BS ISO 17480:2015

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Packaging — Accessible design — Ease of opening

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National foreword

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The UK participation in its preparation was entrusted to Technical Committee PKW/0/-/12, Packaging - Ease of opening.

A list of organizations represented on this committee can be obtained on request to its secretary.

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Emballages — Conception accessible — Facilité d'ouverture

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ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT), see the following URL: Foreword — Supplementary information.

The committee responsible for this document is ISO/TC 122, *Packaging*.

Introduction

In our ageing world, there has been increasing awareness of full and effective participation of older persons and persons with disabilities in society on an equal basis. A common challenge facing the packaging industry in the world is to develop packages which are easy to open for more people, including older persons and persons with disabilities.

Ease of opening in packaging adds more value to the usability of packaged products. In addition to sealing performance, greater consideration needs to be given to ease-of-opening function when designing packaging.

While degrees of ease of opening and satisfaction of opening can vary widely in ages, sex, physical ability, and features, etc., this International Standard addresses essential points to enhance ease of opening in packaging from accessible design viewpoints.

INTERNATIONAL STANDARD ISO 17480:2015(E)

Packaging — Accessible design — Ease of opening

1 Scope

This International Standard specifies requirements and recommendations for the accessible design for packaging with a focus on ease of opening. It applies to reclosable and non-reclosable consumer packaging without using any other mechanical means. This International Standard covers the design aspects addressing openability including opening location, opening methods, as well as evaluation techniques, both instrumented and user-based. This International Standard is primarily for designers, developers, and evaluators of packaging and will also be useful for other disciplines.

For products regulated for safety or other reasons (e.g. toxic or dangerous goods and substances, medicinal products, and medical devices), those regulations take precedence.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 21067, *Packaging — Vocabulary*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 21067 and the following apply.

3.1
consumer packaging
packaging, constituting, with its contents, a sales unit to the final user or consumer at the point of retail

[SOURCE: ISO 21067]

3.2
openability
extent to which package contents can be accessed easily with regards to human factors (e.g. strength, dexterity, and cognition)

Note 1 to entry: Packaging with poor openability means that the contents are perceived as difficult to access.

3.3
strength
amount of force needed to achieve an intended task

3.4
dexterity
extent to which a user can manipulate and handle an object

3.5
cognition
extent to which a user can understand the appropriate information as it is intended

3.6
instrument-based evaluation
evaluation that uses measurement instruments to obtain quantified data, such as force and torque levels in physical testing

3.7
user-based evaluation
evaluation that uses a method involving users with or without the use of measurement instruments and provides insight into the user's sensory, physical, and cognitive aspects

3.8
reclosable package
package which, after it has been initially opened, is capable of being reclosed with a similar degree of security and is capable of being used a sufficient number of times to dispense the total contents without loss of security

[SOURCE: ISO 8317:2003]

3.9
pull-tab package
package that can be opened by pulling the ring installed on the upper or side part of the package

Note 1 to entry: It is the general term for full-open tab package, stay-on tab package, and any other tab-attached package.

3.10
full-open tab package
package whose lid can be fully opened by pulling the tab

3.11
stay-on tab package
package that can be opened by pulling the tab which will not be detached after the package is opened

4 Accessible design of ease of opening

4.1 General

4.1.1 Context of use

The packaging design shall encompass the context of use for the package. This should be achieved by considering the following:

— identification of the main goals (e.g. access to the contents);

— identification of the tasks needed to achieve intended goals (e.g. gripping, lifting, pulling, etc.);

— specify intended users, taking into consideration the variety of physical, psychological, and cultural characteristics;

— specify the environments in which the package is (or is intended to be) used. Those attributes of the physical or social environment are likely to have impacts on achieving the goals.

4.1.2 Opening strength

The nominal force to open the package shall be achievable by the intended users. This force should be as low as possible without compromising the packaging integrity. Information on aspects of opening strength is shown in Annex C.

4.1.3 Dexterity

The packaging opening mechanism shall be designed so that it is easily manipulated by the users with the widest range of characteristics and capabilities. Information on aspects of dexterity is shown in Annex C.

4.1.4 Cognition

Opening of the packaging shall be designed so that it is easily understood by the user. Consideration should be given to a user's sense of touch, sight, etc. Information on human cognitive, visual and tactile aspects is shown in Annex E.

4.2 Specific considerations

4.2.1 Opening location

The opening location shall be readily found and its use easily understood. This can be achieved by applying the following design considerations.

— The opening location is differentiated by visual markings using characters and/or imagery, such as pictograms.

— Visual markings are designed by appropriate combinations of colour, font size, font type, etc.

— The opening location is differentiated by tactile markings using shape, notches, embossing, texture, etc.

NOTE Supporting data for human cognitive, visual and tactile aspects is in Annex E.

4.2.2 Methods and mechanisms of opening the package

The opening method and mechanism shall be easily identifiable and intuitively understandable. This can be achieved by applying the following design considerations.

— The opening methods and mechanisms (turn, tear, peel, pull, push, etc.) are clearly shown if not evident.

— The package is designed so that it can be opened smoothly, irrespective of the size or power of the users' hands.

— The package is designed in such a way that spillage is prevented and that there is no risk of injury for the user.

4.2.3 Force and handling aspects

The forces and handling aspects of the opening shall result in favourable openability.

The nominal force to open the package shall accommodate the large variety of the opening strength by the intended user (e.g. children, people with disabilities, and older people) and the packaging integrity.

The package and its opening mechanisms shall be easily manipulated, taking into account the large variety of-users' dexterities (e.g. children, people with disabilities, older people, etc.).

NOTE Supporting data for strength and dexterity is in Annex C.

4.2.4 Reclosing of the package

Reclosing of the package (if applicable) shall be easy. This can be achieved by applying the following design considerations:

— reclosing method is easily understood if not clear immediately;

— reclosing method and procedure are made clear by using characters/imagery, such as pictograms with appropriate combinations of their size, font, contrast, and colour;

— reclosable packages are designed so that they can be re-opened smoothly.

EXAMPLE A touch or auditory (e.g. click) mechanism is used for reclosable packages to affirm that the package has been reclosed.

5 Evaluation of ease of opening

5.1 General

Instrument-based evaluation uses measuring instruments to obtain quantified data, such as force and torque levels in physical tests.

Instrument-based methods in their current form (as shown in Annex B) will provide indicative measures as to the nominal values of opening torque or force required but are unlikely to establish exact limits on a user's ability.

Hence, user-based studies are needed to be undertaken in parallel with instrument-based studies to complement the results from those tests (i.e. if instrument evaluation consistently predicts lower opening forces on Pack A than Pack B, we would expect Pack A to be opened by more people more easily).

User-based evaluation relies on methods involving humans with or without the use of measuring instruments.

It provides insight into the user's sensory, physical, and cognitive aspects of accessibility.

5.2 Instrument-based evaluation

Instrument test methods can provide quantitative data with regards to certain attributes, such as removal torque, peel strength, and ring pull force (mechanical). Evaluation of package design properties such as glare, colour contrast, friction, size, weight, and temperature can be measured by different types of instruments.

When designing a packaging to be easy to open, the data obtained from mechanical tests should be used in combination with other design criteria of importance, as those described under Clause 4. See Annex B and Annex C.

The data generated by these instrument-based evaluation test methods can be used to compare characteristics of related packaging systems and to provide possible insights for improved designs.

5.3 User-based evaluation

Panel tests enable the qualitative assessment of packaging designs and allow the development of an understanding of users approach to packaging openability and handling. Panel tests can be used in conjunction with other qualitative research methods such as questionnaires and structured or unstructured interviews. Panel tests can aid in the development process and the resulting data can inform on the performance of a packaging against predetermined criteria.

The data generated by these user-based evaluation test methods can provide possible insights for improved designs.

Instead of testing with the general population, one can select a test population from those that are most sensitive based on their characteristics and capabilities in use of the packaging. The result will be valid also for the general population that are less sensitive. An example of this is the selection of a panel in the CEN 15 945 containing people in the ages between 65 and 80, which is regarded to be more sensitive than the general population. General information on how to set up and perform user-based evaluation can be found in the ISO 20282 series. See Annex D and Annex E.

To enable a fast screening of relevant basic features with regard to information design and handling of consumer packaging, a checklist is included as Annex F.

6 Conformance

Conformance with this International Standard is achieved by satisfying all the requirements.

If a package is claimed to have met the requirements in this International Standard, the procedure used to determine how they have been met shall be specified. The detail to which the procedure is specified is a matter of negotiation between the involved parties.

Users of this International Standard may either utilize the procedure and forms provided in Annex G or develop another procedure tailored to their particular needs.

Annex A
(informative)

Examples of opening-types

A.1 Turn to open

A screw cap can increase the accessibility of opening.

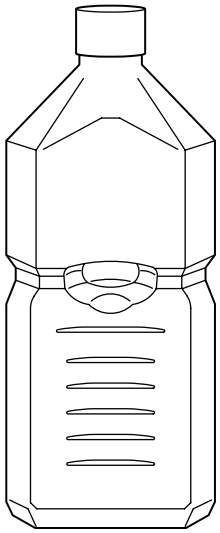


Figure A.1 — Screw top bottle

A.2 Tear to open

Notch or perforation helps open the package easily with fingertips.

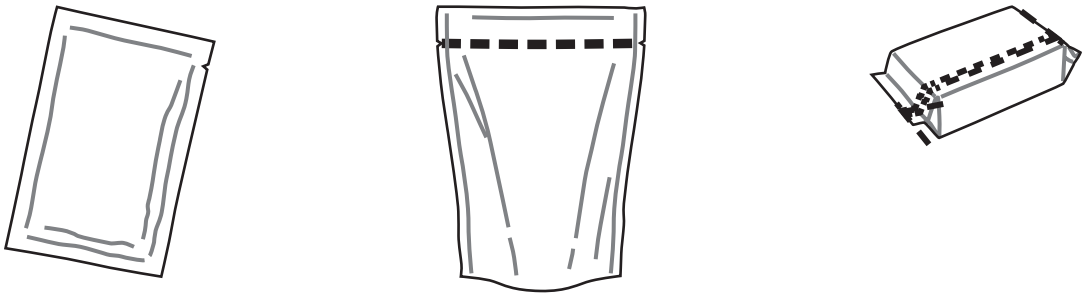


Figure A.2 — Heat-sealed flexible bags

A.3 Tear (apart) to open

The opening tab large enough to pinch and/or perforation applied on the film help open the package easily.

Figure A.3 — Shrink film

A.4 Peel to open

The opening tab large enough to pinch helps open the package easily.

Figure A.4 — Heat-sealed semi-rigid containers

A.5 Pull to open

The lid can be easily removed by putting a finger into the ring and pulling it up.

Figure A.5 — Pull-tab packages

A.6 Push to open

The package will easily open by pushing through the back sheet (made of aluminium foil, paper, etc.).

Figure A.6 — Blister packages, a carton box, etc.

A.7 Push (up) to open

The package will open easily by pushing the intended part.

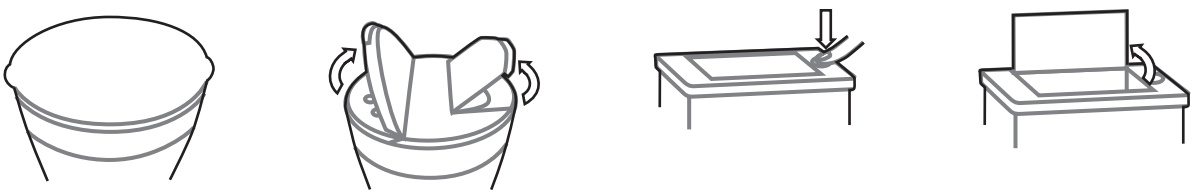


Figure A.7 — Hinged cap, a push-and-open container, etc.

A.8 Pinch and peel to open

The package will open easily by pinching and peeling the intended part.

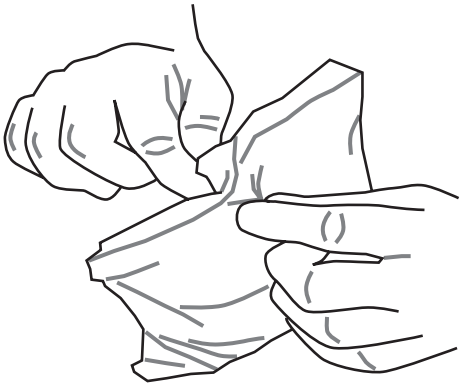


Figure A.8 — Flexible bag

Annex B
(informative)

Examples of mechanical evaluation methods

B.1 General

Test methods might vary depending on the opening mechanisms and types of packaging. Conditioning might depend on specific test standards or types of packaging.

The following are examples of test methods by opening-types. Other test standards that are not introduced here may apply.

The data generated by these instrument-based evaluation test methods that can be used to compare characteristics of related packaging systems and to provide possible insights for improved designs.

B.1.1 Turning

B.1.1.1 Equipment

A mechanical or electronic torque measuring device as shown in Figure B.1.

B.1.1.2 Test sample

Screw top container such as PET bottle, glass container, etc.

B.1.1.3 Procedure

Fix the test sample on the supporting table. Grasp the screw top preferably with a suitable chuck and turn slowly anticlockwise. Read the torque at the time when the screw top starts turning. Also, read the torque when the bridge has been detached. When turning the screw top, grasp it with just enough force to turn without a slippage. Do not apply force more than necessary. For the packages intended to be reclosed, turn the screw top clockwise until it stops turning. Turn slowly anticlockwise again and read the maximum torque at the time when the screw top starts turning.

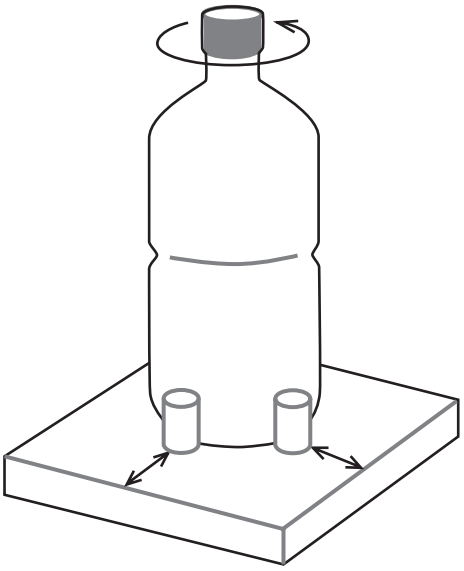


Figure B.1 — Mechanical or electronic torque measuring device

B.1.2 Tearing

B.1.2.1 Equipment

A tensile tester with two clamps, one of which is mobile, as shown in Figure B.2.

B.1.2.2 Test Sample

A heat-sealed flexible bag with perforation, laser pre-cut, or notch.

B.1.2.3 Procedure

Hold the heat-sealed flexible bag with two clamps. Pull the mobile clamp at the load end of the equipment in a perpendicular direction at a speed of 500 mm/min and tear 20 mm along the opening line. Read the maximum force.

For the bags designed to be torn off for opening, pull the string until completely torn off. (Read the maximum torque.)

Dimensions in millimetres

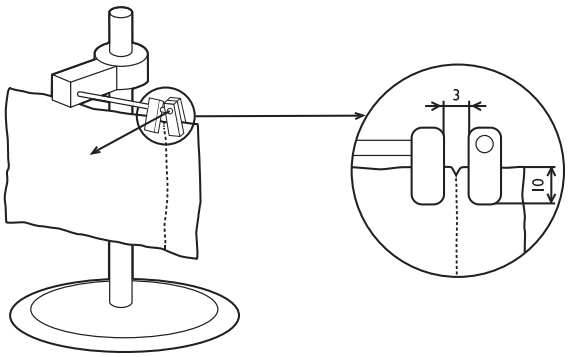


Figure B.2 — Mechanical tensile measurement

B.1.3 Peeling for rigid packaging

B.1.3.1 Equipment

The test equipment has a holder for securing the packaging. This holder simultaneously sets the direction of opening and ensures a constant pull angle of 135° between the packaging components to be separated during the entire opening process. The pull angle has to be constant across the opening distance. Therefore, movement of the packaging has to be realized, for example, by a slide connected play-free to the traverse of the tensile testing machine (see also Figure B.3). Secure, play-free clamping of the packaging shall be guaranteed. For rigid packaging systems, securing with adhesive tape on the base of the packaging will suffice. For semi-rigid packaging systems, the packaging shall be clamped on the underside of the sealed seam to avoid bulging and deformation of the seam. Any deformation of flexible packaging components (cover film) caused by the opening process shall not be hindered because the forces which act here also have to be applied by consumers and are hence, relevant for opening the packaging.

NOTE For comparative measurements exclusively for determining the maximum forces (e.g. pull-open force) without evaluating the opening pattern (e.g. the pulling open of the cover film), the use of hold-down plates is allowed for securing the packaging and this has to be noted in the relevant test protocol.

B.1.3.2 Test sample

A peelable heat-sealed rigid or semi rigid container.

B.1.3.3 Procedure

B.1.3.3.1 Setting up the test equipment

— Alignment of the specimen holder to set the direction of opening and for centric alignment of the clamp at the position of the pull geometry of the packaging (preferably use a template).

— Set the test software for automatic evaluation of relevant forces (pull-open force, pull-off force, and other characteristic forces).

— Set an adequately high sampling rate for recording measurement values.

NOTE 50 to 100 measurement values per second are sensible for a test speed of 500 mm/min.

B.1.3.3.2 Clamping the test specimen

— Secure the packaging in the specimen holders and precisely heed the direction of opening.

— Zero the force without any tension in the pull-open tab.

— Clamp the pull-open tab without damaging the sealed seam. The load on the force gauge shall not exceed±0,3 N after clamping the tab. If it does, the film clamps shall be loosened and the tab clamped once again.

— The alignment of the pull contour shall be centric/symmetric to the film clamps.

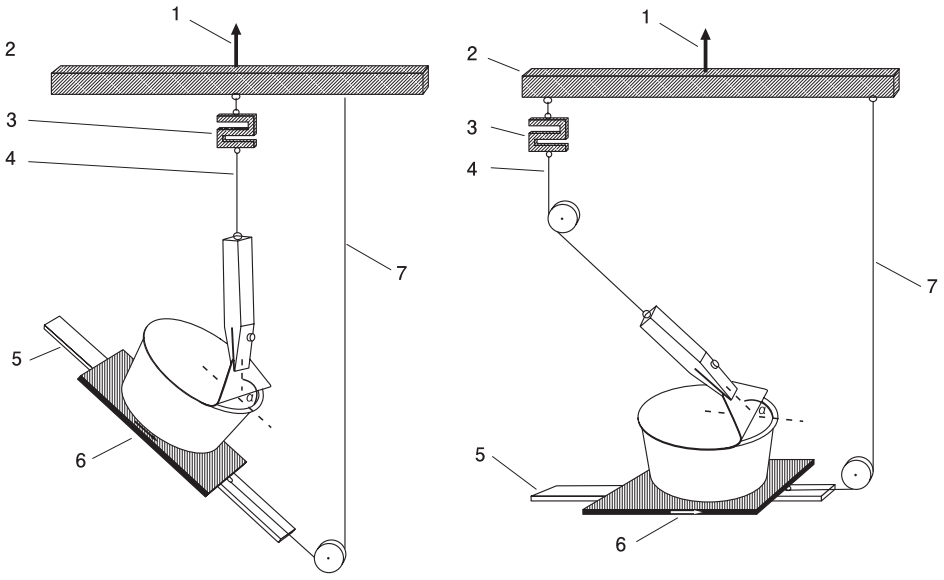
B.1.3.3.3 Testing

— Pull the tab at a speed of 500 mm/min and at a constant angle of 135° between the packaging components to be separated (constant across the opening distance).

NOTE 135° between the packaging components to be separated mostly equates to an angle of 45° on the supporting table.

— Plot the opening force required to open the sealed seam as a function of the opening distance in a force/distance graph and /or read the maximum tensile force at that time.

— Document all observations about the opening behaviour (e.g. pulling of the cover film, delamination, and thread formation).



Key

1 moving direction of the traverse
2 traverse
3 force gauge
4 connection between force gauge and film clamp
5 rail
6 slide
7 connection between slide and traverse
α peel angle

Figure B.3 — Illustration of mechanical tensile measurement tester for heat-sealed peelable semi-rigid container

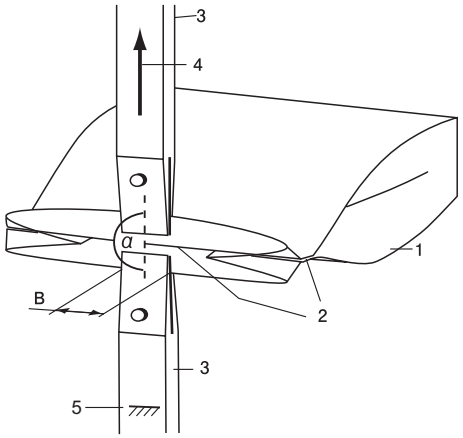
B.1.4 Peeling for flexible packaging

B.1.4.1 Equipment

The measurements are made using a tensile testing machine, which permits measurement and plotting of the force at a constant peel speed and constant peel angle of 180°. The opening force should be able to be measured and plotted to an accuracy of ±1 %.

Secure, play-free clamping of the packaging shall be guaranteed. Any deformation of flexible packaging caused by the opening process shall not be hindered because the forces which act here also have to be applied by consumers and are hence, relevant for opening the packaging.

For bags, the width of the clamps has a demonstrable effect on the resulting opening force. Hence, use 20 mm wide film clamps for clamping bags.



Key

1 bag with side fold
b sealed seam
3 film clamps
4 moving direction
5 fixation
B width of film clamp
α tear angle

Figure B.4 — Illustration of mechanical tensile measurement tester for heat-sealed peelable bags

B.1.4.2 Test sample

A peelable heat-sealed bag.

B.1.4.3 Procedure

B.1.4.3.1 Setting up the test equipment

— Set as high as possible sampling rate for recording measurement values.

— Align the clamps parallel and centred to each other.

NOTE If the position below top seal is clamped, heat seal strength corresponding to human force can be measured.

B.1.4.3.2 Preparing/mounting the test specimens

— Open filled packaging, if necessary, at the base, and remove the contents.

— If necessary shorten bags in order to avoid contact with the test rig.

— Clamp the packaging without damaging the sealed seam.

— After clamping one side of the packaging (in the clamp on the force gauge), zero the force value.

— The alignment of the bag and pull contour on “soft” deep-drawn packaging systems shall be centred/symmetrical to the film clamps.

NOTE When clamping the packaging, it has to be ensured that the set peel speed is only reached after certain acceleration (crosshead travel).

B.1.4.3.3 Testing

— Support the packaging with the hand in order to guarantee a pull angle of 90° + 90° = 180° during the whole opening process.

NOTE For (empty) packaging that has adequate intrinsic stability, there might be no need to support the packaging with the hand, provided that preliminary tests demonstrated that the packaging aligns itself symmetrically during the test (see also Figure B.4).

— Plot the opening force required to open the sealed seam as a function of the opening distance in a force/distance graph and/or read the maximum tensile force at that time.

— End the test at the onset of stretching of the packaging after successful opening of the sealed seam (especially for bags).

B.1.5 Peeling for gable-top packaging

B.1.5.1 Equipment

A tensile strength measuring instrument. If no question arises in judgment, a simple push-pull gauge may be used. In this case, pull the test sample at the same speed as done with hands.

B.1.5.2 Test sample

A gable top carton of, for example 500 ml and 1 000 ml

B.1.5.3 Procedure

a) Fix one of the roofs at the opening end with a hand or a jig. Punch a hole of 4 mm diameter on the other side of the roofs, which is 7 mm inward from the top and the end. Reinforce the hole with a grommet. Attach a string to the hole and pull in horizontal direction until the adhered part on the top is torn apart to its middle. Read the maximum tensile peel-off strength at that time.

b) Fix the carton with a hand or a jig. Get the two wings wide open until their back touches the roof. Punch a hole of 2 mm diameter, which is located 5 mm to 10 mm under the vertex of the triangle. Hitch a hook therein to peel in horizontal and lateral direction at a speed of 200 mm/min until it opens 10 mm wide. Read the maximum peer-off strength at that time.

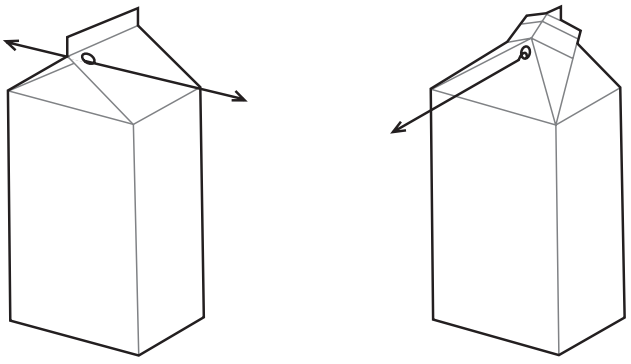


Figure B.5 — Illustration of mechanical tensile measurement

B.1.6 Pulling (up)

B.1.6.1 Equipment

A tensile strength measuring instrument. If no question arises in judgment, a simple push-pull gauge may be used. In this case, pull the test sample at the same speed as done with hands.

B.1.6.2 Test sample

A pull-tab package.

B.1.6.3 Procedure

Fix the pull-tab package horizontally with a hand or a jig. Pull the ring in the way directed below at a speed of 500 mm/min. Read the tensile strength as directed below.

a) For testing a full-open tab package, pull the ring right upward as shown in Figure B.6. Read the tensile strength at the time of pulling upward. Then, open the lid until it is completely taken off. Read the maximum tensile strength at that time.

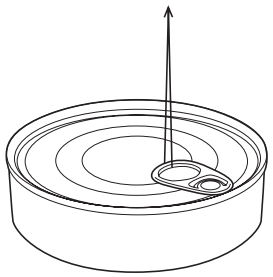


Figure B.6 — Illustration of mechanical tensile measurement

b) For testing a stay-on tab package, read the tensile strength at the time of raising the ring at an angle of 90°as shown in Figure B.7.

Figure B.7 — Illustration of mechanical tensile measurement

c) For testing package with a tab-covered lid, raise the ring until it becomes horizontal as shown in Figure B.8. Pull the ring in horizontal direction until the side of the lid breaks. Raise the ring at an angle of 135°and pull it in the raised direction. Read the tensile strength at that time.

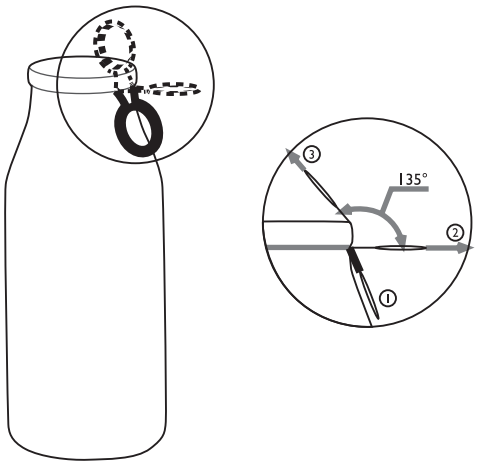


Figure B.8 — Illustration of mechanical tensile measurement

Annex C
(informative)

Relation of human strength and dexterity to the opening of packages

C.1 General

Human strength and dexterity varies as a function of many variables (e.g. age, gender, health, and physical condition). Mechanical testing methods as described in Annex A and Annex B can provide consistent and reproducible data on the physical characteristics of the (opening part of) the package. This Annex describes the methods available for (and some key results obtained with) characterizing the capabilities of the user in opening packaging.

C.2 Strength

C.2.1 Torque forces

Strength of users while accessing packaging has been determined using a device similar to the one shown in Figure C.1.

Figure C.1 — Human torque device

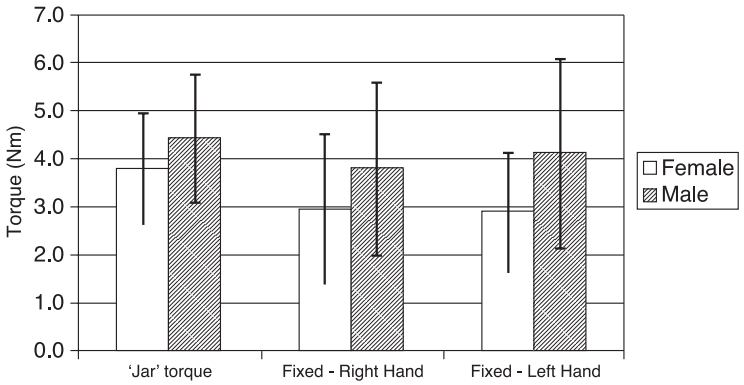


Figure C.2 — Graph showing comparison between fixed lid and "jar" measured torque

Female strength is typically half that of men. Strength is seen to decrease with age for both genders but is, however, more marked in women and the rate of decline is most marked over 70 years of age in line with other strength data.[13]

C.2.1.1 Effect of grip

Standard Torque meters as described in Annex B (see Figure B.1) hold the jar or bottle vertically and the torque is generated using one hand. Users rarely employ this technique generally using one hand to grip the jar and the other the lid.

Furthermore, users tend to employ a wide range of grip types with smaller jars than larger diameter jars.[14] Hand size is seen to effect grip choice and hence, torque, as women on average have smaller hands than men.[14] Also, users rarely clamp the jar and use one hand to gain access and use a range of grip styles using both hands. The effect of the torque produced held freely ('Jar' torque) and then clamped is shown in Figure C.2.

C.2.2 Pinch and pull forces

The grips most relevant to the ability to access flexible packaging is pinch-pull strength usually using the Pulp Pinch Pull (PPP) (pad of the thumb opposing the pad of the index finger) (see Figure C.3 for illustration) and the Chuck Pinch Pull (CPP) (the pad of the thumb opposing the pads of the index and middle fingers). These grips were used in a study by the UK Department of Trade and Industry (2000). Reference [15] has shown that the Lateral Pinch Pull (the pad of the thumb in opposition to the side of the index finger with the rest of the fingers backing it up, LPP) is also used by consumers.

The Pulp Pinch Pull (PPP) grip

The Chuck Pinch Pull (CPP) grip

The lateral pinch pull (LPP) being used to open a lid away and towards the user

Figure C.3 — Typical pinch grips used

Peel strength to open packaging of this type is generally low as compared to maximum pinch and pull forces generated by users. Figure C.4 shows typical pinch-pull forces generated by users (DTI, 2000) shows user forces of comparable magnitude.

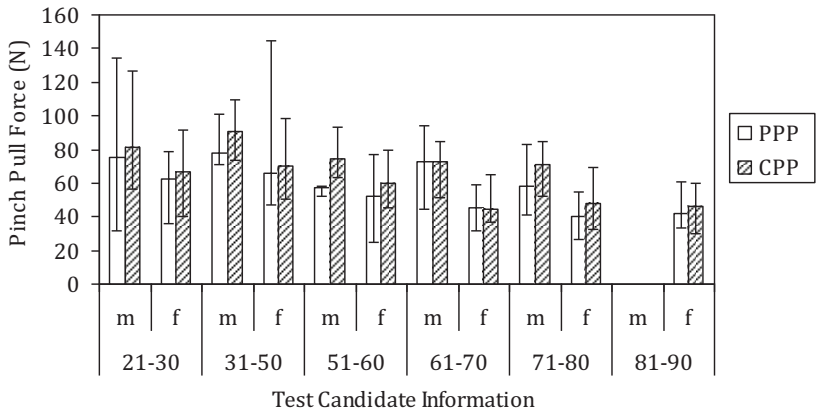


Figure C.4 — Pinch pull force (DTI 200)

This indicates that access to packaging of this type might more likely to be one of dexterity rather than of strength.

C.2.3 Squeeze forces

Squeeze forces can be determined by using non-invasive force sensors. These sensors allow the production of force-time or pressure-time data. Peak force against age can then be determined. Figure C.5 shows this type of data for four different pack formats and contents.

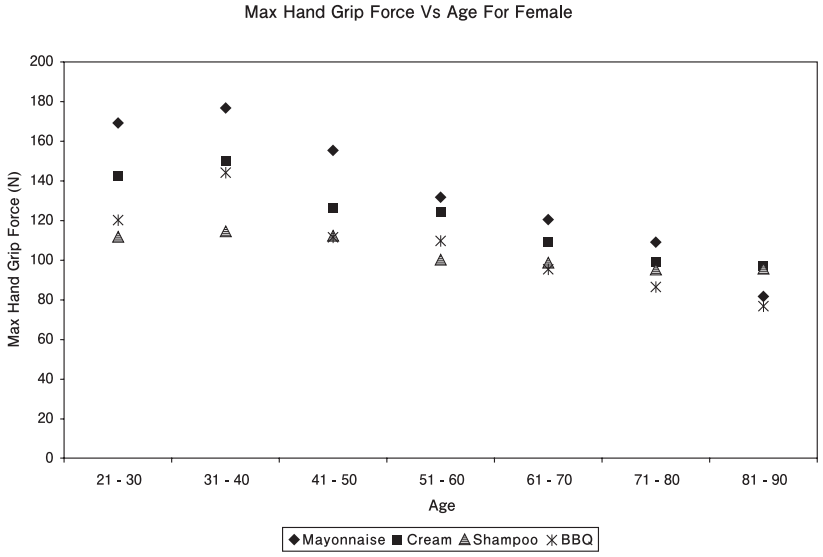


Figure C.5 — Max hand grip force versus age for four different product types

As with other forms of packaging, specific grips are employed to squeeze flexible packaging of this type however, it can still be seen that, like torque strength, squeeze strength decreases with age. Squeeze strength is also lower for females than males.

C.2.4 Other factors: effect of diameter and friction

While age, gender, grip, and wrist strength will affect the forces applied by a user,[16] there are two factors beyond the users control, namely, diameter and friction coefficient between the user and the product.

The frictional coefficient between finger and hand can quite considerably. The slip forces for oily conditions are shown in Figure C.6 for different ages and sexes. As can be seen, the forces are mainly well above the opening forces measured (see Figure C.7) so it should be possible for most users to open the pots even with oil on the tab. With oil though, more elderly female users might have problems as the minimum forces come close to the forces measured for pot opening.

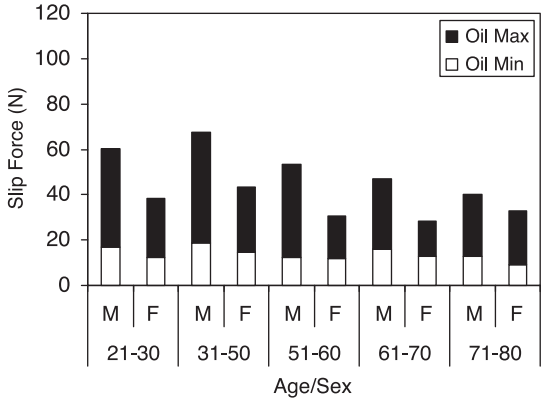


Figure C.6 — Slip forces for oil against a PP packaging material

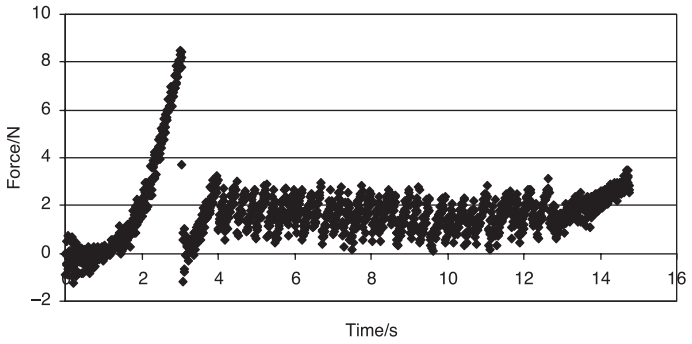


Figure C.7 — Typical peel strength for lidded product

Similarly, the friction coefficient can have a major effect on the likelihood of access to other forms of packaging. Reference [17] showed that a small change in friction coefficient can have a major effect on accessibility. Jars with lacquered aluminium closures were found to be less likely to be able to be opened than lacquered tinplate.

C.3 Dexterity

For certain pack types, dexterity can be the limiting factor for opening. Dexterity can be measured using peg-board type test such as the one shown below. A series of tests are undertaken placing small pegs into holes on the board from which a dexterity score can be determining. An example of users undertaking this test is shown in Figure C.8.

Normative data produced by Desrosiers et al. in a study of 360 aged 60 years and over, confirms that dexterity does reduce with age. In this study, the rate of decline varied between 1,1 % and 1,7 % per year depending on gender and test.

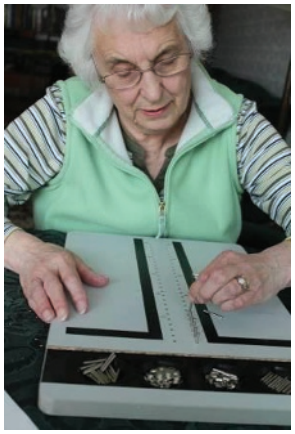


Figure C.8 — Example of peg-board type test

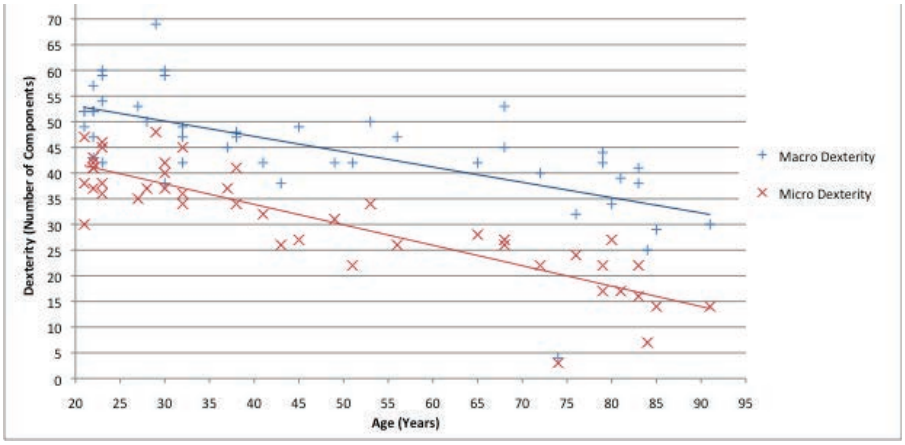


Figure C.9 — Dexterity against age

Annex D
(informative)

Consumer panel test for ease of opening

D.1 General

This Annex is a modified version of CEN/TS 15945:2011, Annex A.

D.2 Panel test method

D.2.1 General

Knowing that strength in the hands reduces with age, a panel test method that focuses on elderly consumers with less than the average hand strength can help to gain a new perspective on the ease of opening of packaging. Packaging that is easy to open for elderly consumers will, in most cases, be easy for the average consumer to open. It is recognized that there will be consumers with extreme impairment that this International Standard cannot represent.

To limit the size of the test panel, while maintaining the validity of the test results, a sequential test method is used. Groups of 20 panellists are selected as described in Table D.1.

Panellists who need reading glasses should wear them during the test.

The purpose of the test shall be explained in reasonable detail, but no opening demonstration shall be given.

Randomization shall be the guiding criterion in panel selection.

The 20 valid panellists shall be randomly selected between the ages of 65 to 80 according to the criteria given in Table D.1.

The panellists shall indicate for every packaging tested if they have experience with identical or similar types of packaging. The information shall be presented in the test report, but shall not be decisive for the result of the test.

Table D.1 — Composition of the test group for sequential testing

Age range (years)	**Male** %	**Female** %	**Total** %
65 to 69	10	25	35
70 to 74	10	25	35
75 to 80	10	20	30
Total	30	70	100

When a test group of 20 panellists have completed the test, the total number of failures noted is summarized. A mean value for each satisfaction score is calculated. The score for the phase of opening is the crucial score for pass or failure.

If the mean value for the satisfaction score for opening is equal or more than three (with a scale 1 to 5), the test is noted as a success, as noted in Table D.2.

If the total number of failures recorded is more than what is noted in Table D.2 for the number of panellists tested, the test can either be interrupted or continue adding another group of 20 panellists

Table D.2 — Sequential test method

Number of panellists	Number of successes recorded	Number of failures recorded	Confidence intervals (%)
20	20	0	85 to 100
40	38	2	82 to 99
60	56	4	83 to 97
80	75	5	85 to 97
100	94	6	87 to 97
NOTE The confidence interval gives an indication of the reliability of the test and has been determined assuming a 95 % confidence level. Detailed analysis of how these confidence intervals have been determined is outlined in References [18] and [19].			

Hazardous products are not to be used in the panel tests and should be substituted where necessary with harmless alternatives with similar physical characteristics.

D.2.2 Flow chart describing panel test

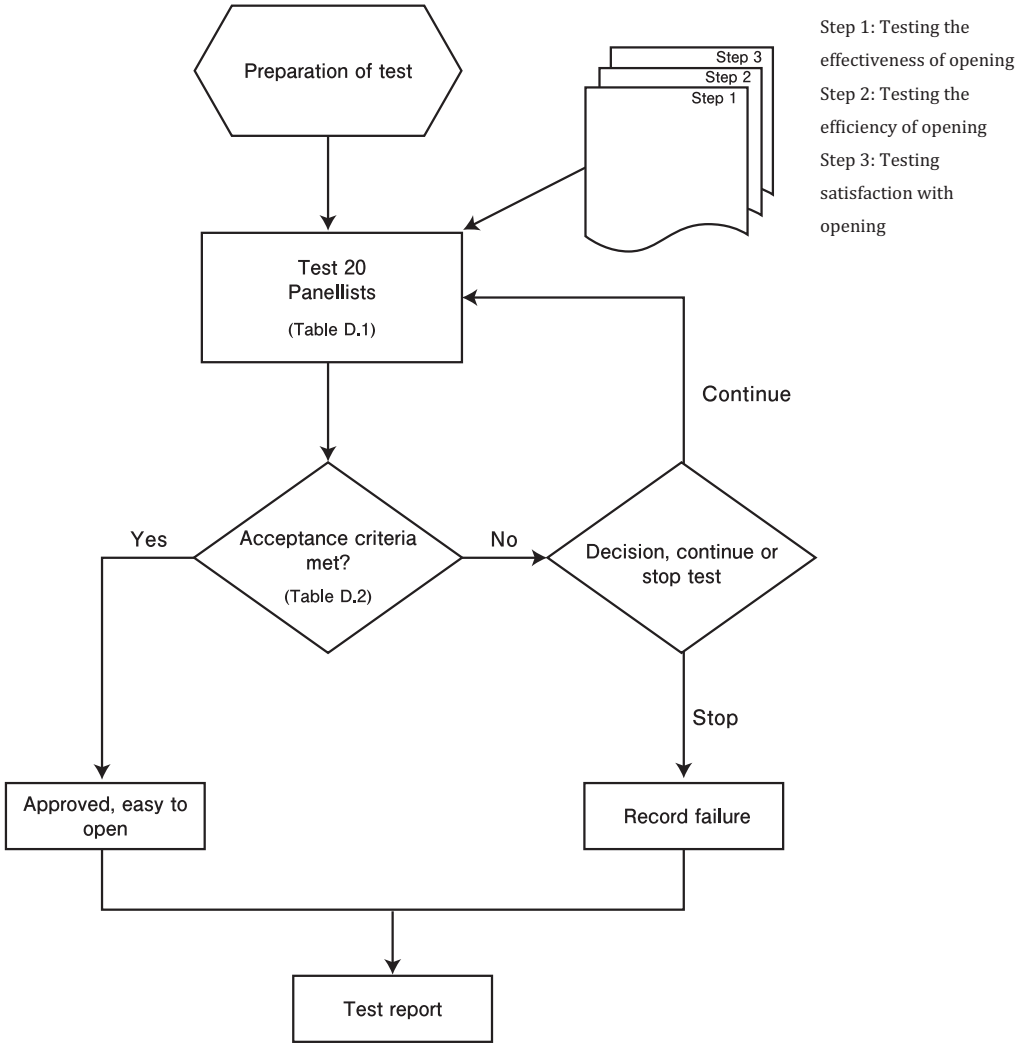


Figure D.1 — Flowchart for testing the ease of opening

D.2.3 Test procedure

D.2.3.1 General

The test will be carried out in three steps, each one of the steps representing one evaluation criterion.

Each panellist shall be given a sample of packaging together with only such written instructions on how to open it properly as will be printed in or on the packaging when supplied to a consumer.

Although the test can be undertaken in a public place, individual testing of panellists shall be done in private.

The use of tools should be discouraged unless the packaging explicitly suggests that a tool should be used (i.e. scissors) or that the tool is integrated in the packaging.

If the packaging is intended to be opened without a tool but the panellist requests a tool in order to be able to open the package, it should be noted as a failure.

The test supervisor shall explain the test protocol found in D.3.2 to the panellists and inform them that the opening system of the packaging under study might differ from packaging with similar design previously known to the panellists and that they should read any supplied instructions. No demonstration of how to open the packaging shall be given.

If more than one packaging is tested at a single occasion, the order of packaging to be tested shall be randomized. Packaging with identical opening systems shall not be tested at the same time.

The panellists shall go through the relevant opening steps while the test supervisor times the test and fills out the test protocol, the satisfaction score should, however, be noted by the panellist.

NOTE It is often valuable for representatives from the manufacturer to participate during the tests as observers. To participate creates good insight and understanding of the difficulties experienced by consumers when handling packaging.

D.2.3.2 Step 1: Testing effectiveness of opening

A period of up to five minutes should be allowed for the panellists to open the packaging; the panellist should not be informed about the time limit set. In this period of time, the panellists shall familiarize themselves with the packaging to be tested by studying the opening instructions.

If a panellist is unable to perform the opening in a period of five minutes, the test shall be stopped and the fact noted.

D.2.3.3 Step 2: Testing efficiency of opening

After step 1, the panellist shall be given a new identical packaging with a request to open it. The time used to perform the opening of the packaging shall be recorded by the test leader.

The test shall be stopped if the packaging is not opened after maximum 1 min.

D.2.3.4 Step 3: Testing satisfaction with opening

After the opening of the packaging has been successfully performed, the panellist shall try to take an intended quantity of the contents from the packaging (tools, such as forks, spoons cups, etc. should be provided to the panellists, if necessary). In the case of a reclosable packaging, after first opening the packaging, the panellist shall proceed to close the packaging. A maximum of five minutes will be allowed for the whole testing procedure (opening, take the intended quantity, and, if relevant, reclose the packaging).

When the panellist has performed these steps, the closed packaging shall be submitted to the test supervisor to confirm that the packaging has been properly closed. If the packaging is not properly closed, it shall be recorded by the test supervisor.

After all the steps of the opening procedure have been performed, the panellists shall be asked to indicate their degree of satisfaction with the opening process. The satisfaction score will be given separately for the three phases; opening, portioning, and closing, as well as an overall judgement of the whole process.

D.2.4 Evaluation of results

D.2.4.1 Effectiveness of opening

If a panellist successfully opens the packaging within the test period of five minutes, the test shall be noted as a success.

If a panellist is unable to perform the opening in a period of five minutes or chooses to give up due to intense pain or other reasons, the test shall be interrupted, the result shall be noted as a failure, and the reason for failure shall be noted.

D.2.4.2 Efficiency of opening

During the second step of the test procedure, the time it takes to open the packaging shall be recorded. If more than one minute is needed for a panellist to perform this step, this shall be noted as a failure to achieve efficiency of operation. Time shall be recorded when the test leader tells the panellist to start the opening process.

D.2.4.3 Satisfaction with opening

After the opening procedure has been performed, the quantity taken and, if relevant, the packaging has been closed, the panellist is asked to indicate their degree of satisfaction. This shall be done separately for the opening, the portioning and the closing process. If the panellist is not able to open the packaging, the score shall be 1.

To be approved, the satisfaction score for the opening process should reach a mean value of 3 or higher on the smiley scale for the total group, described in Figure D.2.

Figure D.2 — Smiley scale

The smileys correspond to the values 1, 2, 3, 4, and 5. No intermediate measures are allowed.

The nature of any difficulties encountered by panellists and the satisfaction scores for the portioning and closing, as well as an overall judgement of the whole process, should be provided as feedback to the manufacturer of the packaging.

D.3 Results

D.3.1 Test report

At least the following information shall be recorded by the test supervisor:

a) reference to this annex (i.e. Annex D);

b) date(s) on which the test was carried out;

c) name and address of the organization ordering the test;

d) name and address of the organization carrying out the test;

e) the name and address of the manufacturer and/or filler/packer of the package tested;

f) name(s) of the person(s) supervising the test;

g) names, addresses, and descriptions of the test locations;

h) number, age, and gender of panellists tested;

i) specification number, drawing numbers (if available), photograph, and a complete description of the package tested (this should include package dimensions and materials);

j) indicate which steps were undertaken in this test (opening, portioning, and closing);

NOTE If the test results obtained are used to compare overall satisfaction of different packaging, it is essential that the same steps have been undertaken in all tests performed

k) direct quotation of the exact instructions, etc. given to the panellists during the test;

l) copy of the manufacturer's instructions on opening and closing the packaging given during the test;

m) overall test results for effectiveness, efficiency, and satisfaction with opening;

n) satisfaction scores for each step undertaken (opening, portioning, and closing);

o) copy of the test protocols (Annex D);

p) executive summary.

The nature of any difficulties encountered by panellists should be recorded, including but not limited to, the following:

— any specific difficulties in manipulating the pack and/or its opening features;

— any specific difficulties in reading and/or understanding how to access and use opening/closing features;

— any specific issues where the packaging failed to work as intended.

The client may specify other questions or observations of interest that the test supervisor should note in the test protocol. A copy of the test protocol and an executive summary should be provided to the client.

D.3.2 Test protocol

Sample ID and sample randomization (n of N): _____

Supervisor ID: _____ Panellist ID/no. _____

Age: _____ Gender: (M) ☐

(F) ☐

1. Questions for selecting the panellist

Do you normally wear reading glasses?

Do you have them with you?

(If the answer to question one is yes and two is no, the panellist shall be excluded from the test)

2. Knowledge of sample for test

Have you had experience with identical or similar types of packaging and/or closure mechanisms or systems?

Yes ☐ No ☐ Not sure ☐

(The information shall be presented in the test report, but should not be decisive for the result of the test)

3. Effectiveness of operation

Was the panellist able to open the packaging for the first time within 5 min?

Yes ☐ No ☐

(Reasons for failure shall be noted! Observations at the supervisor's discretion)

Notes and observations

_____

_____

4. Efficiency of operation

How long did it take to open the packaging? Time (s): _____

(Max. 60 s. The elapsed time and reasons for failure shall be noted by the supervisor)

Notes and observations

_____

_____

5. Satisfaction with opening

(Note that the mark of satisfaction shall be placed by the panellist!)

After having performed all for the test relevant steps, the panellist should be asked to mark the smiley best representing their satisfaction with the packaging tested.

5.1 Opening the packaging

				
Extremely dissatisfied	Dissatisfied	Neither satisfied or dissatisfied	Satisfied	Extremely satisfied

5.2 Taking the intended quantity of the contents

				
Extremely dissatisfied	Dissatisfied	Neither satisfied or dissatisfied	Satisfied	Extremely satisfied

5.3 Re-closing the packaging (if applicable)

				
Extremely dissatisfied	Dissatisfied	Neither satisfied or dissatisfied	Satisfied	Extremely satisfied

5.4 And an overall judgement for the packaging tested:

				
Extremely dissatisfied	Dissatisfied	Neither satisfied or dissatisfied	Satisfied	Extremely satisfied

(Any spillage during opening shall be noted by the test supervisor and optional client questions can be recorded)

Notes and observations

Annex E
(informative)

Relation of human cognition to the opening of packages

E.1 General

The ability to analyse, process, and comprehend instructions on packaging is related to a person's cognitive ability. Important aspects of cognition are the visual and tactile acuity of the user. This Annex describes the generic aspects characterizing the cognitive ability of the user in opening packages with special emphasis to visual and tactile information presentation.

E.2 Cognition

Cognition is a group of processes such as memory recall and attention that enable decision making, problem solving, and the use of language. Many factors can affect a person's cognitive ability and can affect their decline or otherwise. Lifestyle issues such as smoking and contextual issues such as exercise, playing games, or loneliness will all, to some degree, affect a person's cognitive abilities.[20]

Age is an important factor in any case: most research indicates that from 60 years onwards, most individuals will start to experience some decline in cognitive skills particularly those associated with memory.[21]

Cognitive aspects include memory, carrying out complex tasks, time need to acquire and process information, recognition and comprehension of new information, reactions, language and literacy, and intellect, all of these aspects showing age-related reduction and impairment.

Figure E.1 shows data for age-related changes of inductive reasoning, spatial orientation, perceptual speed, numeric ability, verbal ability, and verbal memory.[21]

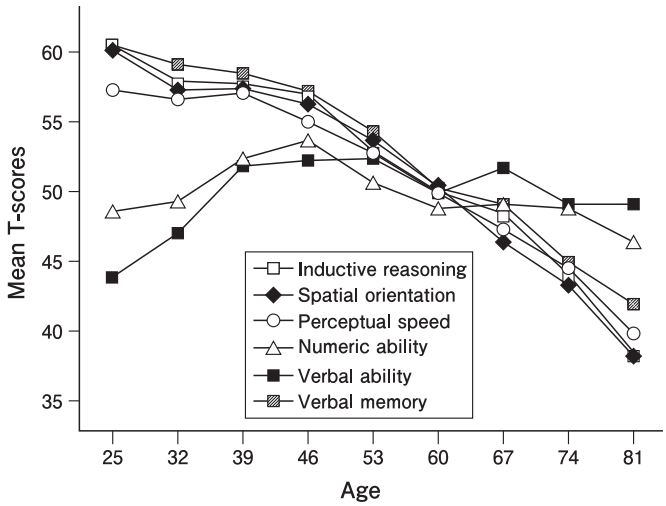


Figure E.1 — Cross-sectional data from The Seattle Longitudinal study[21]

E.2.1 Memory and ageing

Declining memory is reported by virtually all older adults over the age of 60. However, memory should not be considered as a single entity but combination of several memory systems such as episodic memory, working memory (short-term memory), semantic memory (long-term memory), and sensory memory.

Episodic memory and working memory can decline rapidly in older adults[22] while memory for perceptual information and general knowledge hold up well. So, for example, an older person might go to the refrigerator but then forget why, i.e. they know what the refrigerator is for but forget why they wanted to access it.[20]

This difference in memory affects older persons packaging use in several ways. The use of semantic memory and general knowledge enables older people to build up a set of skills through the life course. Reference [23] showed that when faced with difficult to open packaging, many older people had developed "coping strategies" to enable access such as the use of a tool, a rubber mat, and that more coping strategies were seen across more people as they aged until the best strategy was chosen (see Figure E.2).

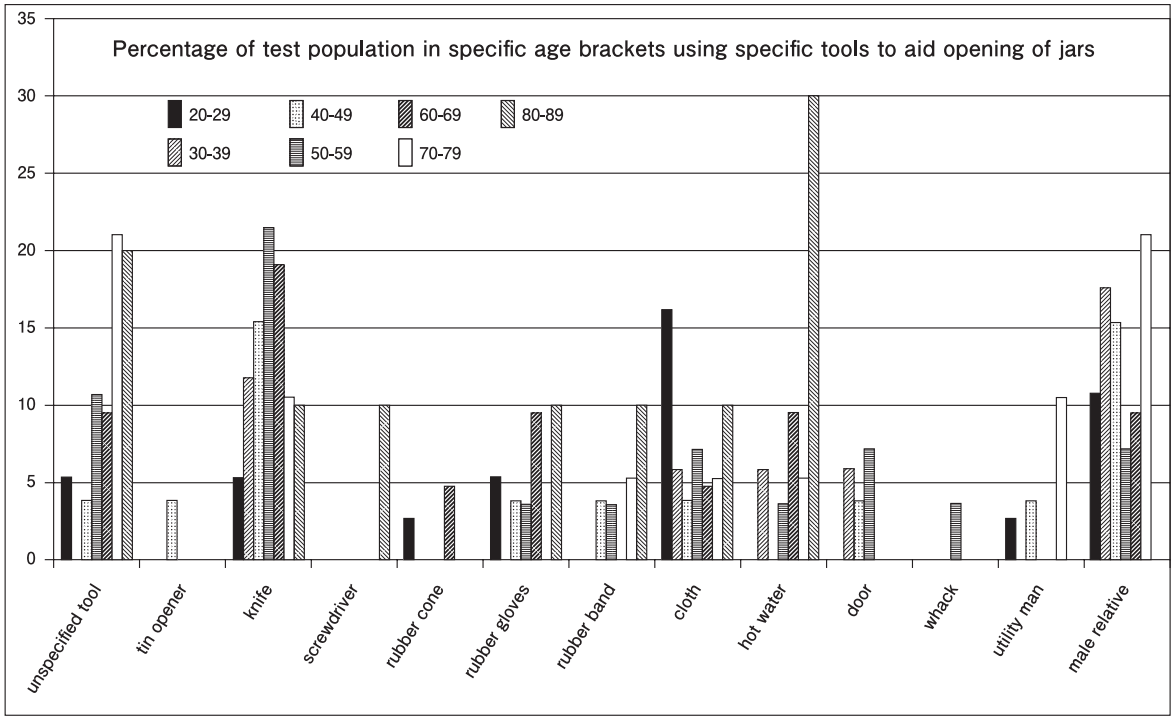


Figure E.2 — Graph of total test population broken down by age group and coping strategy employed

The decline in processing skills and working memory indicate that older people will have more difficulty multi-tasking, particularly if those tasks involve high memory loads[24] information processing and understanding grammatical complexity. Further work by Sorensen[25] studying understanding of packaging labelling using eye tracking software showed that older users dwell times and what they looked at were different than younger users with older users using more of their semantic memory using what the authors term "factual knowledge" and relying less on "signpost" knowledge largely ignoring symbols. Designing opening methods and locations taking account of these cognitive aspects and declines of older people increases ease of opening.

E.3 Three sensory aspects affecting cognition

E.3.1 Vision

Clear and precise visual information for opening locations, as well as for way of opening, helps users to open packages easily. Different aspects of visual functionality might concern with finding and understanding the opening (e.g. visual acuity, contrast sensitivity, colour perception, and useful field of vision). Dalke[26] identified five key factors for predicting an object's visibility, visual ability (acuity), contrast, light (lux) levels, dimension of the object, and distance from the observer. Due to changes in the eye, either from ageing or an eye condition, the function of the eye can change leading to blurriness, loss of peripheral vision, and reduced.

E.3.1.1 Visual acuity

Visual acuity is the ability of the eye to see fine detail and is used by users to identify graphics and symbols along with packaging labelling. Being able to see these details can be affected by the viewing distance, ambient illumination, contrast, and the smallest feature that the retina of the eye can resolve (i.e. text size or thickness). Reading text has a high visual acuity demand and legibility is affected by the thickness and spacing and shape of the character.

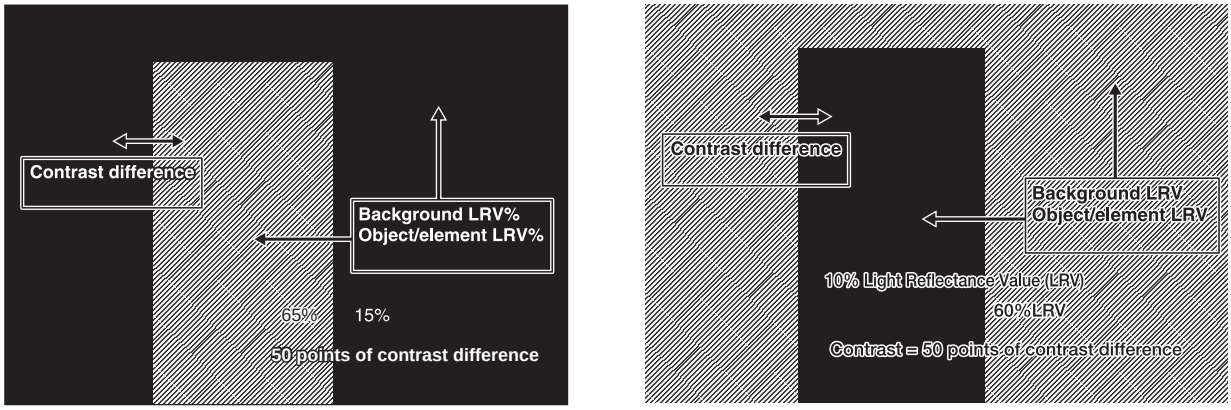
Reference [27] showed that consumers had more difficultly reading some fonts than others even those of the same nominal size. However, much of the research to establish exact fonts (serif or sans-serif) that should or should not be used is inconclusive, general good practice considers fonts with clearly visible ascenders and descenders (such as "b") and characters that avoid confusion such as between zero "0" and the letter "O" with decorative fonts (as showed in Figure E.3) avoided, where possible. Light text on a dark background is also preferable than darker text on a light background.

Packaging Packaging *Packaging*

Figure E.3 — Example of serif font, sans-serif font, and decorative font

E.3.1.2 Contrast sensitivity

Contrast sensitivity is the ability to distinguish between a background and foreground colour. Contrast difference is seen to significantly enhance visibility for people with visual impairments.[25] [26] For items with the same contrast difference, darker backgrounds with lighter foregrounds produce enhanced contrast difference as shown in Figure E.4. Reference [28] showed that colour contrasts can significantly affect consumer's perception of quality and purchase intention.



NOTE Diagrams from ISO 9186-1

Figure E.4 — Darker backgrounds produce enhanced contrast and aid visibility for visually impaired persons than lighter backgrounds with the same colour perception contrast

Colour discrimination or identification is also significant for accessibility and care is needed on that approximately 5 % to 8 % of the male population are colour vision impaired. Furthermore, as people age, the lens becomes yellowed reducing an older observer's ability to distinguish between white and yellow and causing issues with certain colour perception such as blue, which looks darker to older people than to the younger.

E.3.1.3 Usable visual field

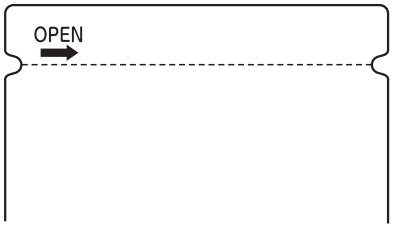
The central visual field is used for focusing and perceiving detail. Detection of visual markings such as for opening position is best at this central field. The useful field of vision can change as a result of

ageing or defects, resulting in a loss of visual field. This loss can occur in the centre of the visual field (central field loss) or from the outer edge of visual field (peripheral field loss).When the central field is obscured, tasks that require perception of detail (such as reading) can become extremely difficult. People generally adapt to compensate for this loss and attempt to use the peripheral visual field. Loss of peripheral vision results in tunnel vision and can affect users mobility. Locating opening markings at positions for easy to find facilitates accessibility.

E.3.2 Tactile sense

Tactile sense is one of touch senses generated by a pressure on skin in a static contact mode, so-called "passive touch". The detection of grooves and vibration falls into this category of touch. Tactile sensitivity also decreases with age and a small and rapid change of tactile information, spatial or temporal, is hard to detect for older people.

Tactile sense is a useful tool to making packages accessible with regard to ease of opening. For persons with visual disabilities, tactile information is an alternative for visual information to identify the location of opening. Figure E.5 shows an example of indicating opening location by using tactile notches.



NOTE Diagram from ISO 11156

Figure E.5 — Example of tactile notches to indicate the location of opening

E.3.2.1 Spatial resolution

When using tactile information, spatial resolution is one of the most important characteristics to consider. Tactile spatial resolution largely depends on the part of the body concerned. The most sensitive parts include the fingers, nose, and lips, and the least sensitive parts, the back, the legs, and the soles of the feet. For fingers, the resolution is approximately 1 mm to 3 mm, with the forefinger having the highest sensitivity.

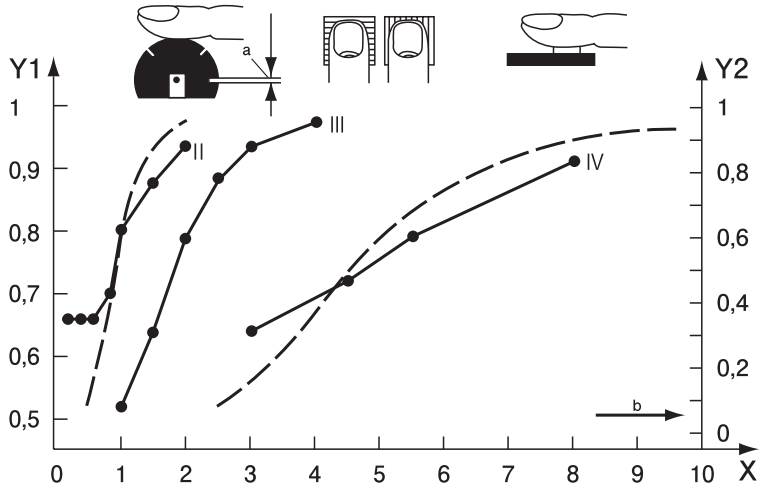
Spatial resolution also changes with the type of user task. Figure E.6 shows the following three typical examples of tactile spatial resolution measured for different tasks:

a) to detect a gap with variable width embedded in a rotating rounded surface (left, curve II);

b) to recognize the orientation of a tactile grating pattern with variable width (middle, curve III);

c) to recognize a raised letter of variable size (right, curve IV).

The abscissa denotes gap width, grating period, and letter size (in height) in millimetres for each task. The probability of correct response for detection or recognition is shown as the ordinate. The threshold, when defined by a 75 % correct response rate, for the gap detection and the grating orientation recognition is about 1 mm and 2 mm, respectively. For letter recognition, the threshold, defined as 50 % correct, is 5 mm. The dashed curves, overlapped with curve II and curve IV in Figure E.6, represent curve III scaled horizontally by factors of 1/2 and 5/2, respectively, to make a relative comparison.[8]



Key

X	stimulus dimension (gap width, grating period, letter height)
Y1	probability of correct response (gaps and gratings)
Y2	probability of correct response (letters)
II, III, and IV	see text for explanation
a	Gap.
b	Chance level.

Figure E.6 — Tactile spatial resolution for three different types of task[8]

Annex F
(informative)

Designer's checklist

F.1 General

These design advices are meant to be used when designing consumer packages. It enables fast screening of relevant basic factors and is intended for packaging designers and developers. The list covers the most important features with regard to information design and handling of consumer packaging. The recommendations are based on standards, scientific references, and best practice.

The design advices are based on a more extensive document, "Guidance on the Development of Consumer Packaging", Innventia.

F.2 How to use the document

— The document consists of a number of statements. The statements support the usability features of a package. Read them through and for each statement, mark with an "x" as to whether the package fulfils the statement (Yes) or (No) or (Not applicable) if not relevant for the package under development.

— All statements are not relevant for all packages, hence the alternative "Not applicable".

— If a package consists of more than one part (e.g. an outer and an inner package), treat each part separately.

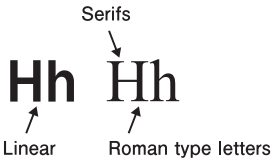
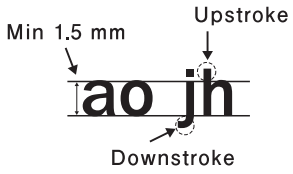
F.3 Checklist

F.3.1 Context

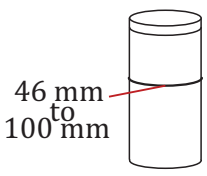
Statements	Has the requirement been met?	Comments
The context of use including description of the users shall be identified and clearly described before the design starts.	Y/N/not applicable	See ISO 9241-11 See ISO 20282-1

F.3.2 Information design

Statements	Has the requirement been met?	Comments
Information about how to open, empty/dose, reclose and recover shall be placed so that it is easy to find and read.	Y/N/not applicable	Instructions shall be possible to read without the risk of product waste and they should be readable without having to twist/turn the package.
Instructions for opening, emptying/dosing, and resealing shall be possible to read when handling the package.	Y/N/not applicable	Instructions shall be possible to read without the risk of product waste and they should be readable without having to twist/turn the package.

Statements	Has the requirement been met?	Comments
The information shall be located with reference to how the package is to be used, i.e. the relevant information can be easily read and understood when the package is being used.	Y/N/not applicable	Instructions shall be possible to read without the risk of product waste and they should be readable without having to twist/turn the package.
The text shall be black or dark and printed on a white or light background.	Y/N/not applicable	
The text/symbols shall be printed on a matte background.	Y/N/not applicable	Reflexes are more apparent on dark and on shiny surfaces.
Symbols and informative illustrations shall be clear and simple, i.e. they contain few details and the printing contrasts well with the background.	Y/N/not applicable	Aim at least at a contrast of minimum 70 %. On a white surface, the colours black, blue, green, and red can be used if the contrast requirement is met.
Use a font that has a linear one, i.e. has a clear line without "feet". 	Y/N/not applicable	
There shall be no running text written only in italics.	Y/N/not applicable	
There shall be no running text written only in capitals.	Y/N/not applicable	
The height of lower case letters shall not be less than 1,5 mm. (Check letters without upstrokes or down strokes, e.g. a, c, or m.) 	Y/N/not applicable	For elderly users, a larger size is recommended.
The information shall not be given in colour combinations of red + green, yellow + green or blue + red.	Y/N/not applicable	
The information shall be designed so that the intended users do understand the information.	Y/N/not applicable	Understanding can be tested using ISO 9186-1.

F.3.3 Handling of packages: Gripping

Statements	Has the requirement been met?	Comments
The grip width shall be less than 80 mm (refers to multi-edged packages). 	Y/N/not applicable	Optimal grip with one-handed handling is obtained at these measurements.
The grip diameter shall be between 46 mm and 100 mm (refers to round or cylindrical packages). 	Y/N/not applicable	Optimal grip with one-handed handling is obtained at these measurements.

Statements	Has the requirement been met?	Comments
Minimize the weight of the package. Preferable less than 2 kg.	Y/N/not applicable	Handle is recommended for better handling and precision.

F.3.4 Handling of packages: Opening

Statements	Has the requirement been met?	Comments
A tear tab shall have an area equal to 20 mm × 20 mm.	Y/N/not applicable	
The design shall clearly indicate how the package should be opened.	Y/N/not applicable	
The package shall be able to be opened as instructed.	Y/N/not applicable	
The package shall be able to be opened without having an effect on: a) the contents	Y/N/not applicable	
b) the reclosing device	Y/N/not applicable	
c) important information	Y/N/not applicable	
d) storability	Y/N/not applicable	

F.3.5 Handling of packages: Emptying and dosing

Statements	Has the requirement been met?	Comments
Emptying and dosing shall be able to be done without spilling the contents.	Y/N/not applicable	
It shall be possible for the user to take out the exact required quantity of contents.	Y/N/not applicable	The right amount and the right direction/precision without spillage should be possible.
It shall be possible to completely empty the package.	Y/N/not applicable	
The package shall have stability, i.e. it maintains its shape from being opened until the contents are emptied.	Y/N/not applicable	

Annex G
(informative)

Checklist for conformance with this International Standard

G.1 General

These checklists are to show that the requirements and applicable recommendations from this International Standard have been met.

G.2 Context of use

Requirements regarding context of use	Has the requirement been met?	How has the requirement been met?
Does the packaging design encompass the context of use for the package?	Y/N/not applicable	
Are the main goals of the packaging identified?	Y/N/not applicable	
Are the tasks needed to achieve intended goals identified?	Y/N/not applicable	
Are the intended users specified (taking into consideration the variety of physical, psychological, and cultural characteristics)?	Y/N/not applicable	
Are the environments in which the package is (or is intended to be) used identified?	Y/N/not applicable	

G.3 Opening strength

Requirements regarding opening strength	Has the requirement been met?	How has the requirement been met?
Is the nominal force to open the package achievable by the intended users?	Y/N/not applicable	

G.4 Dexterity

Requirements regarding dexterity	Has the requirement been met?	How has the requirement been met?
Is the packaging opening mechanism easily manipulated by the intended users?	Y/N/not applicable	

G.5 Cognition

Requirements regarding cognition	Has the requirement been met?	How has the requirement been met?
Is the opening of the packaging easily understood by the intended users?	Y/N/not applicable	

G.6 Opening location

Requirements regarding opening location	Has the requirement been met?	How has the requirement been met?
Is the opening readily found by the intended users?	Y/N/not applicable	

G.7 Methods and mechanisms of opening the package

Requirements regarding methods and mechanisms of opening the package	Has the requirement been met?	How has the requirement been met?
Is the opening method and mechanism easily identifiable?	Y/N/not applicable	
Is the opening method and mechanism intuitively understandable?	Y/N/not applicable	

G.8 Force and handling aspects

Requirements regarding force and handling aspects	Has the requirement been met?	How has the requirement been met?
Does the nominal force to open the package accommodate the large variety of the opening strength by the intended users?	Y/N/not applicable	
Are the package and its opening mechanisms easily manipulated, taking into account the large variety of the dexterity of the intended users?	Y/N/not applicable	

G.9 Reclosing of the package

Requirements regarding reclosing of the package	Has the requirement been met?	How has the requirement been met?
Is reclosing of the package easy?	Y/N/not applicable	

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