

KBOH-TNO Homologation Directive D 01

AIDS FOR SHOWERING, SHOWERING IN A SITTING POSITION

Definitions and measuring procedures

This report is a reissue of the KBO-TNO Homologation Directive D 01 of May 1995. Apart from changes from the KBO to KBOH as being responsible for the certification for the GQ-approval mark, no changes in requirements and/of definitions and measuring procedures are made.

In case of doubt the Dutch text is definite

Quality and Usability Research of Technical Aids

Woerden, November 1997

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1 Introduction

Chapter 2 of this part contains the definitions and measuring procedures of the properties used in the reports covering the shower aids for showering in a sitting position

The properties are listed in alphabetical order (Dutch version).

Chapter 3 also deals with the performance of the measurements (evaluation limits, measuring equipment, measuring conditions and measuring accuracy).

Chapter 4 includes an elaboration of some measuring procedures.

2 Definitions and measuring procedures

Property: **Propulsion**

Definition: Device designed for propulsion of the shower aid.

Property: **Propulsion and steering: one or both legs**

Definition: Propulsion/steering by using one or both legs.

Property: **Propulsion and steering: pushing without servo-mechanism**

Definition: Propulsion and steering effected by means of pushing (attendant).

Property: **Propulsion and steering: one hand, one leg**

Definition: Propulsion and steering performed by one hand and one leg or a combination.

Property: **Propulsion and steering: hand two-sided, front, centre or rear handrims**

Definition: Propulsion/steering by means of both arms/hands without a transmission mechanism.

Property: **Accessory**

Definition: An added feature of the shower aid to enhance its application possibilities.

Property: **Reduced dimensions**

Definition: The space occupied by the shower aid measured after reducing its dimensions.

Measuring procedure: The dimensions after reducing the size of the shower aid are determined. In case of fixed shower aids, the horizontal distance of the reduced shower aid to the wall is determined. Reducing the size does not include removing arm and legrests. Folding or swivelling of armrests is permitted as far as these remain fitted to the aid.

Property: **Removable**

Definition: The possibility to remove a part of the shower aid without using tools.

Property: Protective cover of moving parts

Definition: The presence of a protective cover of moving parts, or sufficient space for the fingers.

Relevance: When effecting an adjustment, parts may move along each other as a result of which fingers and hand run the risk of getting caught.

Measuring procedure: Visual evaluation

Property: Armrest

Definition: The top of the armrest supporting the arm.

Property: Armrest

Definition: Part of the shower aid designed for supporting the arm during sitting and on which the hand can be placed when getting into a sitting or standing position, pushing over or tilting forwards and sideways during washing and drying.

Property: Armrest, type

Definition: Method of removing armrests for the purpose of making a transfer or performing hygienic daily routine activities
There are five types:
A. fixed (including the side-rests)
B. removable
C. folding up
D. folding sideboards
E. sinking downwards

Property: Armrest

Definition: Part of a shower aid designed for supporting the hand of the user during getting up and sitting down.

Property: Ease of operation, braking facility user

Definition: The fact whether the braking facility can be reached or operated by the user and the way in and extent to which the braking unit can actually be operated.

Relevance: The user should be able to apply and release the brake of the shower aid for the purpose of fixation when performing activities and getting up/sitting down or pushing over, or disconnection for making transfers.

Measuring procedure: Experimentally.
The operating force is measured.

Property: Ease of operation braking facility attendant

Definition: The fact whether the brakes can be reached or operated by the attendant using the hand or foot and the way in and extent to which the braking facility can be actually operated.

Relevance: The attendant user should be able to apply and release the brake of the shower aid for fixation when performing activities or disconnection for making transfers.

Measuring procedure: Experimentally.
The operating force is measured.

Property: Ease of operation reducing/disassembly

Definition: The way in and extent to which the shower aid can be disassembled or reduced in size.

Relevance: In situations in which other persons than the user of the shower aid make use of the bathroom the size of the shower aid needs to be reduced. Reducing its size may also facilitate moving and transporting the shower aid.

Measuring procedure: Experimentally.

Property: (Business) economic requirements

Definition: Aspects (requirements) relating to the purchase, delivery and maintenance of the shower aid.

Property: Legrest

Definition: Total system of footrests, calfrests and frame attachment system.

Property: Legrest, type

Definition: The method of removing legrests for making a transfer.
There are six types:
A. fixed, length NI/EI, fixed footrest;
B. fixed, length, NI/EI, footrest removable by user;
C. fixed, length NI/EI, footrest removable by attendant;
D. removable by user, length NI/EI, footrest fixed;
E. removable by user, length NI/EI, footrest removable;
F. removable by attendant, length EI/PVT, footrest fixed/removable.

Property: Attendant

Definition: The attendant is the person positioned behind the shower aid and effecting the PVT adjustment for the user.
Note: The evaluation is based on the anthropometry and strength of a 65-year-old female.

Property: Evaluation limits

Definition: Pre-set limits against which the measured value is tested.

Property: Accessibility for cleaning purposes

Definition: The method of and extent to which dirty places can be adequately reached for cleaning activities.

Relevance: The shower aid may get dirty from using this facility. This particularly concerns hair and soap remains and in exceptional cases faeces, blood and urine. The way in which this dirt can be removed should be taken into consideration.

Measuring procedure: Experimentally:
Places where dirt may easily occur are recorded;
if support components are detachable the components involved are also recorded; if tools are required:
- type of tool;
- whether or not supplied with the product.

Property: Fixing of support elements, technical quality of construction

Definition: The extent to which the fixing of the support elements to the frame meets a generally accepted quality level.

Relevance: Despite its strength and durability a construction may still function poorly because of occurring play (free motion) or bad finishing of welds.

Measuring procedure: Visual evaluation.

Property: Cluster (target group)

Definition: A group of users with the same characteristics as regards the functional limitations, expected use and any usage conditions as far as related to the properties of (a group of) technical aids and appliances.
Or as seen from the technical aids and appliances:
A cluster represents an as large group of users as possible for which all individual programmes of requirements to be set to the aid concerned can still be realised in one product.

Property: Corrosion susceptibility

Definition: The degree of corrosion resistance of the shower aid to water and water containing aggressive substances.

Relevance: To use shower aids permanently while these facilities keep an acceptable appearance, the construction material should be able to resist wet usage conditions and any cleaning liquids.

Measuring procedure: Measuring in accordance with the so-called salt mist test (DIN 50021) during 96 hours. The entire product is placed in a salt mist cupboard. The evaluation of white corrosion (oxidation of non-ferro metals) and rust formation (expressed in Ox en Re respectively) is carried out according to the 10 grade 'European Rust Scale' DIN 53210 (Ox=0/Re=0 means no oxidation or rust formation)

Property: Disassembly

Definition: Disassembly of the shower aid means taking the shower aid apart, for the purpose of reducing the length/width/height of the shower aid for transportation.

Property: Turning radius/diagonal

Definition: The turning radius is half of the axial line of the smallest circle described by the outer point of the shower aid.
The diagonal is the largest distance between the right back and left front (or left back and right front) of the projection of the shower aid on the floor.

Relevance: Occasionally, the shower aid may be moved from the bathroom to the bedroom. The turning radius/diagonal is of importance then for manoeuvring in and around the bathroom.

Measuring procedure: The distance is measured between the centre of the axis of the fixed wheels and the farthest outer point of the showering aid (turning radius). The largest distance is measured between rear right en front left (rear left and front right respectively) of the projection of the shower aid on the floor (diagonal).
In the case of four casters the turning radius is the half of the smallest circle which the shower aid describes when turning around its centre (diagonal).

Property: Threshold requirement

Definition: The value of functional, technical or economical properties which the shower aid at least shall meet.

Property: Dummy

Definition: Model of the human body to simulate a load or dimension in testing shower aids.

Property: Pushing handle

Definition: Pushing handles are the grips (protruding parts) with which the attendant can hold the shower aid to push and steer it. Instead of pushing handles, pushing bars or a pushing rail occasionally occur.
Note: Pushing bars: two bars positioned vertically left and right at the back of the backrest.
Pushing rail: this involves one horizontal bar positioned from the left to the right side of the backrest designed for pushing the shower aid.

Property: Economic properties

Definition: Aspects relating to costs, delivery and management of the product.

Property: EI: Single adjustment

Definition: An adjustment is considered to be EI:

- if adjusting a (loaded or unloaded) support component requires the use of tools, or
- if the adjustment can be effected without tools but only if the user is not occupying the shower aid.

Property: Property

Definition: A measurable aspect of a product (technical aid) on the basis of which (measuring result) the product is evaluated in conformity with pre-defined requirements.

Property: Fixing facility

Definition: The possibility to attach removable and detachable supporting components and the construction thereof to the shower aid in such a way that a stable support remains present when sitting and performing activities, making transfers and during movements.

Property: Frame, technical quality of the construction

Definition: Carrying part to which all components designed for sitting support and propulsion/moving are attached.

Property: Frame, technical quality of construction

Definition: The extent to which the frame construction meets a generally accepted quality level.

Relevance: Despite its adequate strength and durability, a construction may still not function properly because of occurring play (free motion) or a bad finishing of welds.

Measuring procedure: Visual evaluation.

Note: In case of permanently positioned shower aids fixed to the wall or floor, the fixing method forms a part of the frame construction.

Property: Functional properties

Definition: Aspects directly relating to the user's functional limitations, the use and conditions of use of the product.

Property: Functional requirements

Definition: Functional requirements concerning aspects in connection with the use and conditions of use of the shower aid in relation to the user's or attendant's limitations and possibilities.

Property: User

Definition: The user is understood to mean the person occupying the shower aid.

Property: Ease of moving

Definition: The way in which and ease with which the shower aid can be moved with the use of one hand.

Relevance: Moving the shower aid over short distances (within the bathroom) will often take place with the use of one hand. The other hand will remain free for getting support.

Measuring procedure: The ready for use mass is measured.

Property: Fixation of paint coating

Definition: The quality of the fixation of the paint coating on the material which may be subjected to corrosion in the bathroom.

Relevance: To be able to use the shower aids permanently while maintaining an acceptable appearance the construction material should be able to resist wet usage conditions. For this purpose metals are provided with a number of paint coatings. The fixation of this coating on the metal indicates whether corrosion sources may simply occur by bumping or scratching the shower aid. When the shower aid is used by several persons, for example in an institution, a closed paint coating will further the cleaning properties and therefore the hygiene.

Measuring procedure: Measurement in accordance with the so-called grid test (NEN 5337). The fixation is determined before and after the corrosion test (see property 2.1.02.04).

Property: Ankle support

Definition: Part of the legrest designed for supporting the lower leg at the back of the foot. An ankle support is positioned within a height ranging from 0 tot 100 mm in relation to the surface of the foot or feetrest.

Property: Angle α

Definition: The angle between the seat and backrest.

Relevance: Users with a good or average sitting balance need a maximum support for performing activities, making a transfer and/or while giving care. The angle between the seat and backrest determines, together with the angle ϕ , considerably the required support.

Measuring procedure: The angle is measured of the loaded backrest from the vertical (angle α'). Measuring according to ISO DIS 7176/7, size 6.
Angle α is calculated as follows:
$$\text{angle } \alpha = \text{angle } \alpha' + 90^\circ - \text{angle } \phi$$

Property: Attendant

Definition: The attendant is the person walking behind the shower aid, who operates the PVT adjustments for the user and assists the user in performing the daily routine (hygiene) activities.

Property: Impact strength

Definition: Indication of the extent to which the shower aid or its components are resistant to repeated impact loads.

Relevance: The shower aid or its components are loaded at impact strength during sitting and performing activities, making a transfer, moving (if applicable) and lack of space and/or transportation.

Measuring procedure: If applicable, the following sequence of tests derived from ISO DP 7076/8 are carried out:

- seat, test, centre
ball of 25 kg on centre of seat from a height of 250 mm
- seat test, corner
ball of 25 kg on right seat corner from a height of 250 mm.
- backrest test, centre
ball of 25 kg against centre of backrest at a swinging height of 250 mm (at the time of impact the pendulum has an angle of 45° from the vertical)
- backrest test, side
ball of 25 kg. against right hand side of backrest at a swinging height of 250 mm (at the time of impact the pendulum has an angle of 45° from the vertical).

Property: **Foldable**

Definition: The possibility to reduce the size of the shower aid for the purpose of reducing the occupied space.

Property: **Test requirement**

Definition: The value in the functional and technical sense that the shower aid should at least satisfy.

Property: **Tilting facility**

Definition: Facility of the shower aid for tilting the aid slightly backwards in such a way that during moving only two wheels touch the ground for a short while.

Relevance: The possibility to negotiate low thresholds of approx. 20 mm by means of tilting contributes considerably to the possibility to move the shower aid in a simple manner.

Measuring procedure: Visual evaluation.

Property: **Force of self-propulsion (leg)**

Definition: The force required to set the shower aid in motion, keep it moving and to turn it in such a way that the user can provide the required moving force with the use of the legs.

Relevance: Users who move while sitting in the shower aid do this by exertion of leg force (tripping), however, possibly in combination with pulling (objects, bars to the wall).

Measuring procedure: The following measurement is made:

- pushing force start/continuous

Note: Propulsion forces required for manoeuvring are evaluated in 1.3.01.03 manoeuvring force.

Property: Force of self-propulsion (hand)

Definition: Arm strength required to set the shower aid in motion, to keep it moving and to turn it in such a way that the user can provide the required moving force.

Relevance: Users moving while sitting in the shower aid do this by exertion arm strength (handrims, pulling objects).

Measuring procedure: The following measurements are made:
- turning force for changing rolling direction
- pushing force start/continuing
pushing force is converted to handrim propulsion force with the formula a/h , for which
a = axle distance in relation to the floor
h = height of handrim top in relation to the floor
The highest value is taken into account for the evaluation.

Property: Calf support

Definition: Part of the legrest designed for supporting the lower leg at the back of the leg.

Property: Quality of the adjustments

Definitions: The extent to which the different adjustments of the body support part are geared to one another.

Relevance: The sitting posture substantially determines the possibility to perform activities and making transfers while sitting in the shower aid. An adequate sitting posture is determined by a proper matching of the different sitting angles.

Measuring procedure: Visual evaluation.

Property: Lumbar area free from backrest

Definition: This is understood to mean that during performing an activity the user's body up to the lumbar point comes free from the backrest (about 2/3 of the back free from the backrest).

Property: Measuring system

Definition: The measuring system relates to the different sizes in which the shower aid can be supplied.

Property: Ease of manoeuvring

Definition: The extent to which it is possible to effect small movements of the shower aids in every desired direction in such a way that the movements can be operated in a controlled and smooth manner and in conformity with the operation commands of the user/attendant.

Relevance: In and around the bathroom the user will transverse small distances while sitting in the shower aid. In connection with possible 'obstacles', manoeuvring should be an easy operation.

Measuring procedure: Experimentally
The following details are recorded:

- number of wheels;
- diameter of wheels;
- materials of wheels (massive rubbery, massive synthetic, pneumatic);
- type of wheels (castors, fixed wheels, castors fixed in rolling direction).

Property: Manoeuvring force

Definition: Force required to set the shower aid in motion, to keep it moving and to turn it in such a way that the required force can be supplied comfortably by the attendant.

Relevance: Users unable to move in the shower aid by means of self-propulsion may be moved by someone else, e.g. the attendant.

Measuring procedure: The following measurements are made:

- turning force for turning rolling direction;
- pushing force start/continuing.

The highest value is taken into account for the evaluation.

Property: Maximum unevenness

Definition: The maximum unevenness is the difference in level that the loaded shower aid can resist without a part of the floor surface coming loose from the floor.

Relevance: The floor of the bathroom may not be even as a result of a slipping surface or joints between tiles etc. To enable a stable support the shower aid should have a correction facility (e.g. an adjustable base) or the springs of the frame should be such that the difference in level can be compensated.

Measuring procedure: The shower aid is placed on a support surface with three wheels/legs and the fourth wheel/leg positioned on a separate support surface.
The shower aid is loaded with a 75 kg dummy.
The distance between both support surfaces is gradually increased by steps of 1 mm each.
It is determined at which distance between these support surfaces one of the four wheels/legs comes loose from the surface.

Property: **Transportation**

Definition: The possibility to use the shower aid for transportation purposes outside the area of use.

Property: **Ease of transportation**

Definition: The way in which and the ease with which the shower aid can be used outdoors.

Relevance: Some users may want to use the shower aid in another place, for example at a holiday address. The reduced dimensions should enable the shower aid to be placed e.g. in the boot of a motorcar.

Measuring procedure: The following is measured:
- dimensions of largest part after reducing/disassembly;
- weight of heaviest part.

The following is determined:
- movability after reducing/disassembly (if applicable);
- tools required for reducing /disassembly.

In case of disassembly all parts such as armrests and legrests are removed as far as this is possible without using tools. Lowering the backrest is also included in the disassembly operation.

Property: **Surplus design**

Definition: A change or added facility of the product necessary for the individual user, for which standardised interchangeable components are applied.

Property: **NI: Not Adjustable**

Definition: A position of a support component is considered not adjustable (NI) if it is not PVG, PVT or EI.

Property: **Lower legsupport**

Definition: The facility offering support to the lower legs.

Relevance: As the user is positioned in a more tilted position, the lower legs need to be adequately supported.
As regards shower aids with which the lower legs reach a more or less horizontal position in relation to the floor (large angle α and/or large angle β), the feet may slide off the footrest. For some users the feet may slide off the rests due to spasms.

Measuring procedure: Visual evaluation.
The following details are recorded:
- type of lower leg support (calf or ankle)

Property: Supporting elements

Definition: These include elements of the shower aid that support in one way or another the body at specific points. (seat, backrest, armrest, headrest, legrest and footrest).

Property: Foldable

Definition: The possibility to reduce the size of the shower aid for the purpose of reducing the space occupied by the shower aid.

Property: Surface

Definition: Largest surface on the floor occupied by the shower aid, measured on the largest width and length.

Relevance: The surface occupied by the shower aid relates to the space occupied by the aid when used and also affects the manoeuvrability of mobile shower aids.

Measuring procedure: Measuring the largest width. Measuring largest length and height.

Property: Get-up height

Definition: The height available for getting up and sitting down. The available height is determined by the distance from the seat front edge to the floor.

Relevance: The seat clearance is relevant for limiting the strain as much as possible when getting up and sitting down again.

Measuring procedure: The vertical distance between the front of the loaded seat and the floor is measured. Measurement in accordance with ISO DIS 7176/7, size 5.

Property: Get-up space

Definition: Space underneath the seat of the shower aid available to place a foot under the body centre of gravity in such a way that the user is able to get up in a stable position by effecting one operation only.

Relevance: To get up in a stable position enough leg space is required to position the feet under the body centre of gravity. If this space is lacking, the user will have to pull himself up or shift forwards first in order to create adequate space.

Measuring procedure: Removable legrests/feetrests are taken away. It is determined whether the get-up dummy reaches the depth of 0 mm compared to the seat front at a distance of 115 mm of the centre line of the RLG dummy. Next, the distance from left to right is measured in which this get-up depth has not changed.

Property: Overlap toilet opening

Definition: The overlap of the toilet opening, measured from the backrest of the shower aid, with the opening of the toilet which the shower aid is positioned.

Relevance: The place of the toilet opening in relation to the toilet is important to ensure that bowel movement takes place without the toilet getting dirty.

Measuring procedure: The shower aid is positioned over a:
- standard toilet (2 models) with toilet seat lowered, height (excluding seat) 39 cm.
The following is measured:
- length of overlap toilet opening shower aid with toilet opening of toilet.

Property: Go over facility (rolling)

Definition: Possibility to go with the shower/toilet chair over the toilet (rolling).

Property: Push over distance

Definition: The distance between the support surface of the shower aid and the home support element to be reached as from the starting position for the purpose of pushing over.

Relevance: To get in and out the shower wheel chair a transfer is made, if necessary with the use of a push over board. The push over distance is affected by protruding legrests, brakes and wheels.

Measuring procedure: The distance from the seat edge of the shower aid to the fixed wall is measured, for which the shower aid is positioned parallel to the wall.

Property: Push over depth

Definition: The minimum depth available to support the bottom during pushing over.

Relevance: When the push over depth is too small, the user has insufficient space during pushing over for an adequate support of the bottom.

Measuring procedure: The distance is measured from the seat front to the place where other parts than the supporting surface determine the push over height (large wheels, backrest tube), for which measurements are made in accordance with ISO 7176/7 along the bottom support surface.

Property:: Push over height

Definition: Maximum height of the shower aid to be pushed over when making a push over transfer.

Relevance: If parts protrude the seat when pushed in, these may obstruct the use of a patient lifter or a pushing over operation.

Measuring procedure: The height is measured of the most protruding part in relation to the seat support surface with a seat loaded by RLG and an unloaded seat over a distance of 200 mm from the seat front.
Obstructing support elements (armrests/legrests) are removed).

Property: Product information

Definition: Information in the form of indications/inscriptions on the shower aid (labels) and separate written explanation (manual).

Relevance: For the user and attendant the product information is important with regard to

- the safe use of the product;
- reporting defaults to the manufacturer/importer.

Measuring procedure: Visual evaluation.

Property: PVG: Permanently Adjustable by the User

Definition: An operation is called permanently adjustable by the user if it involves a mechanical operation and the user himself can place the (loaded) support element in the required position.

Property: PVT: Permanently Adjustable Therapist/Attendant/Assistant

Definition: A control is called permanently adjustable by the therapist or attendant (PVT) if the control is designed in such a way that one attendant at any time and without help can position and fix a loaded support element without the use of tools.

Property: Brakes

Definition: The determination of the presence of the type of braking system and the points of application of the shower aid.

Property: Brakes, technical quality of construction

Definition: The extent to which the construction of the brakes and its fixing satisfies a generally accepted quality level.

Relevance: Despite its adequate strength and durability a construction may still not function properly because of the occurrence of play (free motion) for example or a bad finishing of welds.

Measuring procedure: Visual evaluation.
The method of braking is determined:
- number of wheels provided with brakes;
- method of operation (hand/foot);
- operation for each separate wheel or several wheels.

Property: Backrest height

Definition: The length available for supporting the back in such a way that sufficient support is provided to the user while adequate freedom of movement for performing activities is still maintained.

Relevance: The backrest height together with the backrest width determines the degree of support and freedom of movement for performing activities.

Measuring procedure: The backrest height is determined by the distance from the upper contact point of the backrest to the loaded seat.
Measurement according to ISO DIS 7176/7, size 7.

Property: Sharp parts

Definition: The presence of sharp parts on the shower aid.

Relevance: The finish of the shower wheelchair is important when getting up/sitting down and making transfers because during this process the body is relatively under poor control. Moreover, the product is designed for use by persons not wearing clothes as a result of which there is no protection provided by these clothes.
In addition, adjusting and cleaning should take place without the risk of getting injured.

Measuring procedure: Visual evaluation.

Property: Stability tilting, loaded

Definition: The stability of the aid when loaded on one side during sitting and performing activities.

Relevance: The stability of the aid is important during washing (reaching forwards and sideways) because of the forward, backward and sideward forces that may be involved.

Measuring procedure: The forward, sideward and backward stability is measured (in degrees). This is done by placing the shower aid on a slope and measuring the angle at which the shower aid start tilting. During this measurement the shower aid is loaded with 75 kg. Brakes are applied on a moveable shower aid, with the castors positioned in the rolling forwards position.

Property: Standard components

Definition: These comprise standard parts supplied with the shower aid that are interchangeable for each make.

Property: Standard design

Definition: The model of the shower aid with which the needs of the major part of the user population in a target group are met.

Property: Static strength

Definition: Indication of the extent to which the shower aid is resistant to a single extreme load.

Relevance: The shower aid is statically loaded during sitting and performing activities and, if applicable moving.

Measuring procedure: If applicable, the following sequence of tests carried out derived from ISO DP 7176/8:

- armrest test: 250 N under 45° downwards on 50 mm from the front of armrest
- footrest test: 1500 N downwards on the centre of the footrest (for supporting both feet)
750 N downwards on centre of footrest (for supporting one foot)

Property: Technical Requirements

Definitions: Technical requirements concern the aspects directly relating to the construction, durability, repair and maintenance-friendliness of the technical aid (rigidity of the frame, finish etc.).

Property: Technical properties

Definition: Technical properties concern the aspects directly relating to the construction, durability, repair and maintenance-friendliness of the shower aid.

Property: Toilet opening

Definition: The dimensions of the toilet opening (or washing opening at the back of the body) in the main directions of the seat, and the position of the back of the toilet opening compared to the backrest.

Relevance: The dimensions are important to make urinating and defecating possible and for washing the genital area.
The place is important to make urinating and defecating possible while the user maintains supported by the seat. This applies to the use above a toilet as well as the use as a toilet chair.

Measuring procedure: Measuring along the surface of the seat of the main dimensions of the toilet opening. Measuring the horizontal distance from the back of the toilet opening of the shower aid to the most backwards protruding point of the shower aid. If the backrest angle is adjustable, it is placed at an angle of 10° from the vertical, or the nearest possible angle.

Property: Transfer

Definition: Moving or being moved from one to another home support element.
The following types can be distinguished:
1a Sitting down from a walking or standing posture;
1b Getting up or walking from a sitting posture;
2 Getting up from a sitting posture, turning the body (usually moving the feet a little, possibly with the use of a turning disk) and sitting down again;
3 From a sitting posture: moving in a horizontal direction (shift over board) with the use of the arms by pushing up or pulling up (pulling aid) and sitting down again;
4 Moving a person from a supine or sitting posture from one home support element with a body support aid to be placed under or around the person to another home support element (use of patient lifter).

Property: Transfer angle ϕ

Definition: The angle of the seat, temporary for performing activities or making a transfer, from the horizontal.

Relevance: Making a transfer and performing some activities are easier when the user adopts a sitting posture. The angle of the seat from the horizontal determines, together with angle α , the straight sitting posture.

Measuring procedure: The angle is measured of the loaded seat from the horizontal. Measuring according to ISO DIS 7176/7, size 1.

Property: Transfer height

Definition: The height available for pushing over. The available height is determined by the distance from the front of the seat to the top of the seat of other body support elements such as a bed and wheelchair.

Relevance: The clearance between the seat and the floor is important to limit the required effort and the difference in level between the shower aid and other home support elements.

Measuring procedure: The vertical distance is measured from the front of the loaded seat to the floor. Measuring according to ISO DIS 7176/7, size 5.

Property: Tripping height

Definition: Height available for tripping in such a way that the user can push his feet against the floor when tripping. The height is determined by the distance from the seat to the floor.

Relevance: When moving, users will effect the propulsion by pushing their feet (heels) against the floor. They will usually move in a backwards direction.

Measuring procedure: The vertical distance is measured from the front of the loaded seat to the floor. Measuring according to ISO DIS 7176/7.

Property: Tripping space

Definition: Space available for tripping in such a way that the user can push his feet against the floor. The space is determined by the presence of support elements or frame parts.

Relevance: When moving, users will effect the propulsion by pushing their feet against the floor.

Measuring procedure: Detachable legrests/footrests are removed. It is determined whether with a get-up dummy the depth of 0 mm in relation to the front of the seat is reached at a distance of 115 mm from the centre line of the RLG-dummy. Next, the free distance from the left to right is measured in which this tripping depth remains unchanged.

Property: Removing/placing toilet pot

Definition: The way in which and ease with which the pot can be removed or placed with respect to the toilet opening of the shower aid.

Relevance: When shower aids are used as support and transfer aids it is possible to combine showering and going to the toilet, for which the shower aid can also be used as a toilet chair.

Measuring procedure: Experimentally.
The following is measured:
- dimensions of opening (length and width)

Property: Design of push chair

Definition: The following models occur:
2 fixed rear wheels - 2 front castors
2 rear castors - 2 fixed front wheels
4 castors

Property: Design of self-propulsion model

Definition: The following models occur:
2 large rear wheels - 2 front castors
2 rear castors - 2 large front wheels

Property: Fixed position

Definition: Product design for use on a clinched and riveted place in a bathroom and not intended for use in another place. A distinction can be made to fixed to the wall and fixed to the floor.

Property: Reducing

Definition: Folding, lowering, disassembling, reducing height or a combination of these operations for the purpose of transporting or storing the shower aid. Note: Folding, lowering, disassembling, reducing height or a combination of these operations concern the way in which the size of the shower aid is reduces after removing the armrests and legrests as well as any seat and back cushions.
The evaluation of the method reducing does not include removing the armrests and legrests (this aspect is evaluated elsewhere) but it does include the removing of seat and back cushions (if possible and required to reduce the size of the shower aid). Reducing is effected without the use of tools.

Property: Lowering

Definition: Lowering the frame of the shower aid for the purpose of reducing the height of the shower aid.

Property: Moveable

Definition: Product design for use on different places in the bathroom and moving the user by means of pushing, lifting or rolling.

Property: Mobile

Definition: Product design for use in and around the bathroom and moving the user while sitting in the support aid.

Property: Shifting resistance (friction, static)

Definition: Force required to just compensate the friction between the shower aid and the surface or brake and wheel, so that the shower aid starts moving.

Relevance: During sitting, performing activities and making a transfer, all kinds of forces are exerted on the shower aid.

Measuring procedure: The horizontal pulling force backwards is measured at the level of the wheel axles or the underside of the legs (5 cm above floor surface) at the moment the shower aid starts moving.

The shower aid is placed on a wet and slippery tiled floor (soap). The floor has been prepared with a solution of 100 ml washing liquid in 5 litres of water. The shower aid is loaded with a dummy of 75 kg. Brakes are applied on mobile shower aids, castors are positioned in the rolling backwards direction. The total wheel surface is moistened.

Property: Folding

Definition: Folding the frame for the purpose of reducing the overall width of the shower aid.

Property: Adjustable

Definition: PVG: Permanently adjustable by the user.
PVT: An adjustment is called permanently adjustable by the therapist or attendant (PVT), when the adjustment is designed in such way that one attendant, at any time and without help, can position and fix a loaded support component without using tools.
This is based on a 65-year-old female.
EI: An adjustment is called a single adjustment (EI) if the adjustment of a (loaded or unloaded) support component has to be effected with the use of tools or if it can be effected without tools but only if the user is not occupying the shower aid.
NI: A position of a support component is considered non-adjustable (NI) if it is not PVG, PVT, or EI.

Note:
The adjustments of the support components are measured when loads are applied if it concerns PVG or PVT.

Property: Adjustment of angle α

Definition: The way in which and ease with which angle α can be adjusted.

Relevance: The angle between the seat and backrest is, if adjustable, adjusted to the user's requirements when the shower aid is first put into use.

Measuring procedure: Visual evaluation/experimentally.

Property: Adjustment of angle ϕ (transfer angle)

Definition: The way in which and the force with which the supporting part can be tilted in relation to the horizontal by the user or the attendant while the user is occupying the support aid.

Relevance: A straight sitting position is in many cases more required for making a transfer than during performing activities or sitting. Adjusting the body support part in these two different positions should be effected by the user and/or attendant without any difficulties.

Measuring procedure: Experimentally and by measuring required force. It is recorded whether the user comes free from the backrest, and the required operation force.

Property: Adjustment of angle ϕ (wedge angle)

Definition: The way in which and ease with which angle ϕ is adjustable.

Relevance: If adjustable, the wedge angle is adjusted to the user's requirements when the shower aid is first put in use.

Measuring procedure: Visual evaluation, experimentally.

Property: Adjustment of sitting height EI

Definition: The way in which and ease with which the sitting height is adjustable.

Relevance: The sitting height is adjusted to the lower leg length of the user.

Measuring procedure: Visual evaluation/experimentally.

Property: Adjustment of seat height EI

Definition: The way in which and ease with which the seat height is adjustable.

Relevance: If adjustable, the seat height is adjusted to the user when the technical aid is put into use. The adjustment is matched to the user's lower leg length.

Measuring procedure: Visual evaluation/experimentally.

Property: Height for performing care activities

Definition: Height available as working height for the attendant while giving care to the user. This height is determined by the height of the top of the seat in relation to the floor.

Relevance: When giving care to the user while this person is occupying the shower aid and when offering assistance during a transfer, the attendant should be able to adopt the best possible working posture. A proper working height is of key importance in this respect.

Measuring procedure: The vertical distance is measured from the front of the loaded seat to the floor. Measuring according to ISO DIS 7176/7, size 5.

Property: Footrest

Definition: Part of the legrest designed for supporting the feet.

Property: Footrest, type of

Definition: Method of removing the foot (feet) rest for the purpose of making a transfer. There are four types:

- A: fixed
- B: folding back (sideways)
- C: folding back (backwards)
- D: pushing aside

Property: Footrest

Definition: Part of the legrest designed for supporting one foot.

Property: Footrest design

Definition: The space available for supporting the feet in such a way that the bare feet are provided with comfortable support.

Relevance: Supporting the bare feet requires an adequate support surface to give support without any pain. The feet should not get stuck between the footrests.

Measuring procedure: The opening between the footplates is measured.

The following is recorded:

- material/upholstery;
- design of support surface (flat, round).

Property: Removeable

Definition: The possibility to fold back a support component and its construction in such a way that certain activities are made easier (sitting, performing activities, making a transfer) and/or the space occupied by the shower aid can be improved.
Contrary to detachable the removeable part should remain fixed to the shower aid.

Property: Removing support components (armrest, footrest, legrest)

Definition: The way in which and ease with which support components (armrest, foot/legrest) can be removed and replaced.

Relevance: For a transfer of the user in and out of the shower aid it may be necessary to temporarily remove support components such as arm rests and foot/legrests.

Measuring procedure: Experimentally
It is recorded whether elements can remain fixed to the aid after removing. The basis is that the footrests can be removed in such a way that the user is able to get up and at least do a few steps in the forward direction.

Property: Wheels and wheel suspension, technical quality of construction

Definition: The extent to which the wheel constructions and its suspension to the frame meet a generally accepted quality level.

Relevance: Despite its adequate strength and durability a construction may still not function properly because of occurring play (free motion) or bad finishing.

Measuring procedure: Visual evaluation.
It is determined whether the construction of the wheels is susceptible to dirt (hair, soap) and humidity.

Property: Wedge angle ϕ

Definition: The angle of the seat from the horizontal.

Relevance: The user will need maximum support when adopting an active sitting posture for the purpose of performing activities and moving, if applicable. The angle of the seat from the horizontal substantially determines the possibility to adopt this active sitting posture.

Measuring procedure: The angle is measured of the loaded seat from the horizontal. Measuring according ISO DIS 7176/7, size 1.
In case of rigid and/or short seats without a backrest, measuring takes place by determining the angle of the support surface from the horizontal without using the RLG.

Property: (Self) care

Definition: Reaching in principle all parts of the body for the purpose of performing hygienic activities or getting dressed.

Property: Side support

Definition: Part of the shower aid on which the hands can be place during sitting, getting up and leaning over sideways. A side support is always fixed to the shower aid and usually does not support the forearm.

Property: Sitting width

Definition: The width available to support the upper legs and the bottom when performing activities and moving, if applicable. The available sitting width is determined by the configuration of armrests, side supports and seat width.

Relevance: Together with the sitting depth the sitting width determines the degree of support during sitting and the degree of freedom of movement for performing activities and propulsion.

Measuring procedure: The sitting width is determent by the smallest of the following three possibilities:
- the actual width of seat cushion or toilet seat + 40 mm;
- the space between the protective parts/side supports - 40 mm;
- the distance between the armrests.
Measuring according to ISO DIS 7176/7, sizes 3, 4 and 21 respectively.

Property: Sitting depth

Definition: The depth available for supporting the bottom in such a way that bottom and upper legs are adequately supported. The available depth is determined by the configuration seat length and, if present, back rest (and possibly leg rests).

Relevance: The users are in particular supported underneath the bottom.

Measuring procedure: If no backrest is present and in case of a fixed positioning, the sitting depth is determined by:
- the distance from the front of the seat to the wall if there is no free space between the back of the seat and the wall (measuring same as sitting depth ISO DIS 7176, size 2);
- distance from the front of the seat to the back of the seat if there is free space between the back of the seat and the wall.
And if no backrest is present and in case of a moveable shower aid:
- distance from the front of the seat to the back of the seat.

If there is a backrest present the sitting depth is determined by:
- distance from the front of the seat to the backrest according ISO DIS 7176, size 2.

Property: Sitting height

Definition The height available for supporting the feet. The available height is determined by the configuration of the seat and the footrests. The sitting height corresponds with the lower legs length.

Relevance: In case of mobile shower aids the feet should be free from the floor during moving for safety reasons. For pushing over, the height of the seat is matched to the height of the bed and/or the seat of a wheelchair for example. In that case the feet should receive adequate support. If shower aids are involved that do not require a footrest and if the seat height is rather high in relation to the floor for getting up and sitting down again, there may be a need for a facility supporting the feet during sitting and performing activities.

Measuring procedure: The sitting height is determined by the distance from the front of the loaded seat to the back of the footrest.
Measuring according to ISO DIS 7176/7, size 11.

Property: Sitting posture

Definition: A sitting posture is largely determined by the angles between seat and backrest: angle α and the angle of the seat from the horizontal: angle ϕ .

3 Measuring equipment and measuring conditions

1 Test limits

The measuring accuracy corresponds with the nature of the measured values. For the determination of the test limits the measuring accuracy has been taken into account.

2 Test and Measuring equipment

Overview of the other test and measuring equipment used.

appliance	make and type (for similar)	measuring accuracy
Protractor	Inogon (mecanic)	0,2°
Protractor	SOAR 1700 (electronic)	0,5°
Dynamometer	Salter (electronic) 0-200N	0,1 N
Balance	MOBBA type SL-4 (0-500 kg)	0,2 kg
Tyre pressure	(hand)manometer (0-4,5 bar)	0,2 bar
Tyre pressure	(on compressor) (0-10 bar)	0,05 bar
Vernier rule (digit)	Mitutoyo 500-501	approx. 0,05 mm
Flexible steel rule, steel rule, try square	Various	
Dynamorecorders	Various	0,2%
Amplifiers	Various	1% adjustable

Other test and measuring equipment:

- ISO Test dummy 75 kg. (ISO 7176-11)[9];
- RLG Dummy ISO/DIS 7176-7;
- Slope board IW-TNO (1,2 meter, angle adjustable from 8° tot $\geq 45^\circ$);
- Impact; pendulum loading mass (ISO/DP 7176-8)[7].

3 Measuring conditions

If the shower aid is to be tested against functional, technical and legal requirements, this is to be performed subject to the following conditions, unless stated otherwise or deemed irrelevant.

- shower aid ready for use;
- sufficiently acclimatised (temperature and humidity test lab.);
- castors in following position for driving straight ahead;
- shower aid loaded with a testdummy of 75 kg or 100 kg according to ISO/DIS 7176-11. The selection of the dummy mass is made on the basis of the maximum weight of the user as recommended by the manufacturer. If the advised weight exceeds 75 kg, the 100 kg dummy is used, in other situations the 75 kg dummy is selected.

Before a shower aid is tested against the criteria the following checks are made:

- overall technical inspection;
- reading the instruction booklet or manual.

The shower aid to be tested is adjusted to its basic position before the measurements start.

- in principle the test is based on the supplied ready for use condition of the technical aid, unless the position of a component is adjustable, in which case an adjustment is selected for each component in accordance with the neutral basic position:
 - footrest, footrest clearance 50 [mm];
 - middle position height adjustment seat;
 - sitting angle 4° from horizontal (or nearest smaller angle);
 - back rest angle, 10° from vertical (or nearest smaller angle);
 - legrest angle 90° from the seat (or nearest larger angle);
 - entire sitting support, in forward position if turnable;
 - entire sitting support, in middle position if horizontally adjustable;
 - armrest height, in middle position;
 - armrest angle, as much as possible in accordance with sitting angle;
 - headrest height and depth, in middle position.

In addition for mobile shower aids:

- fixed/propulsion wheels as supplied or recommended by manufacturer, if adjustable without tools, in middle position;
 - pushing bars, as high as possible or up to a maximum of 11200 [mm] from the floor;
 - standing backrest tubes, as high as possible or up to a clamp length of 50 [mm];
 - tipping and/or anti-tipping facility as far as possible to the back or up to a clamp length of 50 [mm] or to a tilting possibility of the shower aid to negotiate a threshold of 100 [mm].
- tyre pressure (indicated by shower aid manufacturer or tyre manufacturer)*

For fixedly positioned shower aids

- the fixing is as much as possible based on the supplied fixing material;
- the shower aid is as firmly as possible fixed to a steel plate.

For non-fixedly positioned shower aids

- the shower aid is placed on a flat horizontal surface in a position ready for use.

*) If the manufacturer indicates a higher pressure than stated on the tyre the indication on the tyre is taken into account.

- if the length of one of the legs is adjustable, it will be adjusted such that the shower aid is placed in a horizontal position.
If it concerns a non-gradual adjustment facility, the position is selected in which the shower aid is positioned as horizontal as possible.
- if several, but not all legs are adjustable, the length is adjusted such that the shower aid is positioned as horizontal as possible.
If it concerns a non-gradual adjustment facility, the position is selected in which the shower aid is positioned as horizontal as possible.
- if all legs are adjustable, the length of these legs should be adjusted such that $\frac{1}{2}$ of the length of the extendible part overlaps the fixed frame part.

4 Measuring room

If the shower aid is to be tested against the requirements included in this homologation directive, it should be performed in a room subject to the following measuring conditions, unless it is stated otherwise:

- a temperature of 20°C - 3°C/ + 5°C;
- a relative humidity of 60% approx. 15%.

Floor (rolling tests):

- tiled floor.

Slope and sloping board:

- multiplex;
- stepless adjustable slope angle;
- friction coefficient of the surface between 0,75 and 1.0 measured according to ISO 7176/13[11].

Measuring platform (sitting posture and overall dimensions):

- horizontal, even and rigid surface with vertical back.

5 Measuring accuracy

Overview of the required measuring and reading accuracy

entity	object	measuring accuracy	reading accuracy
Length	contour and sitting posture dimensions e.g. l, w. h, diagonal	5 mm	
	e.g. handrim thickness	1 mm	0,1 mm
Angles	protractor reading	1°	0,5°
Forces	e.g. control buttons	1 N	0,5 N
	levers, pushing force e.g. holding force of brake	5 N	2,5 N

ISO measurements are subject to tolerance in accordance with ISO.

4 Testmethods and conditions

1 Functional test

1.1 Pushing force measurements

With the use of a pushing force measuring instrument a horizontal and as slowly as possible increasing force in the rolling direction is applied to the centre of the shower aid. As regards shower aids equipped with pushing handles, pushing bars or pushing rail this force is to be applied at the level of these facilities. If the shower aid does not have these facilities the force is to be applied at the most obvious place, preferably in the area between the 900 and 1200 mm (at a right angle from the floor). The measurement should be made at least three times. The lowest value is to be considered the test value and tested against the test requirement.

1.2 Manoeuvring force/force self-propulsion (hand)

The manoeuvring force/force self propulsion (hand) is determined for shower aids by determining the force required to change the shower aid from a standing position (turning the castors in another rolling/following direction).

The shower aid is to be positioned before the measurement in accordance with the diagram (see appendix A). Next, a slowly increasing force (F) is applied centrally in the extension of the shower aid until the rolling direction (following position of the castors) is reversed.

1. The force is to be applied at the level of the pushing handles. The measurement is made 3 times. The lowest measuring value is to be considered the test value and tested against the test requirement.
2. The force is to be applied at the level of the rear wheel-shaft. The measurement is also to be made at least three times. However, the lowest measuring value is to be multiplied with the factor a/h (radius of the propelled wheel divided by the vertical distance from the top of the handrim to the floor): this result should be considered the test value and tested against the test requirement.

1.3 Operating force

Handles

The operating force of handles is measured with the use of a dynamometer. During the measurement, the dynamometer should be placed parallel to the operated rolling direction and on the centre of the operating unit (knob) or if no knob is present, on 25 mm from the tip of the operating handles. While applying an as slowly as possible increasing force the (maximum) occurring operating force is measured and the outcome is recorded on the measurement list.

This measurement is to be made 3 times. The lowest measuring value of these 3 measurements is considered to be the test value.

Knobs

The operating force of turning knobs is measured with the use of a momentmeter. The momentmeter is fixed concentrically to the turning knob with the use of an accessory device. During an increasing moment the (maximum) occurring operation moment is measured and recorded as the result on the measurement list. This measurement is to be made 3 times. The lowest measuring value is considered to be the test value.

2 Strength and durability tests

2.1 General

The shower aids to be tested are adjusted once in the neutral basic position before the start of the total package of strength and durability tests. The neutral basic position is obtained through adjustments of the ready for use shower aid. If applicable, the shower aid should therefore be first adjusted to its initial, ready for use condition as concerns the model, adjustments etc..

After this, the shower aid can be adjusted to the neutral basic position, except for the lowest point of the footrest 100 mm.

2.2 Static strength

The static strength tests should be carried out according to the sequence as indicated. For test force values see the table in appendix B-4.

1. Armrest test 1: by means of a downwards direction force, placed at an angle of 45 degree from the vertical in relation to the cross-axle. The testing force is to be applied at 50 mm from the front of the armrest (see appendix B-4, figures 3 and 4, force 1)
Test conditions:
 - castors in the rolling forwards position;
 - parking brake applied on the shower aid;
 - shower aid fully loaded.

2. Footrest test: by means of a vertically downwards directed force on the (right) footrest. The testing force is to be applied in the centre of the footrest plate (see appendix B-4, figure 3 and 4, force 2).
If there is an open space = 25 mm at the place where the testing force is to be applied (e.g. two tubes as a footrest) this should be bridged by a 30 mm wide rectangular bar or tube (see appendix B-3, figure 2).
Test conditions:
 - castors in rolling forward position;
 - parking brake applied on the shower aid;
 - shower aid subjected to a load (not the footrests);
 - reaction bar at point 1 (see appendix B-3, figure 5).

2.3 Impact strength

1. Seat test 1: dropping a football filled with lead shot in the centre of the seat.
Test conditions:
 - impact point see appendix C-2, figure 1 and 2, force 8;
 - dropping height of loading pad see table in appendix C-2;
 - castors in rolling forward position;
 - shower aid applied on the parking brake;
 - unloaded shower aid.

2. Seat test 2: dropping a football filled with lead shot on the right side front of the seat (frame). If the armrest is detachable it should be removed before the test is carried out.
Test conditions:
 - impact point see appendix C-2, figure 1 and 2, force 9;
 - dropping height of loading pad see table in appendix D;
 - castors in rolling forward position;
 - parking brake applied on shower aid;
 - unloaded shower aid.

3. Backrest test 1: impact by swinging of a football filled with lead shot fixed to a rope, in such a way that the backrest is loaded at an angle of 45 degrees in the centre and at the top of the backrest.
Test conditions:
 - impact point see appendix C-2, figure 1, 2 and 3, force 10;
 - dropping height of the swinging loading pad see table in appendix C-2;
 - castors in rolling forward position;
 - parking brake applied on shower aid;
 - shower aid loaded without back part of the ISO Test dummy.

4. Backrest test 2: impact by swinging football filled with lead shot fixed to a rope, in such a way that the right backrest tube is hit at the top at an angle of 45 degrees. If the shower aid is provided with non-detachable back cushions paced before the backrest tube, the impact should take place at the right top of the backrest cushion.
Test conditions:
 - impact point see appendix C-2, figure 1, 2 and 3, force 11;
 - dropping height of the swinging loading pad see appendix C-2;
 - castors in rolling forward position;
 - parking brake applied on shower aid;
 - shower aid loaded without back part of the ISO Test dummy.

2.4 Fixing of coating

The test is to be carried out and evaluated in accordance with NEN 5337 [12] (heavier test, with adhesive tape in accordance with statement by paint institute TNO). If one colour and one type of underground material is used for a shower aid, at least two tests are performed both before and after the corrosion test. The tests before the corrosion test should be carried out on different parts. Those after the corrosion test on the same parts. If the coating is applied on different underground materials or if different coatings (statement by client ordering the test) and/or colours have been used these should be tested separately.

Appendix A Manoeuvring force/force self-propulsion (hand)

Appendix B Static strength

Standard loading pad

The standing loading pad should be a rigid circular object 100 mm, in diameter whose face has a convex spherical curvature of 300 mm radius with a 12 mm front edge radius. Pads should be faced with a layer of hard polyether foam 2 mm thick.

Standard loading mass

The standard loading mass is a regulation association football, size 5 (soccer ball) filled with lead shot of approximately 3.0 mm to 4.0 mm diameter for a total weight of 25 kg.

Table	Static strength tests	
Test no.	Brief description of place, direction and maximum test force. If applicable, only the parts situated at the right hand side.	
1.	arm rest 45° downwards	250 N
2.	footrest downwards	750 N

Appendix C impact strength

C-2

Table	Dynamic strength test	
Test no.	Description of place, direction, dropping height (mm), speed [m/s] and mass [kg] (only if these are applicable). If applicable, only the parts at the right hand side.	
8.	at the centre of the seat	drop. height 250 mm M = 25 kg
9.	right corner of the seat	drop.height 250 mm, M = 25 kg.
10.	centre top of backrest	drop. height 175 mm, M = 25 kg
11.	right top of backrest tube	drop. height 175 mm, M = 25 kg

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