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Packaging — Accessible design — Handling and manipulation

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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 of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 122, *Packaging*.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

While packages have become usable to a wide user range, including older people and people with disabilities, some users have difficulties with handling and manipulating packages. This includes holding, lifting, carrying, and grasping packages. These difficulties can be due to a heavy weight or a large size which is hard to lift or grasp for people with reduced physical abilities because of age or physical impairments. These problems, which are clearly addressing accessibility issues, should be solved with urgent attention for consumer packages to be used widely by users who have weakened or limited physical abilities.

Standards for increasing accessibility in packaging have been developed progressively for some particular issues, such as ease of opening and clear information and marking, as well as some specific cases, such as Braille on medicinal packages. While these standards have contributed effectively to make packages accessible, they still do not cover all the accessibility issues related to handling and manipulation of packages, even though the issues have been clearly addressed in the general framework of a set of accessibility standards in packaging.

This document was developed with an intention to provide requirements and recommendations with regard to handling and manipulation for increasing accessibility of packaging in the concepts and goals which are expressed in ISO/IEC Guide 71[1] and ISO/TR 22411[2].

Packaging — Accessible design — Handling and manipulation

1 Scope

This document provides requirements and recommendations in designing consumer packages, independent of material, to increase accessibility with regard to handling and manipulation. The document considers packaging needs from a wide range of users with diverse human abilities and needs in diverse contexts of use.

Handling and manipulation include human physical abilities like holding, lifting, carrying, pulling, pushing, sliding, grasping, twisting, tearing and any combination of those actions related to portability, opening, re-closing and taking out contents of packages as well as to storage and disposal. Requirements and recommendations with regard to those abilities are provided for people with special needs including older people and people with disabilities in their handling and manipulation of packages. This document focuses on physical handling and manipulation which necessarily includes the processes of opening and closing specifically detailed in ISO 17480. It applies to reclosable and non-reclosable consumer packaging without using any other mechanical means.

This document is primarily for designers, developers and evaluators of packaging and is also useful for other disciplines.

Handling and manipulation for transportation of packaging is not covered in this standard. It does not apply to products regulated for safety or other reasons (e.g. toxic or dangerous goods and substances, medicinal products, and medical devices).

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 17480, *Packaging — Accessible design — Ease of opening*

ISO 21067-1, *Packaging — Vocabulary — Part 1: General terms*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 17480, ISO 21067-1 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

3.1
accessibility
extent to which products, systems, services, environments and facilities can be used by people from a population with the widest range of user needs, characteristics and capabilities to achieve identified goals in identified contexts of use

Note 1 to entry: Context of use includes direct use or use supported by assistive technologies.

[SOURCE: ISO 9241-112:2017, 3.15]

3.2
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 8317:2015, 2.4]

3.3
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

[SOURCE: ISO 17480:2015, 3.7]

4 Design considerations for increasing accessibility in handling and manipulation

4.1 General

4.1.1 General considerations

Packaging shall be designed taking into account users with physical, visual, and cognitive disabilities who have increased difficulty when handling and manipulating packaging that is likely to result in undesirable outcomes. Design items that relate to ease of carrying, opening, reclosing, measuring, take-out, storage, and disposal, shall be considered to increase accessibility to those people (see ISO 11156[18]).

4.1.2 Mapping

The direction of movement in handling and manipulation should correspond with that shown in signs or labels.

EXAMPLE A screw-top of clockwise rotation with a label of arrow(s) showing clockwise.

4.1.3 Affordance

The action that users need for handling and manipulation of packaging should be easily understood from the design before operation.

EXAMPLE A triangle notch at the edge of packaging to show to tear off for opening.

4.1.4 Feedback

Feedback of operation in handling and manipulation of packaging should be provided in any form when possible.

EXAMPLE A click sound at reclosing.

4.1.5 Avoidance of simultaneous multiple operations

Simultaneous multiple operations such as pressing and rotating at the same time should not be used except for the case of secure safety such as child-resistance.

4.2 Weight and shape

4.2.1 Weight

Packages should be light enough to be held and lifted whether they are intended to be handled by both hands or by one hand. If packages are too heavy, mechanical assistance should be provided for ease of holding, lifting and carrying. Ergonomic knowledge and data for weight of packages are given in Annex A.

NOTE Some older users or users with physical disabilities like rheumatism have difficulty in holding, lifting, and carrying of packages due to their weak muscle strength.

EXAMPLE Handle(s) attached to the side of a package for easy lifting (see Annex A and Figure B.1).

4.2.2 Shape

The shape of packages should be designed for ease of handling and manipulation in accordance with the types of holding, lifting, and grasping packages.

The shape of packages should be designed so that they accommodate users and situations where only one hand is available.

4.2.3 Grip and grip size

Non-slippery surface finish should be used for ease of handling and grasping to exert the hand and arm strength of the user effectively.

EXAMPLE 1 Grooves or dents on the side of a heavy PET bottle (see Figure B.2).

EXAMPLE 2 Dimple processed edges of a flexible bag (see Figure B.3).

The width and shape for hand-gripping should be designed for easy gripping and holding by users with the widest range of characteristics and capabilities. Ergonomic knowledge and data for grip size and grip force are given in Annex A.

EXAMPLE 3 Pinched waist of a PET bottle or a cosmetic bottle (see Figure B.4).

4.2.4 Balance and stability

Packages should be designed well balanced in weight so that they do not tip over easily when placed on a flat surface.

NOTE 1 Users with hand tremor have difficulty in fine controlling of placing packages.

NOTE 2 Users with visual disabilities are able to touch and tip over packages unintendedly.

4.3 Ease of manipulation for opening and reclosing

4.3.1 Opening and reclosing mechanisms

Opening and reclosing mechanisms of packaging shall be easily understood and manipulated for intended actions such as grasping, pinching, rotating, twisting, tearing, pushing and pulling.

Reclosing should provide a mechanism to confirm the packaging is closed providing visual markings, tactile markings, auditory information such as a click sound, or strength limits (see ISO 17480).

4.3.2 Screw-tops

A screw-top shall be easy for pinching. Its diameter should not be too small or too large. A screw-top should have a sufficient purchase or friction (see Annex A).

EXAMPLE Longitudinal grooves on a screw-top of a PET bottle (see Figure B.5).

EXAMPLE 30 mm is commonly used for the diameter of a PET bottle for drinking.

4.3.3 Top seals

Packages with a top seal or a soft sheeted lid for opening should provide a tongue of suitable size for easy pinching and pulling.

4.3.4 Tearing

Packaging that needs tearing off or peeling off for opening should not require fine dexterity or excessive strength for pinching and grasping to users.

EXAMPLE A large tab of a top sealed package for easy pinching to open (see Figure B.6).

4.3.5 Lids

Lids of jars should be opened without the user feeling pain or discomfort. Care should be taken for appropriate torque force and height for lids as affecting factors on ease of opening of jars (see Annex A).

NOTE Torque force data are found in ISO 17480:2015, Annex C.

4.4 Ease of use: taking out contents

4.4.1 Measured dispensing

Packages should be designed to support measured dispensing when useful and/or required.

EXAMPLE Measured quantity dispenser (see Figure B.7).

4.4.2 Prevention of splashing or spilling

Packages should be designed to assist users by preventing splashing and minimizing waste.

EXAMPLE Anti-splashing or anti-spilling bottle (see Figure B.8).

4.5 Storage

Accessible packages shall be designed in a shape which allows easy and efficient storage and ensures stability during storage.

EXAMPLE Milk containers of rectangular shape that fit in the refrigerator box (see Figure B.9).

4.6 Disposal and recycle

4.6.1 Disposal and separation

Packages should be designed to enable users for easy disposal and for clear separation of material.

4.6.2 Folding and crushing

Packages should be designed for easy folding and crushing after use for disposal, even for users with weak muscle strength.

EXAMPLE Paper boxes easily folded, and plastic bottles easily crushed for disposal (see Figure B.10).

5 Safety

5.1 General

5.1.1 Foolproof

Packaging should be designed so that any misuse or wrong operation cannot happen during handling and manipulation of packages.

EXAMPLE Child-resistance packaging[19].

5.1.2 Failsafe

Packaging should be designed so that the effects can be recovered to the previous state or minimized even when misuse or wrong operation happened.

EXAMPLE Child pouch cap (see Figure B.12).

5.2 Specific considerations

5.2.1 Sharp points or edges

Packages shall not have sharp points or harmful edges on the surface.

NOTE People with visual disabilities have a higher risk of being injured by sharp points or edges.

5.2.2 Weight

Packages shall not be too heavy, to avoid unintended drop during use (see 4.2.1 and Annex A).

5.2.3 Heat protection

Packages that are used with hot water in it, such as dried food, should have a heat protection mechanism for handling.

EXAMPLE A package with double-cup structure for foods that need reconstitution with boiled water (see Figure B.11).

6 Evaluation of handling and manipulation

6.1 General

Accessibility of packaging handling and manipulation shall be assessed by both instrument-based and user-based evaluation. In case of direct evaluation of the user on his/her performance on handling and manipulation, the user-based based evaluation should be used even if it involves measuring instruments.

6.2 Instrument-based evaluation

Instrument-based evaluation can provide physical quantitative data with regard to certain attributes of handling and manipulation. The data includes size, weight, strength, torque and human muscle strength. ISO 17480:2015, Annex B, should apply for the measurement.

6.3 User-based evaluation

User-based evaluation enables packaging designs assessments and allows an understanding to develop of user's performance in handling and manipulation. User-based evaluation should be used in conjunction with other psychological methods, such as questionnaires and structured or unstructured interviews. The data generated by these user-based evaluations can provide insights for improved designs.

Instead of testing with the general population, a test population should be selected from those that are most sensitive based on their characteristics and capabilities in using the packaging. The result can be valid also for general populations that are less sensitive.

General information on how to set up and perform user-based evaluations can be found in ISO 17480 and the ISO 20282 series[3].

7 Conformance

Conformance with this document is achieved by satisfying all the requirements. If a package is claimed to have met the requirements in this document, 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.

Annex A
(informative)

Ergonomics and ergonomic data for handling and manipulation of packaging

A.1 General: Task analysis of packaging handling for understanding factors affecting handling and manipulation of packaging

Assessment and understanding of packaging handling can be determined using task analysis methods. While there are a number of different methods of task analyses, a simple Hierarchical Task Analysis (HTA)[4][6] can be used to interrogate the process of human-package interaction. This method provides a structured, objective approach to characterize the steps required to accomplish a goal (in this case, opening and using a package). Subsequent to initial mapping, the analysis can help identify sources of confusion and assist to optimize the design of the packaged products and labelling to mitigate the likelihood of unintended actions. The steps taken to perform and accomplish a given goal are documented, described and analysed using task analysis methods.

A full task analysis would be conducted by a suitably qualified Human Factors and Ergonomics professional and would be useful when considering individual population groups such as older people living with dementia in the community setting, people with visual deficits, etc.

Schematically, the life cycle of the package and the complexity of its different activities, from the consumer's point of view, consumer variables, as well as the packages variables, is shown in Figure A.1.

There are basically two different problems for each phase given in Figure A.1 that are of interest to the consumer. One problem is with the information on the package, the other is with manual handling of the package. Information shall be designed so that its content and form are relevant to the intended purpose of the package so that it can be used with maximum convenience and a minimal number of mistakes. The package shall also be designed so that it can be manually handled safely, conveniently and easily in all aspects of use, bearing in mind the anatomical and physiological characteristics of its users.

In order to generate normative useful data in design the variables, consumer variables and packages variables, specified in Figure A.1 shall be lined up against each other as in Figure A.1.

As described above a full HTA can be a complex and detailed process involving multiple layers of tasks and subtasks. A simplified approach can be used for an initial review of physical package design.

An example of a simplified task analysis approach to identify the steps involved in human-package interaction for accessing a cereal package, is described in Figure A.2.

It can be seen that the number of tasks and the complexity of those tasks can vary between package types. Yoxall, et al.[7] has shown that the time to perform a task and the perceived ease with which a task can be achieved, significantly affects a participant's satisfaction with using the product and the scope for error. The ease of manipulation and handling of the package is further complicated by the package size, shape, weight, and context of use.

Therefore, packaging that facilitates the required outcome using the minimum number of tasks possible is preferred. The tasks that do not have high strength or dexterous demands on the user and those that are easy to understand are also preferred.

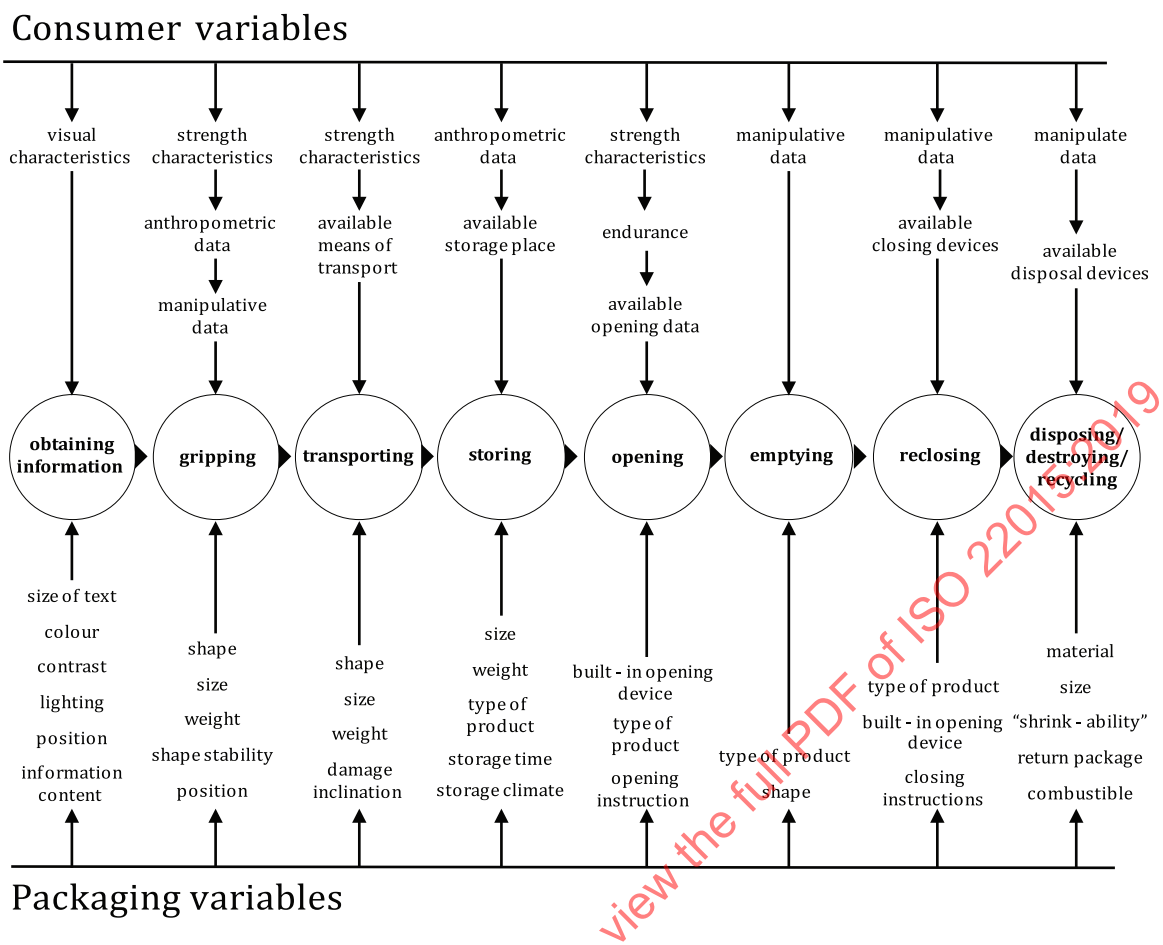
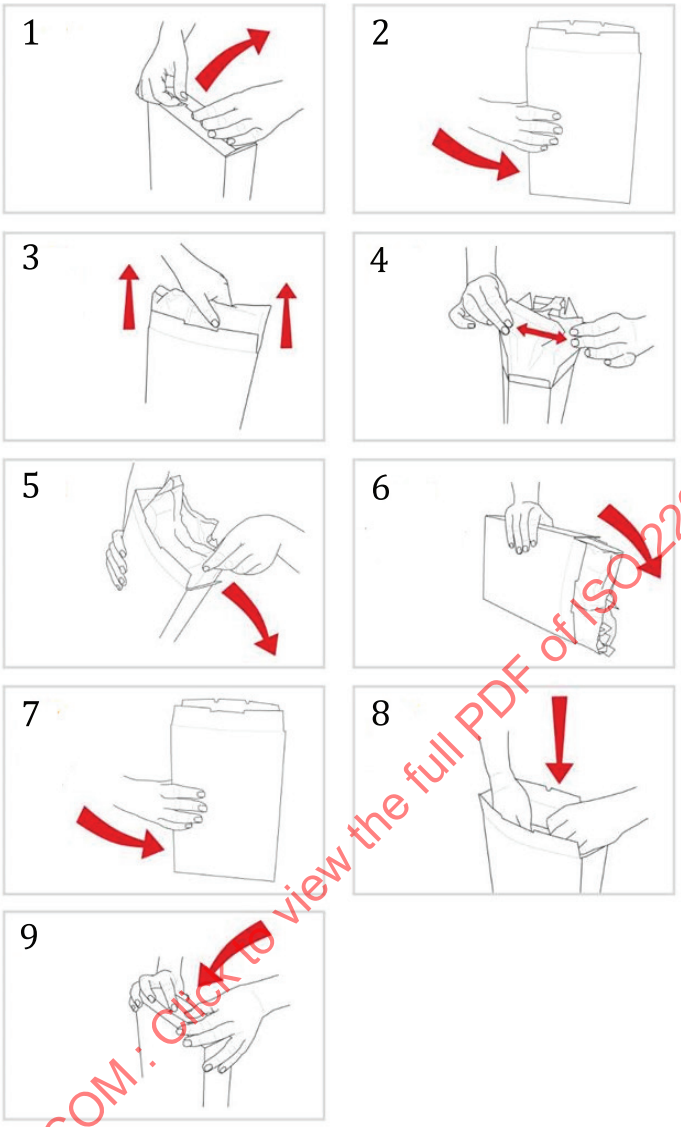


Figure A.1 — Packages variables and consumer variables in the life cycle of packaging



Key

1 locate and lift tab
2 pick up box
3 lift bag
4 open bag
5 adjust bag to pour
6 tip and pour contents
7 steady box
8 replace bag
9 close box

Figure A.2 — Simplified task analysis for manipulating and handling a cereal box

A.2 Physical factors and reference data

A.2.1 General

Work by Rowson and Yoxall[8] identified six general human physical factors that affected the opening of containers. These factors can also be applied to the manipulation and handling of packaging by users in general. These physical factors are namely:

— their age;

— their gender;

— their grip strength;

— the coefficient of friction between the hand and the package;

— their wrist strength;

— the size and shape of the container.

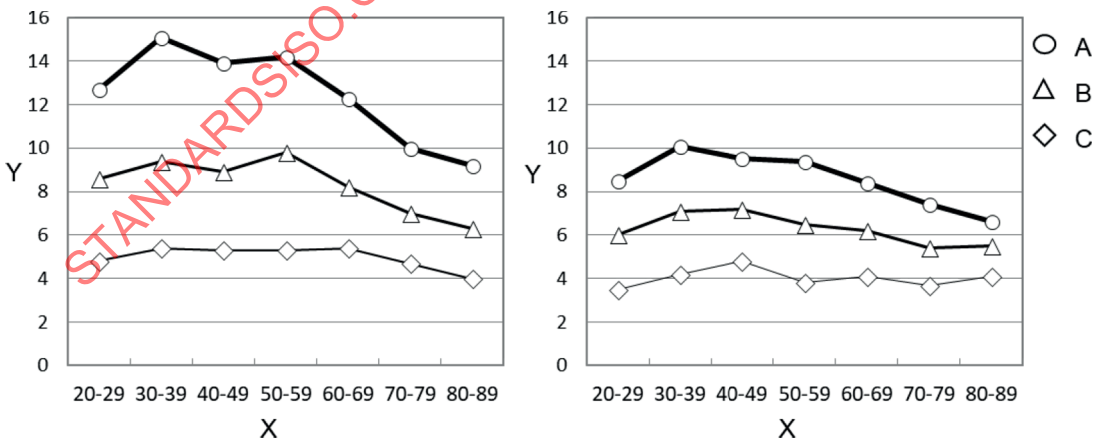
More recently, work by Yoxall, et al.[7] has also identified finger movements and finger coordination strategies as indicators to the likelihood of successfully manipulating packaging.

However, both studies looked at users able to use both hands. Consideration should be made for circumstances where only a single hand can be used.

A.2.2 Lifting weight and gripping

As we age, our strength declines, and thus our ability to carry and lift heavy objects comfortably, decreases. Further, the maximum amount that a person can carry differs between men and women, with women typically being able to carry approximately one third less than a man with extreme effort and approximately one fifth less comfortably.

Figure A.3 shows the weight a person can lift with both hands against a box[9]. The data are based on the measurements for a total of 214 people (109 male and 105 female) in their twenties to eighties. It can be seen that the weight that men [Figure A.3 a)] and women [Figure A.3 b)] can comfortably carry lift is approximately the same by the time they reach the age of 80, which is about 4 kg.



a) Men **b) Women**

Key

X age (years)
Y weight (kg)
○ with an extreme effort
△ with a slight effort
◇ with comfort

Figure A.3 — Lifting weight versus age for men and women

Work identifying the loads carried comfortably and with a slight effort for younger and older cohorts with one hand and two hands is shown in Figure A.4[10]. The data were obtained for 8 younger people, 4 in their twenties and 4 in thirties, and for 12 older people, 3 in their sixties, 5 in seventies, and 4 in eighties.

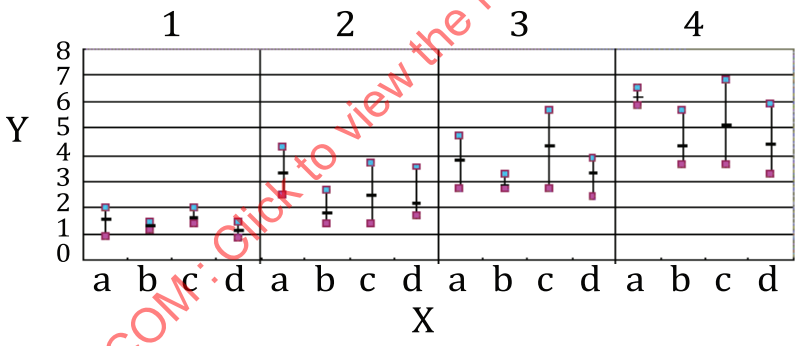
The results of this study indicate that the weight of a packaged product for carrying is the following.

— 1 kg to 2 kg for carrying with comfort by one hand;

— 2 kg to 3 kg for carrying with a slight effort by one hand;

— 3 kg to 4 kg for carrying with comfort by one hand;

— 4 kg to 6 kg for carrying with a slight effort by two hands.



Key

X participants
Y weight (kg)
a young, male
b young, female
c older, male
d older, female
■ maximum
▬ average
▪ minimum

1 carrying with comfort by one hand
2 carrying with comfort by two hands
3 carrying with a slight effort comfort by one hand
4 carrying with a slight effort comfort by two hands

Figure A.4 — Carrying weight versus age for men and women

A.2.3 Handles for heavy packaging

Packages that are heavy or of a shape that is difficult to hold easily, are better to have a handle or feature to aid with carrying and pouring the package as shown in the examples in Figures A.5, A.6, and A.7.

The handles that are large enough so that all the fingers of a typical hand can fit through the handle feature as shown in Figure A.6 improve handling.

On packaging that requires to be poured, handles placed as close to the centre of the bottle as possible, improve comfort and ease of pouring for the full range of the pour (see Figure A.7).

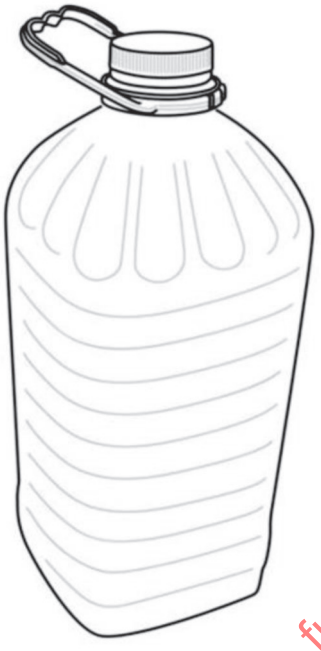


Figure A.5 — 5-litre oil bottle with handle

Figure A.6 — Cooking kit with handle

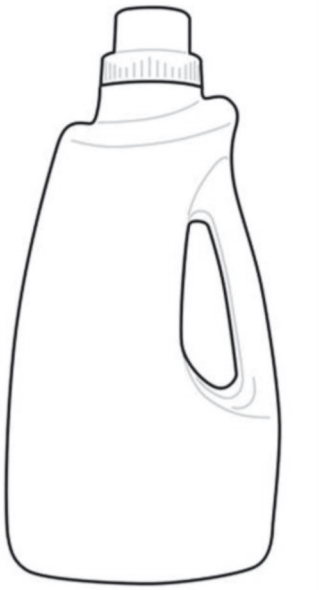


Figure A.7 — Bottle with shaped handle

In his adult human hand anthropometric study, Garett[11] indicated that the average hand breath (measured at the palm) is 8,96 cm for men and 7,69 cm for women. These studies were carried out in the USA. A more recent study in the UK indicated smaller average values of 8,38 cm for men and 7,39 cm for women. Similar measurements have been taken by various researchers in such diverse populations as Jordan, China, Mexico and Vietnam (Jang and Ahram[12]). The combined data for men is shown in Table A.1.

Table A.1 — Hand size data for differing populations (only for males)

Measurement	Mean in cm					
	China	Jordan	Mexico	Vietnam	USA	UK
Hand length	18,76	19,12	18,5	17,7	19,71	18,9
Hand breadth	8,40	8,77	8,53	7,92	8,96	8,38

This indicates that handle features to facilitate the easy entry and exit of the hand are approximately 9 cm long. However, the extremities of the fingers and joints of the hand are more flexible and narrower than the palm. While less data exists for measurements of the joint dimensions, Garett's work suggests that, to facilitate easy and comfortable exit and entry of all the fingers, handle features are approximately 6,5 cm long.

A.2.4 Grip size

Steenbekkers and Van Beijsterveldt[13] undertook work measuring the grip diameter of adults using a conical rod as shown in Figure A.8. The results are presented in Table A.2.

Table A.2 — Grip size data for men and women versus age

Age (years)	Men		Women	
	n	mean (cm)	*n*	mean (cm)
20–30	55	4,3	68	3,9
31–49	—	—	—	—
50–54	35	4,2	35	3,9
55–59	46	4,1	50	4,0
60–64	44	4,2	53	3,9
65–69	50	4,1	51	3,8
70–74	59	4,1	62	3,9
75–79	36	4,1	38	3,7
80+	33	3,9	35	3,6
n number of people who participated				

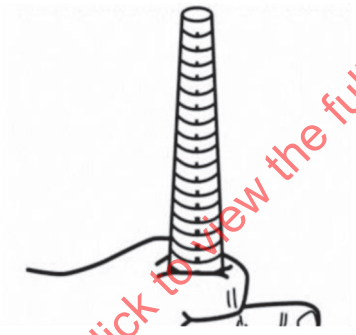
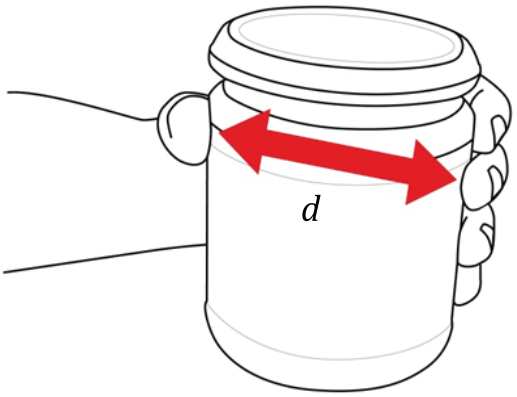


Figure A.8 — Conical rod used to measure thumb and index finger circumference

Fransson and Winkel[14] in their study measuring resultant grip forces for various distances and grip styles. The resultant grip force and finger force varied according to the distance between the handles. For both grip types measured, the highest resultant force was obtained at a handle separation of 50 mm to 60 mm for females and 55 mm to 65 mm for males. For wider handle separations, the resultant force was reduced by 10 % per cm. The force-producing ability of the hand was influenced by the grip type, the maximal force of one finger depended not only on its own grip span, but also on the grip spans of the other fingers. Further, approximately 35 % of the gender difference in hand strength was due to hand size differences, in that females have smaller hands than males. This work therefore suggests there are optimum diameters and grips for manipulating packaging with the optimum grip span for peak force at approximately 60 mm with the fingers gripping the package together as shown.



Key

d optimum grip diameter: 60 mm

Figure A.9 — Optimum grip diameter

Similar conclusions were found in the work by Rowson and Yoxall[8]. Work by the Yoxall and Janson[14] showed that there is a simple relationship between the forces applied by the consumer, and the maximum torque required to open a circular jar as shown in Figure A.9. They are related by the friction coefficient between the closure and hand, μCH. TH is the resulting torque the lid will experience due to these frictional forces. Therefore, the maximum torque, TH, can be defined as:

$$TH = \mu CH \cdot NH \cdot rC \quad (1)$$

where

TH is the maximum torque required to open a circular jar;

NH is the grip force applied by the user;

FH is the frictional force resulting from that grip as the user attempts to twist their hand against the outside edge of the closure;

rC is the radius of the closure;

μCH is the friction coefficient between the closure and hand.

This work showed that the relationship hand size and package size affected the grip choice of the user which, in turn, affects the maximum amount of twist or torque a user can generate. Females would choose an optimal grip which produced the maximum force, the spherical grip with the fingers in line similar to the results found by Fransson and Winkel[15]. An example of the spherical grip is shown in Figure A.10.

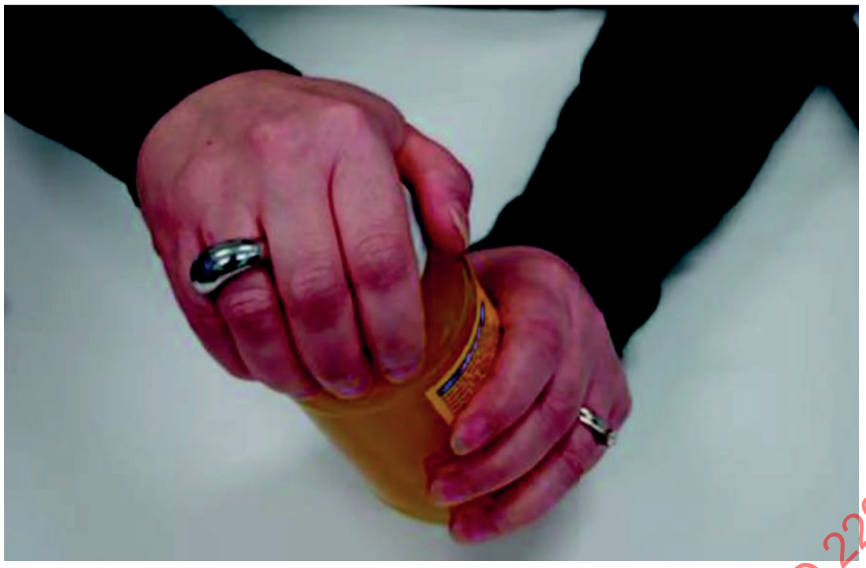
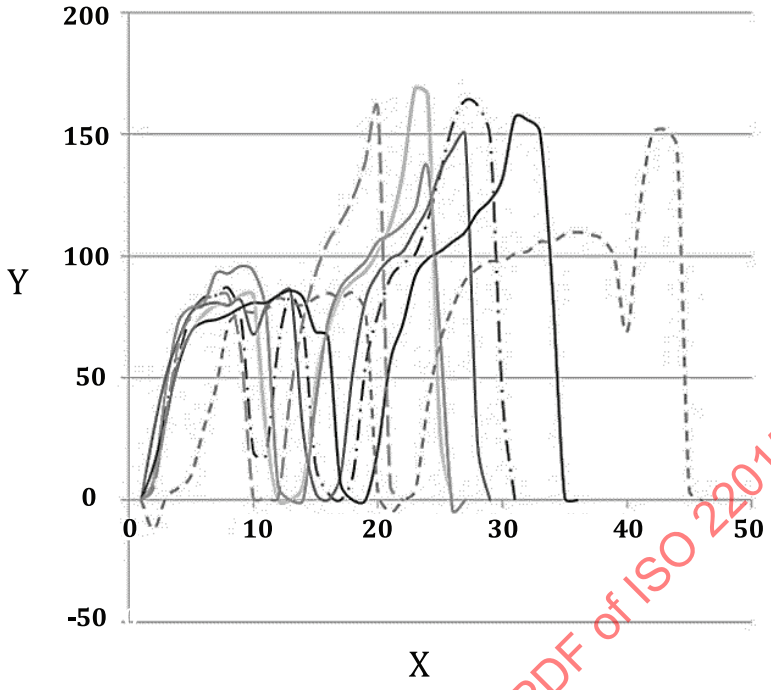


Figure A.10 — Example of the spherical grip

A.2.5 Size and handling

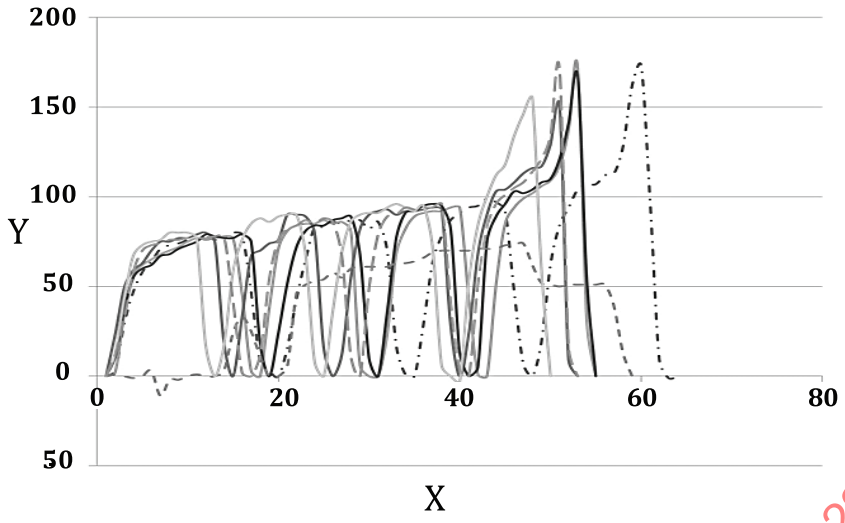
The effect of size on the ability to manipulate packaging is shown in Figure A.11. This graph shows the time and the angle of pour for a 1,14-litre bottle for seven participants pouring a dose of liquid. It can be seen that the angle of pour is affected by the amount of contents in the container at use (i.e. the bottle has to be tipped at a higher angle to fully empty the contents). It is noted that the older participant (participant 5) takes significantly longer to empty the container. For bottles larger than 1,14 litres, the older participant was seen to use two hands to complete the pour. Similarly, for the 3,4-litre bottle, as shown in Figure A.12, the pouring requires more attempts to pour a typical dose, takes longer, and in this instance the older participant was unable to complete the task and tip the bottle to the full angle needed even with two hands (see Figure A.13).



Key

X time (s)
Y angle of pour (degrees)
participant 1 (male aged 46)
participant 2 (male aged 32)
participant 3 (male aged 22)
participant 4 (male aged 20)
participant 5 (female aged 71)
participant 6 (female aged 24)
participant 7 (female aged 25)

Figure A.11 — Graph of pour angle versus time for a 1,14-litre bottle



Key

X time (s)

Y angle of pour (degrees)

participant 1 (male aged 46)

participant 2 (male aged 32)

participant 3 (male aged 22)

participant 4 (male aged 20)

participant 5 (female aged 71)

participant 6 (female aged 24)

participant 7 (female aged 25)

Figure A.12 — Graph of pour angle versus time for a 3,4-litre bottle

Figure A.13 — older participant pouring bottle

A.2.6 Grip force

Mathiowetz, et al.[16] undertook a significant study to measure the grip and pinch strength of adults aged between 20 and over 75. Data was gathered from over 600 adults in the US. Bohannon, et al.[17] also undertook a meta-analysis of grip strength data of men and women over the age of 75. The results

indicated that grip strength generally peaks between the ages of 25 to 39 and subsequently declines. Typically, the grip strength of a 75-year-old adult is approximately 60 % that of a 75-year-old adult and the grip strength of females is 60 % that of males across all age groups. Beyond the age of 75, there is significant decline in grip strength and convergence of strength between males and females. Sample data from both studies is shown in Table A.3.

Table A.3 — Average grip strength for males and females versus age edited from Mathiowetz, et al., and Bohannon, et al.

Age	Average grip strength (kg)	
	Males	Females
25-29	54,9	33,9
55-59	45,9	26,0
70-74	34,2	22,5
75-79	33,0	21,6
80-84	30,1	17,3
85-89	25,8	17,1
90-99	18,8	15,2

Data for tip and pinch grips was also measured by Mathiowetz, et al.[16], and was also seen to decline with age. In all instances, tip pinch, key and palmar pinch groups produce significantly lower peak forces than full hand grips.

A.2.7 Shape of packaging and handling

The shape of the package can affect a user's ability to pick up the package easily and control the manipulation such that it is comfortable and the required amount of contents delivered. Where possible, "power grips" are encouraged where strength is needed to lift and control the package. The shape of the package can encourage the use "power grip" and coordinated finger strategies make using the package easier. The bottle in Figure A.14 has a "waist" that allows for easy holding and manipulation. Square and other non-round shapes can also facilitate easier grips and manipulation of packaging.

NOTE A power grip is any grip that involves moving fingers of the grip towards the palm of the hand.

Figure A.14 — Shaped bottle for ease of control

Annex B
(informative)

Examples of packages of ease of handling and manipulation

B.1 Holding and lifting to weight

Handle(s) attached to the side of a package for lifting.

Figure B.1 — Handle attached to a bottle

B.2 Holding and lifting to grip

Grooves or a hollow on the side of a heavy PET bottle.

Figure B.2 — PET bottle with grooves or dents

Dimple processed edges of a flexible bag.

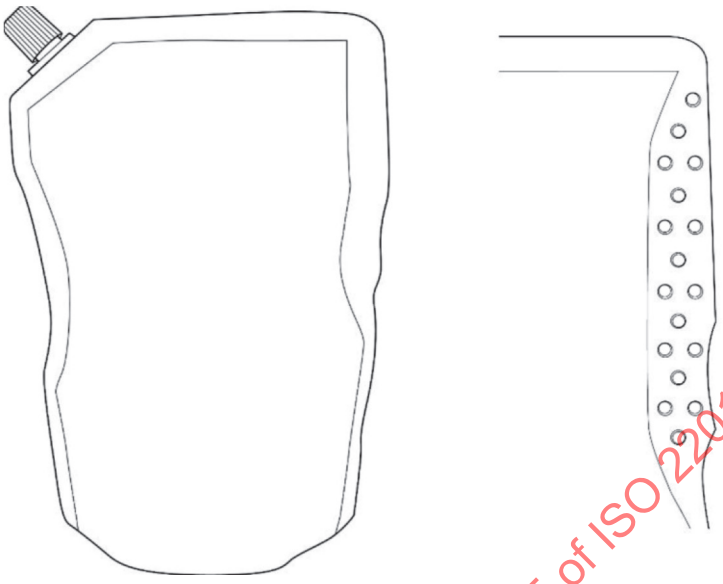


Figure B.3 — Dimple processed flexible bag

B.3 Holding and lifting to grip size

Pinched waist of a PET bottle or a cosmetic bottle.

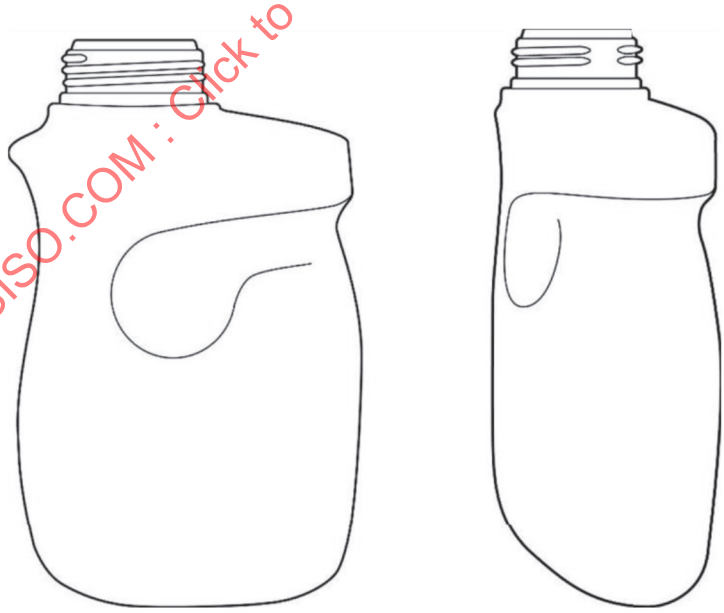


Figure B.4 — Pinched waist bottle