Holistic approach to individual packaging solutions

Six steps to the ideal child-proof packaging

How can the increased demands on child safety in drug packaging be implemented quickly, efficiently and sustainably with the help of an individual development process?

CR functions are appearing more and more frequently in the requirement specifications for new packaging solutions. CR stands for "child-resistant" and aims to protect children from accidentally ingestion of medication. In the United States, around 60,000 children receive emergency treatment every year after accidentally swallowing medication. In Europe, approximately 3,000 children die from the consequences of mistakenly ingested drugs.

Accordingly, the World Health Organization (WHO) describes medicines stored at home as a particularly high risk. Consequently this topic ranks high on pharmaceutical producers' requirement list for medical packaging. The road to an ideal child-proof packaging is long: It starts with design and ends in reliable large-scale production. But how can all those requirements be reconciled? How can pharmaceutical manufacturers who have already invested a lot of time, effort and money in the development of a new drug get it into the market quickly? Which characteristics must a pharmaceutical primary packaging solution fulfill to be user-friendly, efficient and child-safe at the same time. And how can the packaging ensures the necessary performance for stability tests and that the approval process runs smoothly? The development examples of the child-resistant TabTec CR provides information.

CR-Packaging Examples

Thanks to many years of experience, the Sanner specialists know exactly what is important and, in close cooperation with the pharmaceutical manufacturers, develop individual child-proof primary packaging concepts for large-scale production. The Sanner IDP-Process® shows how a modern and efficient packaging concept can be successfully implemented. The holistic Sanner IDP® development process comprises six phases.

IDP stands for 'Idea. Design. Product.' From the idea to serial production, developments are managed and individual packaging solutions are realized.

1. Concept Phase

In the concept phase, the Sanner specialists develop different child-proof approaches based on customer requirements. These concepts are taking into account the requirements of the drugs to be packaged and the criteria of the customer with regard to usability design. A special focus of the product designers and the engineering team is always the compatibility of child safety with the opening requirements of older people and people with disabilities. For the latter, low opening forces and large gripping surfaces are important, as well as clear opening instructions. To ensure child safety, on the other hand, opposing movements are required when opening, i.e. two-handed operation, that must be carried out at the same time, is a prerequisite. For this reason, the conception and design of the child safety function is carried out in close cooperation with an external testing institute for child-safe packaging.

Once all these aspects have been incorporated, it is also about the feasibility of the packaging in series production, as well as an initial, rough cost estimate and a detailed examination of the patent situation.

That the customer understands exactly how Sanner envisions the implementation of the packaging solution, the first sketches are created in CAD and explained to the customer in detail. In the first phase, the customer can choose between several options, all of which meet the specified requirements. The Sanner product designers and engineers are also breaking new ground beyond the well-known push-turn mechanism, such as Squeeze-flip, Squeeze-lift or Push-up-Pull-down opening mechanisms.

Examples of a Squeeze-flip opening mechanism, as it is also used in the TabTec CR.

Examples of a Squeeze-lift opening mechanism, where two sides must be pressed together and the lock lifted upwards.

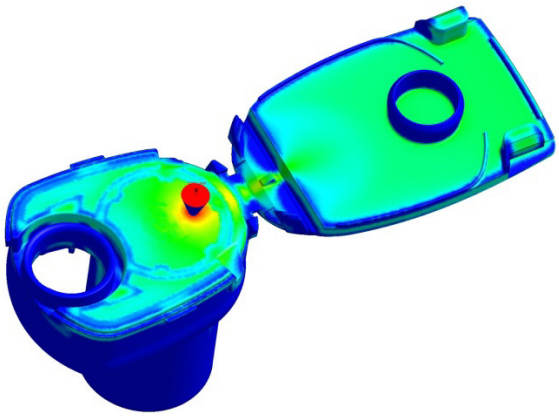
Example of a PushUp-PullDown opening mechanism in which the lock is released for opening after the safety ring has been moved up and then back to the starting position.

The TabTec CR has a squeeze-flip opening mechanism with a flip-top closure, which is opened by pressing and lifting the cap at the same time. A movement in the opposite direction that is difficult for children to perform, but is easy to use, especially for people with restricted mobility or elderly people. The FlipTop makes a click to ensure that the packaging is completely closed. An attractive, modern design with a user-friendly haptic is also particularly important. In addition, a tamper-evident function should ensure protection against manipulation. The tablet dispenser is designed for approx. 50 tablets and must protect the tablets from moisture. For this purpose, desiccant is also integrated into the packaging - one of Sanner's core competencies. With the service of the Sanner Atmo Guard System® the exact amount and type of desiccant is determined in order to achieve the desired shelf life of the product.

2. Design phase

In the design phase, the selected product concept is developed in further detail, while the manufacturing of close-to-production product samples is prepared.

In order to show the customer the basic functionalities of the concept, he receives a detailed elaboration of the CAD data as well as a physical 3D model, for example based on rapid prototyping. In parallel, the material is selected. In addition to the technical properties, the suitability of the material in accordance with the regulatory requirements and its long-term availability are of particular interest.



Mold-Flow-Analysis of a close-to-production sample

The tool engineering for near-serial product samples is of particular importance in this phase. Using mold flow simulation, the Sanner engineers analyze the filling of the cavities and the temperature

conditions in the planned tool in order to achieve an ideal quality. In this manner, the number of subsequent approval loops can be reduced, which leads to considerable time and cost savings.

When it comes to the TabTec CR for example, the closure is injected with an open FlipTop, then the lid is closed via the capping unit on the cap mold. The desiccant chamber was integrated into the floor. Ensuring the tightness was a particular challenge, as this is the only way to create the right climatic conditions in the container. In addition to the tried-and-tested, olive-shaped sealing geometry, a material combination of PP for the container and PE for the bottom part was chosen. In addition, all materials must meet the requirements of the European and US Pharmacopoeia (USP); According to ICH, a shelf life of at least 24 months must be guaranteed.

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In this phase the basis of the production concept for the subsequent series production is established together with the customer. For the pharmaceutical manufacturer, it is advantageous to cooperate with a partner who has extensive experience in large-scale production with different technologies. This includes injection molding, multi-component injection molding, injection blow molding or in-mold labeling as well as desiccant processing.

The risk assessment has a key function during the design phase: in order that the packaging solution is ready for the prototype phase, an FMEA analysis is used to carefully check whether the design meets all requirements. In close coordination with the tool manufacturer, an implementable and validated packaging design is created.

3. Prototype phase

In the third project phase, the necessary for the manufacture of near-serial product samples is realized. It forms the basis for the production tool with which the products are ultimately manufactured in large numbers. At the same time, it is the phase in which final changes to equipment and packaging design can be made without spending a lot of time and money. The actual multi-cavity production tool can only be manufactured once series maturity is reached.

In the case of the CR packaging, a steel tool with one cavity for the container including a flip-top closure and dosing opening, as well as one for the bottom part, is first produced. Necessary dimensional adjustments and functional optimizations for the CR function and the click sound when closing are performed on the product sample. Permeation tests ensure the required tightness, which has a major influence on the shelf life for at least 24 months, while detailed consumer tests provide information about the manageability and - in our example - about the correct function of the closure according to US 16 CFR 1700.20 and ISO 8317 type.

The prototype phase is the most critical and time-consuming phase in the entire process: all requirements must be finalized and tested. This is also where the decision of the testing institute for childproof packaging, such as the IVM Childsafe, is given.

In a test with a group of approx. 100-200 small children between the ages of 42 and 51 months, it is tested whether they may not be able to open the packaging filled with a harmless substitute. At the same time, a test group of seniors between the ages of 50 to 70 must be able to open the packaging without any problems. Only packaging that proves to be child-safe in the test with small children as well as suitable for seniors in the sense of the standard meet the requirements of ISO 8317 (2015).

How is a test for child safety conducted?

a. Examination with young children between the ages of 42 and 51 months

During the exam, the children have five minutes to open the packaging in whatever way. After this time, the opening process is demonstrated to the children once and without explanation. The children then have another five minutes to try and open the packaging. The packaging is considered childproof if a maximum of 15% of the children are able to open the packaging within the first five minutes. During the full test duration, a maximum of 20% of the children are allowed to get to the contents of the packaging.

b. Exams with seniors between the ages of 50 and 70

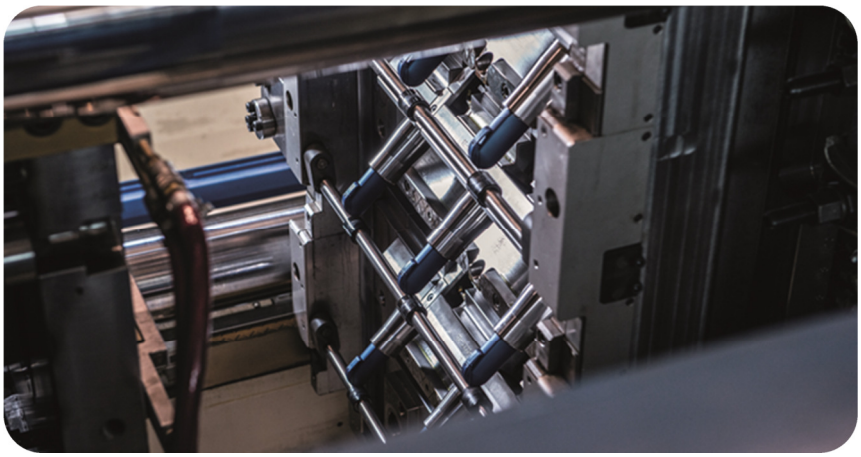
During the test with seniors, they initially have five minutes to open the packaging. There is no demonstration. In a second run, the seniors only have one minute to try to open the closure. The packaging is considered suitable for seniors, when at least 90% of the participants of the test group are able to open the packaging and close it properly again.

The composition of the test group is specified with 100 people, of which 25 participants must be between the ages of 50 and 54, 25 between the ages of 55 and 59 and 50 seniors between 60 to 70 years of age. In each of these groups of age, 70% should be female.

A similar test procedure is carried out in accordance with USA - Poison Prevention Packaging Act (PPPA) 15 U.S.C. Section 1471-76, (CPSC) US 16 CFR Section 1700 carried out to meet this requirement. Accordingly, good project management at the manufacturer of the packaging solution is very important, as is close cooperation with the customer during the finalization. The stability tests can only be started at the customer's premises and if all quality requirements and deadlines are met. This creates a tested and approved product design for successful transfer to series production.

4. Industrial Phase

The industrialization phase primarily consists of the production, installation and qualification of the serial production equipment, as well as the definition of the parameters for a smooth, efficient production process, if required also under clean room conditions.



Sanner production of child-proof packaging

In order to ensure consistently high product quality and an efficient production process, the manufacturing tool is subjected to a comprehensive qualification process in accordance with the cGMP

guidelines. This includes the design qualification (DQ) for the construction of the injection molds and the approval (FAT) of the tools at the manufacturer's site, followed by the installation qualification (IQ) and the operational qualification (OQ), which includes the process determination and definition of the process window with the help of statistical test planning (DoE - Design of Experiments).

5. Implementation phase

In the implementation phase, the production processes are then validated and all documents required for packaging approval and registration are completed. During the performance qualification (PQ), the manufacturing equipment generally produces three validation batches in order to prove its performance in permanent operation. According to a test plan specially developed by Quality Management, the Sanner experts inspect all function-relevant parameters, such as test dimensions or desiccant weight. If the final inspection is successful, constant product quality is ensured. Nothing stands in the way of the pharmacists for entering the market on time.

6. Market introduction and production monitoring

In order to ensure the quality of the product and processes during, but especially after, the market launch, a continuous control of the serial production must take place. The individually created In-Process Control (IPC) inspection plan defines the test criteria and intervals. In addition to the attributive and variable tests of the CR tablet packaging itself, the functionality of the CR closure or the flip top, for example, must be tested at defined time intervals. The functions of the system are also continuously monitored at Sanner and ensured by preventive maintenance.

Over the entire product life cycle, the Sanner IDP-Process® ensures the highest quality, especially for large quantities. All test results as well as the operating data flow into Sanner's own MES. This ensures continuous traceability at all times. A look at the complaint rate and OTIF level shows that customers can rely on this: For every ten million parts shipped, Sanner records less than 0.5 complaints across the entire manufacturing process and the supply chain up to the point of arrival at the customer. And, thanks to professional process and production management, over 98 percent of all deliveries arrive on time and in full at the client.

For them it is also important to be closely involved in the development process. A high level of transparency and open communication in all project phases is crucial so that everyone is always informed about the current status. Thanks to professional project management and profond expertise, the six-stage Sanner IDP-Process® creates a successful, tailor-made child-proof packaging solution

with a focus on quality, time and cost efficiency. Thanks to many years of experience, Sanner knows exactly what the customer is looking for.