

Medicine container with screw cap and pull ring

The packaging is a 110 ml round plastic container with screw cap used for vitamins. The screw cap's diameter is 51.3 mm. The container has a plastic pull ring with a diameter of 25 mm (Figure 1).

Focus areas

The medicine container's opening mechanism consists of two steps: 1) screw cap and 2) pull ring. The analysis can thus be based on mechanical measurements and user studies of the two types of opening mechanisms where both studies are focused on the use of force referring to dimensions, material and tightening torque. On top of this a design analysis of the packaging concerning graphics and choice of colour, shape and the end users' opening strategy should be conducted.



Figure 1 Medicine container with screw cap (d:51.3 mm) and inner pull ring (d:25 mm).

REFERENCE TO GUIDELINE: Physical force, Design, Graphics and choice of colour, Opening strategy.

Form

Basically the packaging diameter is seen as good related to grip when opening. The height of the lid is 8 mm and could benefit by being more (about 20 mm) in order to increase the possibility of a steady grip.

Design

On the top of the lid is an arrow pointing in the opening direction. This facilitates the understanding as a lot of end users turn the lid the wrong way. However, the arrow is white like the lid and therefore easy to overlook. A coloured arrow would be better.

When it comes to the inner opening – the pull ring – most end users are familiar with this mechanism and know they have to pull it to open. It is, however, possible to pull in various directions and at different angles in order to diminish the force needed to open. The easiest way to open is to pull opposite to where the ring is fastened. The pulling directions could be given on the packaging. By examining the packaging an arrow showing the pulling direction is discovered, but it is nearly invisible. If this arrow shall be useful in helping the end user in opening the packaging easily it has to be marked more clearly.

Mechanical test

When simulating the end user's opening force it is important to choose an arrangement simulating the real opening situation closely. When measuring the opening force needed for the medicine container we measured an un-tightening torque of the screw cap of 0.5 ± 0.1 Nm and of 0.9 ± 0.3 Nm (see Figure 2a) respectively without and with friction. The friction indicates how much the end user deforms the container during opening and thus varies for each person. Therefore it is difficult to simulate and measure the opening force needed for a certain packaging using mechanical test methods. It is estimated that the force including friction is the most correct one as this method reflects the user situation most adequately. When making comparison tests, however, it is the method without friction that provides the most adequate illustration of the difference.

The force necessary for opening the pull ring was measured with a 45° angle opposite of the fastening point. The force was measured to be 56±2.5 N (see Figure 2b).

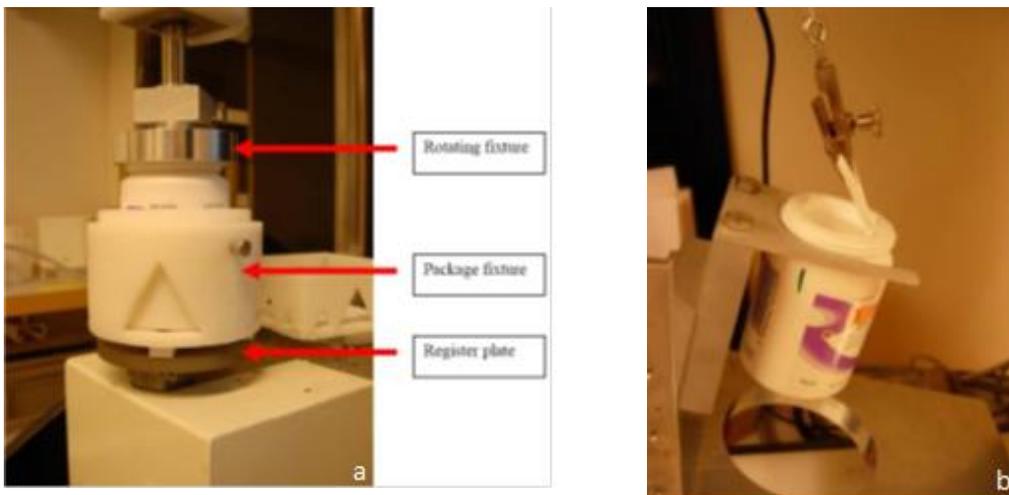


Figure 2 Mechanical measurement of the force needed for opening the medicine container with screw cap and pull ring. a) measuring opening torque (without friction), b) measuring pull of ring.

End user's physical force needed

A calculation model has been developed for the guideline estimating the end user's critical force needed related to different packaging types. Based on dimensions and force measured the model illustrates which people potentially could have difficulties opening the packaging.

According to the model nobody regardless of age or sex is expected to have any trouble opening the screw cap (Figure 3a). Opening the pull ring on the other hand can cause trouble. 30 % of women between 10 and 30 yrs old and 30-50 % of women between 60 and 80 yrs old will experience difficulties opening this packaging (Figure 3b). Men are not considered to have any trouble opening a pull ring of the mentioned dimensions and measured force (3b). Further information on the model and background data can be found in the guideline under "Calculation of critical force".

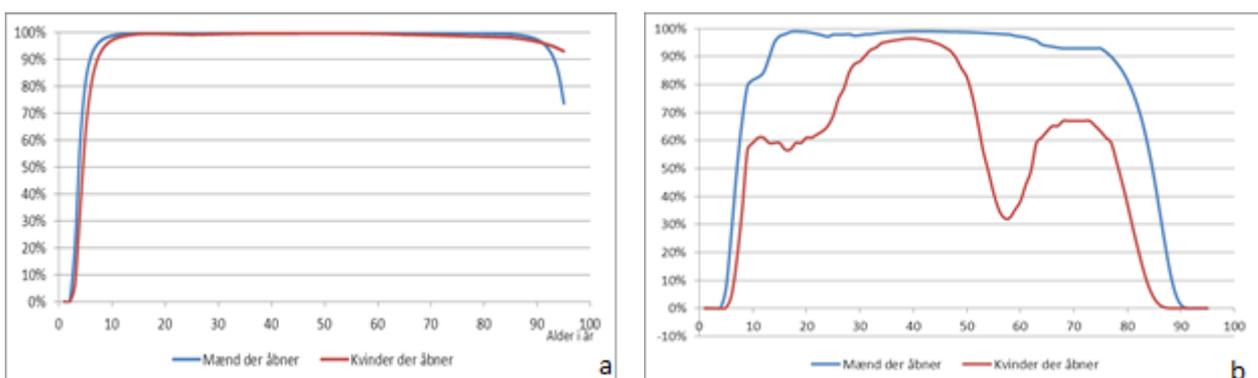


Figure 3 The share of men able to open a) screw caps of 51 mm with a torque of 0.9 Nm and b) pull ring in cans with a diameter of 25mm using an opening force of 56 N (Model based on data from DTI, UK 2002).

End user test

In relation to an evaluation of the new technical specification "DD CEN/TS 15945:2011 Packaging. Ease of opening. Criteria and test methods for evaluating consumer packaging" user tests were conducted in 2008

at Danish Technological Institute with this type of medicine container. Test users consisted of 35 randomly chosen elderly people in the age group of 50-90 yrs. Of these 1/3 was men and 2/3 were women. Half of the group had a physical ailment, e.g. arthritis in the hands. The group was asked to open the packaging and then evaluate how easy or difficult they found it on a scale from 1 to 5 where 1 is very easy and 5 is very difficult or impossible to open. The result is depicted in Table 1.

As expected none of the test persons experienced any problems with the screw cap (no figures shown). The user study showed that the women generally experienced the largest difficulties when opening the container and all of the difficulties were related to the pull ring (Table 1). All figures can be influenced by the user group's age range, e.g. the 90 yrs old man in the group who had no physical ailments but still found it difficult to open the container. The result of the user test confirms the model estimates as shown in Figure 3.

Table 1 User test of medicine container with screw cap and pull ring rated on a scale from 1-5 where 1-2 is easy to open and 4-5 is difficult or impossible to open. The test group consisted of 35 persons, men (M), women (F), with (D) or without (N) physical ailments affecting their hands. Number of persons in the group is given in parentheses.

End users' evaluation of the medicine container	MD (3)	FD (14)	MN (9)	FN (9)	Total (35)
Difficult to open	67 %	36 %	11 %	44 %	34 %
Easy to open	33 %	36 %	89 %	56 %	54 %

Conclusion

The problems with this packaging solely relates to the pull ring. This is mainly due to the fact that it takes too much force to pull the ring and it is especially difficult for women over the age of 60. To solve this the pull ring can be made easier to open either by reducing the force needed or by increasing the ring diameter, so more fingers can be used for pulling and thereby increase the force transfer.

The calculation model can give an idea of what diameter and force to use in order to make a given percentage of the target group able to open it. If the success criterion is that 90% of all persons should be able to open the container, the best result can be obtained by simultaneously reducing the force necessary and increase the ring diameter. In order to reach the success criterion most efficiently a ring diameter of 50mm and 50N as maximum opening force will be needed (Figure 4).

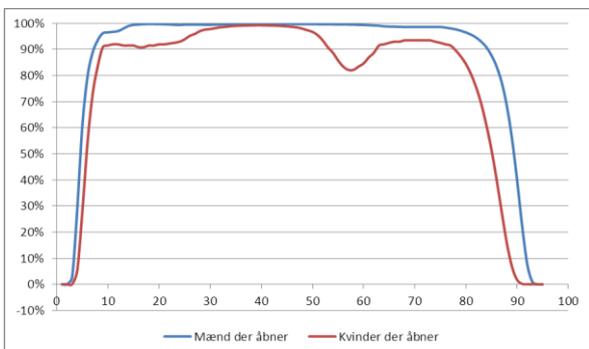


Figure 4 The share of men and women who can open the pull ring in cans when the diameter is 50 mm and the opening force 50 N (Model based on data from DTI, UK 2002)

During the end user study it was furthermore observed that end users approach a pull ring in quite different ways. Some people pull vertically to the container and others pull at random while a third group pull directly at the ring fastening point (with no luck).

These suggestions to improvements are pretty obvious. If the company requires more unorthodox or innovative solutions we suggest that a workshop for idea generation is held (see User-friendly Packaging - Guideline for the industry).