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Hand hole design principles and test methods for handheld packages

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Foreword

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This document was prepared by Technical Committee ISO/TC 122, *Packaging*, Subcommittee SC 3 *Performance requirements and tests for means of packaging, packages and unit loads (as required by ISO/TC 122)*.

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

The product categories that logistics workers handle manually are diverse, including various electrical and electronic products, household goods, food and beverage products, etc. One of the major ergonomic safety issues that arise is musculoskeletal disorders and spinal injuries caused by repetitive vertical movements, movements, and momentary loads.

According to Reference [11] most market staff are women in their 40's and 50's. They pick up and put down boxes an average of 149 times a day, and 85,3 % of them suffer from musculoskeletal injuries such as pain in the shoulders, backs, and knees. The study concluded that even just adding hand holes to boxes would reduce the load by 10 %.

Although hand holes in boxes cannot completely eliminate all risks of accidents, they can enhance safety and efficiency by making logistics and distribution activities, including loading, unloading, warehousing, sorting, and transportation, more convenient and less dangerous to handlers, thus helping to prevent musculoskeletal disorders. Transport packaging designed appropriately for the size and/or weight of the product, the durability of the package material, etc., reduces the risk of workers using excessive lifting forces. Poor design can lead to product damage or worker injury.

This document provides hand hole design criteria and test methods for handheld packages to provide a safer working environment for workers who lift or move boxes. Some criteria and test methods in this document are based on ASTM D6804, with some modifications to the design requirements and test methods to ensure the usability of this document.

Hand hole design principles and test methods for handheld packages

1 Scope

This document describes the ergonomic design criteria and test evaluation methods for the hand holes of handheld packages that are handled by human operators during the distribution and logistics process. This document is applicable to handheld packages with a maximum weight of up to 23 kg.

This document does not cover all issues of safety, health, and the environment related to the handling of packages.

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 186, *Paper and board — Sampling to determine average quality*

ISO 187, *Paper, board and pulps — Standard atmosphere for conditioning and testing and procedure for monitoring the atmosphere and conditioning of samples*

ISO 527-1, *Plastics — Determination of tensile properties — Part 1: General principles*

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 21067-1 and the following apply.

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

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

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

3.1
handheld package
courier freight and distribution packaging, weighing up to 23 kg, intended to be handled by one adult

Note 1 to entry: The maximum allowed weight that one person can handle at one time can vary depending on individual strength, box weight, size, operation frequency, moving distance, and country-specific regulations.

3.2
hand hole
pre-cut hole on the package, intended to be used as a handle during logistics and distribution activities

4 Design criteria

4.1 General

When establishing the design criteria for hand holes, manufacturers and sellers of handheld boxes can take into account various elements including those covered in this document as well as material, structural and technical feasibility, logistical suitability, application effects, and other safety functions and costs.

4.2 Hand hole

4.2.1 General

An adequate hand hole should be used for packages, allowing one or two people to safely handle the product. Such a hand hole is intended for lifting the package upwards in a vertical direction. It is not designed to be pulled, pushed, or lifted with one hand. The hand holes described in this document are intended to be used with two hands in a common handling environment.

Hand holes can be used as handles, but not all hand holes are designed for this function. Some of them can be designed for other purposes, such as ventilation, or inspection and adjustment of the contents. Some hand holes can be designed to facilitate moving or rotating heavy packages rather than lifting them. Even if a hole is made onto the packaging for ventilation or inspection of contents, if it is used for handling of the packaging, it shall meet the design criteria of 4.2.2.

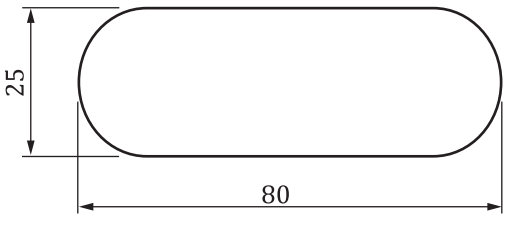
4.2.2 Hand hole design

4.2.2.1 Structure and size

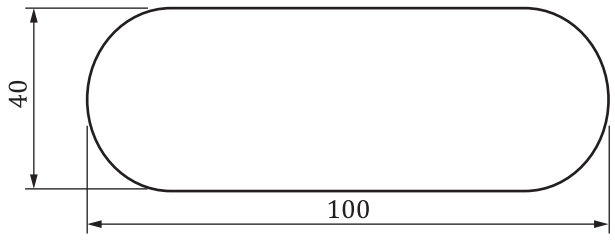
A hand hole should allow the box to be gripped by hands. The perforated part should not be sharp so as to avoid injuries. The hole should have a high shear durability and a streamlined shape for the dispersion of pressure.

Figure 1 shows the structure and size of a standard hand hole suitable for most adults. The shape and size depend on a number of factors such as the characteristics and the weight of the product and may be subject to negotiation between the supplier and the user.

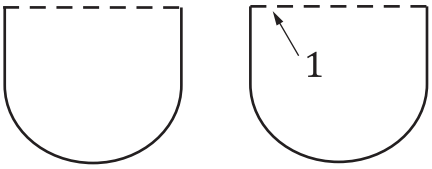
Dimensions in millimetres



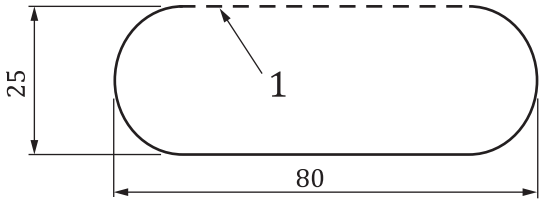
a) Ordinary oval hand hole



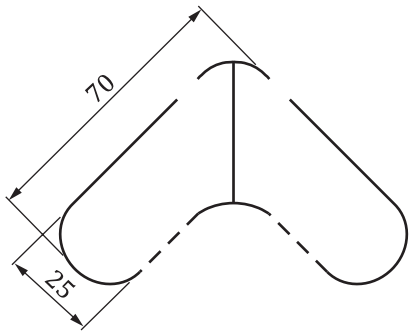
b) Long oval hand hole suitable for gloved hands



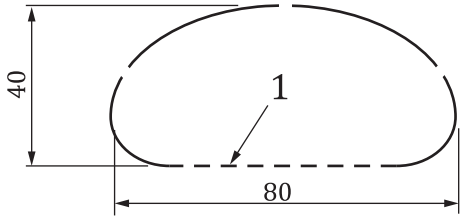
c) Hand hole to insert two fingers into or to use a pulley with



d) Half-folded hand hole, mainly used for heavy objects thanks to its foldable top



e) Triangular top-arched hand hole for increased tear strength



f) Deformed upper arch hand hole

Key

1 folding side

Figure 1 — Examples of structure and size of hand holes

4.2.2.2 Reinforcement

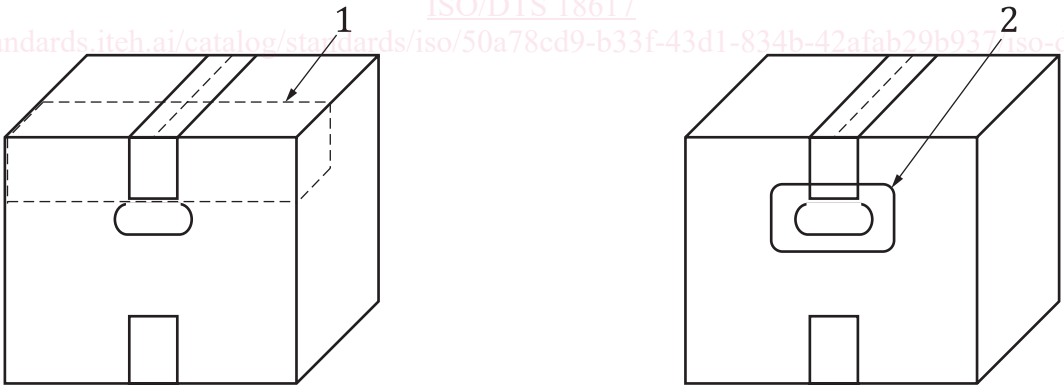
If necessary, the arrangement of the product and cushioning material can be changed or reinforced during the packaging design stage to strengthen the corrugated cardboard at the top of the hand hole and to prevent its damage, thus complementing the perforated hole. Reinforcement can be achieved

— through a composite mould where a material that reinforces is placed around the hand hole, or

— by attaching some handle tape.

NOTE Composite moulds can have negative effects on recyclability of packaging materials.

Figure 2 shows examples of application of reinforcing material.



Key

1 reinforcing material (partial part of the product, cushioning material, etc.)

2 reinforcing material (strengthening with corrugated cardboard)

Figure 2 — Examples of hand holes with reinforcing material applied

4.2.2.3 Placement of hand holes

Hand hole placement depends on the product's centre of gravity and the way the box is sealed, including tape sealing.

For the cardboard which uses a hand hole with a tape seal or if it is necessary to support most of the weight of the product, to prevent deterioration of the compressive strength of the box, the hand hole can be placed at least 1/3 of the height of the box from its centre top section [Formula (1) and Figure 3].

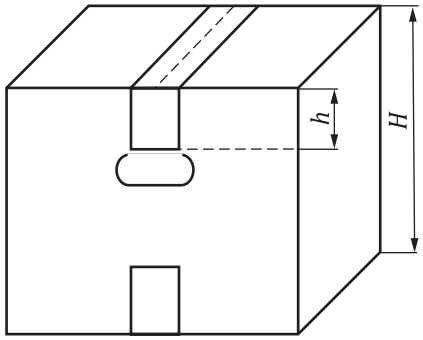
$$h \geq H / 3 \quad (1)$$

where

h is the height from the top centre of the hand hole to the top of the box;

H is the height of box.

For telescope, rigid or bliss type boxes with an adhesive top, the hand hole can be placed immediately below the adhesive area.



Key

h height from the top centre of the hand hole to the top of the box

H height of box

Figure 3 — Example of hand hole placement

4.3 Caution signs

4.3.1 General

Caution signs should be used to provide caution and warnings, and to explain the appropriate use of the hand holes when handling the product. Caution signs and symbols for handling should follow ISO 780. For atypical packaging, significantly displaced centre of gravity, or packages with length of at least one of its sides exceeding 100 cm, the appropriate signs should be used.

An example of a caution sign is shown in Figure 4.

Figure 4 — Example of a caution sign for the correct use of hand holes

4.3.2 Weight warning label

For a single or bundled package serving as a handling unit weighing more than 10 kg, the handling weight should be printed, carved, engraved by laser or pins, or labelled on the surface on the top, as well as on the upper part of left or right side. To ensure visibility, sign dimensions should be at least 30 mm in length and width. Whenever possible, use weight warning labels in a contrasting colour to the packaging material.