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Assistive products for personal hygiene that support users — Requirements and test methods

Produits d'assistance pour l'hygiène personnelle soutenant les utilisateurs — Exigences et méthodes d'essai

Reference number
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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).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

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 173, *Assistive products for persons with disability*.

Introduction

This International Standard specifies requirements and test methods that are relevant to assistive products for personal hygiene that support users in home care, institutions and public places. Some of the devices can be used in more than one environment. This means that different requirements and test methods can be applied to the same product depending on the environment. Clauses 1 to 21 and Clause 25 contain general requirements for all types of products included in the Scope. Clauses 22 to 24 contain specific requirements for mobile, fixed and static products. These clauses indicate additional requirements to the general clauses. In order for a product to claim compliance with this International Standard, all relevant clauses need to be fulfilled, depending on the type of product. For example, some products do not include electrical components; therefore, the clauses related to electrical components may not be relevant.

In addition to the requirements in this International Standard, Annex B gives general recommendations.

Assistive products for personal hygiene that support users — Requirements and test methods

1 Scope

This International Standard specifies requirements and associated test methods for assistive products for personal hygiene (APPHs) that support users and which are intended by the manufacturer to alleviate or compensate for disability. The work environment and safety aspects for assistants are also included. It specifies safety and performance requirements that apply during normal use and foreseeable misuse and failure. It also specifies methods of measurement of the forces necessary to operate controls and specifies limits on the forces needed for some operations.

This International Standard specifies requirements and test methods for assistive products within the following divisions of ISO 9999:2011:

09 12 03 Commode chairs;

NOTE This covers mobile and static products.

09 12 06 Toilets with built in raising and height adjustable mechanism;

NOTE This excludes toilets with built-in douche and air dryers.

09 12 09 Toilet seats;

09 12 12 Raised toilet seats mounted on frame;

09 12 15 Toilet seats inserts;

09 12 18 Raised toilet seats fixed to toilet;

09 12 21 Toilet seats with built-in raising mechanism to help standing up and sitting down;

09 12 24 Toilet arm supports and toilet back supports mounted on toilet;

09 12 25 Toilet arm supports and toilet back supports, free standing;

09 12 36 Douches and air dryers for attachment to a toilet;

09 33 03 Bath/shower chairs (with and without wheels), bath boards, stools, back supports and seats;

09 33 12 Bathing stretchers, shower tables and diaper-changing tables;

18 15 06 Height adjustable plinths and brackets;

NOTE Refers to height adjustable plinths and brackets when used as an assistive product for personal hygiene (APPH). Height adjustable mechanisms for other items such as basins may be included.

18 18 03 Handrails and support rails;

18 18 06 Fixed grab bars and handgrips;

18 18 10 Removable grab rails and handgrips;

NOTE This excludes removable grab rails and handgrips which are static as defined in 3.27.

18 18 11 Hinged rails and arm supports;

This International Standard does not encompass requirements regarding:

— safe mounting in building structures;

— requirements regarding fixed building installations e.g. water and electricity;

— bathtub hoists that are covered by ISO 10535;

— 09 33 21 Bathtubs of ISO 9999:2011;

— stability and friction issues in relation to slippery surfaces due to soap;

— products that have been customised or custom-made for an individual user.

2 Normative references

The following referenced documents are indispensable for the application 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.

CISPR 11, *Industrial, scientific and medical (ISM) radio-frequency equipment — Electromagnetic disturbance characteristics — Limits and methods of measurement*

ISO 3746, *Acoustics — Determination of sound power levels and sound energy levels of noise sources using sound pressure — Survey method using an enveloping measurement surface over a reflecting plane*

ISO 8191-1, *Furniture — Assessment of the ignitability of upholstered furniture — Part 1: Ignition source: smouldering cigarette*

ISO 8191-2, *Furniture — Assessment of ignitability of upholstered furniture — Part 2: Ignition source: match-flame equivalent*

ISO 9227, *Corrosion tests in artificial atmospheres – Salt spray tests*

ISO 9999:2011, *Assistive products for persons with disability — Classification and terminology*

ISO 10993-1, *Biological evaluation of medical devices — Part 1: Evaluation and testing within a risk management process*

ISO 12100, *Safety of machinery — General principles for design — Risk assessment and risk reduction*

ISO 13850, *Safety of machinery – Emergency stop – Principles for design*

ISO 14155, *Clinical investigation of medical devices for human subjects — Good clinical practice*

ISO 14971, *Medical devices — Application of risk management to medical devices*

ISO 15223-1, *Medical devices - Symbols to be used with medical device labels, labelling and information to be supplied - Part 1: General requirements*

ISO 22442-1, *Medical devices utilizing animal tissues and their derivatives – Part 1: Application of risk management*

IEC 60335-1, *Household and similar electrical appliances – Safety – Part 1: General requirements*

IEC 60529, *Degrees of protection provided by enclosures (IP Code)*

IEC 60601-1:2005+A1:2012, *Medical electrical equipment – Part 1: General requirements for basic safety and essential performance*

IEC 60601-1-2:2014, *Medical electrical equipment - Part 1-2: General requirements for basic safety and essential performance - Collateral standard: Electromagnetic compatibility - Requirements and tests*

IEC 60601-2-35, *Medical electrical equipment – Part 2: Particular requirements for the safety of blankets, pads and mattresses, intended for heating in medical use*

IEC 61000-3-2, *Electromagnetic compatibility (EMC) — Part 3-2: Limits — Limits for harmonic current emissions (equipment input current ≤16 A per phase)*

IEC 61000-3-3, *Electromagnetic compatibility (EMC) — Part 3-3: Limits – Limitation of voltage changes, voltage fluctuations and flicker in public low-voltage supply systems, for equipment with rated current ≤16 A per phase and not subject to conditional connection*

IEC 61000-4-3, *Electromagnetic compatibility (EMC) — Part 4-3: Testing and measurement techniques — Radiated, radio-frequency, electromagnetic field immunity test*

IEC 61000-4-8, *Electromagnetic compatibility (EMC) — Part 4-8: Testing and measurement techniques — Power frequency magnetic field immunity test*

IEC 60695-11-10, *Fire hazard testing – Part 11-10: Test flames – 50 W horizontal and vertical flame test methods*

EN 614-1, *Safety of machinery — Ergonomic design principles — Part 1: Terminology and general principles*

EN 1041, *Information supplied by the manufacturer of medical devices*

EN 12527:1998, *Castors and wheels - Test methods and apparatus*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
applied part
part of device that in normal use necessarily comes into physical contact with the occupant to perform its function

3.2
APPH
assistive product for personal hygiene
assistive product (3.3) intended to support personal hygiene

3.3
assistive product
any product (including devices, equipment, instruments and software), especially produced or generally available, used by or for persons with disability

— for participation;

— to protect, support, train, measure or substitute for body functions/structures and activities; or

— to prevent impairments, activity limitations or participation restrictions

[SOURCE: ISO 9999:2011, definition 2.3]

3.4
assistant
person who operates the assistive product if not the person with disability

3.5
backward
180° to the forward direction of travel

3.6
cleaning
removal of foreign materials from a surface

3.7
disinfection
the act of disinfecting, using specialized cleansing techniques that destroy or prevent growth of organisms capable of infection

3.8
essential performance
performance necessary to achieve freedom from unacceptable risk

Note 1 to entry: Essential performance is most easily understood by considering whether its absence or degradation would result in an unacceptable risk.

3.9
fixed product
product designed to be fastened to a support or otherwise secured in a specific location

EXAMPLE 1 Fixed by the shape of the fixation and not by friction.

EXAMPLE 2 Products permanently affixed by welding.

EXAMPLE 3 Products affixed by means of fasteners such as screws, nuts, vacuum, etc.

Note 1 to entry: A fixed product can have moving parts.

Note 2 to entry: Friction bath boards and friction toilet seats are excluded from this definition.

3.10
forward
intended direction of travel, as indicated by the manufacturer in the instructions for use

3.11
foreseeable misuse
misuse which may be reasonably anticipated

3.12
hand-held product
assistive product intended to be supported by the hand during normal use

3.13
home care
care provided in a domestic area where the assistive product is used to alleviate or compensate for an injury, disability or disease

Note 1 to entry: See IEC 60601-2-52:2010, subclause 201.3.204.

3.14
institution
established or organized society, usually with its own premises

EXAMPLE Hospital, rehabilitation, residential care or educational facility.

3.15
intended use
intended purpose
use of a product, process or service intended for medical purposes in accordance with the specifications, instructions and information provided by the manufacturer

[SOURCE: ISO 14971:2007, definition 2.5, modified]

3.16
maximum load
greatest permissible load specified by the manufacturer

3.17
maximum user mass
greatest permissible mass of the user, specified by the manufacturer, intended to be supported by the assistive product

3.18
mobile product
transportable equipment intended to be moved from one location to another while being supported by its own wheels or equivalent means

3.19
normal use
use of a product, process or service in accordance with the specifications, instructions and information provided by the manufacturer, not only intended for medical use but also maintenance, service, transport, etc.

3.20
occupant
person in or on an assistive product with a support surface

3.21
operator
person who operates the assistive product

Note 1 to entry: The operator can be either the person with disability or an assistant.

3.22
permanent deformation
alteration in shape or structure of a previously normally formed part that will stay altered as the test is completed

3.23
portable product
transportable equipment intended to be moved from one location to another while being carried

3.24
public use
use of a product in a surrounding that is available for everyone

Note 1 to entry: Public use includes areas for swimming, public restrooms etc.

3.25
risk
combination of the probability of occurrence of harm and the severity of that harm

3.26
single fault condition
condition in which a single means for reducing a risk is defective or a single abnormal condition is present

3.27
static product
product intended to be stationary with the occupant in place during its intended use and not intended to be fastened to a support or otherwise secured in a specific location

Note 1 to entry: A static product may be portable in normal use. It may have moving parts during intended use.

Note 2 to entry: Bath boards and toilet seats secured by friction are included.

3.28
system
set or series of interconnected or interdependent parts or entities that act together in a common purpose or produce results that are impossible by the action of one alone

3.29
test cycle
full cycle for the intended action

3.30
user
person who uses/occupies the device

Note 1 to entry: The user can be either the person with disability or an assistant.

4 General requirements and test methods

4.1 Risk analysis

The safety of an APPH shall be assessed by identifying hazards and estimating the risks associated with them using the procedures specified in ISO 14971 and, if relevant, ISO 12100.

When an APPH is intended by the manufacturer to be used in combination with a device that is not a medical device the device shall behave in a safe way, as a system.

NOTE 1 In the case of certain disabilities there may be a need for higher levels of safety for equipment used to offset the effects of that disability.

4.2 Intended performance

An APPH shall have sufficient strength and durability to sustain all loads expected during intended use. This shall be confirmed by using, as appropriate, references to relevant clinical and scientific literature in addition to the requirements in this International Standard, strength and/or durability calculations, appropriate test standards and their test results.

The intended performance including, if appropriate, strength, durability and tipping stability of an APPH shall be described in the information supplied by the manufacturer which sets out its functional characteristics, its application(s) and conditions of use.

The information supplied by the manufacturer shall include, if appropriate, references to relevant clinical and scientific literature, any strength and/or life calculations, conformity with appropriate test standards and their test results.

4.3 Clinical evaluation and investigation

If the risk management demonstrates a need for a clinical evaluation, a clinical evaluation shall be done for all APPHs. If, as part of the product conformity assessment, the clinical evaluation requires a clinical investigation, the clinical investigation shall conform to the requirements of ISO 14155. A clinical evaluation shall always be done before performing a clinical investigation.

4.4 Assistive products for personal hygiene that can be dismantled

If it is intended that an APPH can be dismantled for storage or transportation, it shall not be possible to reassemble it in a manner that presents a hazard.

4.5 Fasteners

The fasteners which are loosened or removed to allow this dismantling shall not be single use fasteners.

EXAMPLE Single use fasteners include wood screws and self-tapping screws. Bolts are examples of fasteners that can be used more than once.

All load-bearing fasteners shall be either self-locking or fitted with a locking device to prevent inadvertent detachment.

4.6 Means to prevent falling out

If there is a risk of the user falling out of the product during normal use, means to prevent the user falling out shall be available, e.g. side rails, a seat belt or a harness.

4.7 User mass/load limits

The maximum user mass shall be declared. If the maximum load is different both shall be declared by the manufacturer.

All products with the intended purpose of supporting an occupant/user in a seated or lying position shall be capable of supporting a person with at least 100 kg body mass.

If a product is intended by the manufacturer to be used by a person of less than 100 kg body mass, there shall be a limitation in the design of the product to prevent the potential misuse by a person with higher body mass than the one stated by the manufacturer.

The maximum user mass and the maximum load as specified by the manufacturer shall be used in the relevant test methods of this International Standard.

When the loading pad is used for testing, the mass thereof shall be taken into account for the test value of loading.

4.8 Apparatus

4.8.1 Means to apply a force between 25 N and 2000 N with an accuracy of ± 5 % and with a rate of application less than 5 N/s.

4.8.2 Means to measure force with an accuracy of ± 5 % in increments of 1 N in the range of 0 N to 2000 N (occasionally larger forces than 2000 N might be needed).

4.8.3 Means to measure distance in the range of 0 m to 3 m with an accuracy of ± 5 mm or ± 2 % whichever is the greater.

4.8.4 Means to measure angles to an accuracy of ± 0,25°.

4.8.5 Means to measure torque with an accuracy of ± 5 % in increments of 1 Nm in the range of 0,5 Nm to 10 Nm.

4.8.6 Means to measure sound levels and frequencies calibrated in accordance with the manufacturer's instructions, using an acoustic calibrator class 1 as described in ISO 3746 with an accuracy of ± 3 dB(A).

4.8.7 A hard horizontal and inclinable test plane, of sufficient size to support the APPH during testing, such that the whole surface is contained between two imaginary parallel planes 5 mm apart. A non-adjustable test plane can be used, if it is set to the correct angle.

NOTE A hardwood board (e.g. > 600 kg/m^3) is an example of material used.

4.8.8 Stoppers, for mobile APPHs not smaller than half of the wheel diameter and not greater than the wheel diameter. See Figure 1.

For static APPH the stopper shall be designed to prevent the APPH from sliding, and not to prevent it from overturning. The height of the stopper shall be 12 mm or less. In the case where a stopper larger than 12 mm is required because of the construction of the APPH, it shall be the minimum height required to prevent the APPH from sliding.

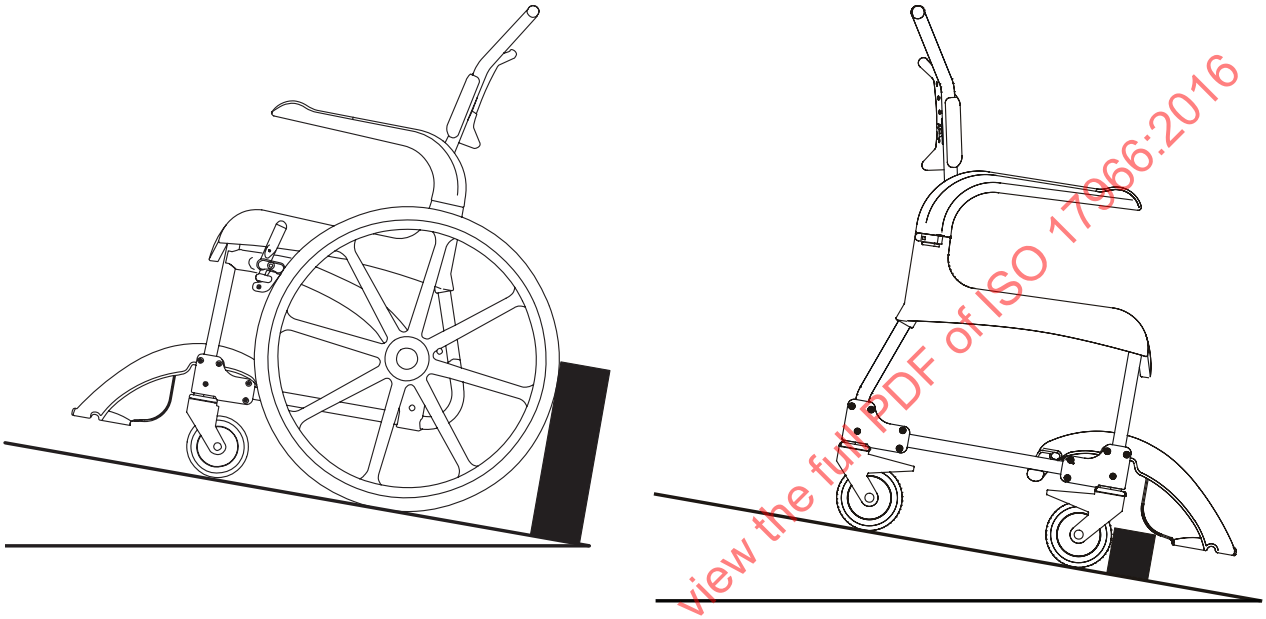


Figure 1 — Wheel-stopper

4.8.9 Equipment capable of simulating human body parts as used in practice (e.g. test fingers).

4.8.10 Equipment for applying loads, with negligible dynamic factor.

NOTE Negligible dynamic force is a small force that does not have a big impact.

4.8.11 Equipment for measuring pressure of water, oil and air with an accuracy of ± 5 %.

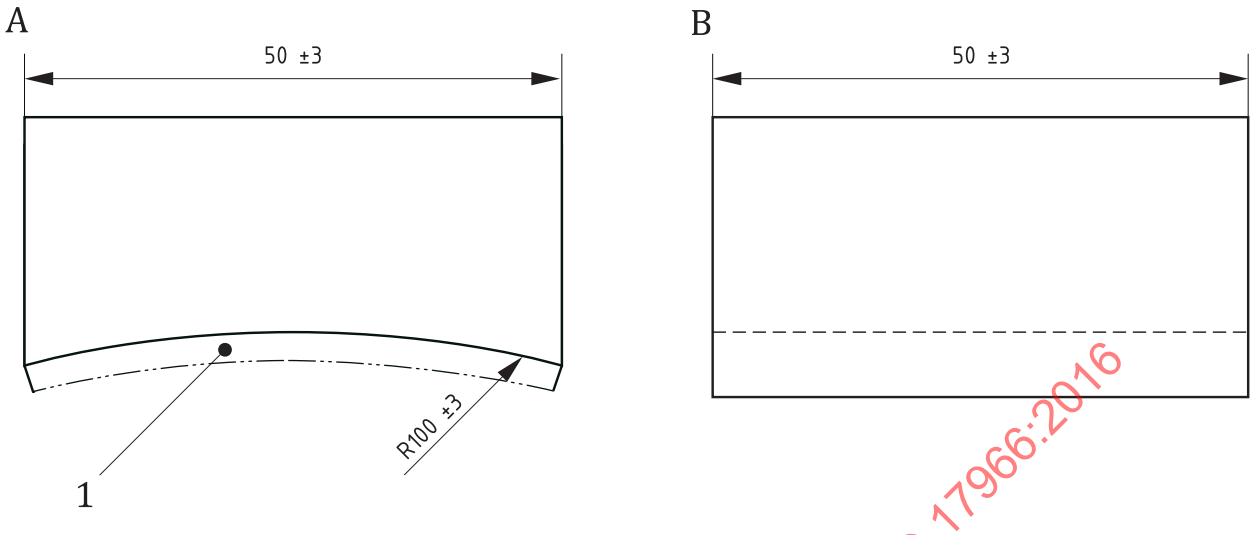
4.8.12 Loading pads, as follows.

4.8.12.1 Concave loading pad.

The loading device shall be capable of applying forces (compressive or tensile) in the range 15 N to 1 000 N with an accuracy of ± 3 %.

The concave loading pad for static loads shall be made of metal or hard wood as shown in Figure 2.

Dimensions in millimetres



Key

A front view
B side view
1 loading surface

NOTE The loading surface may be covered with non-slip material up to 3 mm thick e.g. plastic foam.

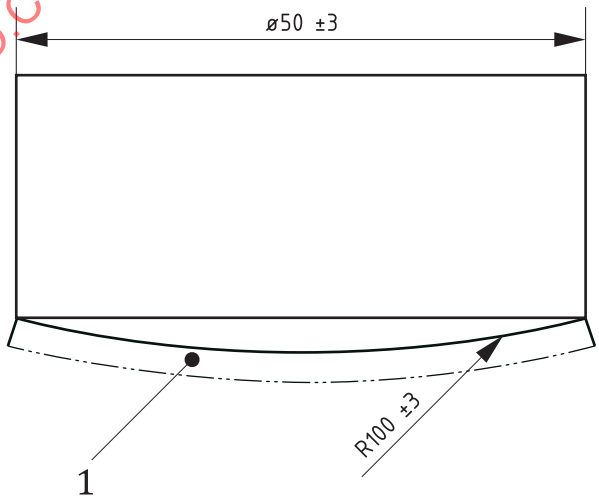
Figure 2 — Concave loading pad for static loads

4.8.12.2 Convex loading pad.

The loading device shall be capable of applying forces (compressive or tensile) in the range 15 N to 1 000 N with an accuracy of ± 3 %.

The convex loading pad shall be circular and made of metal or hard wood, as shown in Figure 3.

Dimensions in millimetres



Key

1 loading surface

NOTE The loading surface may be covered with non-slip material up to 3 mm thick e.g. plastic foam.

Figure 3 — Convex loading pad for static loads

4.8.12.3 Back support loading pad.

The loading device shall be capable of applying forces (compressive or tensile) in the range 15 N to 2 000 N to an accuracy of ± 3 %.

The loading pad shall be made of metal or hard wood and have the shape and dimensions as shown in Figure 4.

Dimensions in millimetres

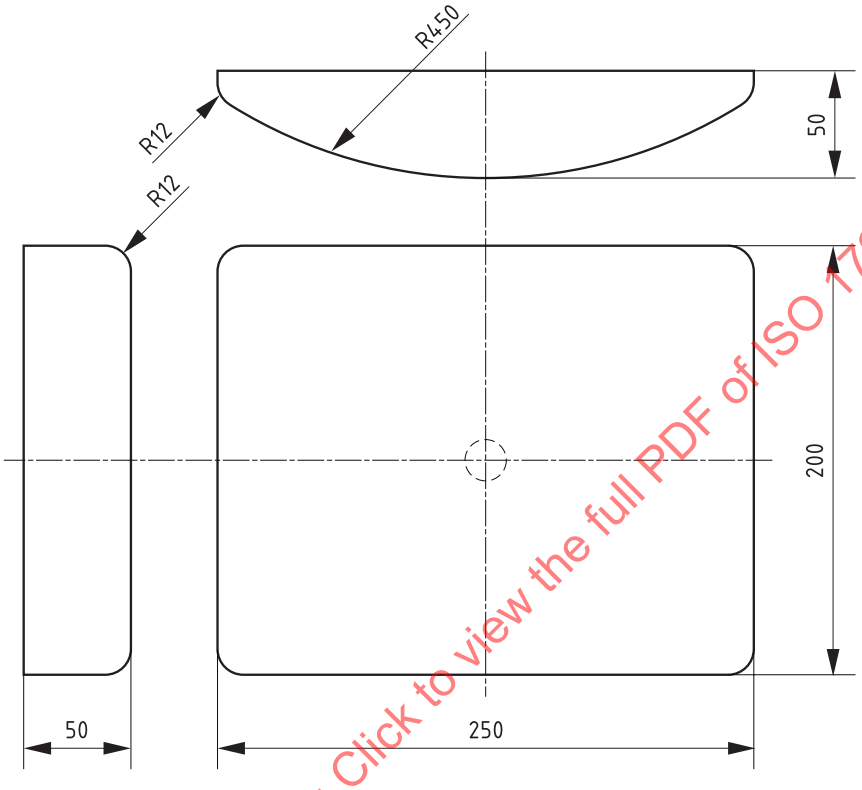
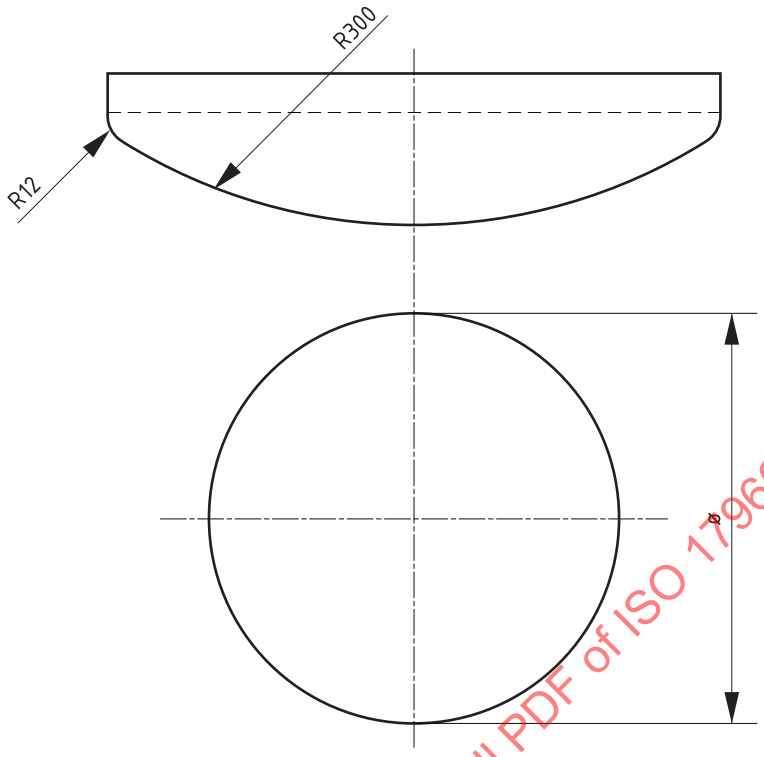


Figure 4 — Loading pad for back support

4.8.12.4 Seat loading pad.

The loading pad shall be made of metal or hard wood and have the shape and dimensions as shown in Figure 5 with rounded edges, with various diameters depending on the test item.

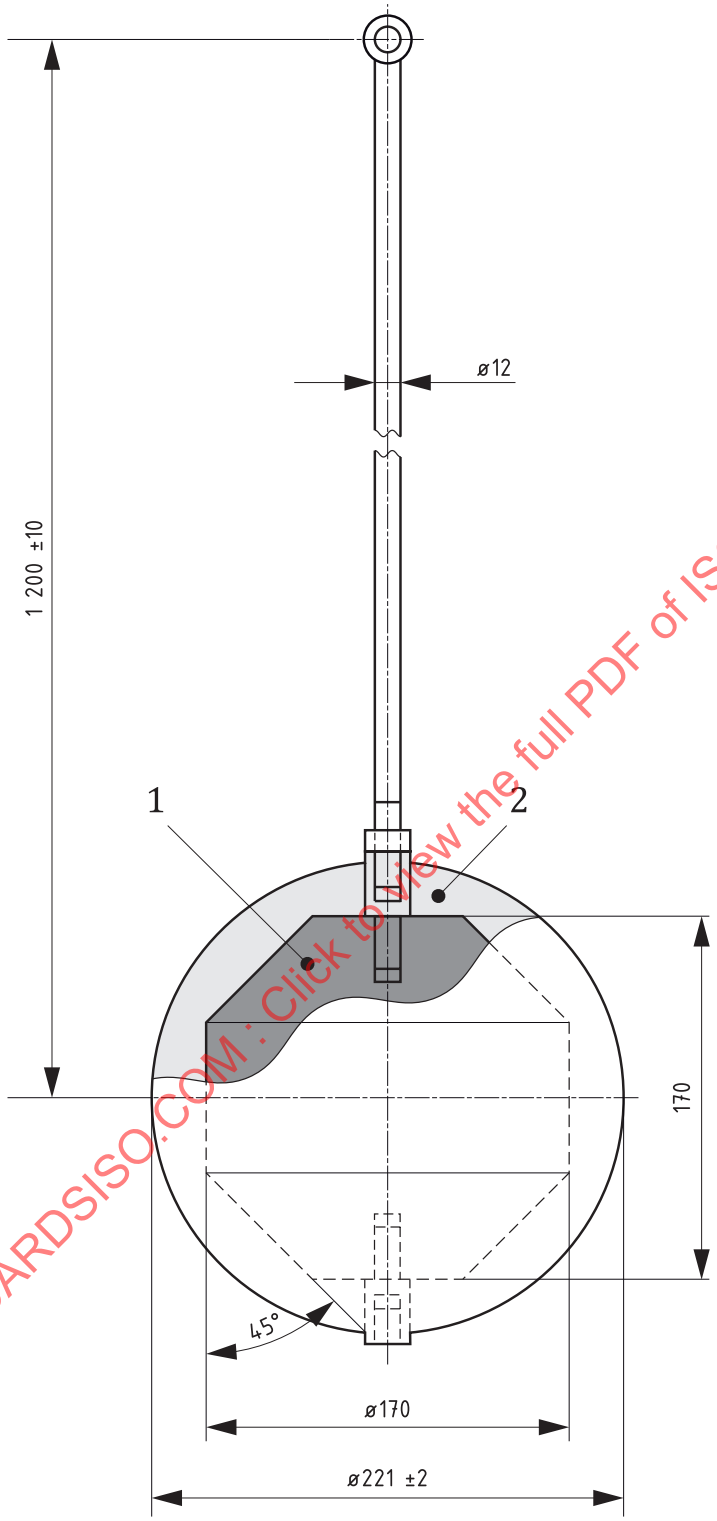


⌀ 350 mm, 250 mm or 200 mm

Figure 5 — Loading pad for seat support

4.8.13 Back support impact test pendulum, which shall meet the requirements shown in Figures 6 or 7. The total mass of the ball shall be 25 kg ± 0,5 kg.

Dimensions in millimetres



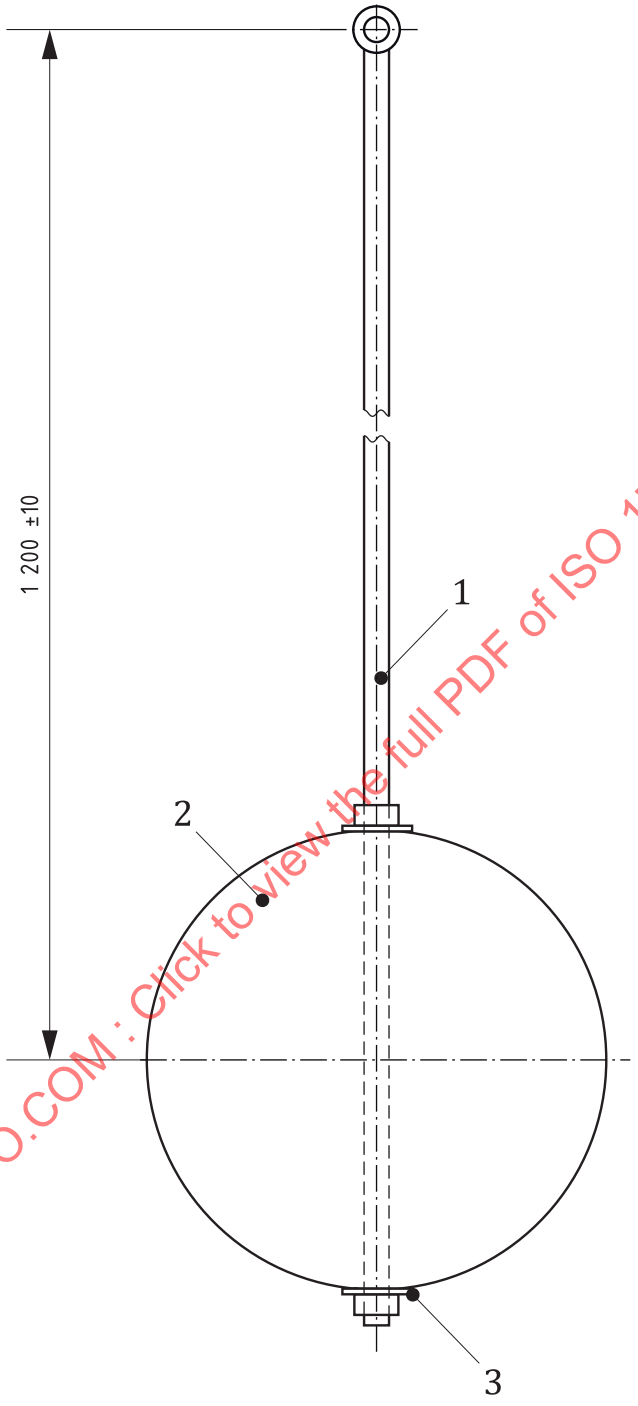
Key

1 steel block

2 polyurethane with the following specifications: Density: 1150kg/m3; Hardness: 80+ shore A; Resilience: 20%

Figure 6 — Back support impact test pendulum

Dimensions in millimetres



Key

1	threaded bar
2	regulation association football (soccer ball) size 5, with diameter of 220 mm filled with lead shot 3.5 ± 1 mm diameter and closed cell high density foam of Density: 75 ± 15 kg/m3 (ISO 845); Hardness: 325 ± 60 N (ISO 2439)
3	washer

Figure 7 — Alternative back support pendulum

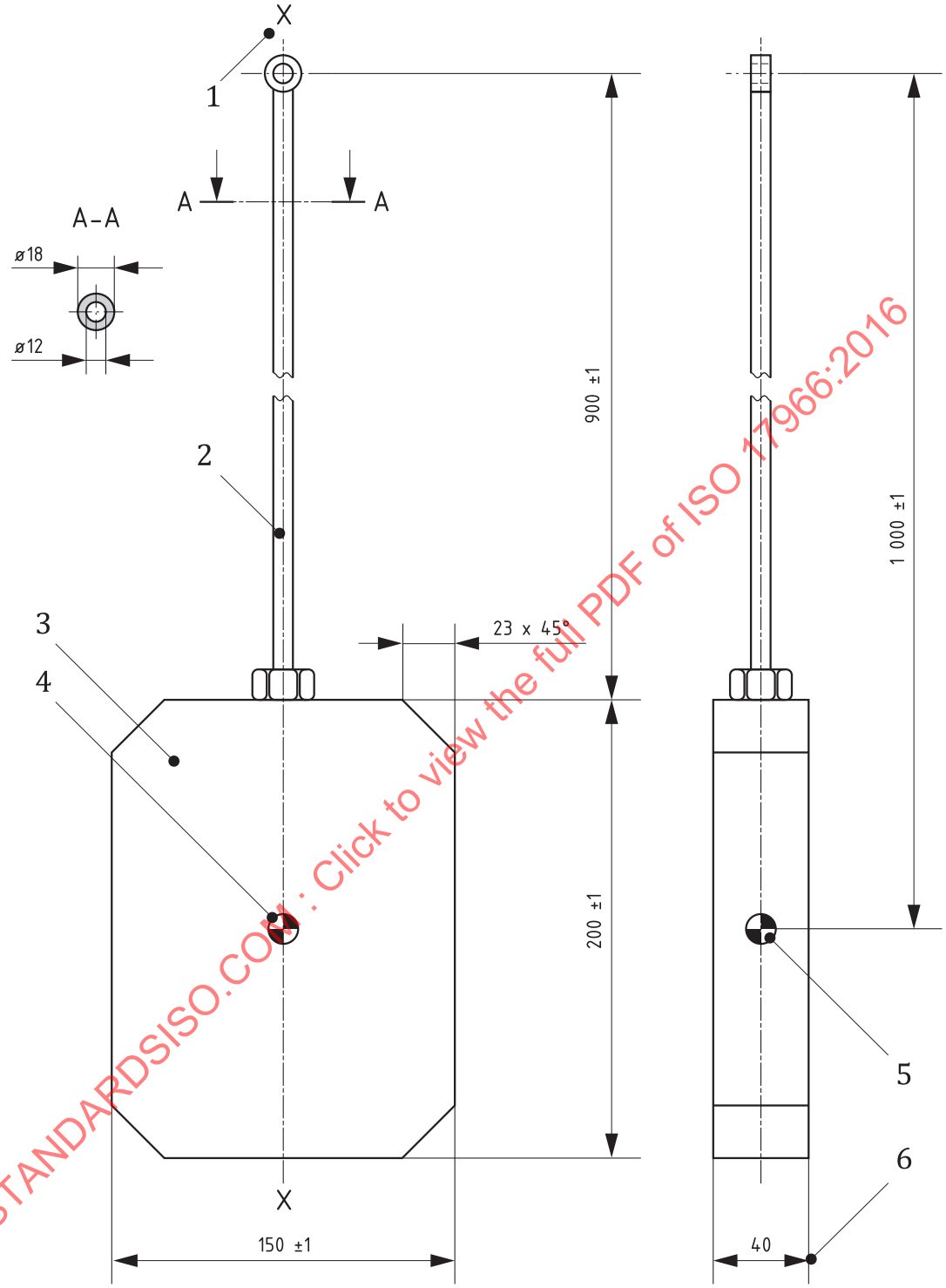
4.8.14 Toilet seat impact test pendulum, with the following properties:

a) total mass 10 kg ± 0,25 kg;

b) distance (d) from pivot to centre of percussion 1,000 m ± 0,005 m,

The impact test pendulum shown in Figure 8 may be used although other shapes may be required to accommodate different layouts and sizes.

Dimensions in millimetres



Key

1 centre adjustment
2 steel tube
3 steel block
4 centre of percussion flat face
5 centre of percussion side face
6 reference dimension

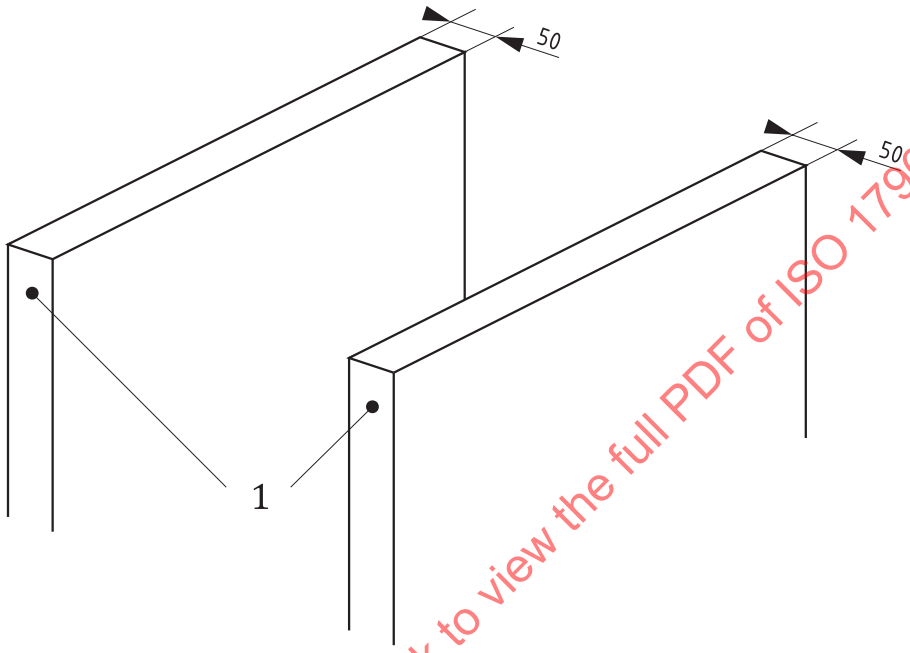
Figure 8 — Example of toilet seat impact test pendulum

4.8.15 Supporting stands, flat, of appropriate materials. The height shall be 1 m ± 0,1 m, the width of upper surface shall be 50 mm ± 5 mm and the side wall shall be perpendicular to the upper surface (see Figure 9). The stands shall have an adjustable width and angle seen from distance at the bottom and top in order to accommodate for positioning of different designs.

It shall be possible to adjust the upper surface so that it always stays horizontal when used at different angles.

Example A bathtub can have sloped sides which the supporting stands can simulate.

Dimensions in millimetres



Key

1 supporting stand

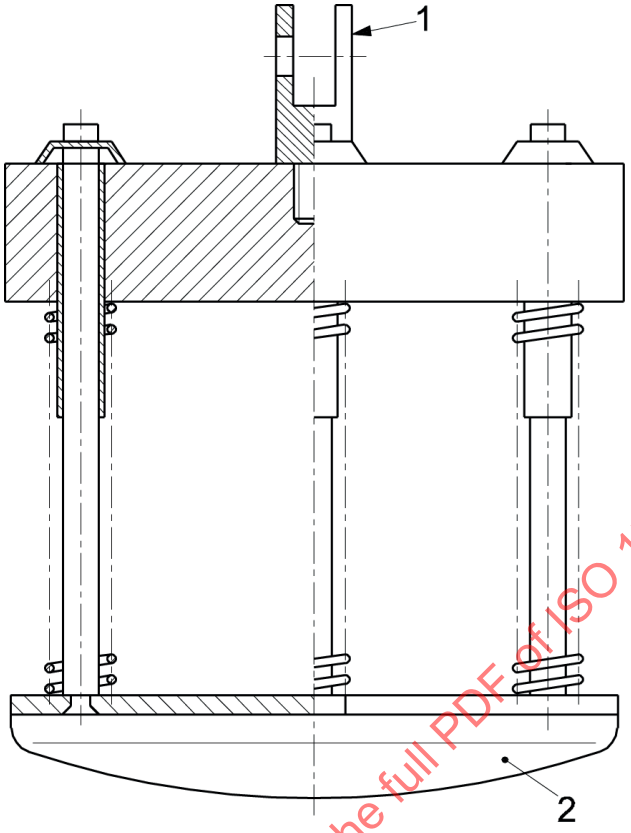
Figure 9 — Supporting stand

4.8.16 Lying support impactor, with the following properties.

a) The impactor body is approximately 200 mm in diameter and is separated from the striking surface by helical compression springs. The body is free to move on a line perpendicular to the plane of the central area of the striking surface.

b) The total mass of the assembly shall be 25 kg ± 0,1 kg and the body and its associated parts (minus the springs) shall have a mass of 17 kg ± 0,1 kg.

c) The combined spring rate (for the system) shall be 6,9 N/mm ±1 N/mm and the total friction resistance of the moving parts is between 0,25 N and 0,45 N. When the spring system is compressed to a load of 1 040 N ± 5 N, the remaining compression distance shall be 60 mm minimum. The striking surface shall be a rigid circular object, (200 ± 5) mm in diameter, the face of which has a convex spherical curvature of 300 mm radius with a 12 mm front edge radius. See Figure10.



Key

1 joint of lifting device not inhibiting free fall

2 striking surface

Figure 10 — Lying support impactor

4.9 Test conditions

The product shall be tested in the as-delivered state (to the customer). However if the product is of a multi-purpose design that can be assembled in different formats, it shall be assembled according to instructions given by the manufacturer. If the product is intended to be used in different combinations, then the most adverse combination shall be tested. If the product is delivered disassembled it shall be assembled according to manufacturer's instructions before testing.

EXAMPLE A shower seat converted into a toilet seat.

Unless otherwise specified, the tests shall be performed under normal indoor conditions:

— with temperatures between 15°C and 30°C;

— with humidity between 20% RH and 85% RH.

All tests shall be performed on a single product. A new product can be chosen if the original test object breaks down, and cannot be repaired. Some tests relevant to the safe functioning of the product might have to be repeated on the new product. This is up to the manufacturer of the product to consider in each separate case.

If the product is tested by a testhouse, the decision shall be taken in cooperation between the third party and the manufacturer.

Unless otherwise stated in a specific clause of this International Standard the order of tests is not important.

5 Materials

5.1 General

Manufacturers should, wherever possible, use materials that can be recycled for further use. It should be stated in the instructions for use which parts can be recycled.

5.2 Flammability

5.2.1 General

Manufacturers shall consider the environments and methods of use to which an APPH, or any materials that are usually used in combination with this APPH, will be exposed and take appropriate steps to minimise any fire hazard.

The manufacturer shall include a warning in the instructions for use about safe combinations of flame resistant and non-flame resistant materials.

NOTE For guidance see B.5.2.

5.2.2 Moulded parts used as enclosures for electrical equipment

If a risk can potentially be caused by an electrical component the housing of the moulded part shall be tested in accordance with FV-1 of IEC 60695-11-10 or better. If the product is of a type that the person with disability cannot escape from or detect as a dangerous situation it shall be FV-0.

5.2.3 Upholstered parts and moulded parts

If the manufacturer claims that the upholstered parts are resistant to ignition by cigarette, progressive smouldering ignition and flaming ignition shall not occur when the materials used for the upholstered parts of an assistive product are tested in accordance with ISO 8191-1 and ISO 8191-2.

If the manufacturer claims that moulded parts are resistant to ignition by small flames, such as those from a match, progressive smouldering ignition and flaming ignition shall not occur when tested in accordance with IEC 60695-11-10.

5.3 Biocompatibility and toxicity

Materials which come into contact with the human body shall be assessed for biocompatibility using the guidance in ISO 10993-1.

The assessment shall also take into account the intended use and contact by those involved in user care. The result of the assessment shall be incorporated in the risk analysis (see 4.1).

The assistive products shall be designed and manufactured in such a way as to reduce to a minimum the risks posed by substances leaking from the assistive product. Special attention shall be given to substances which are carcinogenic, mutagenic or toxic to reproduction and other substances of very high concern (SVHCs).

The assessment should follow the guidance given in Annex C.

5.4 Infection and microbiological contamination

5.4.1 Cleaning and disinfection

If an APPH is intended to be cleaned and/or disinfected, the method and suitable cleaning or disinfection materials shall be described in the information supplied by the manufacturer.

NOTE For guidance see B.5.4.1.

If an APPH is intended to be cleaned by automatic washing systems or hand-held jet stream/steam washing the details of the procedure, such as temperature, pressure, flow and pH value of cleaning/rinsing solution shall be described in the instructions for use. Where practicable, the APPH shall be labelled with appropriate symbols to represent the method of cleaning. See examples of labelling and an example of testing of machine washable APPH in B.5.4.1.

5.4.2 Resistance against temperature alternations

If an APPH is intended to be heated up during the disinfection or washing process, it shall pass the following test.

The test sample is exposed to the maximum temperature ± 2°C during the washing and disinfection process as described by the manufacturer and afterwards cooled down to a temperature of 30°C. This cycle of alternating temperatures is repeated ten times.

For products intended to be disinfected by heat one of the following three temperatures and duration of exposition can be used:

a) a temperature of 90°C for 1 minute;

b) a temperature of 85°C for 3 minutes;

c) a temperature of 80°C for 10 minutes.

The test shall be performed before any strength and/or durability tests of the product.

After the test, the product shall fulfil the following requirements: coating or any relevant labelling on the product shall not come loose from the basic sheet metal, show blisters or any other quality-reducing changes.

5.4.3 Animal tissue

Where a device has been manufactured utilising tissues of animal origin or their derivatives, a risk assessment shall be performed and documented according to ISO 22442-1.

NOTE For guidance see B.5.4.3.

5.5 Resistance to corrosion

The risk of corrosion affecting the safety of the user or an assistant shall be assessed in the risk analysis. Assistive products that are identified to be at risk of corrosion shall be sufficiently protected against corrosion, which can be confirmed by using the salt spray test according to ISO 9227 with a test duration of 72 hours.

6 Emitted sound and vibration

6.1 Noise and vibration

If noise and vibration are not part of the intended performance of an APPH, hazards and nuisance from noise and vibration shall be assessed in the risk analysis (see 4.1).

Measurements of noise from a power operated APPH shall be made in accordance with ISO 3746, and the result of the measurement shall be recorded in the pre-sale information of instructions for use.

NOTE For guidance see B.6.1.

6.2 Sound pressure levels and frequencies of audible warning devices

The frequency shall be within 500 Hz and 3 000 Hz.

NOTE Normal hearing is usually within the frequency range 500 Hz to 16 000 Hz. For people with hearing disabilities the range will be less and in severe cases down to 500 Hz to 3 000 Hz.

A-weighted sound pressure levels shall be at least 65 dB for audible alarms.

The alarm or feedback signal shall be distinguished from the noise of the product itself either by frequency or sound level.

7 Electromagnetic compatibility

7.1 General

An APPH containing electrical or electronic devices/components shall conform to IEC 60601-1-2 and shall, in addition, conform to 7.2, 7.3 and 7.4.

7.2 Emissions

When tested in CISPR 11, the equipment shall meet the radiated emissions limits specified in CISPR 11 for group 1, class B equipment.

The APPH shall meet the requirements of IEC 61000-3-2 and IEC 61000-3-3, if applicable.

7.3 Immunity

In addition to the requirements in IEC 60601-1-2:2014, APPH shall also be tested with a field strength of 10V/m (RMS value of the unmodulated carrier) in the frequency range of 800 MHz to 2,5 GHz. The test shall be performed in accordance with IEC 61000-4-3.

If, as a result of the application of this test, the APPH presents a hazard, or there is any unintentional operation of the APPH, the APPH fails the test.

NOTE 1 It may be necessary to assess the risk associated with the APPH when used in close proximity to mobile telephone(s) or other forms of transmitter. In this case higher field strength values over a broader range of frequency may apply.

NOTE 2 APPHs are used in a wide range of environments and may be used in the presence of other electronic equipment. The electromagnetic compatibility (EMC) needs to be carefully matched to the intended use of the APPH.

7.4 Power frequency magnetic field immunity

When the equipment is tested in accordance with IEC 61000-4-8, test level 4, at any voltage using either 50 Hz or 60 Hz:

a) the equipment shall behave safely in the presence of the applied field;

b) electrically powered devices or electrically moved functions shall not move in the presence of the applied field.

Perform the continuous field immunity test specified in IEC 61000-4-8 on the equipment as table-top equipment. Test the equipment for not less than one minute for each orientation of the applied field.

For guidance see B.7.4.

8 Electrical safety

8.1 General

An APPH shall fullfill the relevant requirements stated in Table 1 regarding electrical safety. An APPH connected to mains shall be either of class I (protective earth) or class II (double isolation). For APPHs which are marketed by the manufacturer as medical electrical equipment and are intended to be used in the home care environment and which are not permanently installed only class II is allowed according to IEC 60601-1-11.

NOTE Local building regulations may have more stringent requirements.

Table 1 — Applicable standards for electrical safety

APPH that fall within the scope of IEC 60601-1:2005 **are tested according to:**	**APPH that fall within the scope of** IEC 60335-1 **are tested according to:**
IEC 60601-1 IEC 60601-1-11 IEC 60601-2-xx	IEC 60335-1 IEC 60335-2-xx

8.2 Electrical systems

An electrical system can consist of several components, each tested to different standards.

For the applicability of standards for components of electrical systems see Table 1.

8.3 Safe positioning

The APPH shall always be capable of being set into a position that enables safe transfer of the occupant in case of a single fault failure or by loss of power.

8.4 Single fault safety

The APPH shall be so designed and manufactured that it remains single fault safe, or the risk remains acceptable as determined through the risk analysis process according to IEC 60601-1:2005, 4.7.

8.5 Hold-to run activation

Electrically operable movements shall only be possible by the activation of control device(s) which initiate and maintain operation of the device only as long as the manual control is actuated and where the manual control automatically returns to the 'Stop' or 'Off' position when released.

NOTE Non-electrically operable movements (e.g. by hand or foot) are considered to comply with this clause, as long as mass and velocity allow adequate control of e.g. positioning without causing an unacceptable risk.

8.6 Emergency stopping functions

If the risk analysis demonstrates that there is a risk for the user or any other person around the APPH to be squeezed or a single fault appearing that might create a safety hazard there shall be an emergency stop as specified in ISO 13850 together with the following requirements:

— the APPH shall be designed to prevent accidental damage. If this is not feasible the APPH shall stop moving;

— the emergency stopping device shall be readily accessible to the operator, and stop the dangerous situation within one action;

— the stopping device shall maintain the equipment in a safe position, but not interfere with any essential performance functions, as defined by the manufacturer;

— the emergency stopping device shall maintain the APPH in a stopped position until it is released by a designated procedure;

— a safe stopping distance shall be considered in the risk analysis;

— the designated procedure for the release of the emergency stop shall be different from the movement needed to activate the emergency stop.

8.7 Continuity of power supply

If the safety of a person using an APPH powered from electrical supply mains depends upon the continuity of the power supply, the APPH shall be provided with a level of protection as follows.

— In case of a power cut, it shall be possible to return the APPH to a position enabling safe transfer using an auxiliary source of power or to provide sufficient power to allow further actions.

— If the power is cut, an auxiliary source of power is automatically connected to the APPH and a means to signal to the assistant that a discontinuity of the power supply has occurred. The auxiliary source of power shall provide sufficient power to allow for further actions.

— If the intended operator is able to react in a reasonable and timely manner by himself as power is cut, an auxiliary source of power and a means to signal to the operator that a discontinuity of the power supply has occurred, the auxiliary power source shall provide sufficient power to allow for further actions.

— If it is feasible, a method of non-electrical operation shall be provided that reduces the risk to users to an acceptable level until they can be moved from the APPH, or until power is restored together with a means to signal power failure to the operator/assistant who is intended for such emergency operations.

If there is a battery backup when there is a failure in the mains, this shall start to function as fast as possible and have a performance time long enough to bring the user into a position to enable safe transfer.

NOTE 1 A timely reaction may be providing access to the supply mains without interruption of the continuity of the power supply.

If the safety of a person using an internally powered APPH depends upon the continuity of the power supply, a means of informing the operator of a critical charge of the power supply shall be provided. At the time of reaching the critical charge, either an auxiliary source of sufficient power or a sufficient reserve charge of the internal power supply shall be available to allow timely reaction.

EXAMPLE Means of informing the operator of critical charge can be visual or auditory (e.g. symbols/lights and/or beeps).

NOTE 2 A timely reaction might be either recharging/replacing an internal power supply without interruption of the continuity of the power supply or by allowing the return to a safe place that provides the possibility to recharge/replace the internal power supply.

8.8 Battery powered assistive products for personal hygiene

8.8.1 Battery housings

Battery housings shall provide protection so that it shall not be possible for the following safety risks to occur.

a) The need for, and the design of, battery housings shall be based on the risk analysis (see 4.1) and shall identify the hazards and evaluate the risks associated with:

   1) leakage of acid and/or other substances from the battery(ies);

   2) ventilation of gases generated during charging and/or use;

   3) short circuits of the battery(ies);

when operated in accordance with the conditions of use.

b) Housings containing batteries from which gases can escape during charging or discharging, shall be ventilated.

   NOTE Ventilation minimizes the risk of accumulation and ignition of flammable gases.

c) If a short circuit of a battery could result in a safety hazard, the battery shall be contained in a housing/compartment that prevents the risk of accidentally short circuiting the battery(ies).

d) Any battery housing/compartment shall collect and store any fluids and/or substances (other than gases) which may leak from the battery(ies) specified by the manufacturer.

e) The materials used in the manufacture of battery housings shall be resistant to the substances that might leak from the battery(ies) specified by the manufacturer.

8.8.2 Connection

If a safety hazard can develop from the incorrect connection or replacement of a battery, an APPH shall be fitted with a means of preventing incorrect polarity.

8.8.3 Charge level indicator

If the safety of a person using an internally powered APPH depends upon the power supply, a means of informing the operator of the state of the charge of the power supply shall be provided. At the time of indicating the critical charge, sufficient reserve charge of the internal power supply shall be available to allow for a timely reaction.

NOTE A timely reaction may be either recharging or replacing the power supply without interruption of the availability of the power or by allowing the return to a safe place that provides the possibility to re-charge/replace the internal power supply.

There shall be some kind of indication of the status of the battery that is adapted to all the needs of operators with different functional limitations, e.g. persons with a vision or hearing impairment.

EXAMPLE Audible, visible or tactile indication that clearly indicates the status of the battery.

For guidance see ISO/IEC Guide 71:2001, Tables 5 and 6.

8.9 Circuit protection

The APPH shall meet the requirements and test methods for circuit protection as in IEC 60601-1+A1:2012:2005.

For guidance, see B.8.9.

8.10 Electrically heated blankets, pads and similar flexible heating appliances

An electrically heated blanket, pad or similar flexible heating appliances shall fulfil the requirements in IEC 60601-2-35 with a maximum temperature according to Table 2.

8.11 Ingress of liquids

Enclosures shall be classified according to the degree of protection against harmful ingress of water as detailed in IEC 60529.

Compliance is checked by tests in IEC 60529 with the APPH placed in the least favourable position for normal use.

APPHs that are not in contact with water during normal use or reasonably foreseeable misuse (e.g. during the cleaning process) shall at least be protected to IPX2.

APPHs that are normally in contact with water or body fluids shall at least be protected to IPX4 and in public areas at least IPX5.

APPHs that are temporarily submerged into water during normal use, shall at least be protected to IPX7.

APPHs that are normally submerged into water during normal use shall at least be protected to IPX8.

If water unintentionally can come into an enclosure there shall be a way for the liquid to get out of the enclosure, or the liquid shall not cause any kind of hazard.

Test the APPH within 5 minutes after the water test and after 1 hour to verify its functions.

9 Overflow, leakage, and ingress of liquids

9.1 Ingress of liquids

9.1.1 Requirements

If liquid can come unintentionally into an enclosure there shall be a way for the liquid to get out of the enclosure, or the liquid shall not cause any kind of hazard.

The hazards that can be caused by the ingress of liquids to non-electrically powered APPHs shall be assessed in the risk analysis (see 4.1).

NOTE 1 See B.9.1.

NOTE 2 For requirements for electrically powered APPH, see 8.11.

NOTE 3 Hazards might be risk of corrosion or bacterial growth.

9.1.2 Test method

Test if there is a way for the liquid to get out of the enclosure, by using procedures as in normal use and handling of the product. If possible tilt the product in different directions to verify this.

9.2 Overflow and leakage

9.2.1 General

The requirements given in 9.2.2 do not apply to the body fluids which may be collected in an APPH (e.g. a commode chair) but only to those substances which are an integrated part of an APPH or are needed for its function (e.g. oil and grease).

9.2.2 Substances which may leak from an APPH in intended use and in fault conditions

The APPH shall be designed and manufactured in such a way as to reduce to a minimum the risks posed by substances leaking from the APPH. Special attention shall be given to substances which are carcinogenic, mutagenic or toxic to reproduction and other substances of very high concern (SVHCs). The assessment should follow the guidance given in Annex C.

Substances which may leak from the APPH shall either:

— be assessed for biocompatibility in accordance with the guidance given in ISO 10993-1 (the assessment shall take into account the intended use and contact by the user as well as those involved in user care, transport and storage); or

— be provided with protection that minimizes the possibility of such substances becoming a biological hazard.

NOTE 1 Substances that can leak include lubricants and hydraulic fluids.

NOTE 2 An example of a method of protection from a hazardous substance is where batteries are placed in a container made from acid resistant material.

10 Temperatures of parts that come in contact with human skin

The risk analysis (see 4.1) shall identify hazards and evaluate the risks associated with the surface temperature of parts which can come into contact with human skin during the intended conditions of use.

The risk analysis shall take account of:

a) the range of ambient temperatures to be expected during the intended use and foreseeable misuse;

NOTE These temperatures could include direct exposure to sunshine, hot water, hot air, extreme cold, saunas, etc.

b) temperatures that may result from single fault conditions;

c) the ergonomic data on acceptable temperatures of touchable surfaces in IEC 60601-1:2005+A1:2012, Table 24 adapted to the use of APPHs by people with insensitive skin (e.g. cannot feel heat) and/or damaged skin for a duration of 10 min or more. In this case the maximum temperature shall not exceed 41 °C (see Table 2 below) when measured by the methods of test in IEC 60601-1:2005+A1:2012.

If a manufacturer cannot meet the requirement of c) without impairing the intended performance of the APPH, each assistive product should be supplied with a warning identifying which surfaces may reach a higher temperature than that specified in Table 2 and a description of the precautions necessary to offset the increased risk.

Table 2 — Allowable maximum temperatures for skin contact with APPH (applied parts)

Applied parts of APPH		Maximum temperature [a] °C		
		Metal and liquids	Glass, porcelain, vitreous material	Moulded material, plastic, rubber, wood
Applied part having contact with a person for a time "t"	$t < 1$ min	51	56	60
	1 min ≤ t < 10 min	48	48	48
	10 min ≤ t	41	41	41

[a] These temperature limit values are applicable for the healthy skin of adults, but in the temperature limitation for durations of more than 10 min, persons with disability with sensitive skin or no sensation have also been considered. They are not applicable when large areas of the skin (10 % of total body surface or more) can be in contact with a hot surface. They are not applicable in the case of skin contact with over 10 % of the head surface. Where this is the case, appropriate limits shall be determined and documented in the risk management file.

11 Safety of moving and folding parts

11.1 Squeezing

Unless the intended purpose of an APPH, or part of an APPH, is to grip, cut, squeeze etc., or if the intended use cannot be achieved without a hazard such as risk of squeezing:

a) any moving parts that constitute a safety hazard shall be provided with guards that can only be removed by the use of a tool; or

b) the gap between exposed parts of an assistive product that move relative to each other shall be maintained throughout the range of movement at less than the minimum value or more than the maximum value set out in Table 3.

These measurements shall be done before and after any relevant strength, durability and impact testing.

Table 3 — Safe distances between moving parts

To avoid	Safe distances for adults	Safe distances for children[a]
Finger traps	Less than 8 mm or more than 25 mm	Less than 4 mm or more than 25 mm
Foot traps	Less than 35 mm or more than 120 mm	Less than 25 mm or more than 120 mm
Head traps	Less than 120 mm or more than 300 mm	Less than 60 mm or more than 300 mm
Genitalia traps	Less than 8 mm or more than 75 mm	Less than 8 mm or more than 75 mm

[a] Also includes adults with a height of less than 146 cm, or a mass of less than 40 kg, or a Body Mass Index (BMI) of less than 17.

c) If cords (ropes), chains and drive belts are used, they shall either be confined so that they cannot run off or jump out of their guiding devices, or a safety hazard shall be prevented by other means (mechanical means applied for this purpose shall be removable only by the use of a tool); or

d) the APPH shall incorporate a control device which initiates the movement when it is operated and stops the movement when it is released (e.g. a spring loaded control device that returns to the stop position when released); or

e) the APPH shall incorporate a means for detecting that a person is in danger of being trapped and automatically activate a means of preventing injury (e.g. by stopping the movement).

For moving parts that can cause squeezing, manufacturers shall take into consideration those part/parts of the body that are at risk. The user/user group has to be specified, so that correct safety distances can be applied.

NOTE An APPH intended for a child can also be operated by an adult.

To avoid a hazard where parts of the body can be trapped when the APPH is folded, the following shall be assessed:

— the APPH shall incorporate means to protect the user from trapping and/or squeezing hazards; or

— the gap between exposed parts of an APPH that move relative to each other shall be maintained throughout the range of movement at less than the minimum value or more than the maximum value set out in Table 3; or

— if the intended purpose of an APPH cannot be met without a hazard such as squeezing, a warning and instructions on how to operate the APPH safely shall be provided in the instructions for use.

If guards are applied, the design of a guard shall take into consideration the forces that can be applied in normal use.

11.2 Velocity of powered lifting and lowering movements

11.2.1 Requirements

Requirements for velocity of powered lifting and lowering movements:

a) the rate of lifting or lowering shall not exceed 0,15 m/s when loaded;

b) the rate of lifting or lowering shall not exceed 0,25 m/s when unloaded.

11.2.2 Test method

When measured with the maximum load, the rate of lifting and lowering shall not exceed the velocity in 11.2.1 a).

When measured unloaded, the rate of lifting and lowering shall not exceed the velocity in 11.2.1 b).

11.3 Mechanical wear

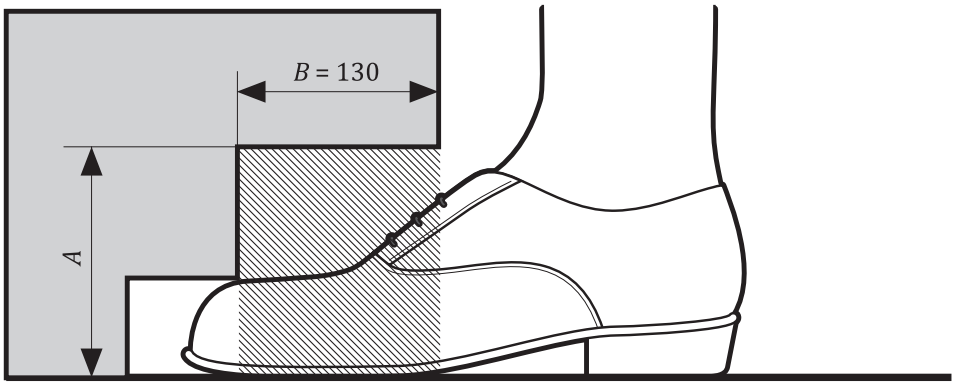
Parts subject to mechanical wear likely to result in a safety hazard shall be accessible for inspection, unless it is intended to be replaced by a service interval specified by the manufacturer.

11.4 Trapping zones for feet in relation to moving parts

The locations identified in Figures 11 and 12 shall be considered as trapping zones for feet.

For the area in Figure 11 where B = 130 mm; the distance A shall always be ≥ 120 mm.

For the area in Figure 12 where the distance B_1 *and* B_2 is between 130 mm to 180 mm; the distance C shall always be ≥ 50 mm.

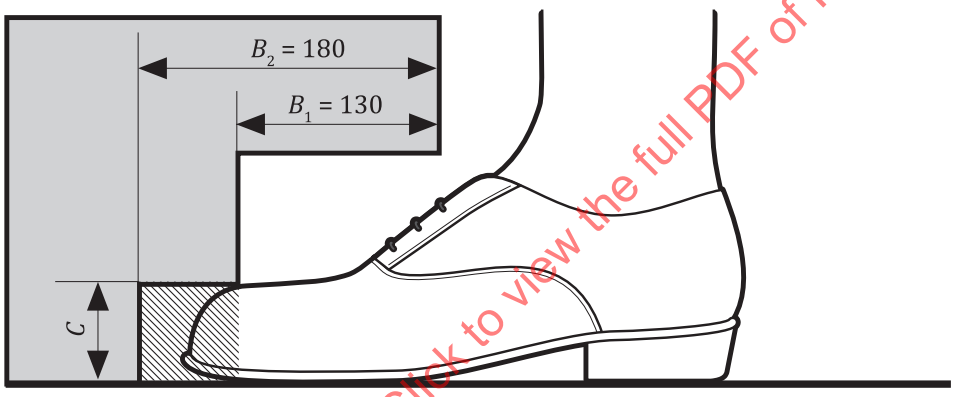


Key

A dimension only measured from the floor

B dimension measured from the outer edge of the APPH including any permanently fixed accessories

Figure 11 — Foot and toe clearance area between moving parts and the floor



Key

B_1, B_2 dimension measured from the outer edge of the APPH including any permanently fixed accessories

C dimension only measured from the floor

Figure 12 — Toe clearance area between moving parts and the floor

12 Prevention of traps for parts of the human body

12.1 Holes and clearances

Holes in and clearances between stationary parts that are accessible to the user and/or assistant during the intended use of an APPH shall be as specified in Table 4.

These measurements shall be done before and after any relevant strength, durability and impact testing.

Table 4 — Safe distances between stationary parts

To avoid	Safe distances for adults	Safe distances for children[a]
Finger traps	Less than 8 mm or more than 25 mm	Less than 5 mm or more than 12 mm
Foot traps	Less than 35 mm or more than 100 mm	Less than 25 mm or more than 45 mm
Head traps	Less than 120 mm or more than 250 mm	Less than 60 mm or more than 250 mm
Genitalia traps	Less than 8 mm or more than 75 mm	Less than 8 mm or more than 75 mm

[a] Also includes adults with a height of less than 146 cm, or a mass of less than 40 kg, or a BMI of less than 17.

If the intended purpose of an APPH cannot be met without a hazard caused by the size of holes and the clearance between stationary parts, a warning and instructions on how to operate the APPH safely shall be provided in the instructions for use.

For stationary parts that can cause a trap, manufacturers shall take into consideration those parts of the body that are at risk. The user/user group has to be specified, so that correct safety distances can be applied.

NOTE 1 An APPH intended to be used by a child can also be operated by an adult.

The design of parts that confine a hole or clearance shall take into consideration the forces that can be applied in normal use.

NOTE 2 A force might cause a hole/clearance to widen. This can then cause a failure, as specified in Table 4.

On holes with the shape of a keyhole or V-shaped openings the lower limit shall not apply. When inspecting the APPH for traps for body parts, any flexibility/elasticity of adjacent parts shall be taken into account.

The test method for measuring the gap between foot rests is specified in 16.4.2.4.

12.2 V-shaped openings

The risk of entrapment in V-shaped openings shall be assessed by the manufacturer. A V-shaped opening should be at least 75 degrees. This will reduce the risk of a user being trapped by the head at any position.

13 Folding and adjusting mechanisms

13.1 General

Folding and adjusting mechanisms may cause a hazard if parts of the body can enter a gap between parts and be trapped when the gap is closed. See Clause 11 for further requirements.

If an APPH incorporates folding and/or adjusting mechanisms it shall conform to 13.2.

If a product is able to be height adjustable the increments shall not exceed 25 mm.

13.2 Locking mechanisms

The mechanisms shall be capable of being securely locked when the APPH is in any fixed working configuration. It shall also be capable of being securely locked when folded if it constitutes a risk for the user or assistant. It shall be protected against unintended release.

14 Lifting and carrying means

14.1 General

Manufacturers should note that national or other requirements may demand test loads different to the following.

If an APPH or a part of an APPH has a mass of 10 kg or more and the intended use is for it to be portable or to be handled according to manufacturer's instuctions, it shall either:

a) have one or more carrying-handles suitably placed which enable the portable APPH or part to be carried by two or more persons, or be provided with suitable handling devices (e.g. handles, lifting eyes); or

b) the instructions for use shall indicate the points where the APPH or its part can be lifted safely and describe how they should be handled during lifting, assembly and/or carrying. If practical, the APPH or component parts shall be labelled to indicate where it can be lifted safely and/or how it can be handled during assembly and/or carrying.

14.2 Requirement

If an APPH incorporates carrying handles or grips, they shall not become detached from the APPH and there shall not be any permanent distortion, cracking or other evidence of failure when tested as specified in 14.3.

After the completion of the test the APPH shall operate as intended by the manufacturer.

14.3 Test method

If an APPH has one handle or grip, or if an APPH can readily be carried or lifted by one of a number of handles or grips, determine the force on each handle or grip when it is carried or lifted.

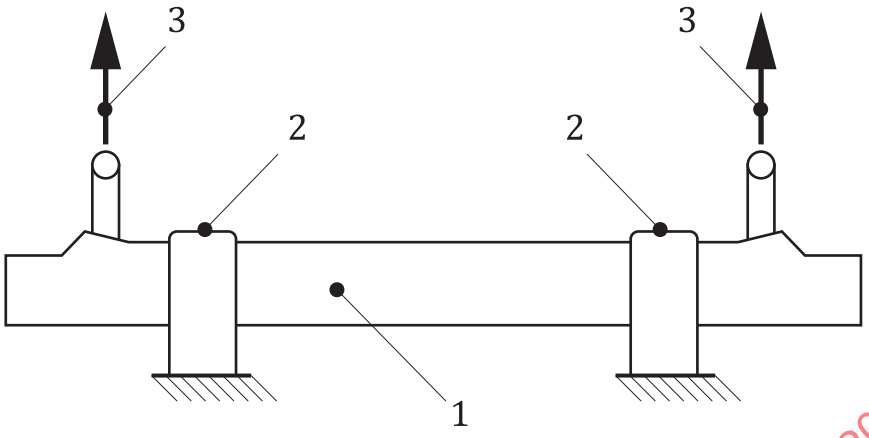
If an APPH has more than one handle or grip, determine the force on each handle or grip when the APPH is carried or lifted in the intended manner.

On each handle or grip determine the force necessary to carry the APPH in the intended manner with a tolerance of $\pm\frac{5\%}{0\%}$. If there is more than one intended manner determine the highest force.

Restrain the APPH from being lifted or moved during the following test. Apply a force to each handle or grip, equal to twice that determined above with a tolerance of $\pm\frac{5\%}{0\%}$, uniformly distributed over a 70 mm ± 5 mm length in the centre of the handle or grip, avoiding shock (see Figure 13).

Maintain the force for between 60 s and 70 s.

Remove the force and the restraints and inspect the APPH for damage and satisfactory operation.



Key

1	APPH
2	restraints
3	test force

Figure 13 — Carrying handle test (example)

15 Portable and hand-held products for personal hygiene or hand-held parts

A portable or hand-held APPH, or any one of its parts that is portable or hand-held during intended use, shall withstand the stresses caused by a free-fall from the height indicated in Table 5 on to a hard surface.

Table 5 — Drop height

Mass (*m*) of portable APPH or its parts kg	Drop height cm
$m \leq 0{,}2$	100
$0{,}2 < m \leq 1$	20
$1 < m \leq 10$	5
$10 < m \leq 50$	3
$m > 50$	2

Compliance is checked by the following test.

To avoid dropping and to have an ergonomic grip the hand-held APPH shall be assessed for grip, mass, size and shape. After the test, the product shall be inspected for any damage, which results in an unacceptable risk or loss of function. Any such damage constitutes a failure.

The sample to be tested is lifted to a height as indicated in Table 5 above the test plane (4.8.7) positioned horizontally. The sample is dropped three times from each orientation in which it may be placed during the intended use.

Hand-held control devices for a powered APPH shall be capable of withstanding being dropped 1 000 times on to a hard surface from a height of 100 cm without damage and still function normally.

Manufacturers should consider the suitability of the appropriate tests in IEC 60068-2-31:2008.

16 Static strength, impact and durability

16.1 General

Static strength, durability and impact are critical tests for a safe product. The formulae for calculating the forces in the different tests are dealt with in 16.2. Each subclause starts with its own requirements followed by test methods.

16.2 Formulae

16.2.1 Formulae for calculating forces

The formulae in Table 6 shall be used to calculate the force, *F*, in the test methods within this International Standard.

Table 6 — Formulae for calculating forces

Test	Formula	Maximum force (calculation based on m_d 130 kg)
Static strength on a seat surface	$F=m\times g\times S$	
Static strength of a lying support surface	$F=m\times g\times S$	
Durability of seat surface	$F=m_d\times g$	
Static strength of back support	$F=0,5\times m\times g$	
Static strength on arm support downward[a]	$F=\frac{m_d\times g\times S}{2\times\cos 15^\circ}$	950 N
Durability of the arm support downward[a]	$F=\frac{m_d\times g}{2\times\cos 15^\circ}$	635 N
Static strength on foot support downward[a]	$F=m_d\times g$	1200 N
Static strength on foot support remaining gap	$F=0,125\times m_d\times g$	200 N

where

m_d is maximum user mass in kg

m is the maximum load (maximum user mass in kg, plus any additional load where applicable)

S is the safety factor equal to 1,5

F is the force to be applied in Newton

g is the gravitational constant = 9,807 m/s2.

[a] The result of the calculation or the maximum force, whichever is lower.

16.3 Number of test cycles for durability

The number of test cycles to which a product is tested depends on the intended environment and shall be calculated according to the following formula.

$$n_{TC} = u_{UC} \times u_{TD} \times 365 \times t_{DL}$$

where

n_{TC} number of test cycles

u_{UC} uses per user cycle

u_{TD} typical uses per day

t_{DL} designed life time, in years

Expected life time shall be a minimum of three years. If the expected life time is less, it shall be stated in the instructions for use and also in the label.

Minimum values for the factors on the environment of intended use. The minimum values as specified in Tables 7 and 8 shall be used.

The intended life time shall be indicated by the manufacturer.

The manufacturer shall indicate in the instructions for use the intended life time and the environment(s) of intended use.

Table 7 — u_{uc} for different functions

Arm support	2
Seat support	1
Lying support	1
Grab support	1
Foot support	1
Brakes	2

Table 8 — u_{td} for different environments

Activity type	Home care	Institutions	Public use
Toilet activity	5	10	10
Shower/bath activity	2	10	5

16.4 Static strength of lying support, arm and foot supports and seat and back surfaces

16.4.1 Requirements

During and after the static strength tests in 16.4.2 no parts of the APPH shall:

— become unstable;

— exhibit any cracking;

— have any loose connections;

— have visible deformations or gaps disturbing the function;

— become detached.

Further depending on the APPH:

— there shall be no permanent tilt;

— all adjustable parts shall function as intended;

— the deflection of an arm support during test shall not disturb the function in relation to transfer;

— the foot support shall either have means to prevent the feet from sliding into the gap between them, or have a gap that is less than stated in Table 4;

— the foot support is allowed to deflect all the way down to the floor during test (after the test the remaining deflection shall not exceed 10 mm);

— if an APPH is intended to be folded for transport and/or storage, it shall not fold unintentionally;

— after the test, the APPH shall operate as intended by the manufacturer.

All pass/fail critera shall be fulfilled after or during the test, whenever it occurs.

16.4.2 Test methods

16.4.2.1 Static strength of a lying support surface

The tests shall be performed on a horizontal surface with the load applied for 20 minutes.

If there are any brakes, they shall be activated.

The APPH shall be kept stable during the whole test.

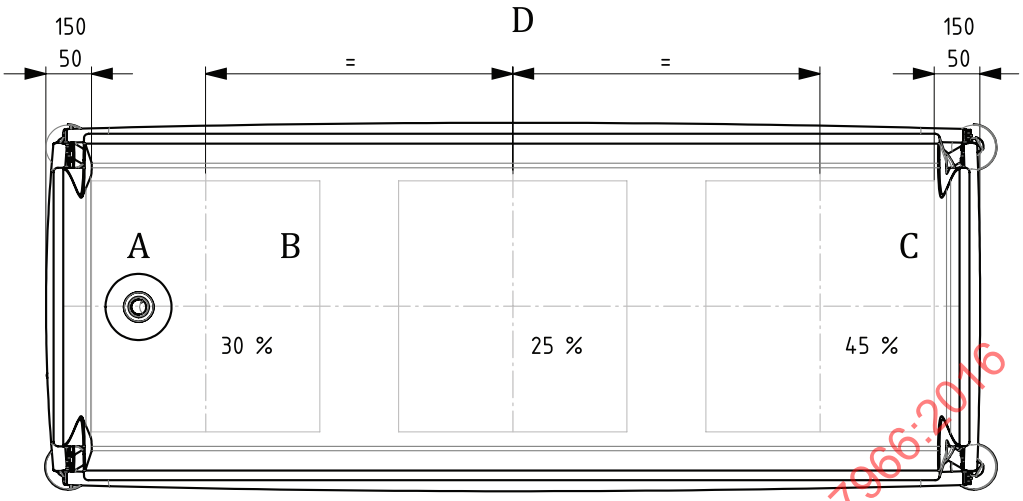
First test. Attach the load according to Table 6 to the lying support surface, distributed according to Figure 14.

Second test. This test(s) shall be performed on the most critical part of the surface where it is possible for the user to put the maximum load while transferring according to Figure 15. If it is possible to transfer both at the ends and along the side of the lying support surface, each test shall be performed separately.

Remove the test load and inspect the APPH for damage.

NOTE The lying support surface includes products within 09 33 12 and 18 15 06.

Dimensions in millimetres



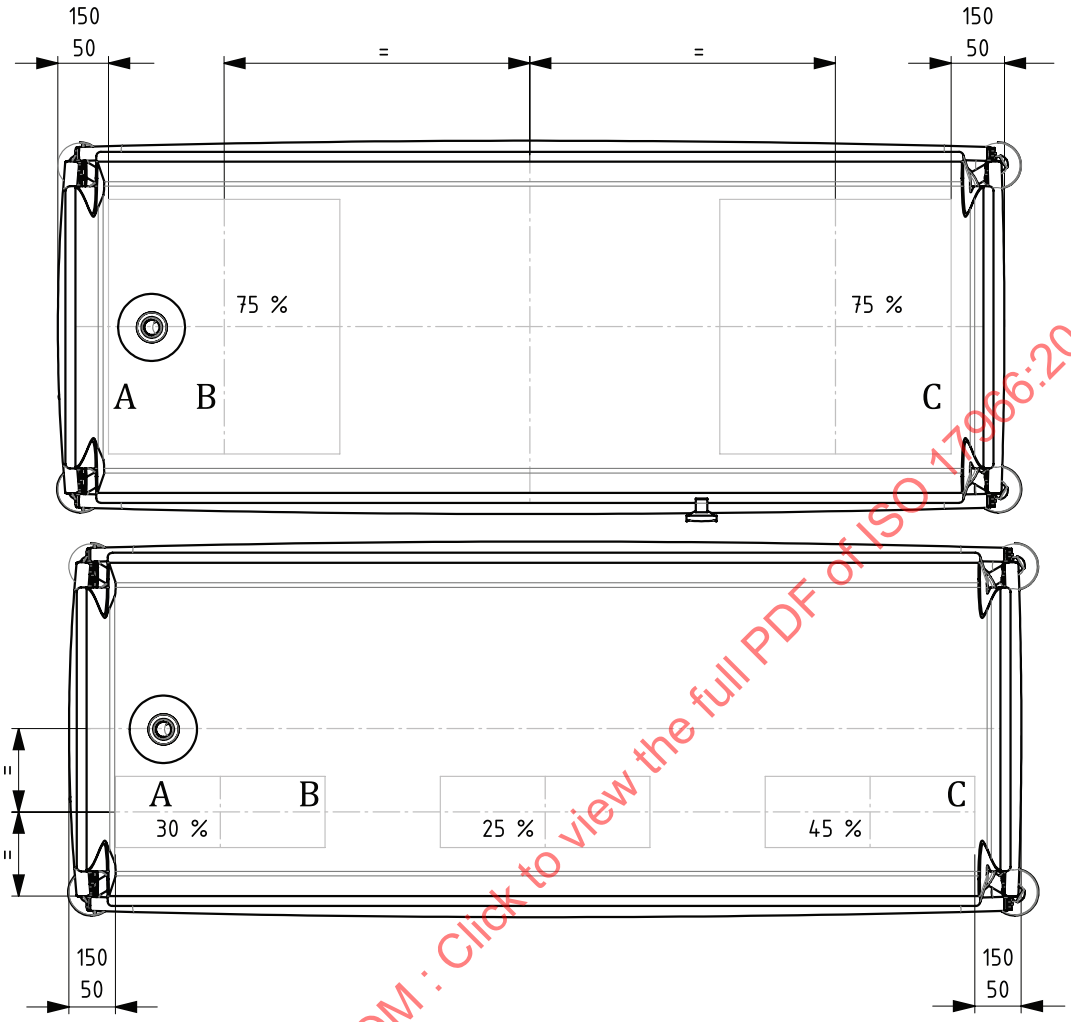
Key

A	drain
B	foot
C	head
D	centre line

NOTE Values shown are percentages of maximum load.

Figure 14 — Placing of loads on a lying support surface

Dimensions in millimetres



Key

A drain
B foot
C head

NOTE Values shown are percentages of maximum load.

Figure 15 — Placing of load on a lying support surface — Maximum load transfer

16.4.2.2 Static strength of an arm support downwards

Calculate downward force to be applied to an arm support using the formulae in Table 6.

Each arm support is loaded for a minimum of 60 s in a point 50 mm from the front edge.

With the APPH standing on the horizontal test plane, attach the maximum load determined by the formula or any greater load specified by the manufacturer, so that its line of action intersects the support surface of the arm support as shown in Figure 18 and 19 using a loading pad selected as specified in 4.8.12.1 and 4.8.12.2.

NOTE Figure 18 shows the configuration of the loading equipment at the start of the test. This configuration will change as the test deflects the arm support.

Before commencing the test set-up, the means to prevent the assistive product from tipping and the means to prevent the assistive product from moving backwards and forwards are applied.

If there are two arm supports half the load shall be applied to each of the arm supports simultaneously or one at a time individually.

Slowly increase the load until the force F1 reaches the value specified in the formula or the greater value specified by the manufacturer.

16.4.2.3 Static strength of seat and back support

Set up the APPH according to manufacturer's instructions.

The APPH shall be secured so that it does not move during testing in a way that does not affect the test.

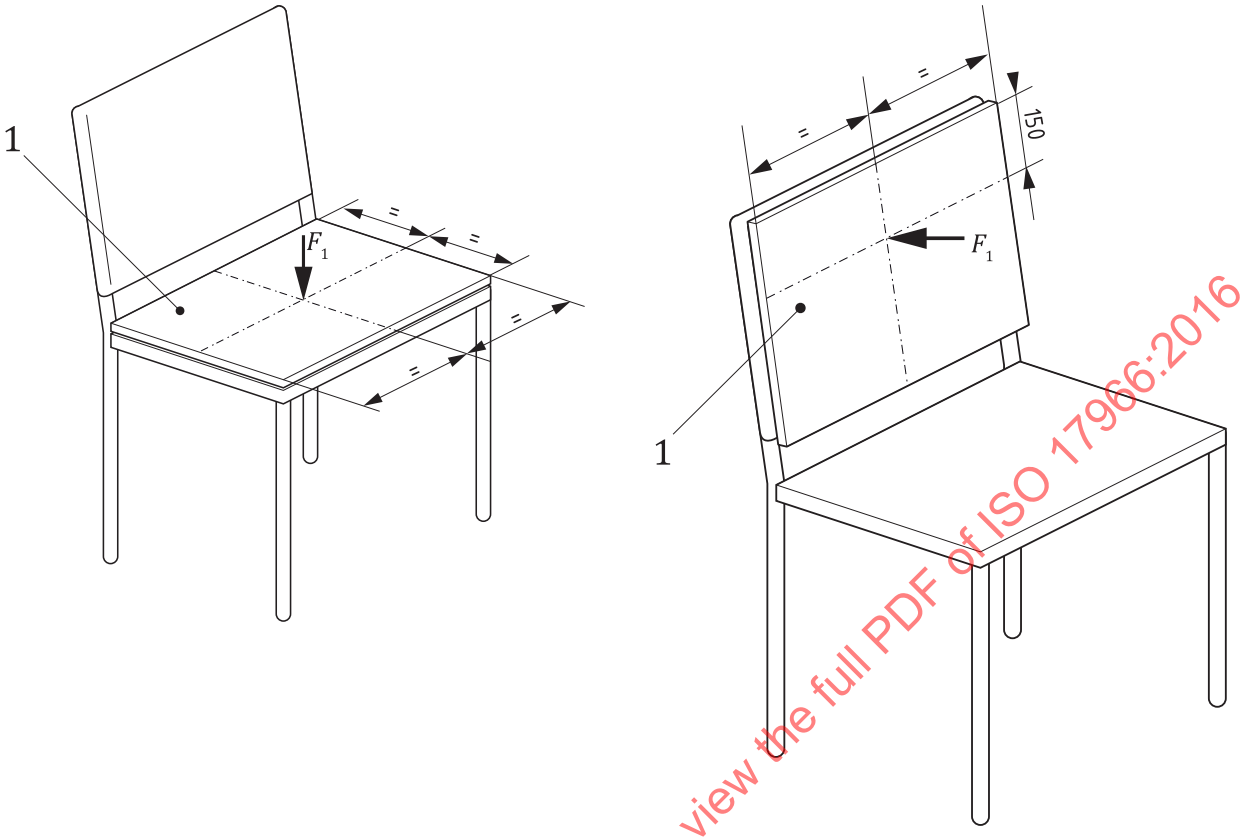
For the static strength test of the seat, apply the maximum load (F_1) according to Table 6, using a loading pad as specified in 4.8.12.4 for 20 min to the part of the APPHs seat support surface according to Figure 16.

If the APPH has a seat lid, the load shall be placed on the upper surface of the lid due to foreseeable misuse.

For the static strength test of the back support, apply the maximum load (F_2) according to Table 6, using a loading pad as specified in 4.8.12.3 for 20 min to the part of the APPH's back support surface according to Figure 16. If there are any brakes, they shall be activated and the APPH shall not be able to tilt during the test.

The test shall be done with the back support in the most adverse position if it has an adjustable recline function.

Dimensions in millimetres



Key

1 loading pad

Figure 16 — Placing of load on seat/back support surface

16.4.2.4 Static strength of foot supports

Before commencing the test set-up, the means to prevent the APPH from tipping and the means to prevent the APPH from moving backward and forward are applied.

Calculate downward forces to be applied to the foot support using the formulae in Table 6. With the APPH standing on the horizontal test plane, apply the forces (F) determined by Table 6, "Static force on foot support downward" and "Static force on foot support remaining gap", or any greater force specified by the manufacturer, at the foot support locations illustrated in Figure 17.

Use a convex loading pad (see Figure 3) to apply the load on flat foot supports and foot supports consisting of two or more tubes and use a concave cylindrical loading pad (see Figure 2) on foot supports consisting of a single tube.

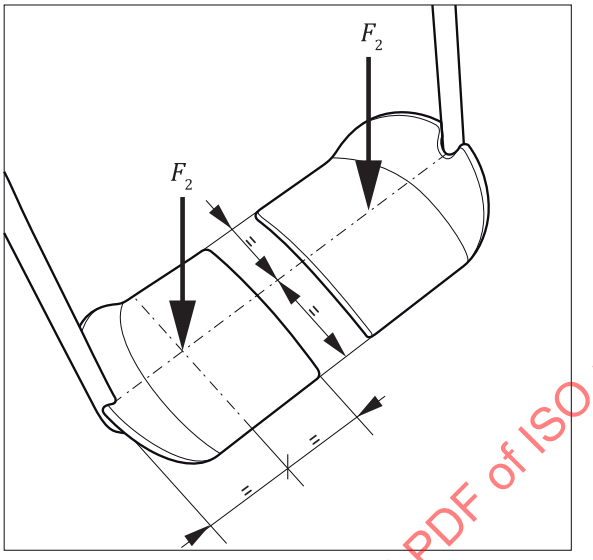
NOTE In some cases where it can be done without weakening the foot support, it may be necessary to drill a hole in the foot plate to secure the loading actuator.

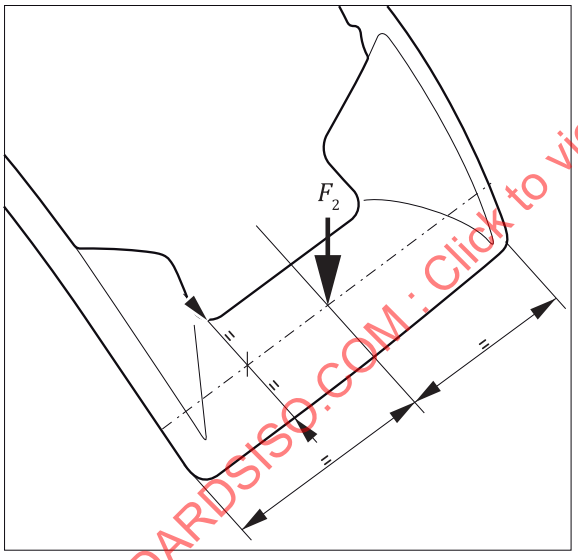
If the foot support is height adjustable it shall be positioned in the most adverse position of intended use.

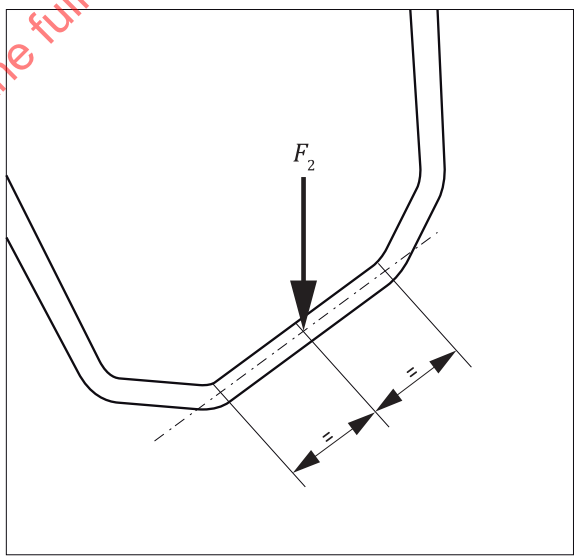
If tubular foot supports or other constructions are used which do not have a flat foot support surface, apply the force at an angle of 25° ± 5° to the vertical inclined towards the seat.

If foot supports are of an open construction so that a standard loading pad cannot transmit load to the structure, fit a suitable rigid plate to the foot support so that load is carried by the parts of the foot support nearest to the loading point.

If two separate foot supports are used apply half of the load to each foot support in turns.







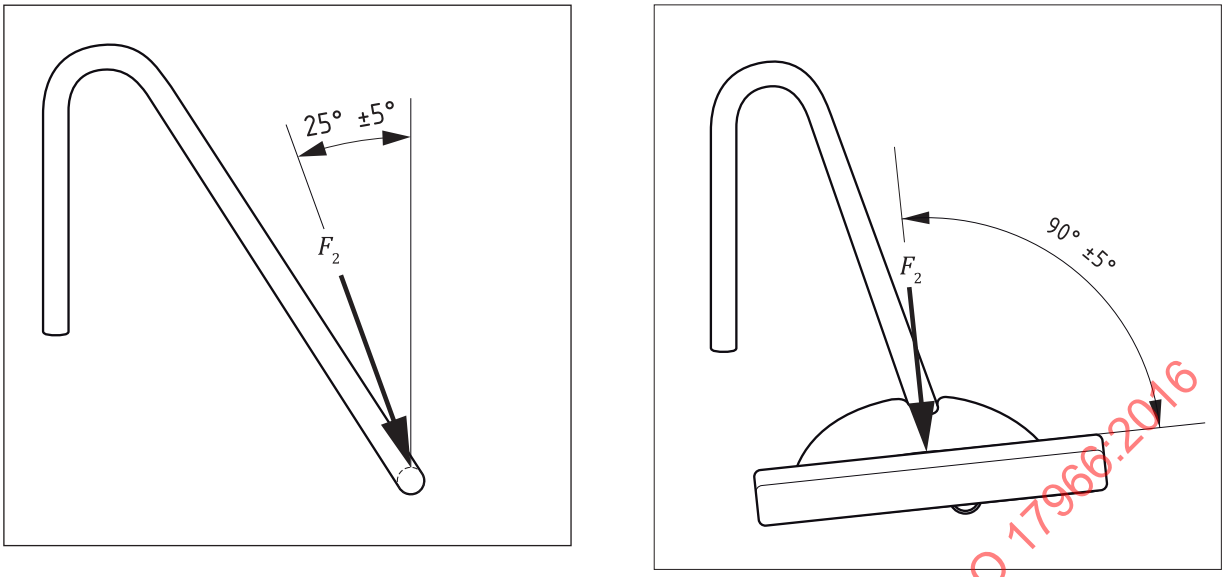


Figure 17 — Location of foot support load

Slowly increase the load until the force F_2 reaches the value specified in the formula in Table 6 or the greater force specified by the manufacturer. Maintain the load for a period of between 5 s and 10 s.

Remove the load.

16.5 Durability

16.5.1 Requirements

During and after the durability tests in 16.5.2 no parts of the APPH shall:

— become unstable;

— exhibit any cracking;

— have any loose connections;

— have visible deformations or gaps disturbing the function;

— become detached.

Further, depending on the APPH:

— there shall be no permanent tilt;

— all adjustable parts shall function as intended;

— the deflection of an arm support during test shall not disturb the function in relation to transfer;

— the foot support shall either have means to prevent the feet from sliding into the gap between them, or have a gap that is smaller than stated in Table 4;

— the foot support is allowed to deflect all the way down to the floor during test (after the test the remaining deflection shall not exceed 10 mm);

— if an APPH is intended to be folded for transport and/or storage, it shall not fold unintentionally (after the test, the APPH shall operate as intended by the manufacturer).

All pass/fail critera shall be fulfilled after or during the test, whenever it does occur.

During the test, the following conditions apply.

1) Readjustment of postural supports is allowed.

2) Retightening, readjusting or refitting of components that are identified in the manufacturer's instructions for use as operator-adjustable components is allowed. Components identified as operator adjustable may require the use of tools, if the tools are provided with the assistive product. If there are operator adjustable components, durability test equipment may be stopped at 25% plus or minus 5% intervals, for inspection of operator-adjustable components to determine if retightening, readjusting or refitting of operator-adjustable components is required. Retightening, readjusting or refitting shall then be performed, following the procedures outlined in the instructions for use for the APPH. Continue durability testing after retightening, readjusting or refitting has been performed.

3) Retightening, readjusting or refitting of any other component is not allowed.

4) During the durability testing, replacement of normal wear items is allowed in accordance with manufacturer's instructions.

5) For electrically operated APPHs, the duty cycle shall be declared by the manufacturer.

16.5.2 Test methods

Apply the maximum load intended by the manufacturer (including any accessories) to the support surface in the most adverse position, in a manner that ensures that there is negligible dynamic loading. The test cycle shall be calculated as specified in 16.3 (see Tables 7 and 8) regarding the intended area of use and specified life time of the product, unless otherwise determined in this International Standard.

The APPH shall be prevented from slipping or moving by means of a stopper.

16.5.2.1 Durability of the arm support

With the APPH standing on the horizontal test plane, apply the force ± 3 % determined by the formula in Table 6, or any greater force specified by the manufacturer, so that its line of action intersects the support surface of the arm support as shown in Figure 18 and 19 using the concave loading pad selected as specified in 4.8.12.1.

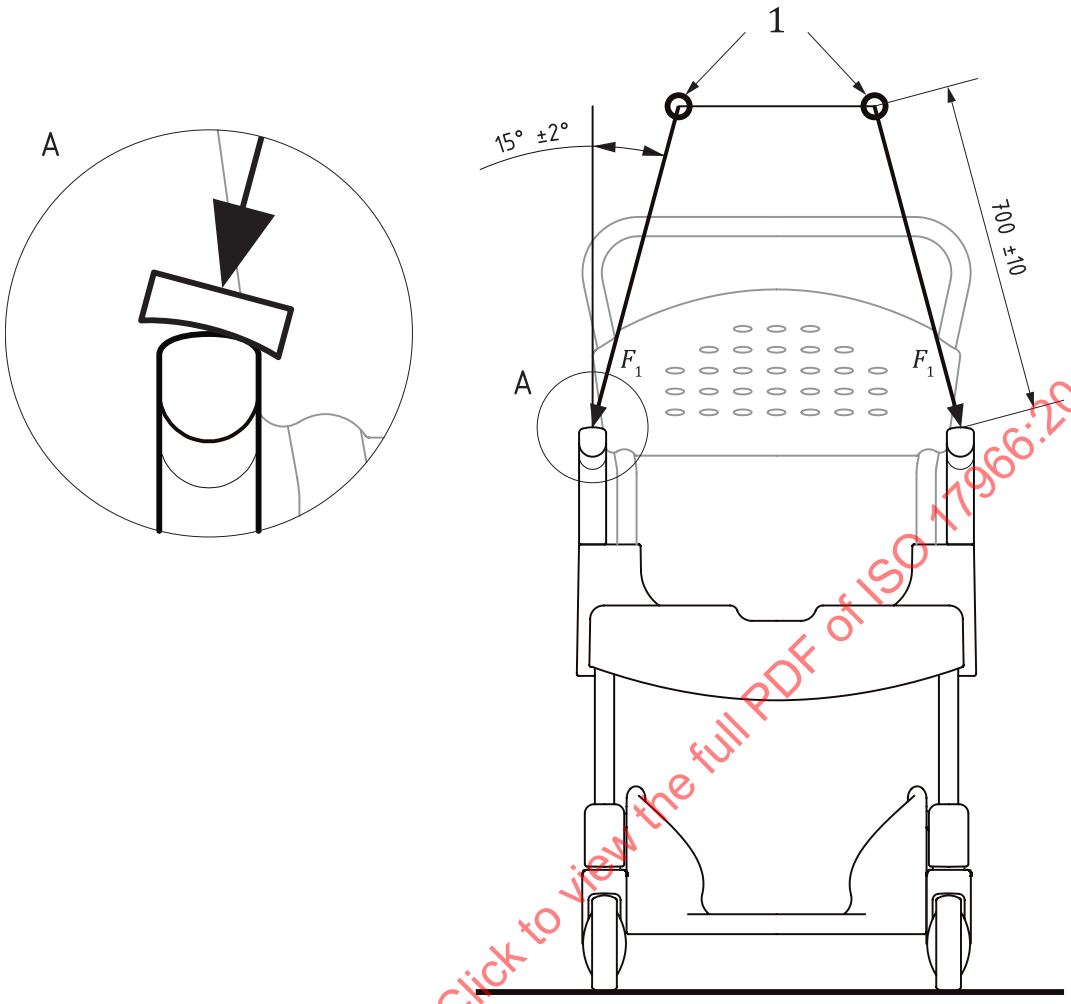
NOTE Figure 17 shows the configuration of the loading equipment at the start of the test. This configuration will change as the test deforms the arm support.

The cyclical application of the load may be applied to both arm supports simultaneously or one at a time. The cycling shall be done in a smooth manner.

Slowly increase the load until the force F1 reaches the value specified in formula in Table 6, or the greater value specified by the manufacturer. The cycling shall be less than 20 cycles per minute.

After the test remove the load.

Dimensions in millimetres



Key

1 pivots for load application

Figure 18 — Downward forces on arm supports: Front view

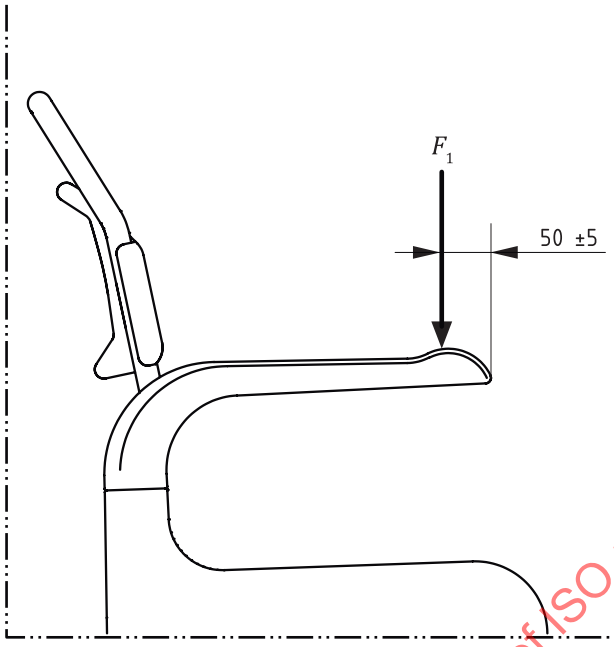


Figure 19 — Downward forces on arm supports: Side view

16.5.2.2 Durability of seat surface

The APPH shall be positioned horizontally on the test plane.

Apply the load as specified in Table 6 vertically to the seat surface, according to Figure 16.

Use a suitable loading pad (see 4.8.12.4) to apply the load.

A test dummy according to ISO 7176-11 may also be used.

The number of cycles shall be calculated as specified in the formula in 16.3 and in Table 7 and Table 8 regarding the intended area of use.

After the test remove the load.

16.5.2.3 Durability of a power operated height adjustment mechanism

Place the APPH in its lowest position horizontally on the test plane. Apply the maximum load distributed as indicated in Figure 14 for a lying support surface or 16.4.2.3 (Figure 16) for a sitting surface. A test dummy according to ISO 7176-11 may also be used.

The APPH is raised and lowered completely in accordance with the procedure stated in the instructions for use. The number of test cycles shall be calculated as specified in the formula in 16.3 and Table 7 and Table 8 regarding the intended area of use.

After the test remove the load.

16.5.2.4 Durability of power operated movable sections

The APPH shall be positioned horizontally on the test plane.

Apply the maximum load distributed as indicated in Figure 14 for lying support surface or 16.4.2.3 (Figure 16) for a sitting surface on the movable section. A test dummy according to ISO 7176-11 may also be used.

Each of the movable sections is operated through their full range of travel as in normal use.

The number of test cycles shall be as specified in the formula and Table 7 and Table 8 in 16.3 regarding the intended area of use.

Inspect the product 5 min after cycling is completed.

After application of the load, no elements of the product shall become loose, fractured or present any hazard. Deformation of more than 10 mm (after removal of the load) from the corresponding measurements taken before the application of the load is not acceptable.

16.5.2.5 Durability of the frame of an APPH with a sitting surface equipped with legs/wheels

This test method is not intended for fixed products.

The APPH shall be positioned horizontally on the test plane.

Set the wheels/legs according to Figure 20, against the stopper.

For hydraulic, mechanical, electrical or any other adjustable APPH, the test has to be performed so that any movement of the adjusting system does not interfere with the test result.

The seat is loaded with 80% of the maximum load in a box, when tilted in the forward and backwards directions.

The seat is loaded with 40% of the maximum load in a box when tilted in sideways directions.

The box (350 mm wide, 350 mm deep and 300 mm high) shall be fastened at the centre of the seat and secured against sliding.

A test dummy according to ISO 7176-11 may also be used.

The number of cycles shall be as specified in Table 7 and Table 8 in 16.3 regarding the intended area of use. It shall not exceed 10 000 times in each direction.

The force is applied perpendicular to the box.

The APPH is tilted at the box (see Figure 20) until two legs have lifted by 30 mm. Afterwards the chair drops freely back onto the test plane (4.8.7). Test 1 is in the backwards direction, test 2 in the forwards

direction and tests 3 and 4 in the two sideways directions. Each test is performed separately with the full number of cycles before the next test is started.

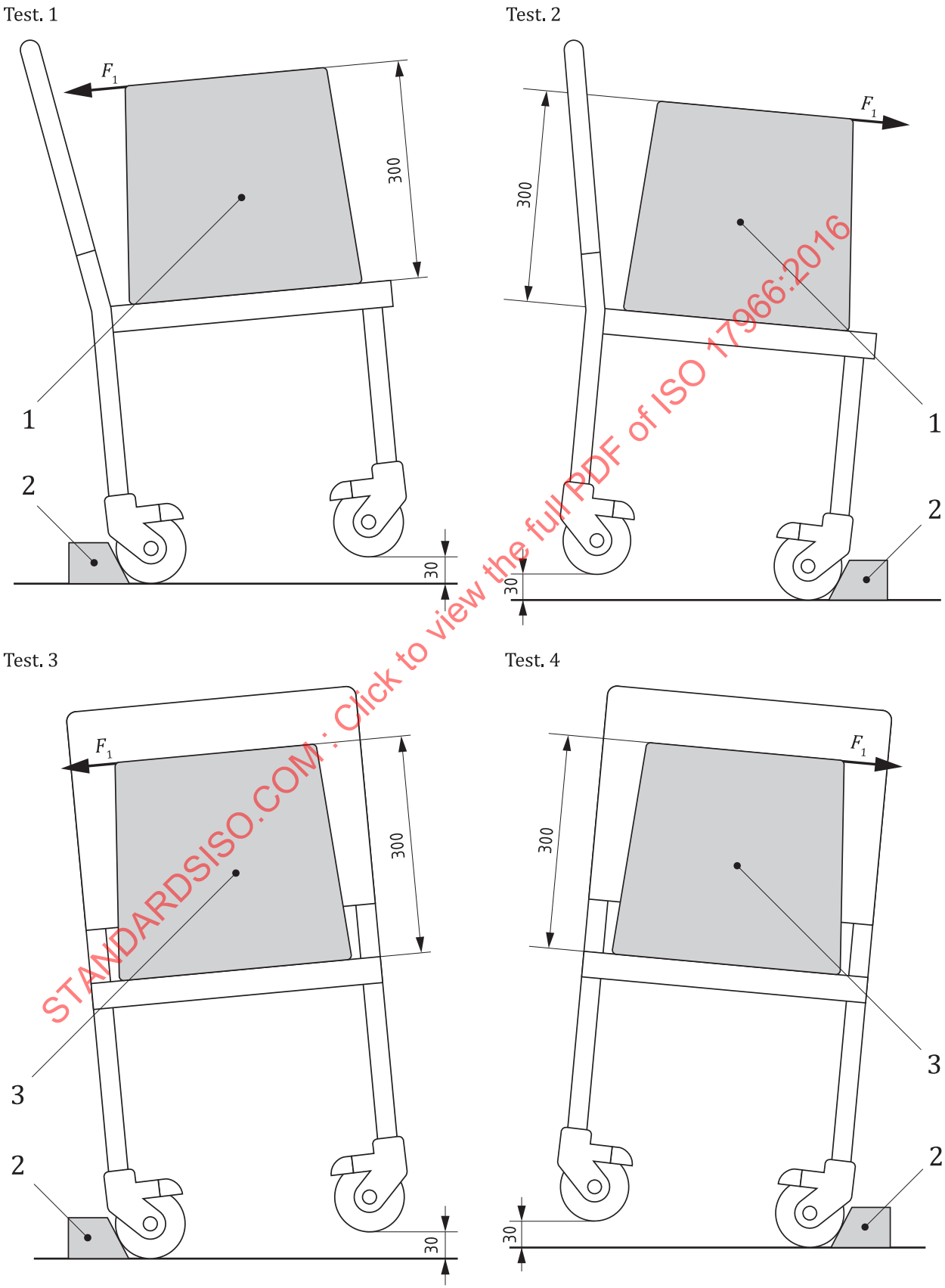


Figure 20 — Durability test for frame of APPH

16.6 Impact

16.6.1 Requirements

After performing the tests in 16.6.2 the following requirements shall be fulfilled.

a) No component shall be fractured or have become detached, with the following exceptions:

— readjustment of postural supports is allowed;

— retightening, readjusting or refitting of components that are identified in the manufacturer's instructions for use as operator-adjustable components is allowed; components identified as operator adjustable may require the use of tools, which shall be provided with the assistive product;

— retightening, readjusting or refitting of any other component is not allowed.

b) Cracks in surface finishes, such as paint, that do not extend into the structural material do not constitute a failure.

c) No externally visible electrical cable shall be abraded or crushed. No externally visible electrical connector shall be crushed or disconnected.

d) All parts intended to be removable, folding or adjustable shall operate as described by the manufacturer.

e) All power-operated systems shall operate as described by the manufacturer.

f) No elements of the APPH shall become loose, fractured or present any hazard.

g) Handgrips shall not be displaced.

h) No component or assembly of parts shall exhibit deformation, free play or loss of adjustment that adversely affects the function of the APPH.

16.6.2 Test methods

16.6.2.1 Test method for a back support

This test applies to products where the back support height is 320 mm or greater above the seat.

The measurement of the 320 mm is taken from the upper surface of the seat base at an angle of 90 ° from the centre of the seat.

For back supports that have a pivot that allows them to align freely with the back of the user as shown in Figure 21, position the back support impact test pendulum (see 4.8.13) with the bar vertical so that the mass is touching the back support on a horizontal line passing through the back support pivot.

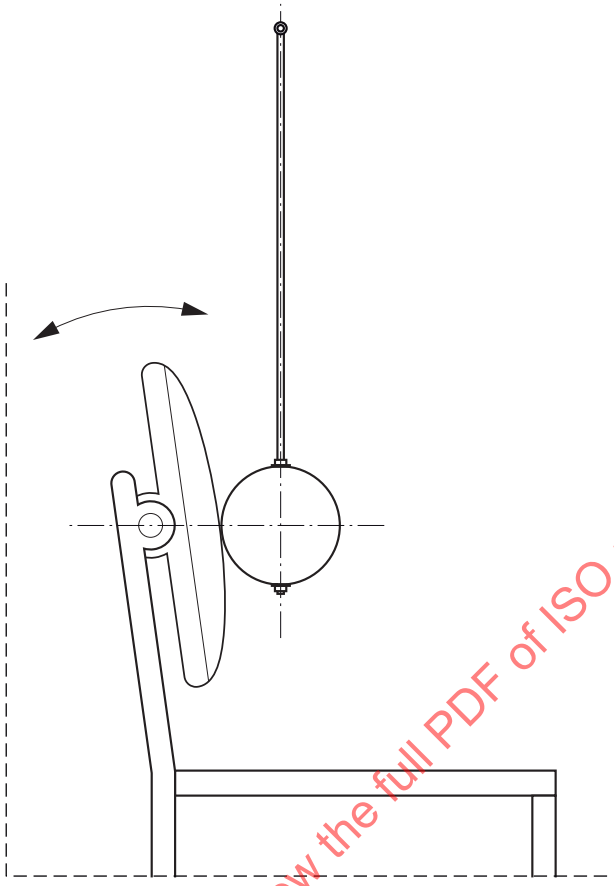


Figure 21 — Pivoted back support impact test

For products with other types of back supports, position the impact test pendulum with the bar vertical so that the mass is touching the centre line of the back support at a point 30 mm below the top of the back support as shown in Figure 22.

Apply the brakes (if any).

Position a rigid stopper (see 4.8.8) against the rear wheels/legs of the product and attach a loose restraint that is just long enough to prevent the APPH from tipping backwards beyond the balance point. Support the pendulum so that the rigid bar is at an angle of 30° ± 2° to the vertical as shown in Figure 22, and then allow it to fall freely one time and strike the back support.

If the manufacturer claims that the product exceeds the minimum requirements, use the angle claimed by the manufacturer ± 2° for the test.

If the back support is height adjustable the test shall be performed in worst case position.

For products where the back support is mounted on two supporting members repeat the test twice with the pendulum repositioned so that it strikes the centre line of each back support 20 mm below the top of the back support.

For products where the back support is mounted on a single central support repeat the test with the pendulum positioned to strike the back support at points located 0,4 times the back support maximum width from each side of its centre line.

Dimensions in millimetres

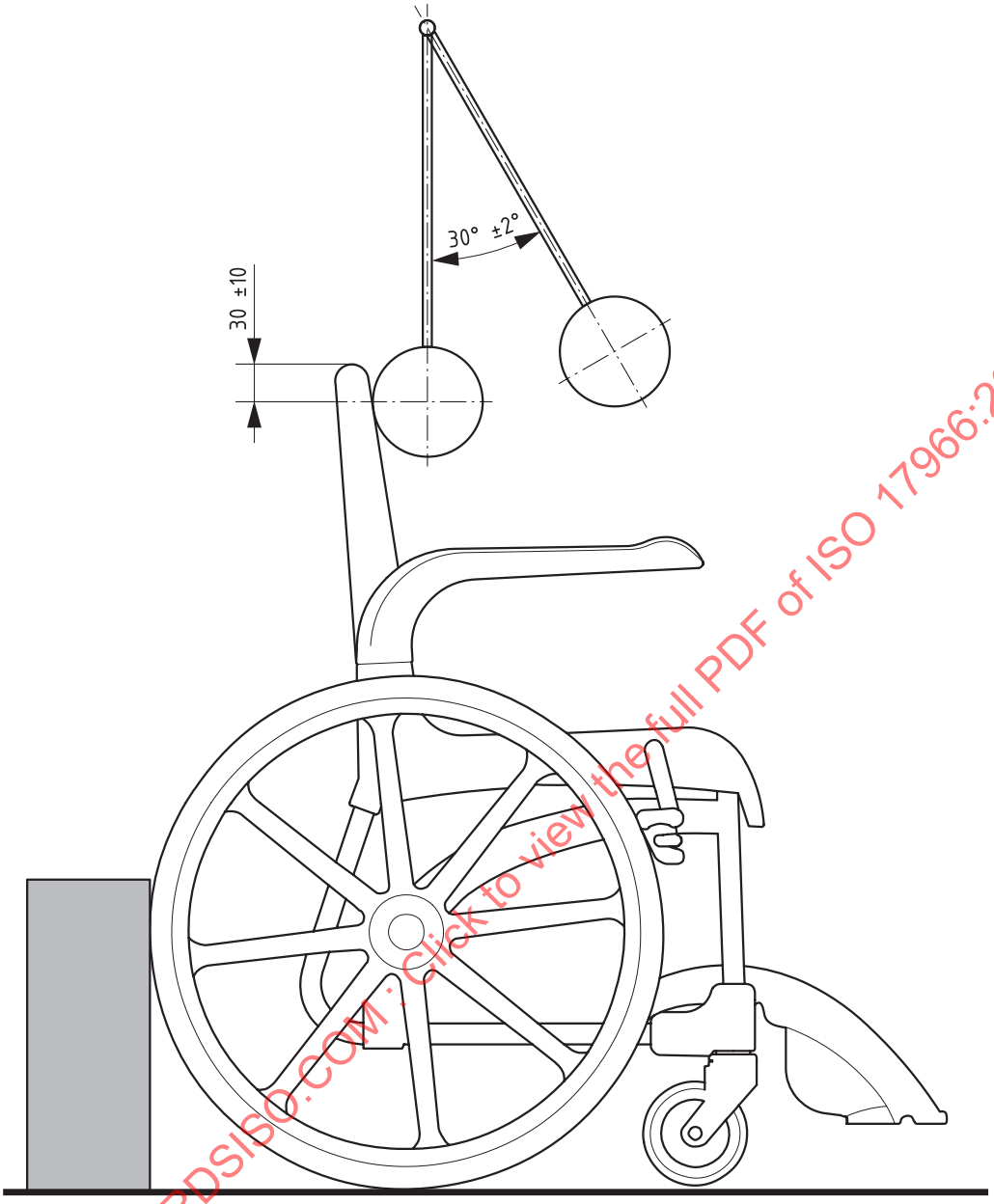


Figure 22 — Back support impact test

16.6.2.2 Test method for a lying support surface

The following tests shall be performed in the sequence in which they are listed.

Dimensions in millimetres

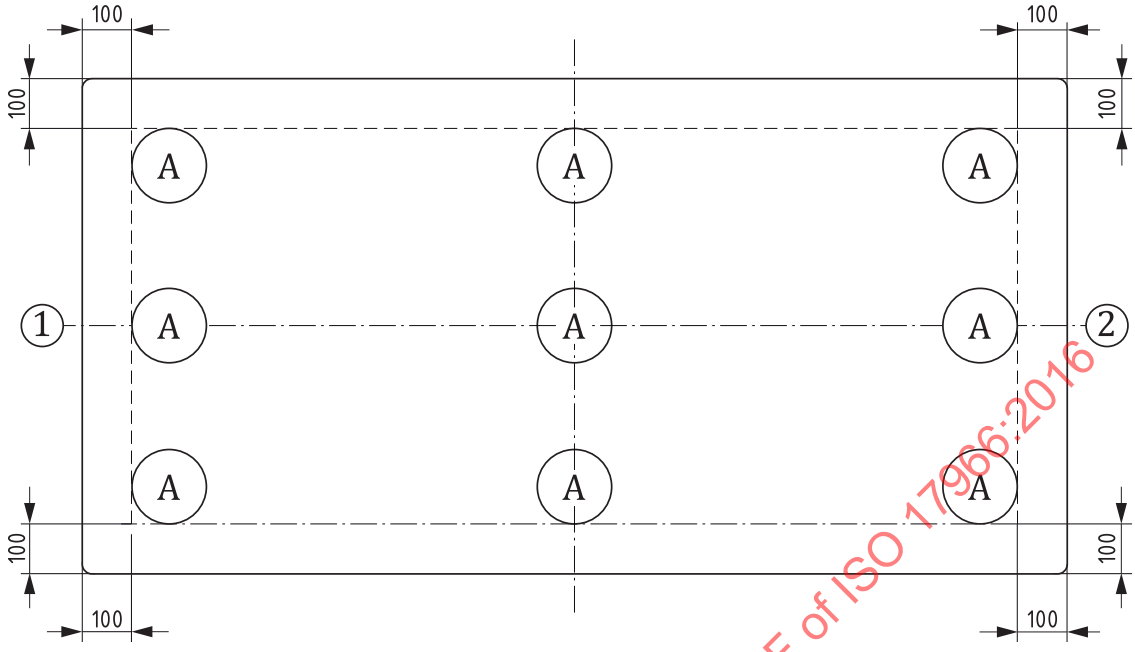


Figure 23 — Impact test of a lying support surface

Place the mattress, if any, as specified by the manufacturer, onto the lying support surface, in a position in which any moving elements are free of supporting elements and their inclination is less than 7° in relation to horizontal, and if height-adjustable, the lying support surface shall be placed in the middle of the possible range of the adjustment.

From a height of 180 mm above the mattress/lying support surface, drop the impactor (4.8.16) onto the APPH 20 times onto each of the locations marked "A" in Figure 23. The impactor shall be allowed to fall freely, but guides may be used to help ensure that the impacts occur as close as possible to the recommended locations.

17 Stability

17.1 Requirements for static stability

During the stability test according to 17.2, a mobile and static APPH loaded with the maximum load shall not lose its equilibrium (balance) at a 10° angle forward and backwards, and at a 5° angle sideways.

17.2 Test method for static stability

The tests shall be carried out in the forward, backward and sideward directions as specified by the manufacturer on the inclined test plane (4.8.7) according to the required angle for each test. If for mobile APPHs, there is more than one intended direction of travel (forwards) they shall all be regarded as forwards. For mobile APPHs, the base is positioned in the travelling position as indicated by the manufacturer.

The APPH shall be secured against slipping on the inclined surface by the means of stoppers (see 4.8.8 and Figure 1).

Apply the maximum load distributed as indicated in Figure 14 for APPHs with a lying support surface. For APPHs with a sitting surface the centre of gravity of the load shall be placed according to Figure 16, force F_1, but not more than 350 mm from the front edge of the seat.

A test dummy according to ISO 7176-11 may also be used.

For an APPH with a lying support surface the tests are repeated on a horizontal surface with loads distributed as indicated in Figure 15 both at the ends and at the sides, one test at a time. The tests shall be carried out with the APPH in its most adverse position regarding the position of wheels, support surface, base and brakes, if applicable.

NOTE It is necessary to assess the risks associated with the APPH when intended to be used on a wet and/or a soapy floor.

18 Surfaces, corners, edges and protruding parts

If not required for the intended function of an APPH, all accessible edges, corners and surfaces shall be smooth and be free from burrs and sharp edges.

If not required for the intended function, an APPH shall not have any protruding parts. Where possible necessary protruding parts shall have protection to prevent injury and/or damage.

NOTE For guidance, see B.18.

19 Small parts

APPHs and their parts intended to be used by small children shall not be of a size where they can create a danger of small children being choked.

Regarding APPHs for children, any part that can be detached without the use of a tool should not fit wholly within the cylinder as specified in EN 716-2:2008, subclause 5.4.

NOTE Small children are considered to be under the age of 5.

20 Forces in soft tissues of the human body

The hazards that can be caused by forces applied to the soft tissues of the body shall be assessed in the risk analysis (see 4.1).

NOTE For guidance, see B.20.

21 Ergonomic principles

An APPH may be used not only by whom it is primarily intended for, but also by an assistant. The ergonomic principles set out in EN 614-1 shall apply to all involved persons.

Grips, handles and pedals shall suit the functional anatomy of the operator, according to the intended use and meet the following requirements (where applicable, the APPH shall be loaded with the maximum load):

a) the surface of buttons shall at least cover a circle of 15 mm in diameter; any distance between buttons shall be more than 10 mm;

NOTE 1 The buttons may have any shape, e.g. they need not be circular.

b) the distance between any handle (part intended to be grabbed) requiring an operating force of more than 10 N and any construction part of the APPH shall not be less than 35 mm;

c) the distance between any upper surface of a pedal (in any operating position) and any other part of the APPH shall have a vertical toe clearance of not less than 75 mm;

d) the diameter of any operating handles and/or knobs requiring an operating force of more than 10 N shall be between 19 mm and 43 mm;

NOTE 2 The handles and knobs can be of any shape.

e) for an APPH operated from a standing position, pedals shall be placed not more than 300 mm above the surface of the floor;

f) for an APPH operated from a standing position, hand operated controls shall be placed at a height of 800 mm to 1 200 mm above the surface of the floor;

g) for an APPH operated from a sitting position, controls intended to be operated by the occupant while seated shall be within the occupant's reach space;

NOTE 3 Regarding e), f) and g), other operating controls may need other positions depending on the use of the APPH.

h) the operating forces or torques required for those parts of the device that are designed to be operated by fingers, hands/arms or feet shall not exceed the values in Table 9.

Table 9 — Operating forces

Operation	Force/torque
operation by using a finger	5 N
operation by using a hand/arm	60 N
operation by using a foot	300 N
operation by turning	1,9 Nm
rotation of seat surface	60 N

22 Mobile APPHs

22.1 General

This clause specifies requirements and test methods for mobile APPHs which are additional to those specified in Clauses 4 to 21.

The requirements and test methods apply to APPHs provided with wheels or other means for transporting an occupant in place within the following examples of divisions of ISO 9999:2011 (in brackets):

— commode chairs (09 12 03);

— bath/shower chairs, bath boards, stools, back supports and seats (09 33 03);

— bathing stretchers, shower tables and diaper-changing tables (09 33 12).

22.2 Immobilizing means

22.2.1 General

A mobile APPH or any of its parts that could constitute a risk for the user or a nearby person shall be fitted with immobilizing means to prevent any undesired movement.

22.2.2 Requirements for locking devices

Mobile APPH shall not result in an unacceptable risk due to unwanted movement when tested in accordance with 22.2.3 and 22.2.4. When the product has come to a total standstill, there shall be no movement of the mobile APPH greater than 50 mm (in relation to the inclined plane) within 1 min.

22.2.3 Test methods for locking devices

Prior to the test, the mobile APPH is prepared with the following in the most adverse position of normal use:

— the height and length;

— castors/wheels.

The mobile APPH is placed with the maximum load in place distributed as indicated in Figures 14, and 16 and the locking device (e.g. brakes) activated, on a test plane (4.8.7) inclined to 6° from horizontal. Any initial movement shall not result in an unacceptable risk, taking into account the normal use of the APPH.

Adjust the locking device (e.g. brakes) in accordance with the manufacturer's instructions for use without exceeding the operating force requirements stated in Table 9.

22.2.4 Test methods for durability of brakes

Set up the mobile APPH as in 22.2.3 on a horizontal surface.

For lever operated brakes, durability testing of the brakes is performed with a test cycle calculated as specified in 16.3 (see Table 7 and Table 8) regarding the intended area of use and specified life time of the product. For foot operated brakes at castors, the durability test shall be performed according to EN 12527:1998.

After the tests the brake shall still comply with the requirement of 22.2.2.

22.2.5 Brake operated by a lever

If a mobile APPH is intended to allow sideways transfer then any brake lever in the engaged position shall not protrude above the unoccupied seat.

22.3 Electrical safety for mobile APPHs

22.3.1 Power-driven mobile APPHs

Power-driven mobile APPHs for transportation shall have a means (e.g. free wheeling) to allow transport by the assistant under single fault condition of the transport system.

NOTE A power-driven mobile APPH incorporates a propulsion system.

22.4 Rough handling and movement

22.4.1 General

Mobile APPHs intended to transport occupants shall withstand the stresses caused by rough handling and movement. The requirements do not apply to mobile APPHs specified by the manufacturer only to be moved a very short distance, e.g. within a room, for cleaning purposes or to allow access to the occupant.

22.4.2 Requirements

After the tests specified in 22.4.3 and 22.4.4 the mobile APPH, product parts and accessories shall present no loss of function, and without unlocking/unlatching of any side rails, or physical deterioration, e.g. deterioration of fixings, unlocking of accessories if fixed on the mobile APPH (like side rails), which can reduce the normal use or create a risk like collapsing, or permanent deformation, modifying gap for entrapment or pinching.

The mobile APPH shall go over the obstruction and shall not overbalance (tip over) when tested according to 22.4.3. The mobile APPH or product parts shall not present an unacceptable risk.

Unacceptable risk is determined by inspection of the mobile APPH, its parts, and relevant information from the risk management file.

22.4.3 Test method for movement over a threshold

All accessories intended for normal use during transport shall be attached to the APPH and with the height in the worst case position and with the maximum load in place distributed as indicated in Figures 14 and 16. A test dummy according to ISO 7176-11 may also be used.

Set up an obstruction which is fixed flat on the floor, with a rectangular cross-section, 10 mm high and at least 80 mm wide with a radius of 2 mm at the top edges.

The APPH shall be moved at a speed of 0,8 m/s ± 0,1 m/s, or for motor-driven mobile APPHs for transportation, the maximum speed shall be used, while all castors shall impact and pass over the obstruction. Manual mobile APPHs are propelled by a force acting at its handle(s). The mobile APPH, with all castors, shall then be pulled back over the obstruction and back to the starting position of the test.

This is repeated 10 times.

Alternative method of testing: A double drum set-up may be used (see ISO 7176-8) on the condition that it cycles back and forth and it is adapted to the attachments and speeds as per above.

This is repeated 10 000 times.

NOTE See also a proposal for an alternative test in B.22.4.3.

22.4.4 Test method for door frame shock

All accessories intended for normal use during transport shall be attached to the mobile APPH and with the maximum load in place distributed as indicated in Figures 14 and 16 and the height in the worst case position. A test dummy according to ISO 7176-11 may also be used.

Set up a hardwood vertical obstacle having a width and thickness of 40 mm affixed to a vertical rigid support (e.g. concrete). The height of the vertical obstacle shall be at the same level as the height of the APPHs contact point(s). The direction of movement is perpendicular to the face of the obstacle. The sample is moved three times in its normal direction(s) of travel as specified by the manufacturer at a speed of 0,4 m/s ± 0,1 m/s, or for a motor driven mobile APPH for transportation, the maximum speed capable of being maintained, against the obstacle.

22.5 Functional requirements for mobile APPHs

22.5.1 Foot supports

If a mobile APPH is provided with a foot support, it shall be designed to minimize the risk of the user's feet being injured from rotation of the wheels.

This shall be assessed in the risk analysis (see 4.1).

22.5.2 Position of push handles/points

Handles for pushing and/or pulling shall be possible to be operated at a height of 900 mm above the floor.

22.5.3 Turning diameter of mobile APPHs

The turning diameter and reversing width of a mobile APPH shall be included in the instructions for use with an accuracy of ± 25 mm. The following measurements shall be determined and recorded.

a) Minimum distance between two vertical and parallel walls between which a APPH can turn 180° in one constant forward drive (see Figure 9).

b) Diameter of the smallest cylindrical envelope in which the APPH can be turned for 360° in one constant forward drive with maximum steering effect.

c) Minimum distance between two vertical and parallel walls between which an APPH can turm 180° allowing for reversing movements.

— Construct a corridor so that the distance between its walls is variable by using two parallel adjustable barriers. Place the APPH into the corridor and orient it parallel to the walls.

— Turn the APPH around in the corridor in the most suitable manner for the particular APPH involved. The test drive is completed when the APPH has turned through 180°.

— Gradually reduce the width of the corridor and determine the minimum corridor width in which the APPH can be turned around without touching the walls.

22.6 Moving forces

22.6.1 Requirements for moving forces

The maximum forces required for moving the mobile APPH shall be as follows when tested according to 22.6.2 with the maximum load on the mobile APPH positioned as indicated in Figures 14 and 16.

a) Starting force maximum160 N.

b) Driving (pushing/pulling) force maximum 85 N.

22.6.2 Test methods for moving forces

The test shall be carried out on a hard and horizontal test plane (4.8.7).

The mobile APPH shall be loaded with the maximum load in place distributed as indicated in Figures 14 and 16 at the support surface.

For the test of the starting force in the forward and backward direction, the castors shall be set at 180° to the direction of pushing/pulling.

The starting force is gradually applied to the push handle until the mobile APPH begins to move. Repeat five (5) times in each direction. The average maximum force for each direction noted during these tests shall be recorded as the starting force.

Remain a constant force at 1 m/s for 1 m, as the mobile product is moving and measure the force needed for driving.

The starting force shall be recorded as follows:

a) in the forward direction;

b) in the backward direction.

The driving force shall be recorded as follows:

a) in the forward direction;

b) in the backward direction.

23 Fixed APPHs

23.1 General

This clause specifies requirements and test methods for fixed APPHs which are additional to those specified in Clauses 4 to 21.

The requirements and test methods only apply to fixed APPHs within the following divisions of ISO 9999:2011 (in brackets):

— shower seats (09 33 03)

— bath/shower chairs (without wheels), bath boards, stools, back supports and seats (09 33 03)

— bathing stretchers, shower tables and diaper-changing tables (09 33 12)

— raised toilet seats (09 12 12 / 09 12 18)

— handrails, handles (18 18 03)

— suction handles, bath clamp handles (18 18 10)

— hinged rails and arm supports (18 18 11)

— height adjustable plinths and brackets (18 15 06)

The requirements and test methods do not take into consideration the fixation of the APPH nor the building structure. During testing the APPH shall be adequately fixed onto a suitable test bench/wall so as not to test the fixation but only the APPH.

NOTE Consider national building codes for the fixation of the APPH.

The number of test cycles in the durability testing of fixed APPHs shall be as specified in 16.3 (see Table 7 and Table 8) regarding the intended area of use and specified lifetime of the APPH and at appropriate intervals.

In case of a hinged APPH, the test method shall include folding from the complete upright position to the complete down position.

23.2 Requirements

After and during performing both static strength and durability tests, the requirements in 16.4.1 and 16.5.1 shall be fulfilled.

During the durability testing of the APPHs, it is permissible to make adjustments according to the manufacturer's instructions for use.

The method of fastening to the wall/tub/floor/other APPH shall be recommended by the manufacturer and included in the instructions for use. It shall be specified by the manufacturer how much load each fastener shall sustain.

Additional requirements (if any) to each APPH group can be found in the relevant subclause.

ISO 21542 should also be looked at for relevant parts as fixed APPHs are tested.

23.3 Shower seats (09 33 03)

23.3.1 Description

Seats for mounting on the wall or to the floor in bathrooms might be hinged, equipped with a back support, arm supports and/or supporting legs. For testing of back supports and arm supports, if applicable, see Clause 16.

23.3.2 Test methods for static strength, durability and impact for shower seats

23.3.2.1 Test method for static strength

The seat is loaded vertically according to Table 6 for 60s (F_1) with the centre of gravity $\frac{1}{3}$ of the distance from the front edge (see Figure 24). The load shall be applied with a loading pad (see 4.8.12.4).

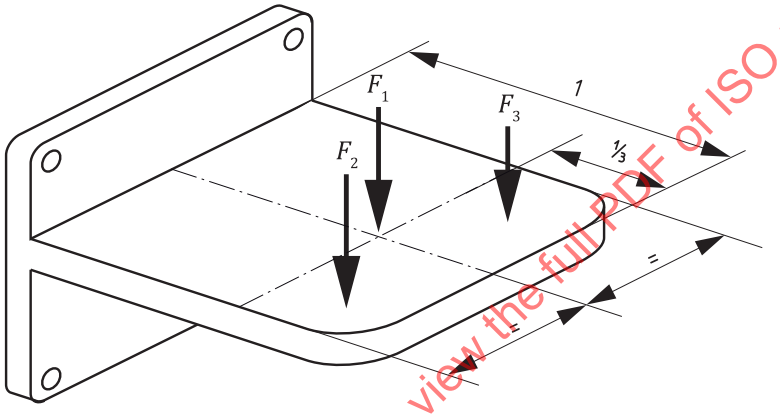


Figure 24 — Static strength shower seat

To test both sides of the seat, the loading pad is then placed in turn on left (F_2) and right (F_3) hand side of the seat as close to the edge as possible. See Figure 24).

23.3.2.2 Test method for durability

The seat shall be tested with a load according to Figure 16 of the specified maximum user mass as specified in 16.5.2.2.

The load shall be applied using the loading pad (4.8.12.4) in the position of intended use.

If the seat is foldable, it shall be folded from the complete upright position to the complete down position as many times as specified in the formula in 16.3 and Table 7 and Table 8 and at appropriate intervals.

23.3.2.3 Test method for impact

The shower seat shall be able to resist horizontal sideward impacts. The test is performed using the 25 kg test pendulum (see 4.8.13 and Figure 6), 50 mm from the front, F_1, according to Figure 25.

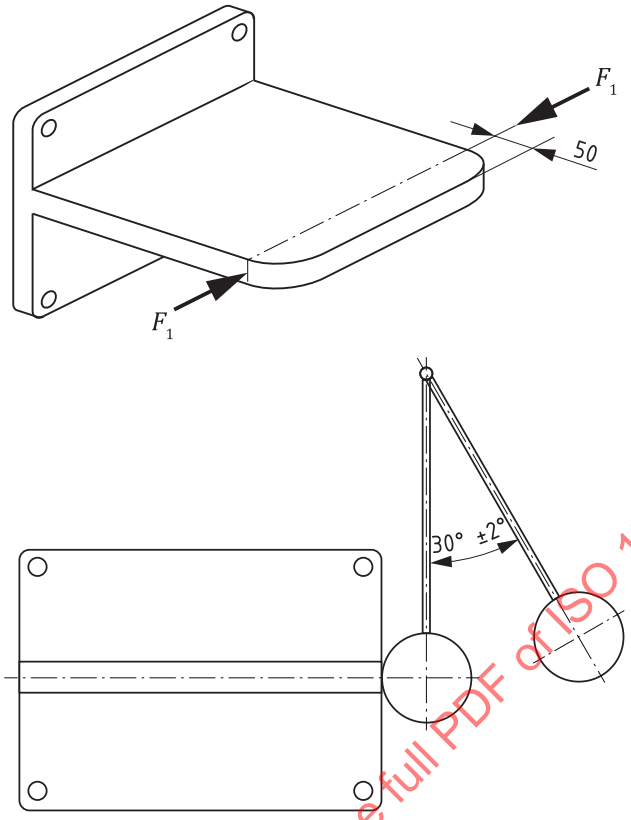


Figure 25 — Impact strength shower seat

23.4 Bathing stretchers, shower tables and diaper changing tables (09 33 12)

23.4.1 Description

Stationary tables on which a person lies during bathing, showering or diaper-changing, often height-adjustable.

23.4.2 Test methods for static strength and durability for bathing stretchers, shower tables and diaper changing tables

23.4.2.1 Test methods for static strength

The support surface is loaded according to Table 6, for minimum 60 s. The load F_1 is distributed over the support surface according to Figure 14 and 16. The load test is then repeated with an asymmetrical load F_1 (according to Figure 26) test where the entire load is placed on each side of the table one at the time, in the worst case position. If the intended use of the table is also to contain water while a person is lying on it, the maximum load shall be used instead of the maximum user mass.

A test dummy according to ISO 7176-11 may also be used.

The test is repeated for both sides.

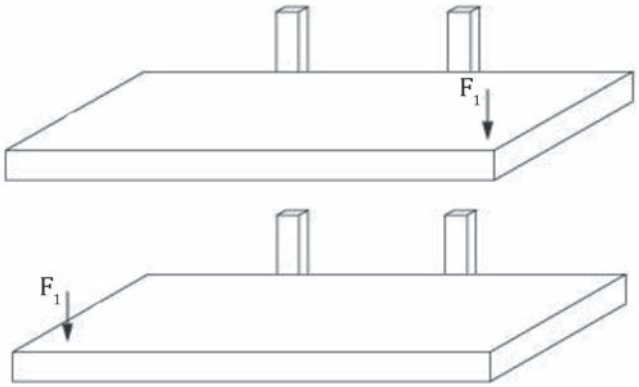


Figure 26 — Asymetric static strength test

23.4.2.2 Test method for durability of support surface and folding mechanism

The support surface shall be tested with a vertical load of the specified maximum load or at least 100 kg as specified in 4.7.

The load shall be placed on the Table according to Figure 14 (on a lying surface).

If the APPH is foldable, it shall be folded from the complete upright position to the complete down position as many times as specified in formula in 16.3 and Table 7 and Table 8 and at appropriate intervals.

A test dummy according to 7176-11 may also be used.

23.5 Bath/shower chairs (without wheels), bath boards, stools, back supports and seats (09 33 03)

23.5.1 Description

APPHs aimed for supporting sitting during bathing or showering. Seats without back support placed on the rim of the bathtub. The seat is at the level of the rim of the bathtub. Seats placed on the rim of or down in the bathtub. These may have solid or detachable back support.

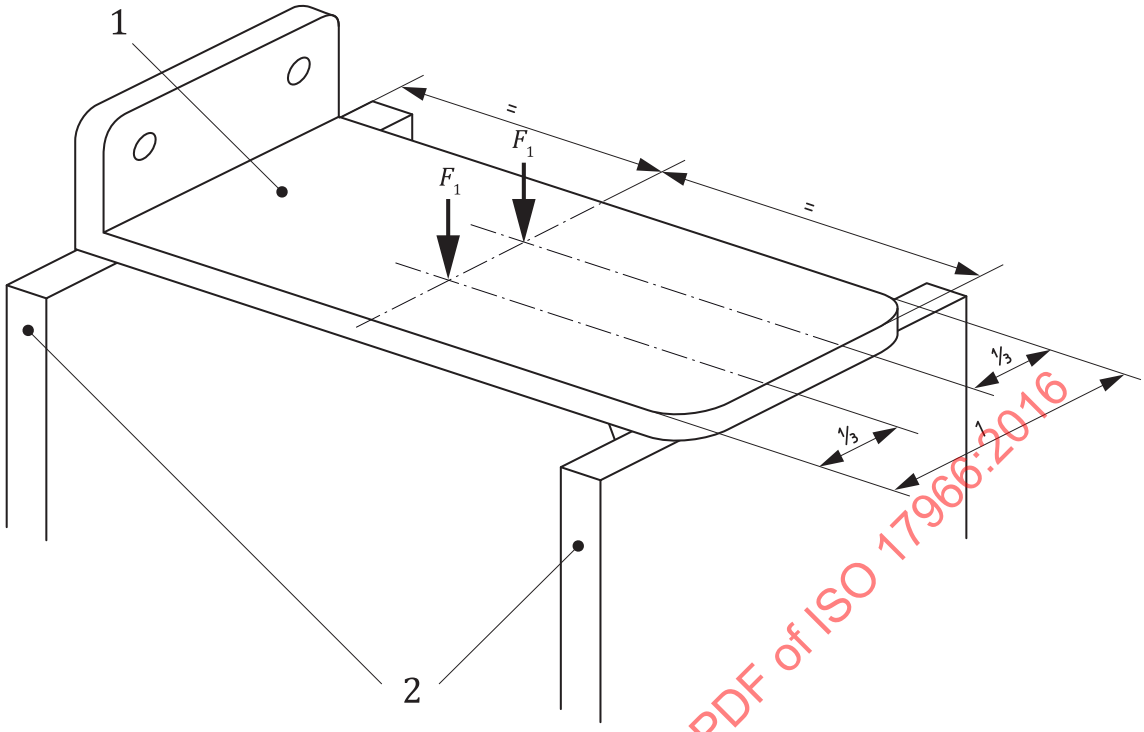
Some can have a rotational function to help the person with disability to ingress/egress in the bathtub.

23.5.2 Test method for durability

The seat/board shall be tested according to 16.5.2.2 with a vertical load of the specified maximum load as stated in Table 6 (see Figure 27). The load shall be applied using the loading pad in 4.8.12.4.

The load F_1 according to 4.8.12.2 shall be placed on the seat.

In the case of a rotating seat it shall be tested as above. The seat must be able to swivel by using forces given in Table 9 when loaded with maximum user weight.



Key

1 APPH

2 supporting stand

Figure 27 — Durability test of bath tub seat/board

23.6 Raised toilet seats (09 12 18)

23.6.1 Description

An APPH to elevate the sitting height of a toilet seat (without raising the toilet itself) to facilitate lowering and rising from the toilet. It may be fixed through the standard holes in the toilet or by other means.

23.6.2 Requirements for static strength for raised toilet seats

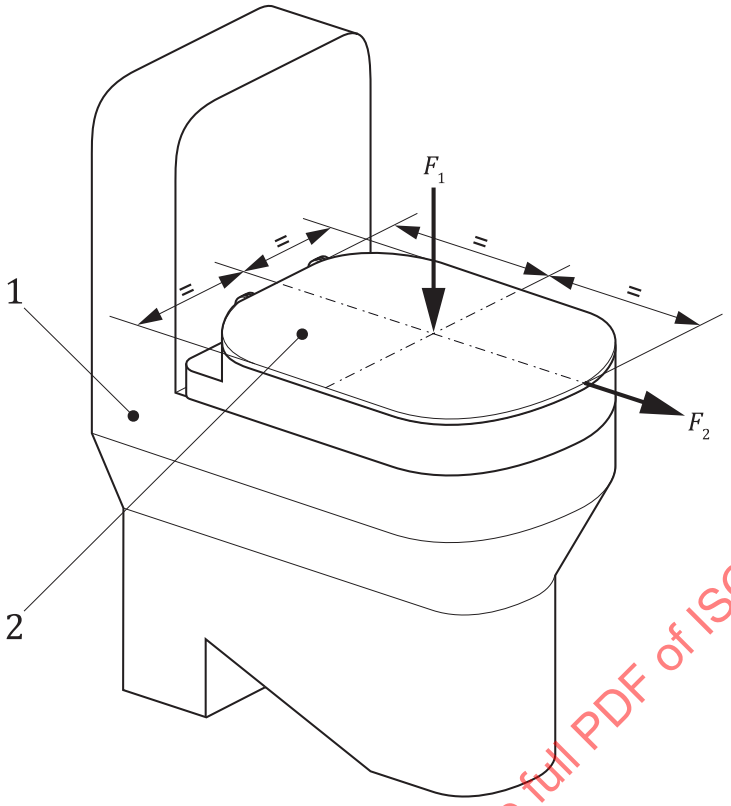
Additional to 23.2, the raised toilet insert shall be equipped with facilities which keep the raised toilet seat safely on the toilet and secures it against slipping off (e.g. form fit/force fit connection). It shall be specified by the manufacturer which toilets the raised toilet seat will fit onto. After performing the test, the raised toilet seat shall not come loose from the toilet.

23.6.3 Test methods for static strength and durability for raised toilet seats

23.6.3.1 Test method for static strength

The APPH shall be fixed onto a suitable surface with characteristics to represent standard toilets in shape and surface texture.

The seat is vertically loaded according to Table 6 for at least 60 s. The load (F_1) shall be applied centrally by means of the loading pad (4.8.12.4) over the whole surface (see Figure 28). The seat, if adjustable, shall be raised to the most adverse position.



Key

1 commode chair or other mean of holding the raised toilet seat

2 seat

Figure 28 — Static strength raised toilet seat

23.6.3.2 Test method for durability

Additional to 16.5.2.2.

The test does not have to be done on a toilet.

The loading pad according to 4.8.12.2 has to be placed on the seat or the lid, if provided.

23.7 Handrails, grab bars and handgrips (18 18 03 and 18 18 06)

23.7.1 Description

Handrails and handgrips are designed to aid balance and prevent people who are weak or unstable from falling.

Grab bars are usually cylindrical, attached to a wall, floor or other stable structure, to provide the means for a person to support or stabilize himself/herself using hands or arms while in the bathroom.

23.7.2 Ergonomic principles for handrails, grab bars and handgrips

Additional to Clause 21 (Ergonomic principles).

The handrail/handle can be round, with a diameter of 25 mmto 45 mm. If it is not round the handrail/handle, it shall have an equivalent grip area. The span between the fixing points shall be defined by the manufacturer as it depends on the materials. The handrail/handle should not have

undue flexibility. The gap between the wall and the grab handrail/handle shall be at least 35 mm and shall furthermore follow the requirements within Table 4.

Suction cup attachments shall be tested and have the same requirements as for attachments above.

NOTE Local building regulations may have different requirements regarding the size of the gap.

23.7.3 Test methods for static strength and durability for handrails, grab bars and handgrips

23.7.3.1 Test method for static strength

The wall-fastened handrail is loaded vertically (F_1) using the formula for static force on seat surface in Table 6 for at least 60 s in the most adverse position and then horizontally using 50% of the static force indicated in Table 6. See Figure 29.

The handrail shall be attached to a solid wall, with material strong enough to withstand the forces of the tests. The fixation shall be strong enough so that the handrail does not come loose during the test.

NOTE The order of vertical and horizontal is not critical.

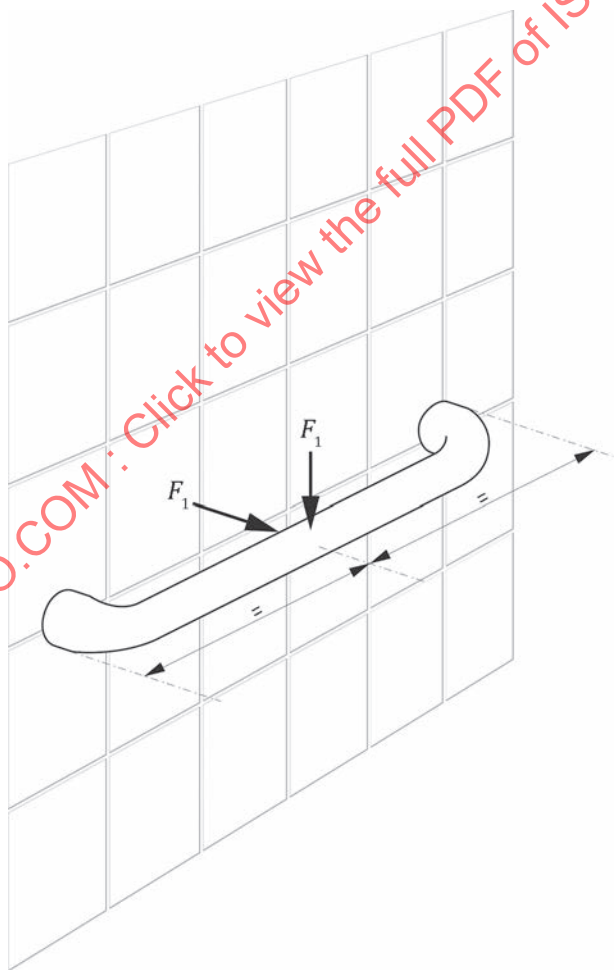


Figure 29 — Handrails/handles

23.7.3.2 Test method for durability

The wall-fastened handrail is loaded vertically and horizontally with 40% of the test force for seat surface in Table 6. The amount of cycles is specified according to the formula and Table 7 and Table 8 in 16.3 (see Figure 29).

The handrail shall be attached on a solid wall, with material strong enough to withstand the forces of the tests. The fixation shall be strong enough so that the handrail does not come loose during the test.

NOTE The order of vertical and horizontal tests is not critical.

23.8 Removable grab rails and handgrips (18 18 10)

23.8.1 Description

APPHs, usually straight or angled bars, that can be temporarily attached to walls, floors, ceilings or furniture (e.g. beds) using e.g. clamps or suction pads and removed without tools; they provide support to a person while changing position.

23.8.2 Ergonomic principles for removable grab rails and handgrips

Additional to Clause 21 (Ergonomic principles).

The handle can be round, with a diameter of 25 mm to 45 mm. If it is not round the bar shall have an equivalent grip area. The span between the fixing points shall be defined by the manufacturer, as it depends on the design of the handle and the materials on which they can be fixed. The gap between the wall and the grab bar shall be at least 35 mm and shall furthermore follow the requirements within Table 4.

Suction handles shall be equipped with a safety indicator. For example a display showing the residual force (= maximum user mass).

Bath clamp handles shall be securely fastened to the bathtub without damaging the tub and the substructure.

The suction/bath clamp handle shall not come loose while tested.

NOTE 1 Different material and different frictions will give different results.

NOTE 2 Local building regulations may have different requirements regarding the size of the gap.

23.8.3 Test methods for static strength and durability for removable grab rails and handgrips

23.8.3.1 Test method for static strength

Attach the test equipment onto the supporting stands (4.8.15).

Suction handrails are loaded (F_1) with 75 % of the maximum load horizontally and 50 % of the maximum load vertically, 90° to the wall and parallel to the wall in the worst case position (see Figure 29 as an example).

Bath clamp handles are loaded (F_1) with 75 % of the maximum load horizontally and 50 % of the load vertically, 90° to the bath tub and parallel to the bath tub on the top of the handle (see Figure 29 as an example).

The test surface shall be of stainless steel that is fixed and has at least the size of the test item.

23.8.3.2 Test method for durability

Attach the test equipment onto the supporting stands (4.8.15).

Suction handles are loaded in the middle of the handle under an angle of 15° outward-upward and outward-downward with 40 % of the maximum load, using Table 7 and Table 8 in 16.3 (see Figure 30 as an example).

Bath clamp handles are loaded parallel to the bath tub on the top of the handle with 40 % maximum user weight according to the formula and Table 7 and Table 8 in 16.3, see Figure 29.

NOTE 1 The order of vertical and horizontal tests is not critical.

NOTE 2 Outward means the direction away from the wall.

The test surface shall be of stainless steel that is fixed and has at least the size of the test item.

23.9 Hinged rails and arm supports (18 18 11)

23.9.1 Description

APPHs that provide support to a person when changing her/his position; they can be fixed to a wall or floor and can be folded upwards or sideways or lowered down to allow access or to stow when they are not needed.

23.9.2 General

Hinged rails/arm supports shall be secured to prevent unintentional folding down.

NOTE This can be done by friction or a mechanical locking device.

23.9.3 Test method for static strength for hinged rails and arm supports

Hinged rails/arm supports are loaded (F_1) according to the test force in Table 6 regarding arm support downward, at a point 50 mm ± 5 mm from the front edge with an angle of 15° ± 2° outwards and downward for at least 60 s (see Figure 30).

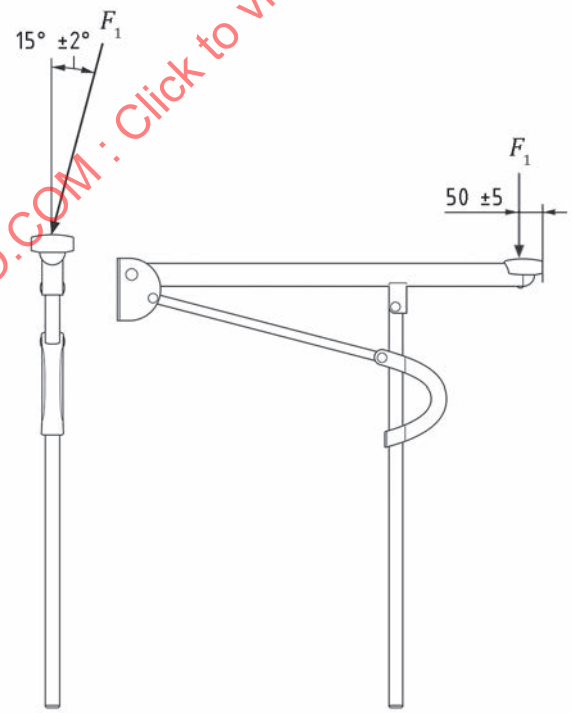


Figure 30 — Hinged rails/arm support static test

23.9.3.1 Test method for durability for hinged rails and arm supports

Hinged rails/arm supports are loaded (F_1) vertically at a point 50 mm ± 10 mm from the front edge under an angle of 15° ± 2° outward with 40 % of the maximum specified load according to the formula in Table 6 and Table 7 and Table 8 in 16.3 (see Figure 30).

23.10 Height-adjustable plinths and brackets (18 15 06)

23.10.1 Description

Height adjustable plinths and brackets when used in the bathroom as an APPH on which hygiene products can be mounted. They can be either manually or electrically operated. They can be used for height adjustment of e.g. wash basins or toilets.

23.10.2 Test methods for static strength and durability for height-adjustable plinths and brackets

23.10.2.1 Test method for static strength

A bracket/plinth used for adjusting the height of an APPH intended to support the weight of a person is vertically loaded according to Table 6 for 60 s as close to the front edge as possible. See Figure 31.

The load shall be applied with a loading pad, see 4.8.12.4.

The bracket/plinth used for adjusting the height shall be able to withstand the load as specified by the manufacturer. In addition, the bracket/plinth shall be able to bear the weight of a user supporting himself/herself and it is tested with a vertical load of 75 % of maximum user weight for 60 s as close to the front edge as possible.

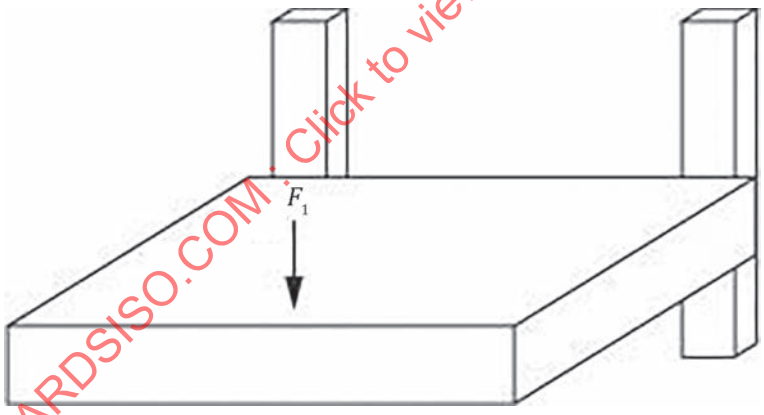


Figure 31 — Static test of height adjustable plinth/bracket

23.10.2.2 Test method for durability

The bracket/plinth intended to support the weight of a person with disability shall be tested with maximum specified load according to the formula and Table 7 and Table 8 in 16.3 (see Figure 31).

The bracket/plinth used for height adjustment of an APPH shall be tested with a load equal to the specified maximum load according to the formula and Table 7 and Table 8 in 16.3 (see Figure 31).

24 Static APPHs

24.1 General

This clause specifies requirements and test methods for static APPHs in addition to those specified in Clauses 4 to 21.

The requirements and test methods for APPHs in this clause apply to the following divisions of ISO 9999:2011 (in brackets):

— raised toilet seats mounted on frame (09 12 12);

— toilet seats inserts (non fixed) (09 12 15);

— toilet seats with built-in raising mechanism to help standing up and sitting down (non fixed) (09 12 21);

— bath/shower chairs (without wheels), bath boards, stools, back supports and seats (09 33 03).

24.2 Stability and strength tests for static APPHs

General conditions for the relevant tests in addition to the general part shall be as follows:

a) in the stability and strength tests, a constant force shall be applied or the force shall be increased gradually;

b) in the strength tests, the force shall be applied with negligible dynamic load;

c) for an APPH that has a dimension adjustment mechanism, the APPH shall be adjusted to the most adverse position in relation to the test.

24.3 Toilet seats inserts (non fixed) (09 12 15)

24.3.1 Description

Raised toilet seats (loose attachments) placed directly on the toilet pan/toilet seat where the APPH can be easily removed from the toilet pan/toilet seat.

24.3.2 Impact

24.3.2.1 Requirements

The APPH shall meet the requirements in 16.6.1 and 24.2.

In addition to the requirements in 16.6.1, the APPH shall not fall from the position of intended use.

If the product becomes dislocated from the position of intended use, it shall go back into the position of intended use after placing the 60 kg test mass on the front edge of the product as described below (see Figure 34).

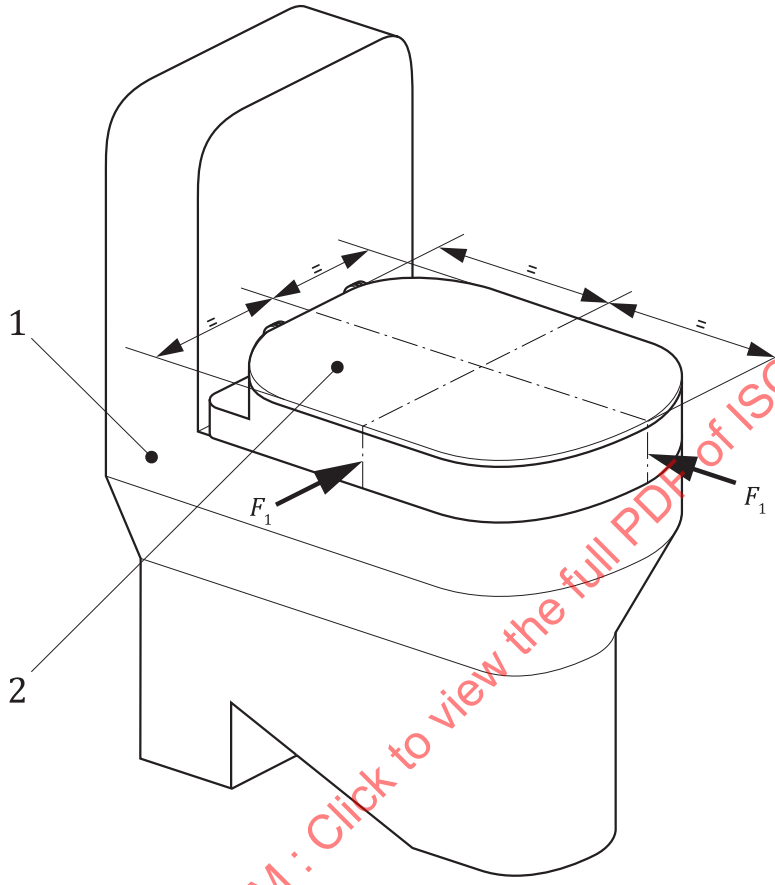
24.3.2.2 Test methods

The following describes one test method for assessing the stability of a toilet seat insert, which has no fixation to the toilet, during a user's transfer onto the APPH from standing. As this is not a validated test method the risks associated with a loosely attached raised toilet seat shall be addressed in the risk analysis (see 4.1).

Set up the APPH in the position of its intended use onto a suitable surface with characteristics to represent standard toilets in shape and surface texture. Position the raised toilet seat impact test

pendulum (see 4.8.14 and 4.8.15) with the edge of the pendulum in contact with the surface of the APPH on either the front or side (see Figure 33).

Support the pendulum so that the rigid bar is at an angle of 30° ± 2° to the vertical and then allow it to fall once F_1 freely and strike the APPH. The impact load shall be applied to the front of the APPH and to one of its sides (see Figure 32).

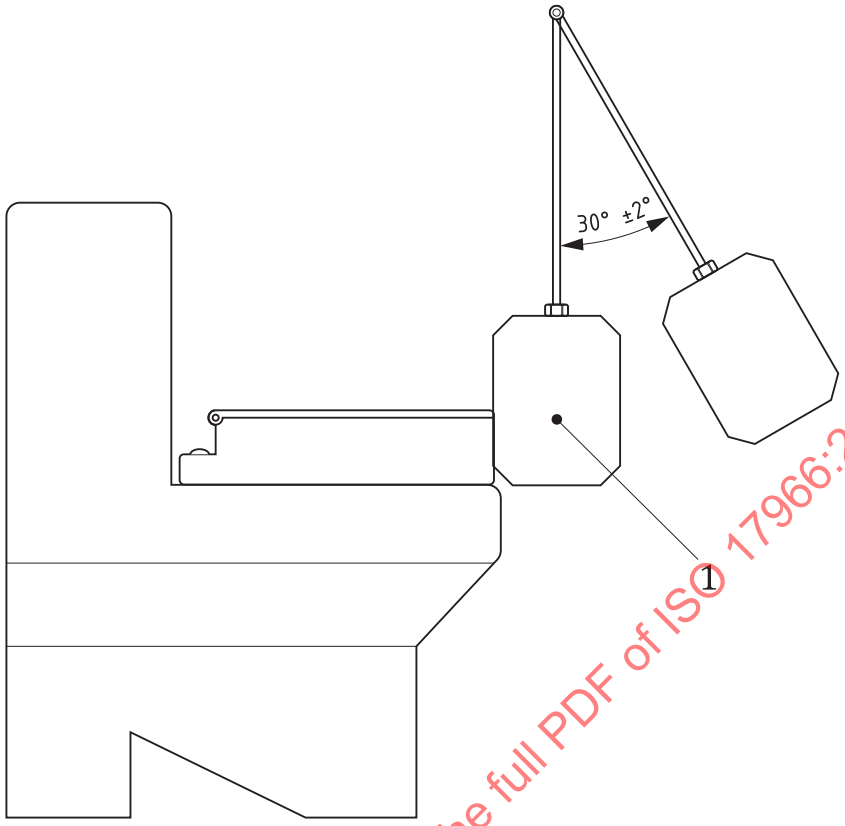


Key

1 standard toilet

2 toilet seat

Figure 32 — Seat impact test



Key

1 test pendulum

Figure 33 — Impact test pendulum

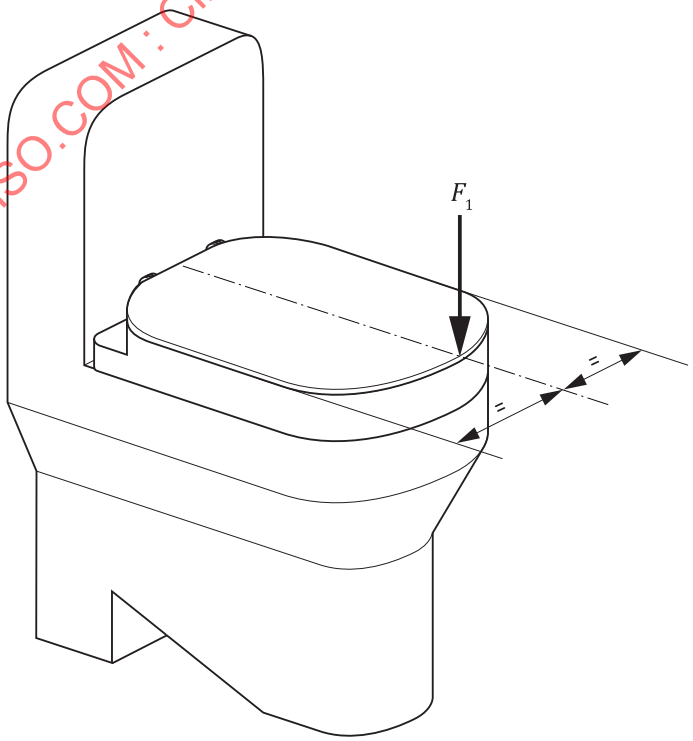


Figure 34 — Dislocation positioner

24.4 Toilet seats with built-in raising mechanism to help standing up and sitting down (non-fixed) (09 12 21)

24.4.1 Description

Toilet seats that have a built-in lifting mechanism to help a person to sit down onto and get up from the toilet.

24.4.2 Durability

The ascending and descending movements of the raising mechanism will be considered as one cycle (two movements per cycle). The number of cycles is specified in the formula in 16.3 together with Table 7 and Table 8.

The tests are to be performed according to 16.5.2.3 with requirements stated in 16.5.1.

24.5 Bath/shower chairs (without wheels), bath boards, stools, back supports and seats (09 33 03)

24.5.1 Description

APPHs for supporting sitting during bathing or showering.

24.5.2 Materials

Bath seats shall not float in water.

24.5.3 Stability

APPHs which are designed to be placed on the floor, such as shower chairs and stools, shall meet the stability requirements in Clause 17.

APPHs which are designed to be supported by the sides of a bathtub, such as bath boards/seats and transfer benches, shall meet the stability requirements in 24.5.4. In addition, such APPHs which also feature a back support, shall meet the requirements of the backward stability test in 24.5.4.5.

APPHs which are designed to be placed on the floor of a bathtub, such as bath seat inserts, shall meet the stability requirements in Clause 17.

24.5.4 Stability tests for APPHs designed to be supported by the sides of a bathtub

24.5.4.1 Requirements

The APPH shall not overturn after the force is applied.

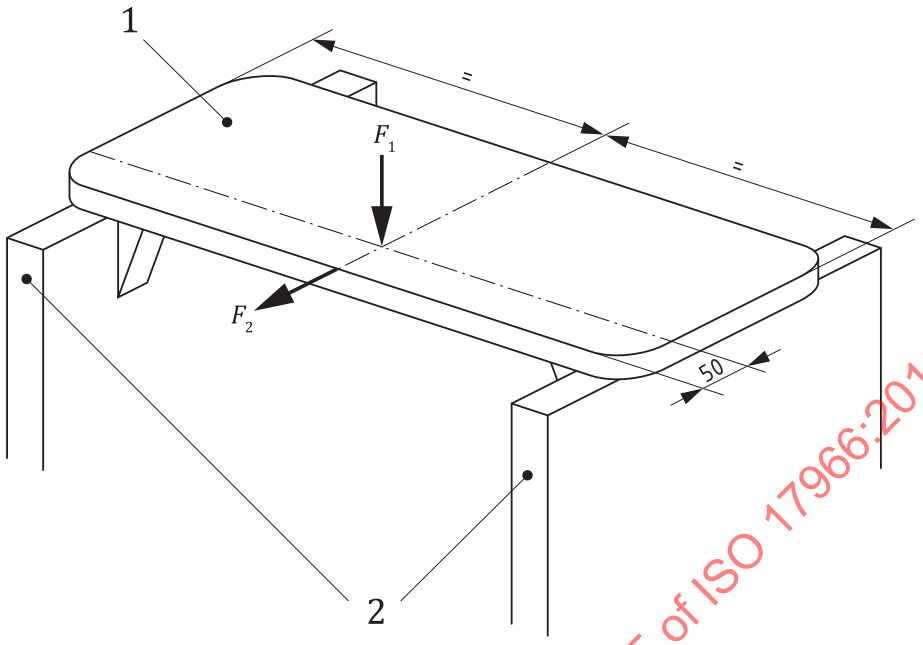
24.5.4.2 Forward stability test method

This test does not apply to rim-mounted bath benches or bath boards.

The transfer bench or bath board/seat shall be placed on the supporting stand (4.8.15) in the position of intended use. The angle of the supporting stands will be adjusted, if required, for the intended use of the APPH. A force of 600 N (F_1) shall be applied vertically on the seat using the seat loading pad (4.8.12.4). In addition, a force of 60 N (F_2) shall be applied horizontally extending forward from the seat (see Figure 35) to test for overturn.

APPHs with height adjustable legs shall have the height set to the maximum level or the most adverse position.

Dimensions in millimetres



Key

1 rim-mounted bath bench or bath board

2 supporting stands

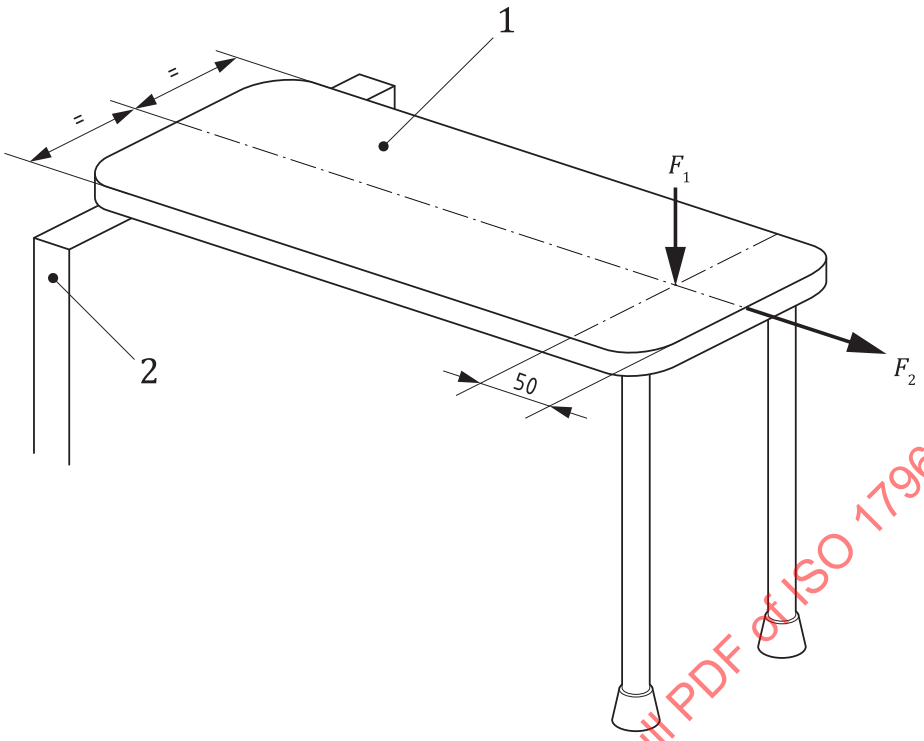
Figure 35 — Forward stability test of transfer bench, bath board or seat

24.5.4.3 Sideward stability test method for transfer bench without a handle

The transfer bench or bath board/seat without a handle shall be placed on the supporting stand (4.8.15) in the position of intended use. The angle of the supporting stands will be adjusted, if required, for the intended use of the APPH. A force of 600 N (F_1) shall be applied vertically on the seat using the seat loading pad (4.8.12.4), according to Figure 36. In addition, a force of 60 N (F_2) shall be applied horizontally extending sidewards from the seat (see Figure 36) to test for overturn.

APPHs with height adjustable legs shall have the height set to the maximum level or the most adverse position.

Dimensions in millimetres



Key

1	transfer bench
2	supporting stand

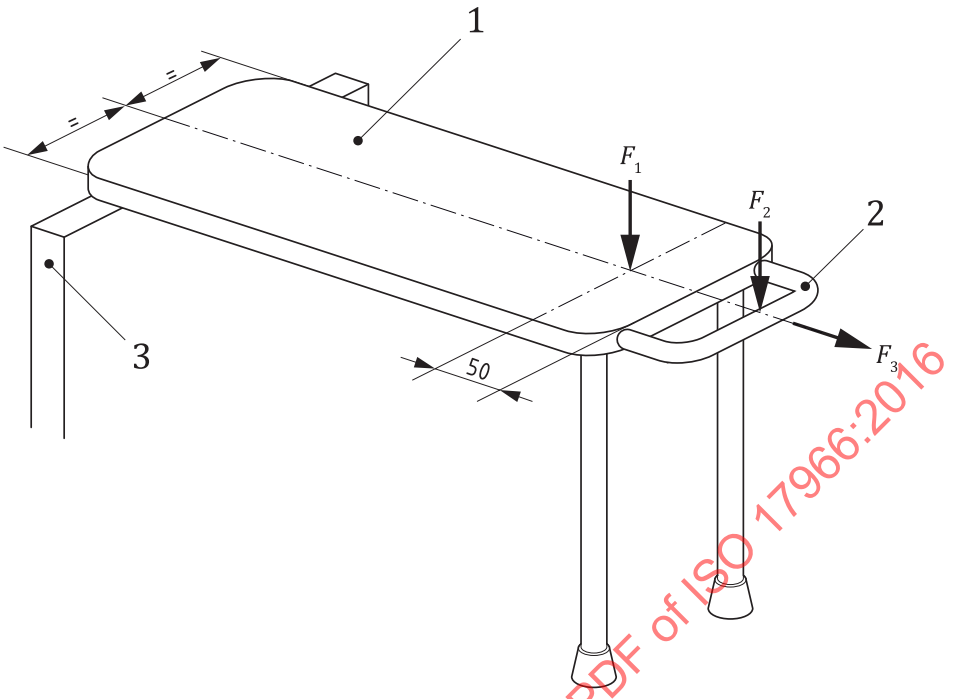
Figure 36 — Sideward stability test of transfer bench without handle

24.5.4.4 Sideward stability test method for transfer bench with a handle

The transfer bench or bath board/seat with handle shall be placed on the supporting stand (see 4.8.15) in the position of intended use. The angle of the supporting stands will be adjusted, if required, for the intended use of the APPH. A force of 250 N (F_1) shall be applied vertically on the seat using the seat loading pad in a postion for intended use (4.8.12.4), according to Figure 37. Next, a force of 350 N (F_2) shall be applied vertically to the centre of the handle using a loading pad (see 4.8.12.4). In addition, a force of 60 N shall be applied horizontally extending sidewards from the seat to test for overturn (see Figure 37 for horizontal handle and Figure 38 for vertical handle).

APPHs with height adjustable legs shall have the height set to the maximum level or the most adverse position.

Dimensions in millimetres

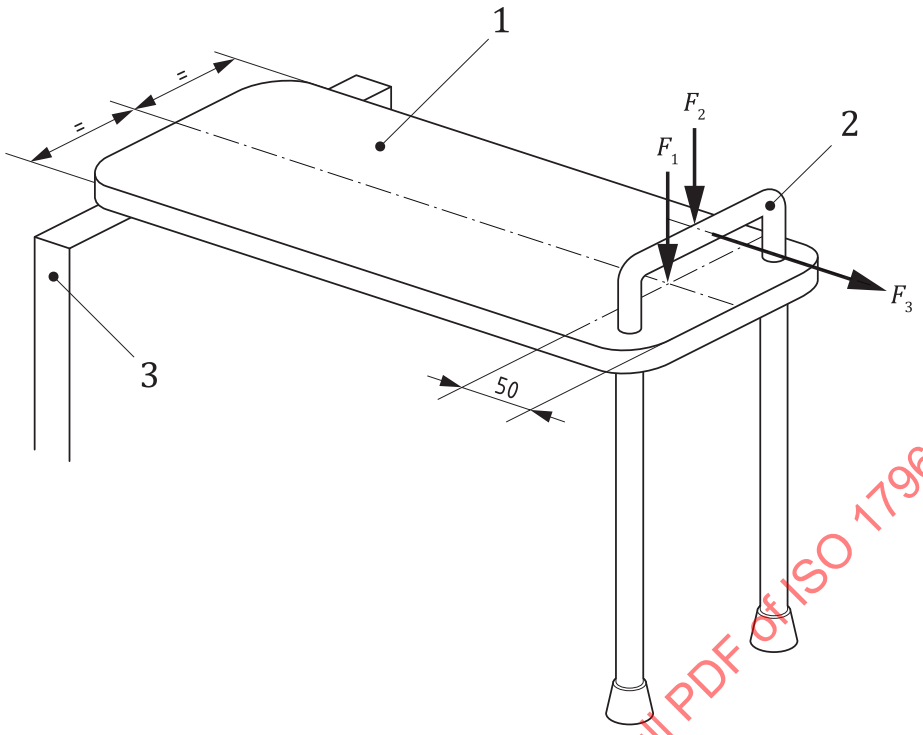


Key

1 transfer bench
2 handle
3 supporting stand

Figure 37 — Sideward stability test of transfer bench with horizontal handle

Dimensions in millimetres



Key

1 transfer bench
2 handle
3 supporting stand

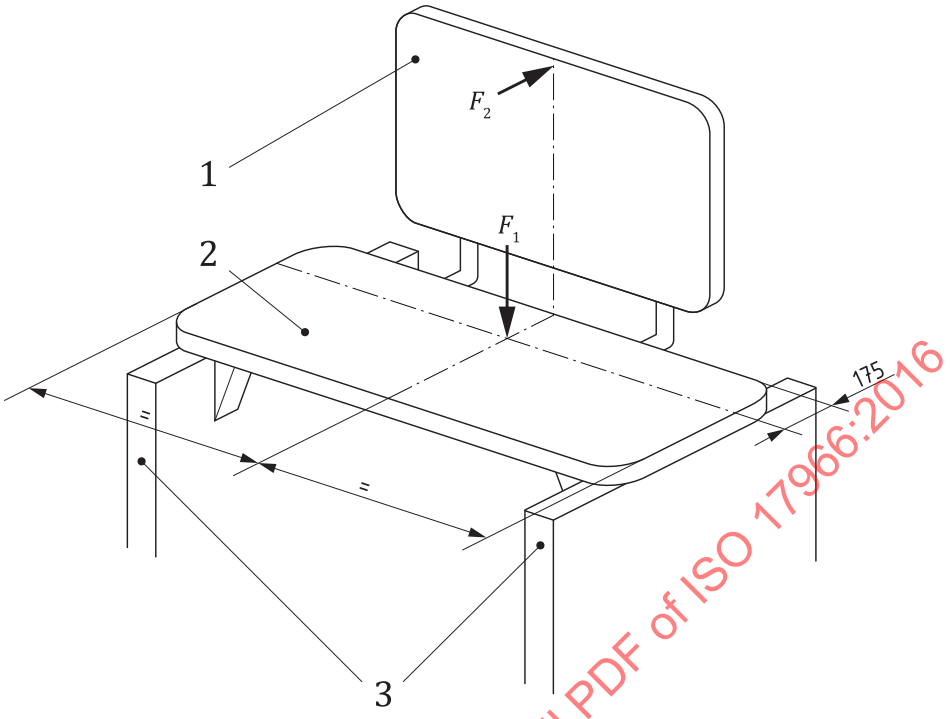
Figure 38 — Sideward stability test of transfer bench with vertical handle

24.5.4.5 Backward stability test method (when back support is provided)

The transfer bench or bath board/seat shall be placed on the supporting stand (4.8.15) in the position of intended use. The angle of the supporting stands will be adjusted, if required, for the intended use of the APPH. The weight of 60 kg (F_1) shall be put at the position 175 mm forward from the centre of rear edge of the seat according to Figure 39. A force of 140 N (F_2) shall be applied horizontally in a backward direction from the centre of the top edge of the back support (see Figure 39) to test for overturn.

APPHs with height adjustable legs shall have the height set to the maximum level or the most adverse position.

Dimensions in millimetres



Key

1 back support
2 transfer bench
3 supporting stand

Figure 39 — Backward stability test method (when back support is provided)

24.5.5 Strength test of brackets

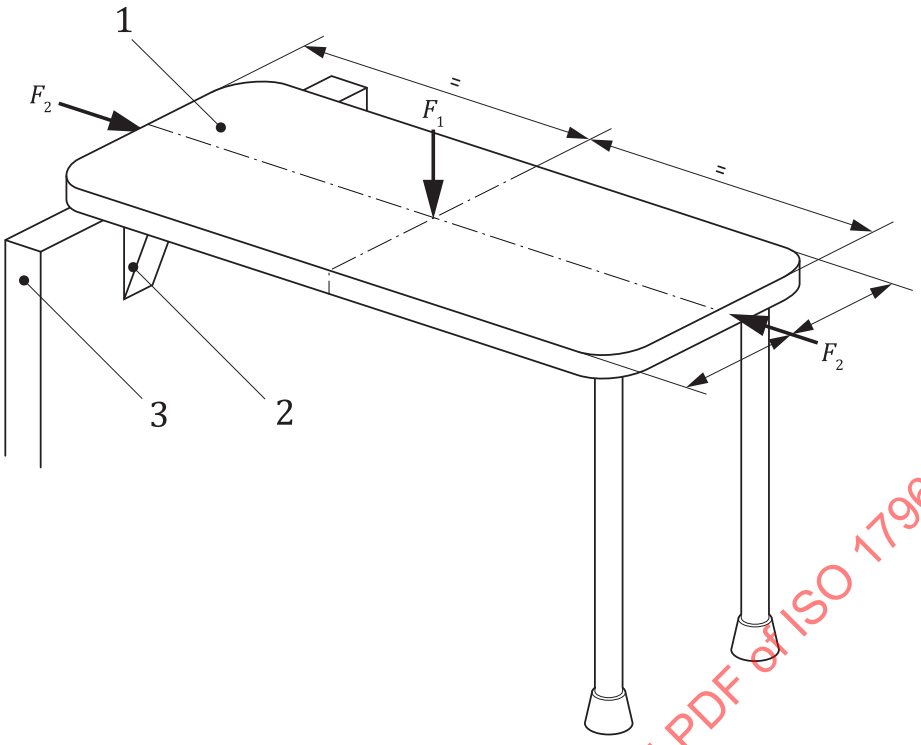
24.5.5.1 Requirements

See 16.4.1.

24.5.5.2 Test method

The transfer bench, bath board/seat or bench-type bathtub shelf shall be placed on the supporting stand(s) (4.8.15) in the position of intended use. The angle of the supporting stands will be adjusted, if required, for the intended use of the APPH. The force of 200 N (F_1) shall be applied vertically to the centre of the seat using the seat loading pad (4.8.12.4). Next, a force of 400 N (F_2) shall be applied horizontally along the length of the APPH and repeated 10 times in alternate directions. The force shall be maintained each time for at least 10 s. After removing the test force, the APPH and its parts shall meet the requirements listed in 16.4.1 (see Figure 40, Figure 41 and Figure 42).

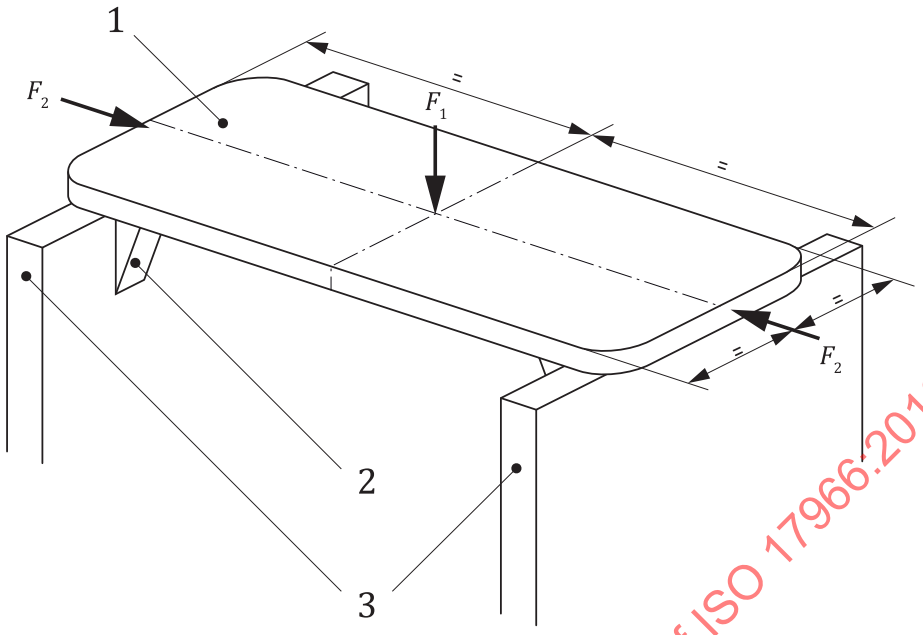
APPHs with height adjustable legs shall have the height set to the maximum.



Key

1 bench
2 bracket
3 supporting stand

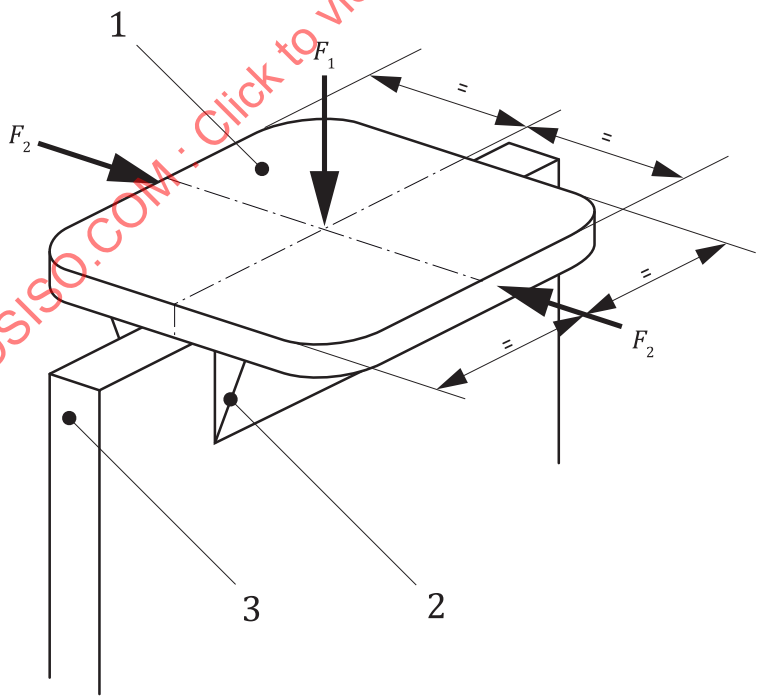
Figure 40 — Strength test of bracket on transfer bench



Key

1 bench
2 bracket
3 supporting stand

Figure 41 — Strength test of bracket on bath seat/board



Key

1 bench
2 bracket
3 supporting stand

Figure 42 — Strength test of bracket on bench-type bathtub shelf

24.5.6 Friction test of bath board/seat

24.5.6.1 Requirements

The static friction coefficient shall be 0,3 or more.

24.5.6.2 Test method

The bath board/seat shall be placed on the supporting stand(s) (4.8.15) in the position of intended use. The angle of the supporting stands will be adjusted, if required, for the intended use of the APPH. A force of 200 N (F_1) shall be applied vertically to the seat using the seat loading pad (4.8.12.4), according to Figure 43. A force shall be applied horizontally in the backward direction (F_2) (see Figure 44). Measure three times the force at which the bath board/seat starts to slip along the support stand. The friction coefficient shall be calculated by using the mean value of the three times according to the following formula:

$$\mu = \frac{F}{9,8 \times W}$$

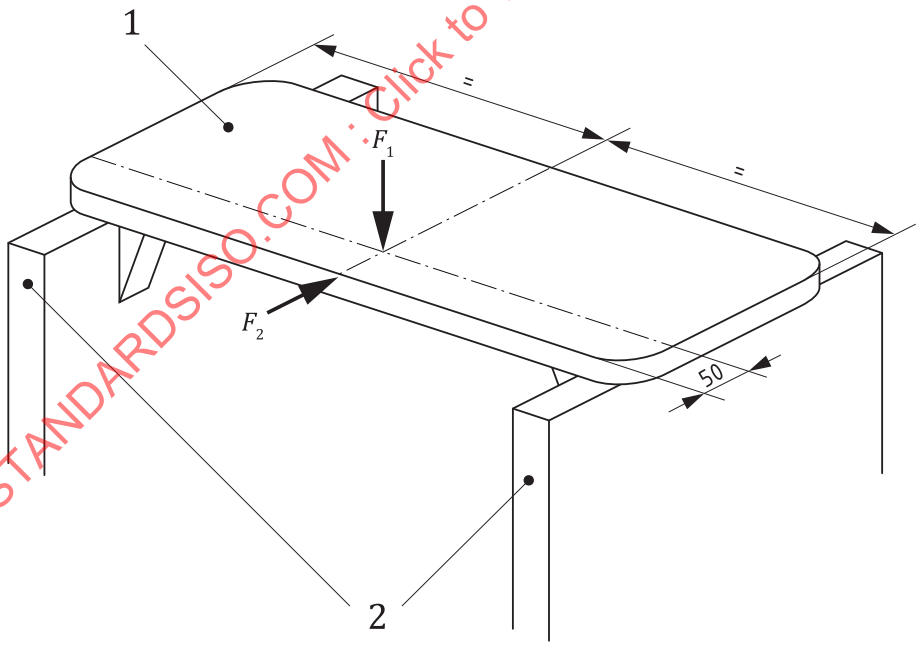
where

μ friction coefficient;

F mean value of forces at start of slip (N);

W total mass (kg).

Dimensions in millimetres



Key

1 bench

2 supporting stand

Figure 43 — Slip resistance test of bath board