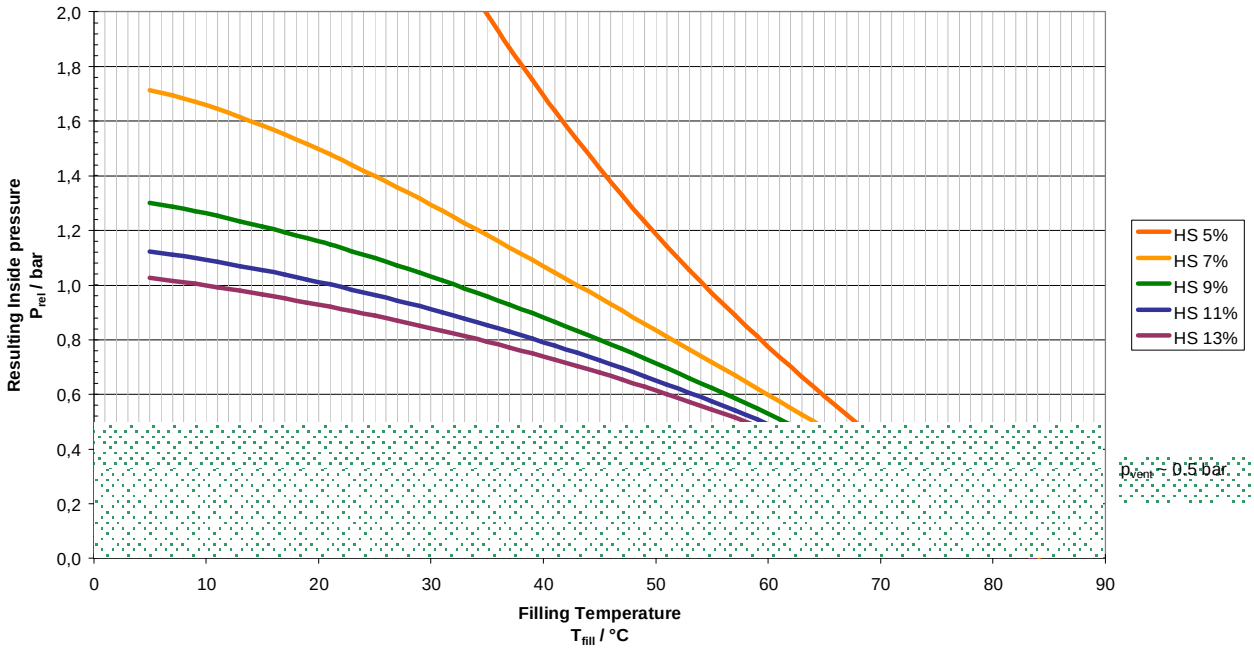
Hot Fill Pasteurisation 98°C
p_{vac} -0.2 bar



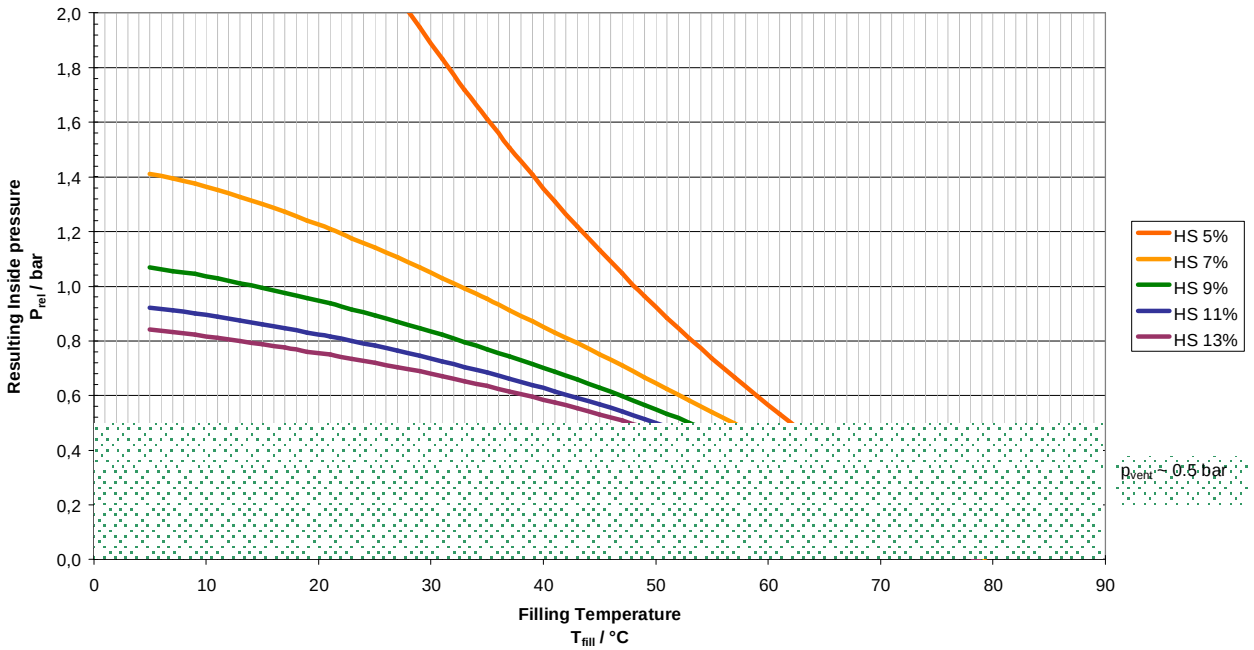
Hot Fill Pasteurisation 98°C
p_{vac} -0.3 bar



Hot Fill Pasteurisation 98°C
p_{vac} -0.4 bar

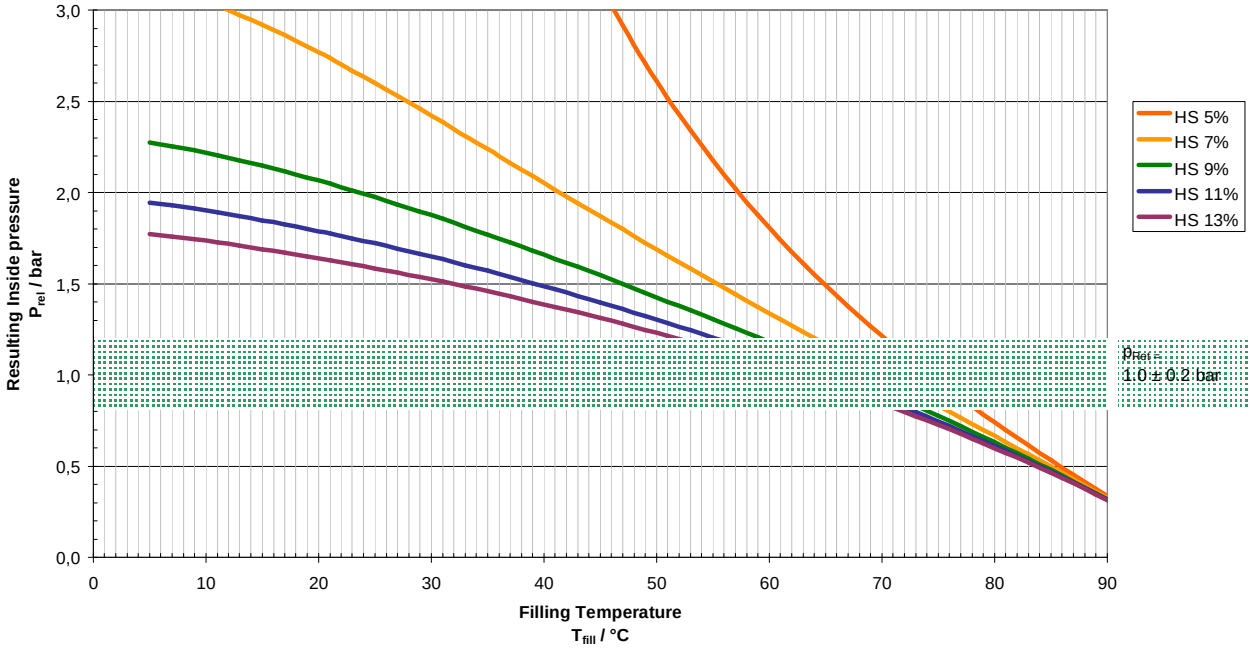


Hot Fill Pasteurisation 98°C
p_{vac} -0.5 bar

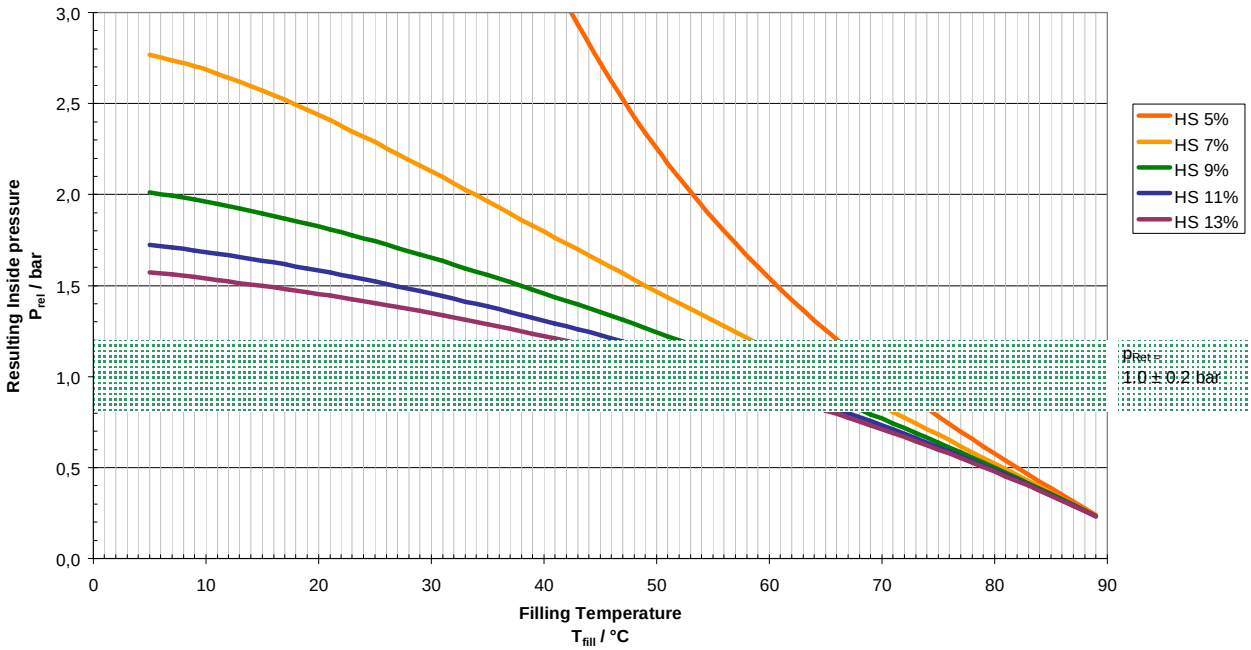


07-1.3 COLD- AND HOT FILL PASTEURISATION WITH SYSTEM PRESSURE 105°C

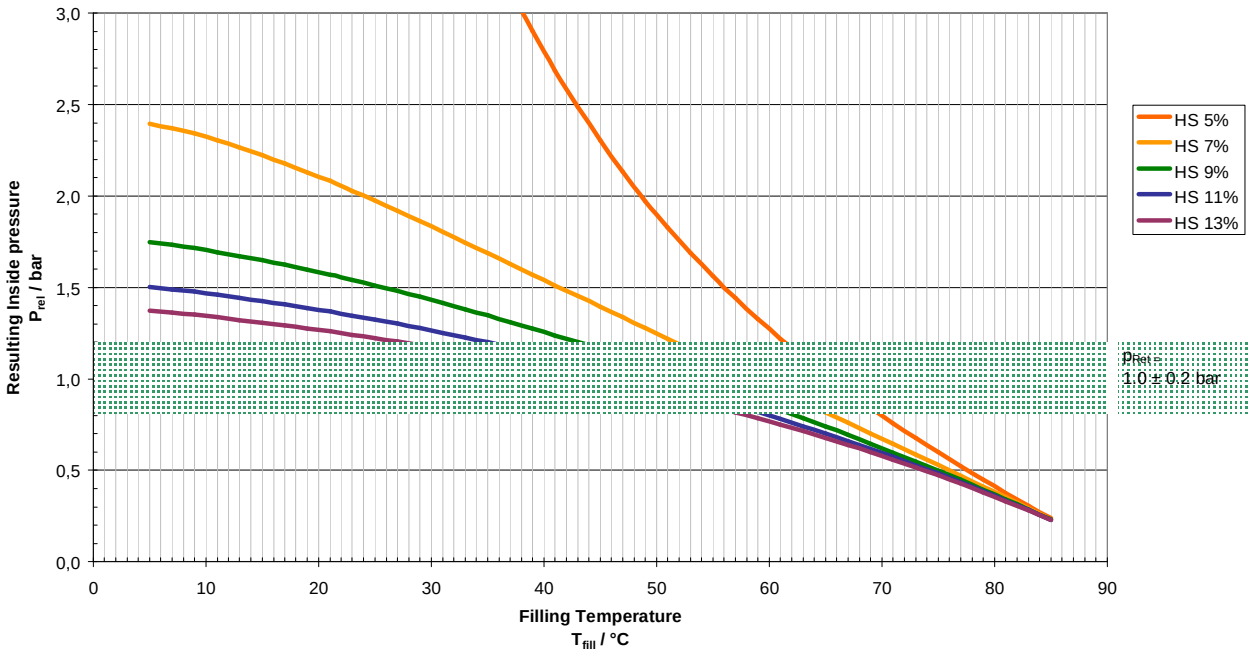
Cold-/hot Fill Pasteurisation 105°C
p_{vac} -0.2 bar



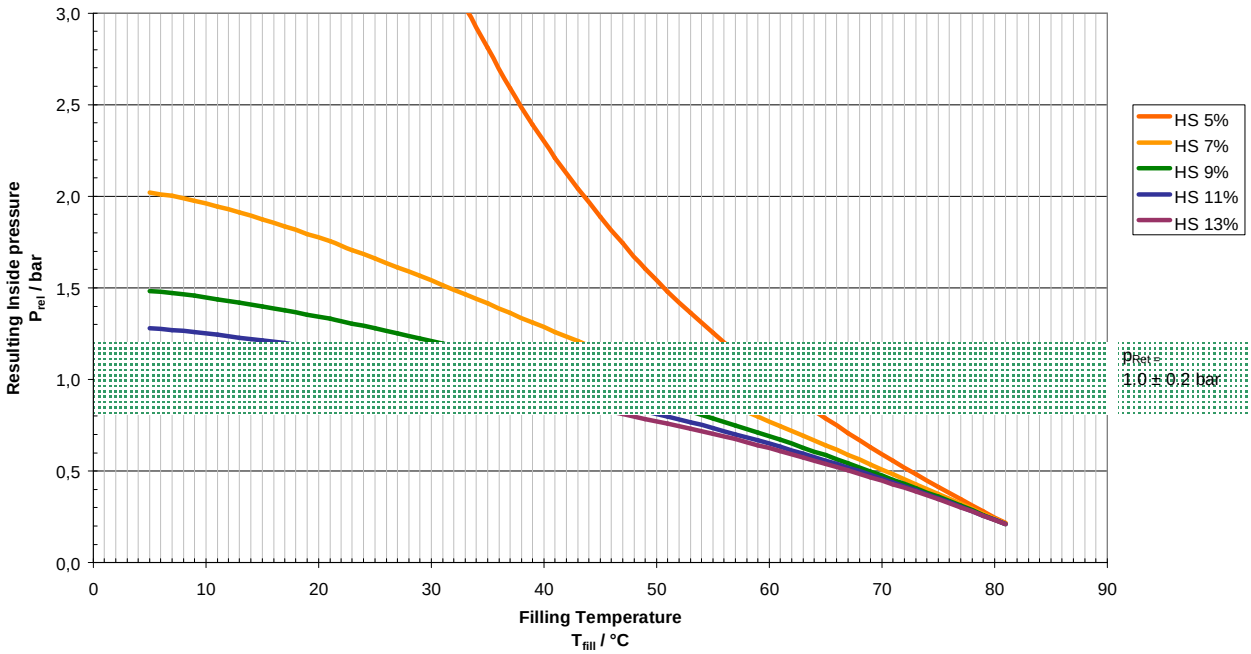
Cold-/hot Fill Pasteurisation 105°C
p_{vac} -0.3 bar



Cold-/hot Fill Pasteurisation 105°C
p_{vac} -0.4 bar

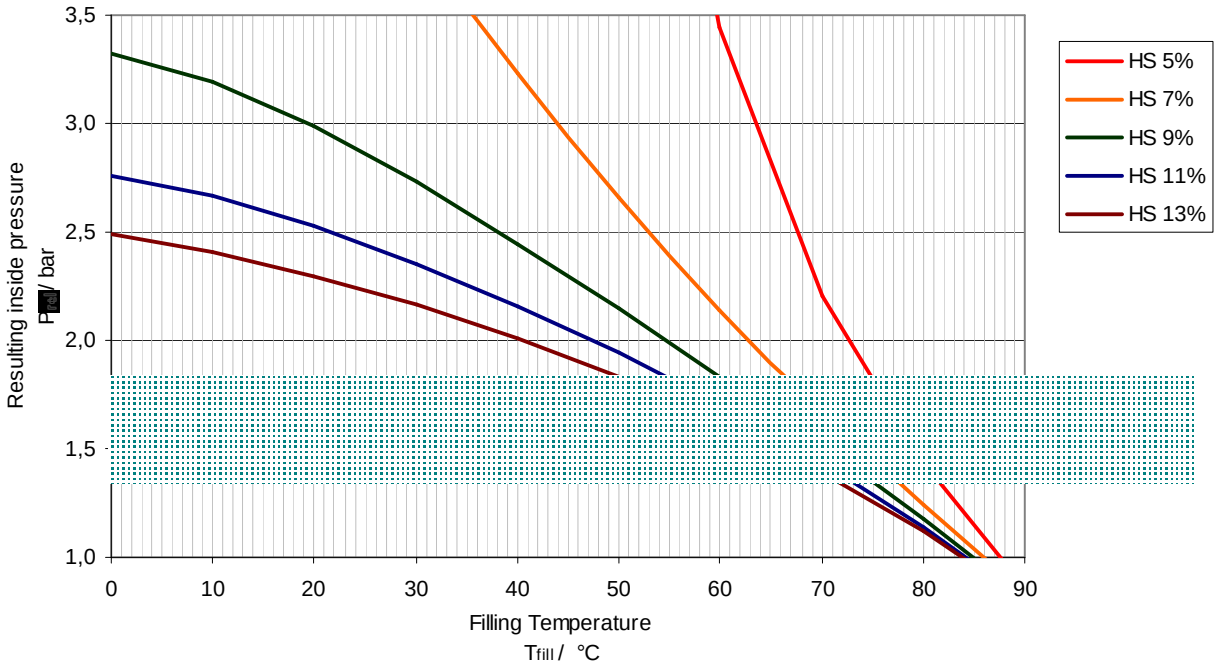


Cold-/hot Fill Pasteurisation 105°C
p_{vac} -0.5 bar

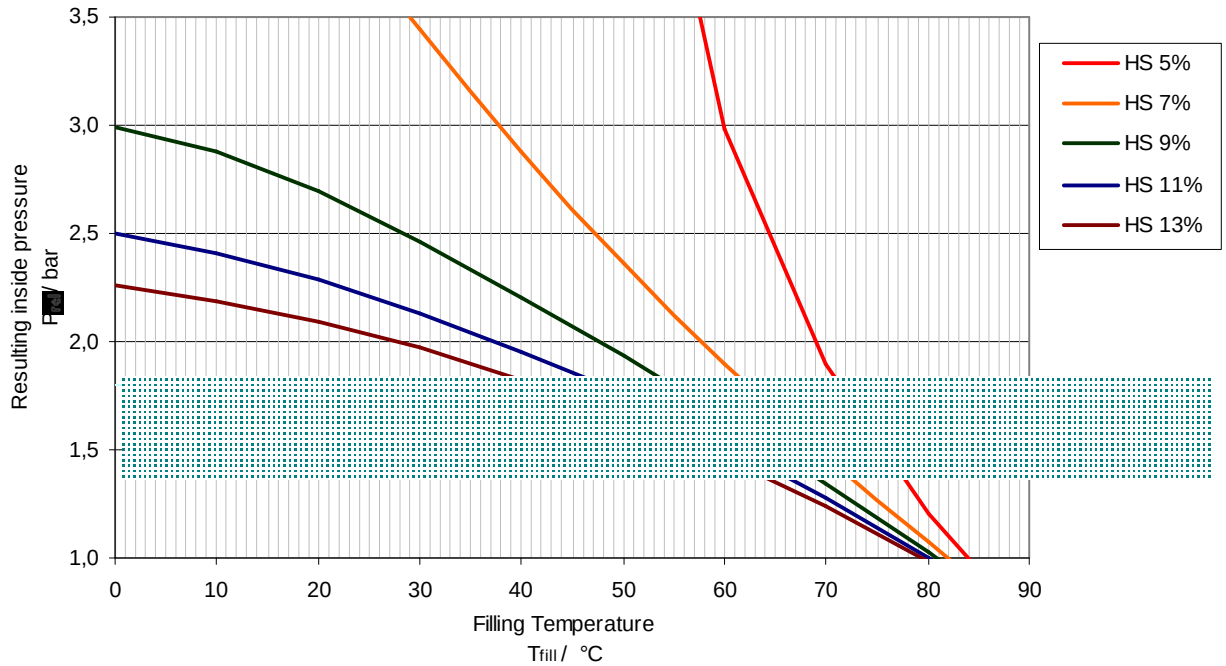


07-1.4 COLD- AND HOT FILL LOW STERILISATION 115°C

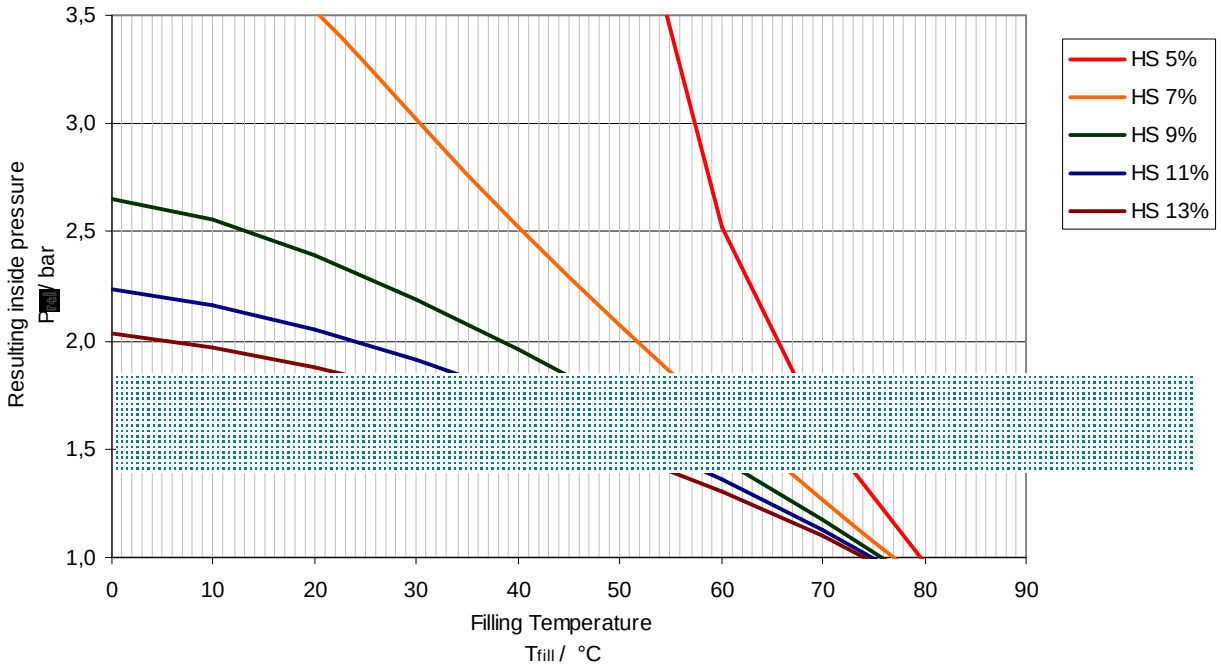
Cold- / Hot Fill Low Sterilisation 115°C
Pvac -0,2 bar



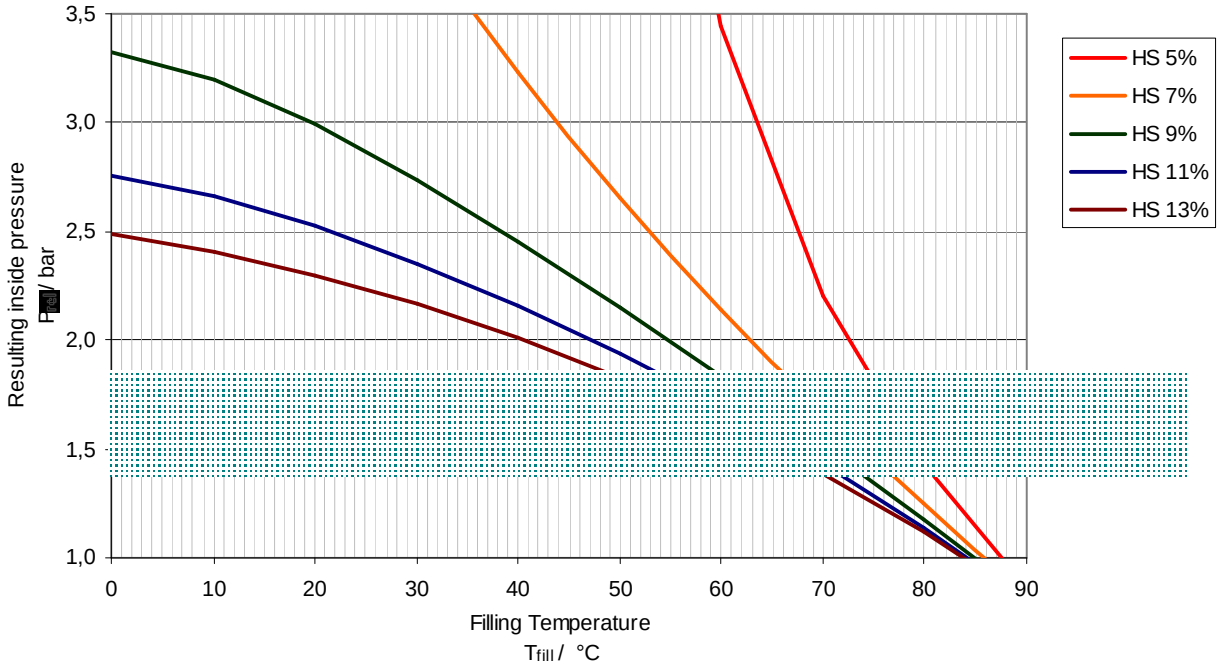
Cold- / Hot Fill Low Sterilisation 115°C
Pvac -0,3 bar



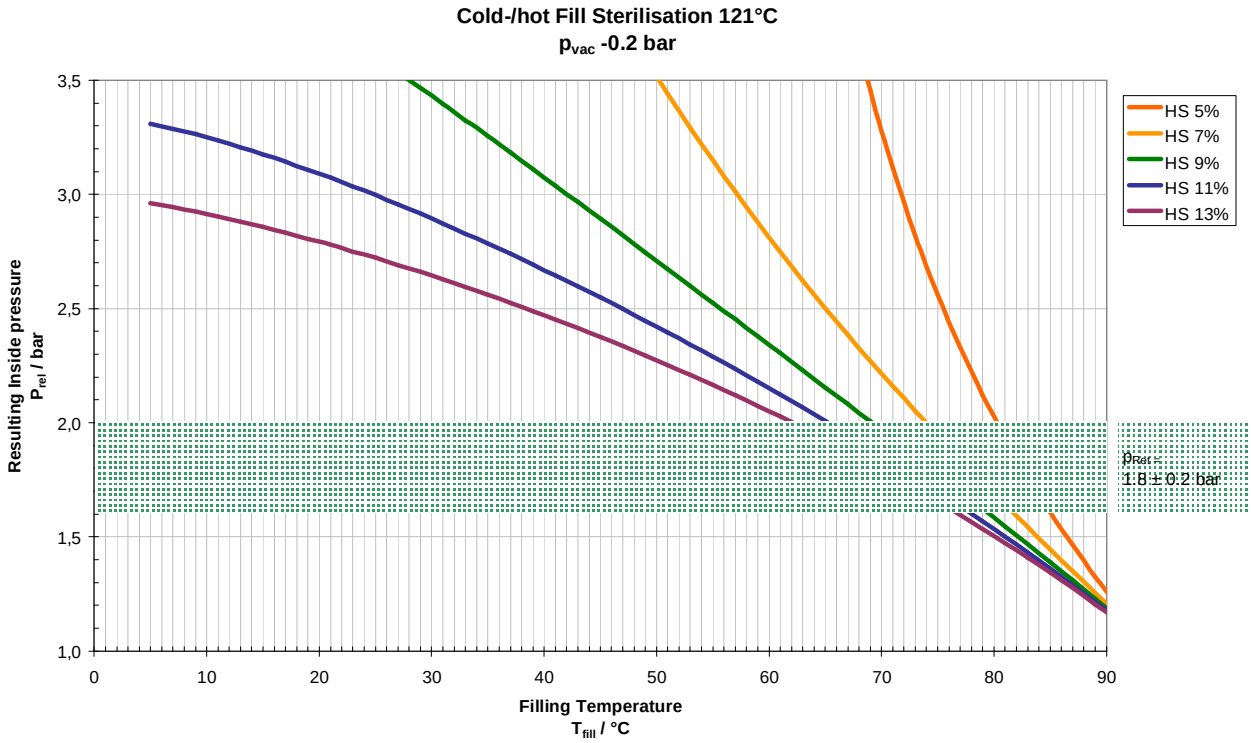
Cold- / Hot Fill Low Sterilisation 115°C
Pvac -0,4 bar

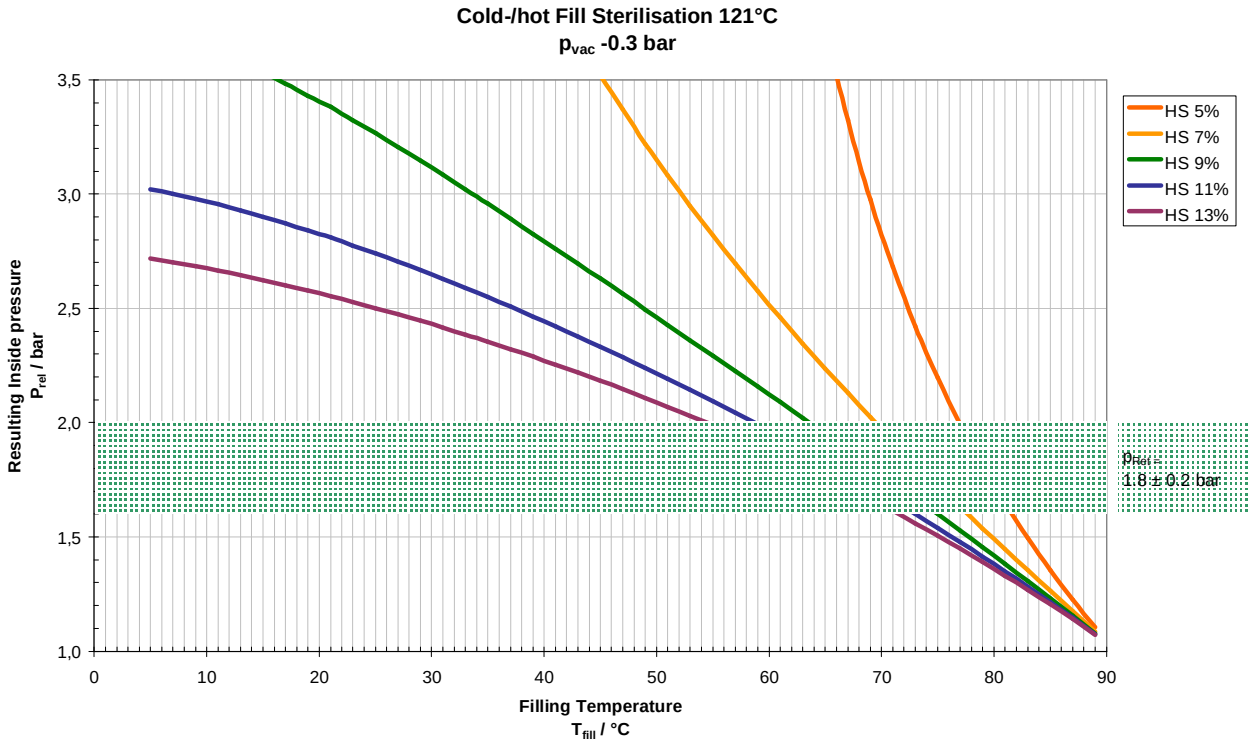


Cold- / Hot Fill Low Sterilisation 115°C
Pvac -0,5 bar

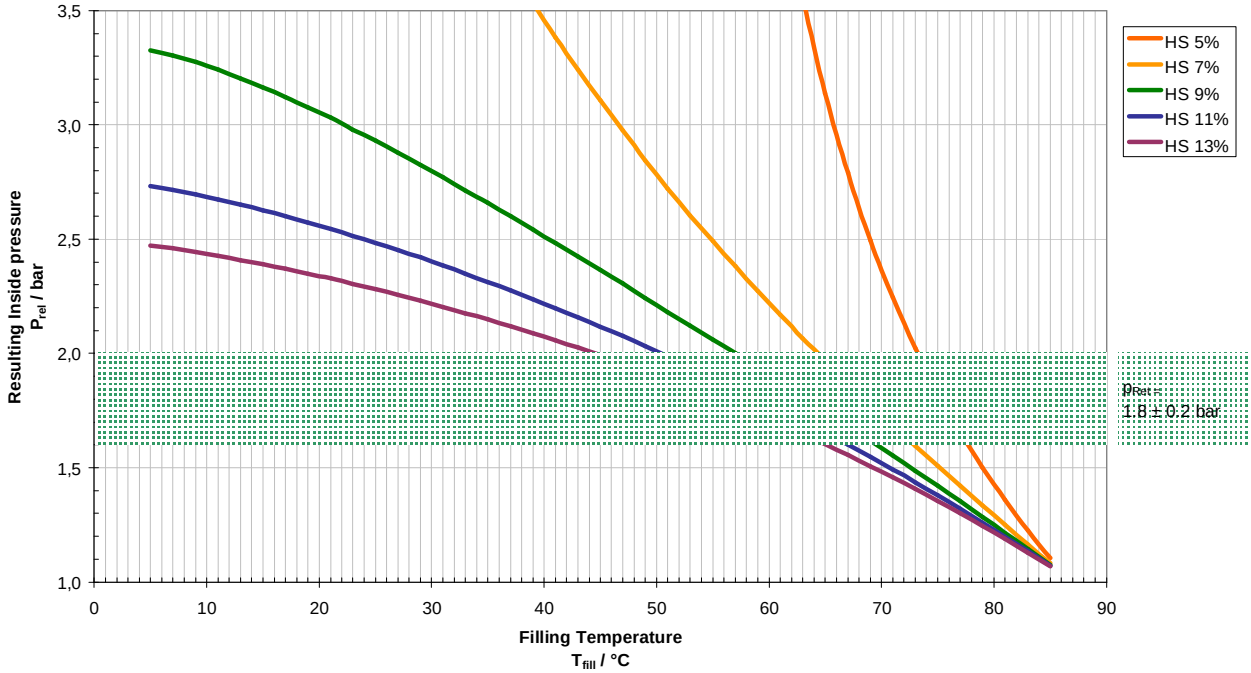


07-1.5 COLD- AND HOT FILL STERILISATION 121°C





Cold-/hot Fill Sterilisation 121°C
p_{vac} -0.4 bar



Cold-/hot Fill Sterilisation 121°C
p_{vac} -0.5 bar