

INTERNATIONAL STANDARD

ISO 7176-7

First edition
1998-05-15

Wheelchairs —

Part 7:

Measurement of seating and wheel dimensions

Fauteuils roulants —

Partie 7: Mesurage des dimensions d'assise et des roues



Reference number
ISO 7176-7:1998(E)

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International Organization for Standardization
Case postale 56 • CH-1211 Genève 20 • Switzerland
Internet central@iso.ch
X.400 c=ch; a=400net; p=iso; o=isocs; s=central

Printed in Switzerland

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

International Standard ISO 7176-7 was prepared by Technical Committee ISO/TC 173, *Technical systems and aids for disabled or handicapped persons*, Subcommittee 1, *Wheelchairs*.

ISO 7176 consists of the following parts, under the general title *Wheelchairs*:

- *Part 1: Determination of static stability*
- *Part 2: Determination of dynamic stability of electric wheelchairs*
- *Part 3: Determination of the efficiency of brakes*
- *Part 4: Energy consumption of electric wheelchairs and scooters for determination of theoretical distance range*
- *Part 5: Determination of overall dimensions, mass and turning space*
- *Part 6: Determination of maximum speed, acceleration and retardation of electric wheelchairs*
- *Part 7: Measurement of seating and wheel dimensions*
- *Part 8: Requirements and test methods for static, impact and fatigue strengths*
- *Part 9: Climatic tests for electric wheelchairs*
- *Part 10: Determination of obstacle-climbing ability of electric wheelchairs*
- *Part 11: Test dummies*

- *Part 13: Determination of coefficient of friction of test surfaces*
- *Part 14: Power and control systems of electric wheelchairs — Requirements and test methods*
- *Part 15: Requirements for information disclosure, documentation and labelling*
- *Part 16: Resistance to ignition of upholstered parts — Requirements and test methods*

The following parts are also on the programme of work:

- *Part 17: Serial interface for electric wheelchair controllers*
- *Part 18: Stair-traversing devices*
- *Part 19: Wheeled mobility devices for use in motor vehicles*
- *Part 20: Determination of the performance of stand-up wheelchairs*
- *Part 21: Requirements and test methods for electromagnetic compatibility of powered wheelchairs and motorized scooters*
- *Part 22: Set-up procedure for adjustable wheelchairs*

A Technical Report will also be made available giving a simplified explanation of these parts of ISO 7176.

Annex A forms an integral part of this part of ISO 7176. Annex B is for information only.

Introduction

The purpose of this part of ISO 7176 is to ensure comparability of information on seating and wheel dimensions by specifying a consistent, repeatable method of measurement that provides information relevant to prescribers' needs.

Wheelchair seats and wheels tend to involve deformable, contoured and flexible structures with few consistent reference points to which reliable measurements can be made. In the past, manufacturers have developed their own methods of measurement that differ from each other. This prevents comparison of measurements from one manufacturer to those of another.

In addition, measurements are sometimes selected for reasons of ease of measurement rather than for clinical usefulness. For example, seat depth for sling seats is usually determined along the sling material and does not consider the gap between the back of the seat and the backrest. This gap can be as large as 5 cm and significantly affects the wheelchair's seat depth.

Further problems can arise from adjustable features which can interact to generate, potentially, very large numbers of measurements.

This part of ISO 7176 involves first placing a standardized loader gauge in the wheelchair seat. Two sizes of loader gauge are specified corresponding respectively to adult and child body sizes. The gauge deforms any flexible structures in a repeatable manner and provides reference points to which dimensions can be measured. The positions at which measurements are made are described relative to the loader gauge. Accurate positioning of the gauge is essential for repeatability of results and is specified in detail in the text. Finally, to facilitate comparisons of different manufacturers' data, a format is included in which results are to be presented.

It should be noted that wheelchairs are often produced in model ranges, consisting of a basic model with a series of variations from this basic model. It is the responsibility of those commissioning the measurements to select which model variations are measured.

Wheelchairs —

Part 7: Measurement of seating and wheel dimensions

1 Scope

This part of ISO 7176 specifies a method for measuring the seating and wheel dimensions of wheelchairs.

It is applicable to wheelchairs and vehicles intended to provide indoor and outdoor mobility at speed up to 15 km/h for people with disabilities whose mass does not exceed 120 kg, including the following classifications from ISO 9999:1992:

Electric motor-driven wheelchairs with manual steering	12 21 24
Electric motor-driven wheelchairs with power steering	12 21 27
Powered attendant-controlled wheelchairs	12 21 21
Manual attendant-controlled wheelchairs	12 21 03
Bimanual rear-wheel-driven wheelchairs	12 21 06
Bimanual front-wheel-driven wheelchairs	12 21 09
Bimanual lever-driven wheelchairs	12 21 12
Single-side-driven nonpowered wheelchairs driven by one arm or one leg	12 21 15
Foot-propelled wheelchairs	12 21 18

It does not apply to wheelchairs with a seat width of less than 212 mm.

This part of ISO 7176 does not specify nominal seating and wheel dimensions for wheelchairs.

NOTE For wheelchairs not covered by the scope, this part of ISO 7176 may still give an indication of where measurements should be made. Observe that for wheelchairs designed for users whose mass is significantly greater than the reference loader gauge (see Annex A) and which have compressible parts such as sprung wheels and/or seats, this measurement procedure may not give the correct seat measurements, as the compressible parts will not be fully compressed.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this part of ISO 7176. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this part of ISO 7176 are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 6440:1985, *Wheelchairs — Nomenclature, terms and definitions*.

ISO 7176-15:1996, *Wheelchairs — Requirements for information disclosure, documentation and labelling*.

ISO 9999:1992, *Technical aids for disabled persons — Classification*.

3 Definitions and abbreviations

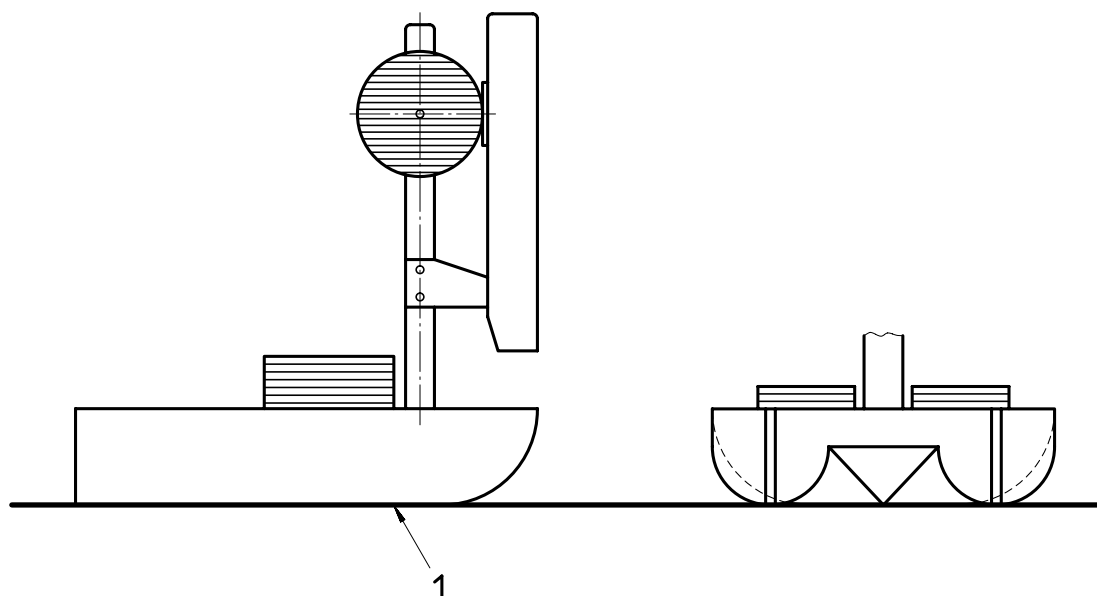
For the purposes of this part of ISO 7176, the definitions given in ISO 6440 and ISO 7176-15 and the following definitions and symbols apply.

3.1 reference loader gauge RLG

device used to load wheelchair seat and form a basis from which to make measurements

3.2 seat reference plane

plane of the bottom surface of the RLG seat unit, as shown in figure 1



Key

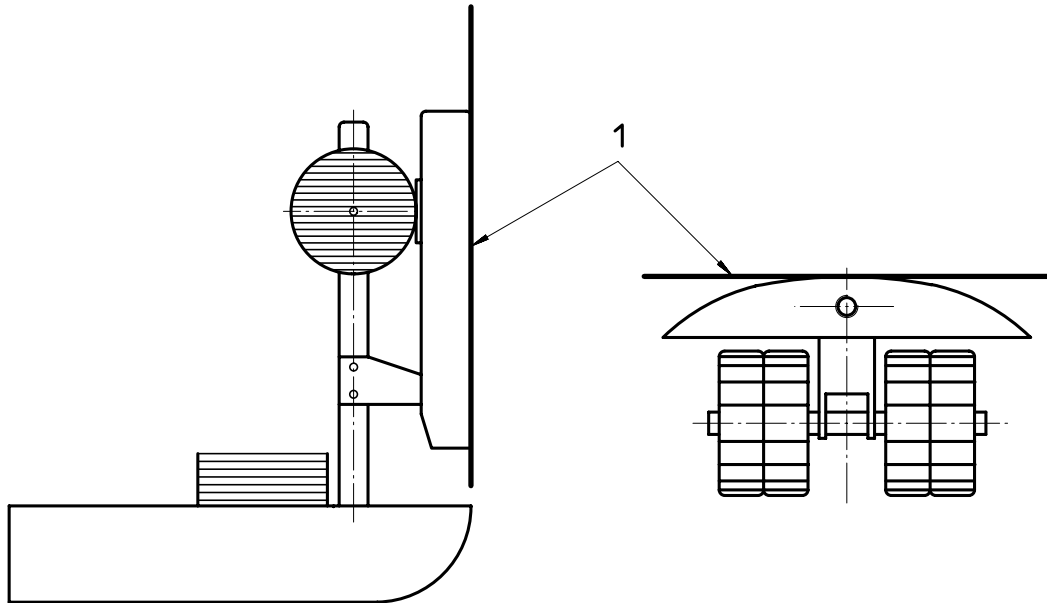
- 1 Seat reference plane

Figure 1 — Seat reference plane

3.3

backrest reference plane

plane tangential to the vertical midline of the outside curve of the RLG back unit, as shown in figure 2



Key

- 1 Backrest reference plane

Figure 2 — Backrest reference plane

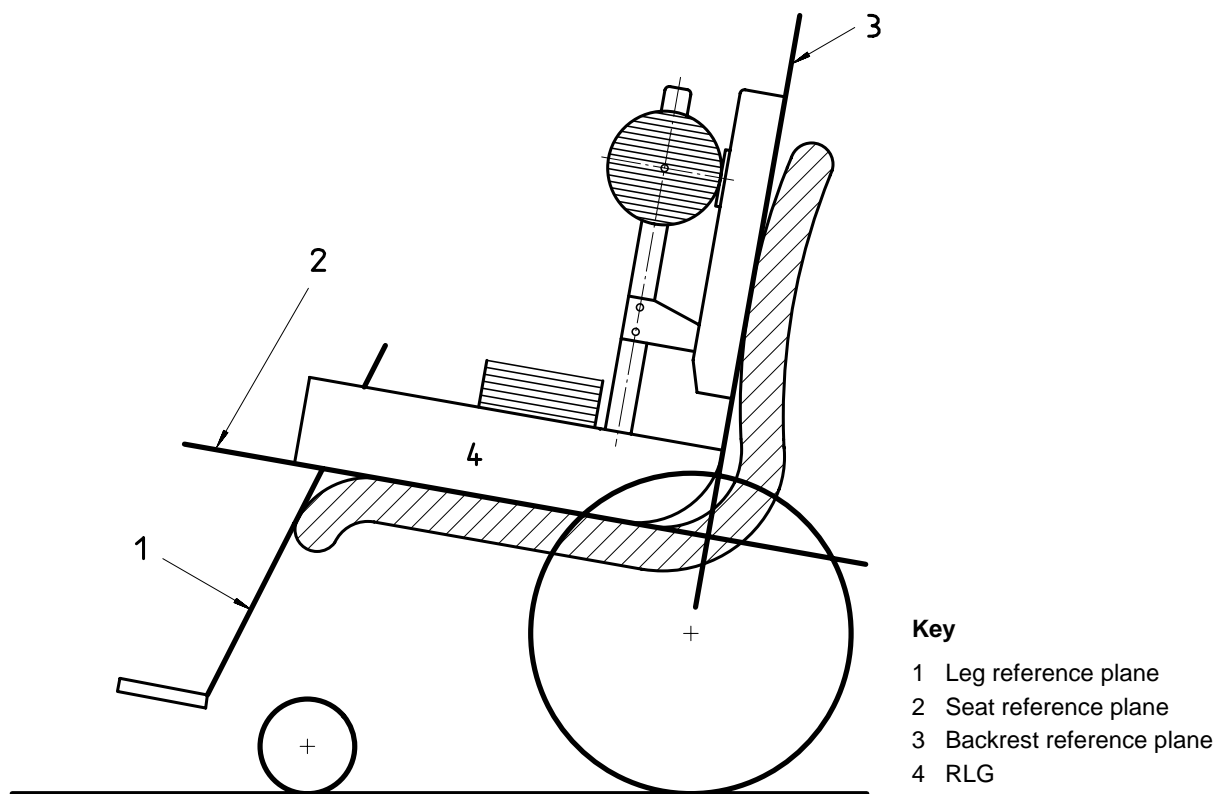
3.4

leg reference plane

1) plane tangential to the rear edge of the foot supports or heel loops and the most forward projection of the seat [see figure 3 a)]

2) plane tangential to the rear edge of the foot supports or heel loops of the wheelchair and the most forward projection of the calf supports [see figure 3 b)]

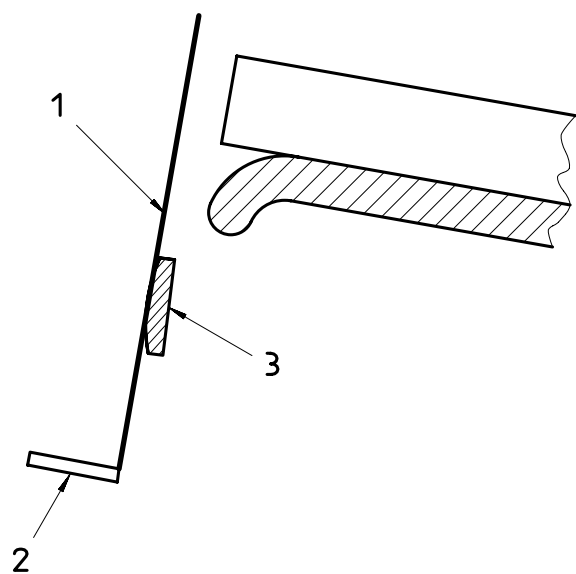
NOTE Figure 4 shows the tangent point of the leg reference plane (point X) with different types of foot support.



Key

- 1 Leg reference plane
- 2 Seat reference plane
- 3 Backrest reference plane
- 4 RLG

a) Leg reference plane with forward seat projection



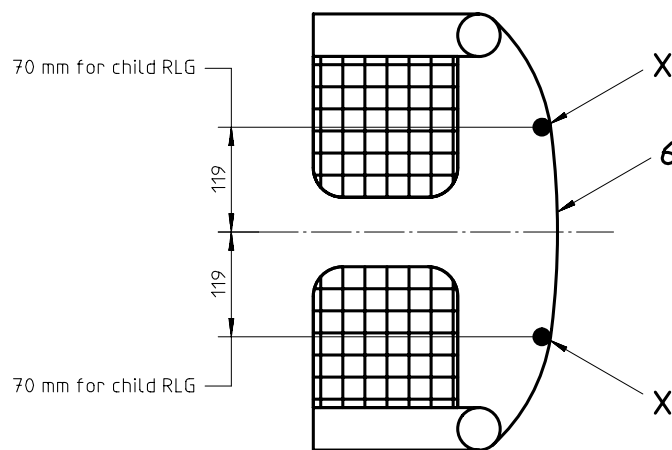
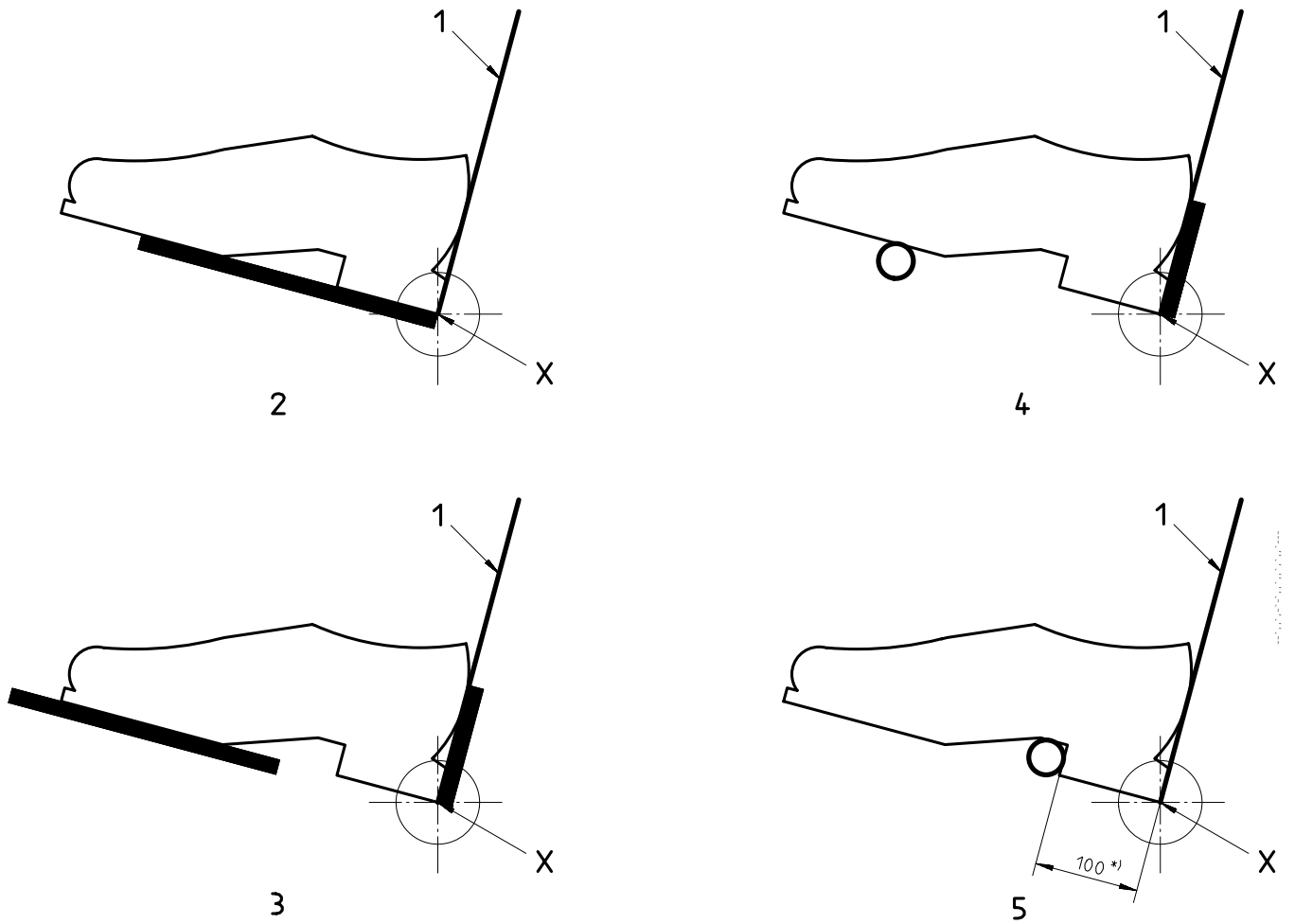
Key

- 1 Leg reference plane
- 2 Footrest
- 3 Calf support

b) Leg reference plane with calf support

Figure 3 — Leg reference planes

Dimensions in millimetres



Key

- X Tangent point
- 1 Leg reference plane
- 2 Standard foot support
- 3 Foot support with heel loop
- 4 Tubular foot support with heel loop
- 5 Tubular foot support without heel loop
- 6 Heel loop
- *) 60 for child RLG

Figure 4 — Leg reference plane intersection with different types of foot support

3.5 reference configuration

configuration for adjustable wheelchairs, produced by a standard procedure of adjustment to ensure comparability of results between wheelchairs

3.6 specification sheet

manufacturer's pre-sale literature that gives wheelchair performance information

3.7 data form

form for recording measurements (see Annex B)

3.8 negative camber

position in which the wheels are inclined toward each other so that the tops of the wheels are closer to each other than the bottoms

4 Principle

An RLG is positioned in the wheelchair seat so as to provide repeatable deformation of the wheelchair and seat structure. Measurements of seating and wheel dimensions are made to reference points and planes on the RLG.

5 Test equipment

5.1 Adult Reference Loader Gauge, as specified in Annex A.

5.2 Child Reference Loader Gauge, as specified in Annex A.

5.3 Means for measuring linear dimensions up to 2 m to an accuracy of ± 1 mm.

5.4 Means for measuring the angles of surfaces to each other and/or to vertical or horizontal to the nearest degree to an accuracy of $\pm 0,2^\circ$.

5.5 Means of measuring forces between 25 N and 250 N to an accuracy of ± 5 N.

5.6 Flat, hard test plane large enough to accommodate the wheelchair throughout the test and that lies between two imaginary parallel planes 5 mm apart when loaded with the wheelchair.

NOTE The imaginary planes are intended to provide a measure of control on the flatness of the test plane.

5.7 Means to prevent movement of the wheelchair during the positioning procedure.

NOTE Locating the test plane adjacent to a wall or similar obstruction is recommended (see figures 7 and 8).

6 Preparation of the wheelchair

6.1 General

Prepare the wheelchair as follows before commencing the sequence of measurements.

6.2 Equipping the wheelchair

Fit any appropriate armrests, headrest, leg supports and/or footrests specified by those commissioning the tests.

Remove any loose cushions, straps, etc. which are not fastened to and are not an integral part of the wheelchair necessary for normal use.

6.3 Inflation of pneumatic tyres

If the wheelchair has pneumatic tyres, inflate them to the pressure recommended by the wheelchair manufacturer. If a pressure range is given, inflate to the highest pressure in the range. If there is no recommendation for inflation pressure from the wheelchair manufacturer, inflate the tyres to the maximum pressure recommended by the tyre manufacturer.

6.4 Adjustments

Set the wheelchair to the reference configuration as follows.

6.4.1 Position parts to any manufacturers recommendations for driving.

6.4.2 For parts where there are no manufacturers recommendations for driving, set the adjustable parts of the wheelchair so that as many as possible of the following settings are achieved with priority given to those earliest in the sequence.

NOTE 1 When adjusting parts of a wheelchair, it is often the case that an adjustment to one part changes another, e.g. changing the wheel position may also change the seat angle. Thus, it may be necessary to make several readjustments to some parts to compensate for the interaction of others. It may also be the case that in order to achieve one setting it is impossible to achieve another.

- a) Place the wheelchair in the test plane (see 5.6) with the castors in their forward trailing position.
- b) Set any castor stem vertical with a tolerance of $_{-p}^{0^{\circ}}$ or, if this is not possible, to the nearest position to vertical in the negative direction.

NOTE 2 A negative castor stem angle is that in which the top of the stem is to the rear of the bottom of the stem.

- c) If the body support system's position relative to the frame can be adjusted horizontally and/or vertically, set at the midposition or, where there is no provision for a middle setting, the nearest to the rear of or below the midposition ± 5 mm.

NOTE 3 At this stage in the process, it is sufficient for adjustments *d*, *e* and *f* to be set based on measurements using an inclinometer placed on the relevant surface.

NOTE 4 This adjustment is not intended for wheelchairs with elevation seat.

- d) Set adjustable seats so that the seat surface has an angle of $8^{\circ} \pm 2^{\circ}$ to the horizontal with its forward edge higher than the rear. If this angle is not possible to achieve, adjust to the nearest greater angle or, if this angle is also impossible to achieve, to the angle nearest to 8° .
- e) Set adjustable backrests so that the backrest has an angle of $10^{\circ} \pm 2^{\circ}$ to vertical with the top behind the bottom. If this angle is not possible to achieve, adjust to the nearest greater angle or, if this angle is also impossible to achieve, to the angle nearest to 10° .
- f) Position adjustable foot supports so that the leg-to-seat surface angle is as close as possible to, but not less than, 90° .
- g) Set wheels with adjustable camber to the midposition between vertical and maximum negative camber $\pm 1^{\circ}$ or, where there is no provision for a middle setting, the nearest midposition with greater angle of camber.
- h) If there is no predetermined range of camber, set the wheels to $2^{\circ} \pm 1^{\circ}$ camber. If this is not possible, set to the nearest greater angle.

NOTE 5 See 3.8 for definition of negative camber.

- i) If the position of the drive wheels can be adjusted horizontally, set them in the midposition ± 3 mm or, where there is no provision for a middle setting, the nearest position to the rear of the middle.

Do not use settings specifically intended by the manufacturer for use by amputees unless this setting is the only setting available.

- j) If the position of the drive wheels can be adjusted vertically, set them to the midposition ± 3 mm or, where there is no provision for a middle setting, the nearest position below the middle.
- k) If the position of castor wheels can be adjusted horizontally, set them in the midposition ± 3 mm or, where there is no provision for a middle setting, the nearest position forward of the middle.
- l) If the position of castor assemblies can be adjusted vertically, set them in the midposition ± 3 mm or, where there is no provision for a middle setting, the nearest position below the middle.
- m) If the width between any castors can be adjusted, set it to its maximum value.
- n) If the position of any castor wheel is adjustable for height within the castor fork, set to the midposition ± 1 mm or, where there is no midposition, the position nearest the middle which gives the greatest distance between fork and wheel.
- o) Position the lowest part of the leg support/footrest as close as possible to, but not less than, 50 mm above the test plane.
- p) Set any remaining physical adjustments as near as possible to their midposition. If increments do not permit a unique midposition, select the midposition that gives the largest dimension of the adjustment.
- q) Check that all fasteners are secured to the manufacturer's specification.

7 Measurement procedure

7.1 Selecting the RLG size

For wheelchairs where the adult-size RLG can be positioned in the seat with lateral clearance of at least 2 mm on each side, select the adult-size RLG.

For wheelchairs which are too small to accept the adult RLG but can accept the child RLG with at least 2 mm lateral clearance, select the child-size RLG.

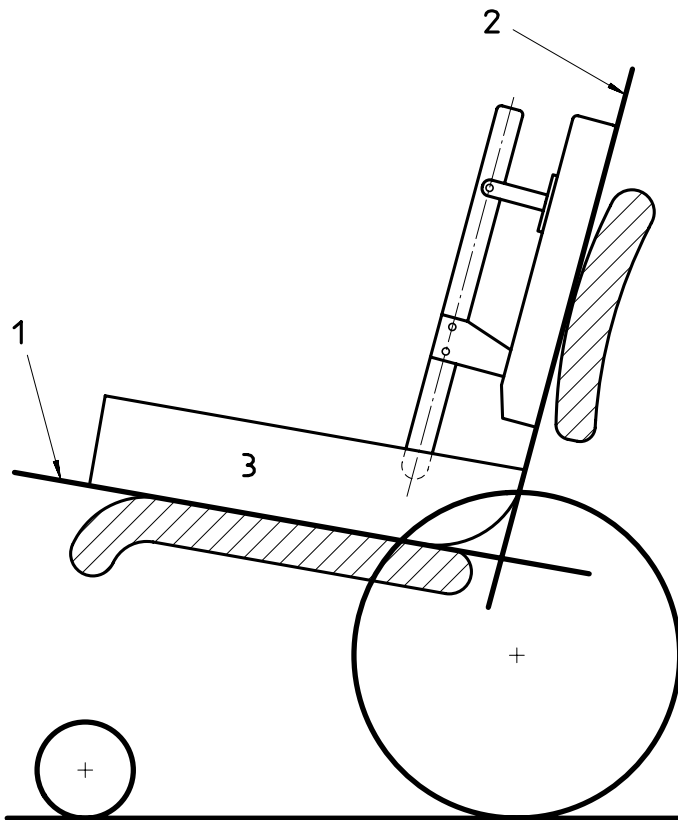
7.2 Positioning the RLG

NOTE Individuals unfamiliar with this technique are recommended to practise the loading procedure a few times and record seat plane angle and backrest angle (see 7.3, dimensions 1 and 6) to establish a consistency within $\pm 2^\circ$.

For reasons of safety, great care should be taken when loading the wheelchair and determining dimensions, particularly for sports-type wheelchairs with low stability. In such cases, secure the wheelchair.

Position the RLG in the wheelchair as follows:

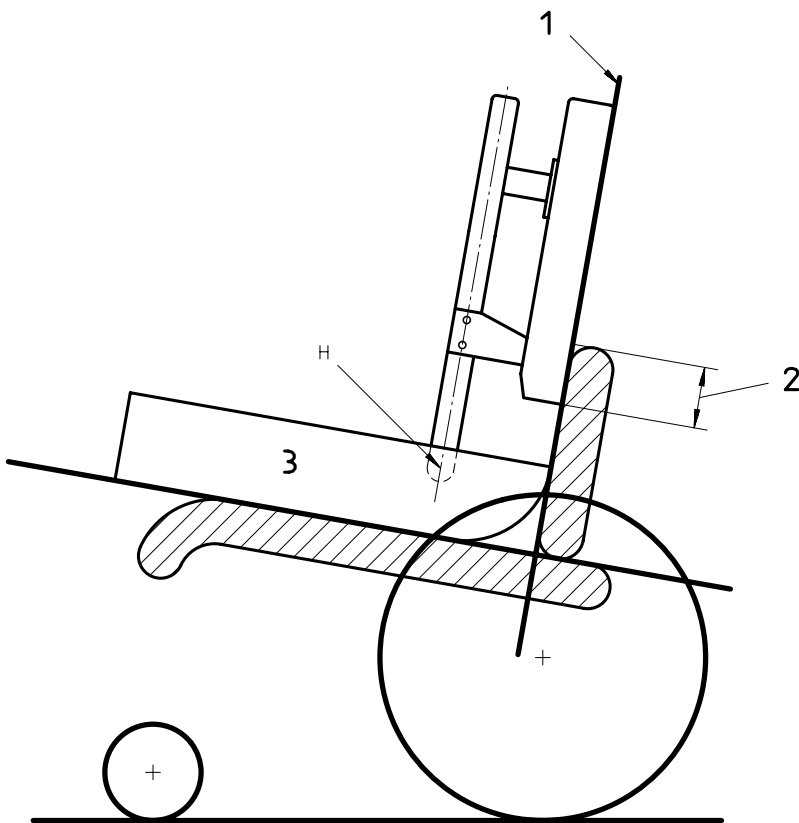
- a) With the wheelchair on the test plane, place the selected size of RLG, without supplementary weights, centrally on the wheelchair seat so that the surface of the back unit and the rear of the seat unit are in contact with the wheelchair backrest [see figure 5 a)].
- b) For wheelchairs with backrests which do not extend 150 mm above the bottom of the adult RLG back unit or 90 mm above the bottom of the child RLG back unit [figure 5 b)], fix the pivot point H with the back unit (backrest reference plane) at $90^\circ \pm 1^\circ$ to the horizontal [figure 5 c)]. Record this in the test report (8.1).



Key

- 1 Seat reference plane
- 2 Backrest reference plane
- 3 RLG

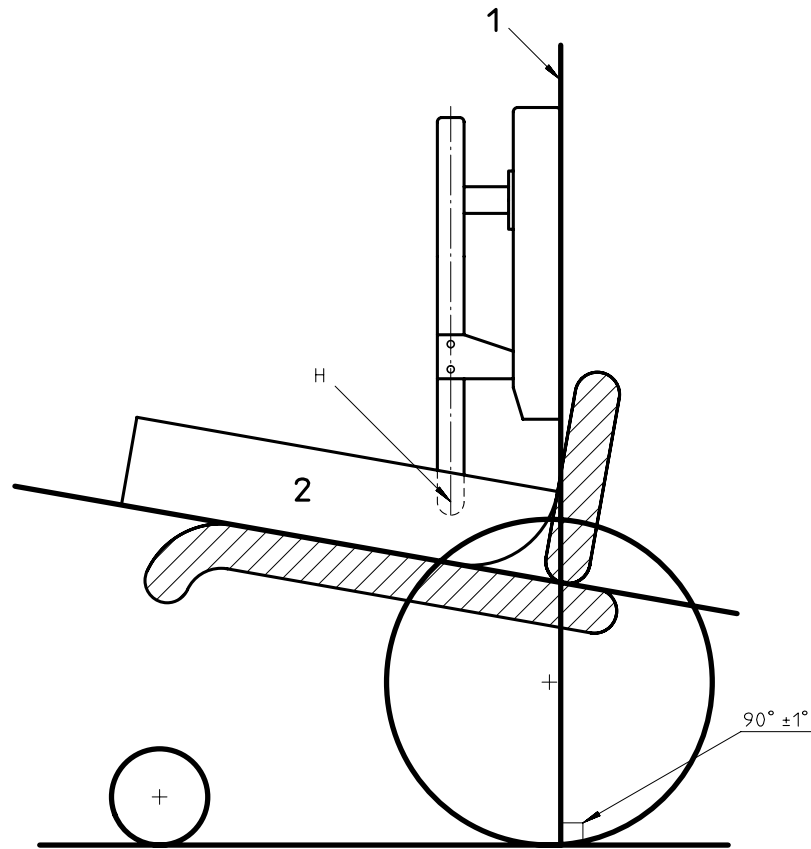
a) Initial positioning of RLG



Key

- 1 Backrest reference plane
- 2 If less than 150 mm (90 mm for child RLG) fix pivot H as in 5 c)
- 3 RLG

b) Determination if backrest is low



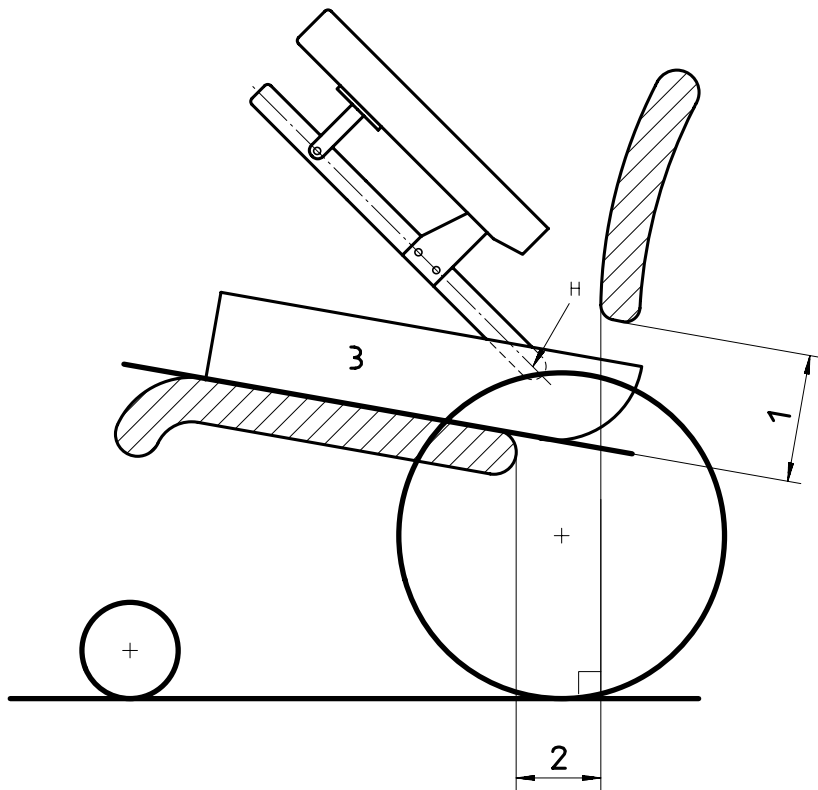
Key

- 1 Backrest reference plane
- 2 RLG

c) Fixing back unit for low backrest

Figure 5 — Positioning of RLG

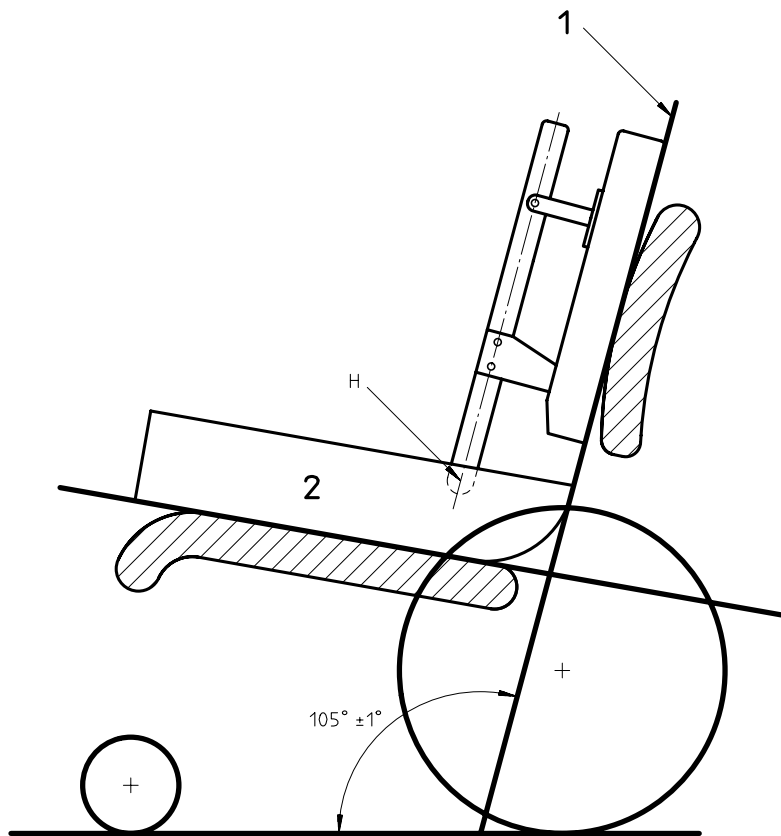
- c) For wheelchairs where the seat unit can slide through a gap at the rear of the seat or in the backrest, resulting in the back unit folding forwards beyond the vertical [figure 6 a)], fix the pivot point H with the back unit (backrest reference plane) reclined backwards to $105^\circ \pm 1^\circ$ to the horizontal [figure 6 b)]. Record this in the test report (8.1).



Key

- 1 Backrest gap
- 2 Seat gap
- 3 RLG

a) Determination if backrest has 'gap'



Key

- 1 Backrest reference plane
- 2 RLG

b) Fixing back unit for wheelchairs with backrest 'gap'

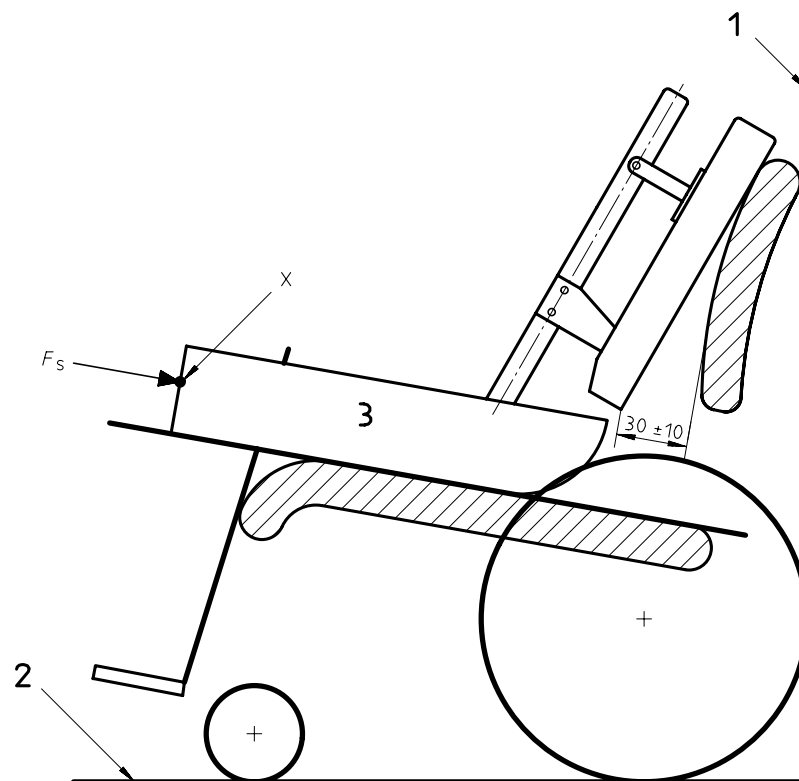
Figure 6 — Wheelchairs with backrest 'gap'

- d) For wheelchairs other than those described in items b) and c) above, allow the back unit to pivot freely at H on the seat unit.
- e) Before commencing the positioning procedure, set up the means to prevent the wheelchair from rolling.

Figure 7 illustrates the test plane located adjacent to a wall (see 5.7) with the wheels braked in order to prevent the wheelchair from rolling.

- f) For wheelchairs as in item d) above, reposition the unloaded RLG in the wheelchair and lean the back unit against the backrest so that when force F_s is applied [see item g) below], there will be approximately 30 mm of rearward movement of the RLG (figure 7). For wheelchairs as in items b) and c) above, position the unloaded RLG in the wheelchair so that there will be approximately 30 mm of rearward movement of the RLG when force F_s is applied.

Dimensions in millimetres



Key

- 1 Wall
2 Test plane
3 RLG

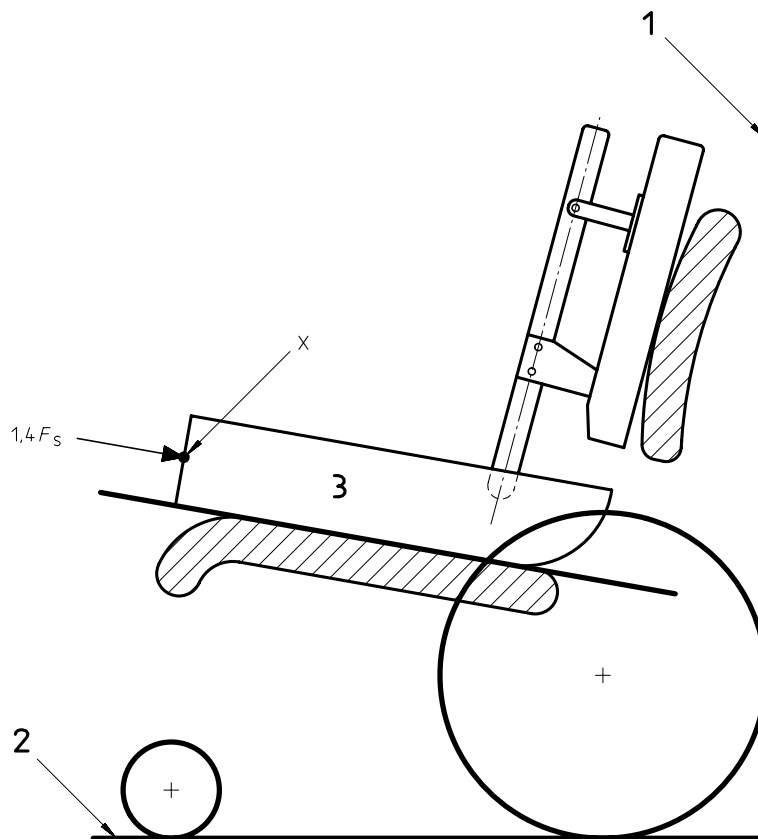
Figure 7 — Positioning the RLG: Determination of F_s

- g) Apply a force at point X on the front surface of the RLG (Annex A, figures A.1 and A.4) via a force transducer as specified in 5.5. Ensure that the force is applied parallel to the top surface of the seat unit, parallel to the midline of the RLG and directed towards the backrest, as shown in figure 7.
- h) Determine force F_s (in newtons) required to just start the RLG sliding.
- i) Repeat the procedures described in items a) to f).

- j) Apply a force F as described in item g) until the RLG stops sliding in the seat and where the magnitude of the force F , in newtons, is given by:

$$F = 1,4 F_s$$

as shown in figure 8.



Key

- 1 Wall
- 2 Test plane
- 3 RLG

Figure 8 — Positioning the RLG: Applying force F

- k) Centre the RLG seat unit in the wheelchair and level it horizontally in the lateral direction, without changing its backwards/forwards position.
- l) Place the supplementary weights on the RLG, commencing with the seat-unit weights followed by the back-unit weights and secure the weights in position.

7.3 Measurements

7.3.1 General

Measure and record the following dimensions, using the apparatus specified in clause 5, to an accuracy of ± 3 mm and angles to an accuracy of $\pm 1^\circ$.

For any adjustable features of the wheelchair which affect seating and wheel dimensions, only that dimension primarily affected by the adjustment need be measured. In such cases, measure the maximum and minimum values of the dimension and the number of adjustments, if not continuously adjustable. Return each adjustment to its reference configuration as specified in 6.4 after measuring the range of dimensions of each adjustable feature.

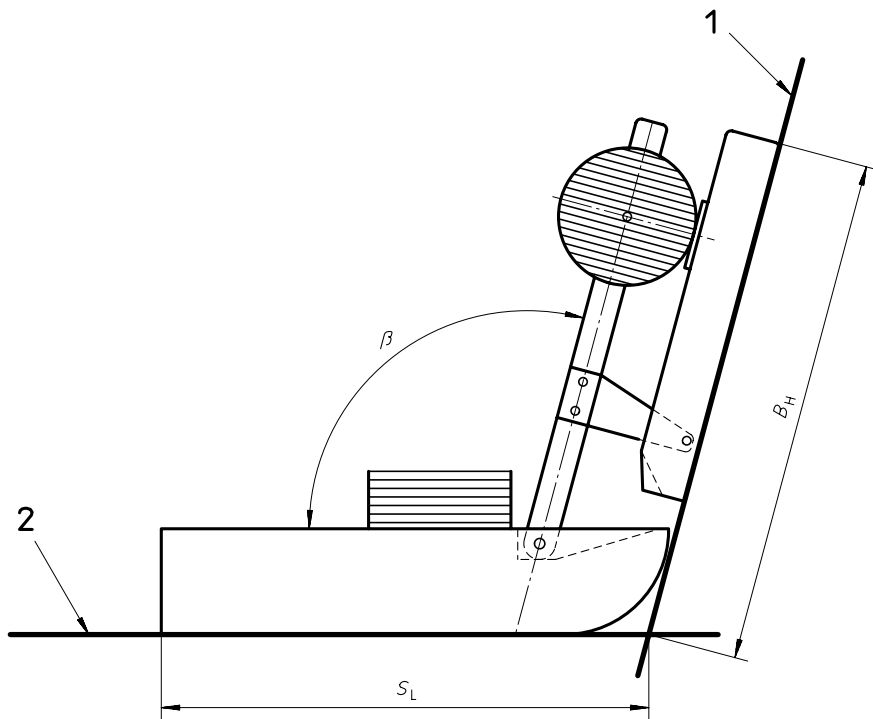
NOTE 1 The size of the RLG (adult or child) influences where certain dimensions are measured.

NOTE 2 The following suggestions will help to facilitate measurement. Most of the following measurements can be made directly from the wheelchair loaded with the RLG. Dimensions 2, 7, 10, 25 and 26, however, are related to an imaginary somewhat inaccessible position in space - the intersection between the seat and back reference planes. This intersection may be determined by sliding thin strips of plastic or metal behind the back unit and under the seat unit. Measurements may then be made to the point where these strips meet at the rear of the seat.

A more elegant solution to this problem involves measuring only the accessible portions of these dimensions to landmarks on the RLG and calculating the full value of the dimension from the known dimension of the RLG. The necessary calculations are provided for each relevant dimension, and the general procedure used is as follows:

- Measure and record dimensions specified in the following section but only measuring accessible components for dimensions 2, 7, 10, 25 and 26 (see each relevant dimension).
- Ensure RLG pivot is locked, fixing angle β of seat (see figure 9) unit relative to back unit.
- Place RLG on a flat surface.
- Position a flat rule along the back unit surface to touch the above flat surface. This gives the intersection of the back and seat reference planes (figure 9).
- Measure and record dimension S_L and B_H .
- Determine the full value of dimensions 2, 7, 10, 25 and 26 from calculations given for each dimension.

NOTE 3 Measurements 23 to 26 are intended only for manually propelled wheelchairs.



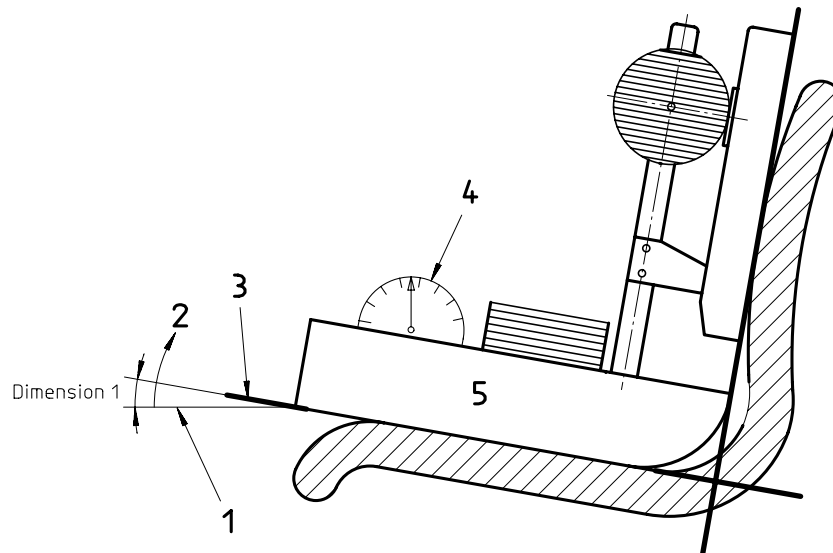
Key

- 1 Backrest reference plane
- 2 Seat reference plane

Figure 9 — Intersection of the back and seat reference plane

7.3.2 Dimension 1: Seat plane angle

The angle of the seat reference plane to the horizontal plane (see figure 10). The angle shown is positive. For seats with adjustable seat-plane angles, measure the maximum and minimum seat plane angles and the number of increments, if not continuously adjustable.



Key

- 1 Horizontal
- 2 Positive direction
- 3 Seat reference plane
- 4 Means of measuring the angle
- 5 RLG

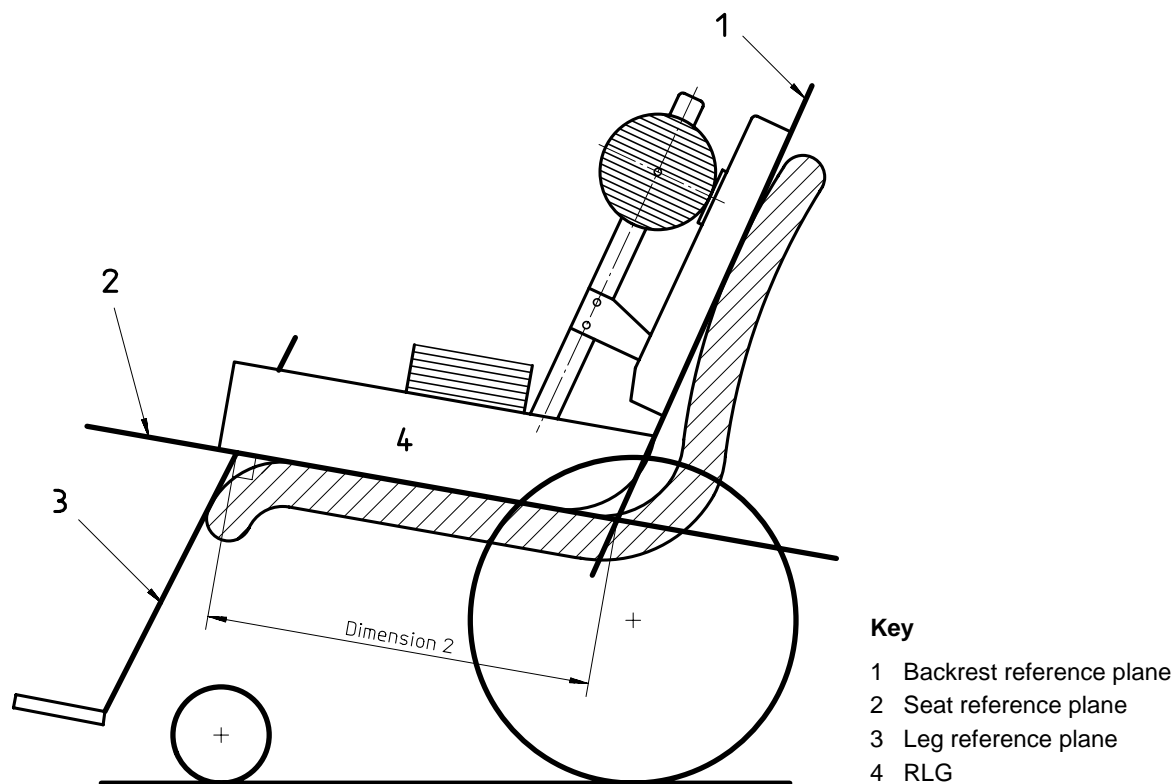
Figure 10 — Seat plane angle and means of measuring

7.3.3 Dimension 2: Effective seat depth

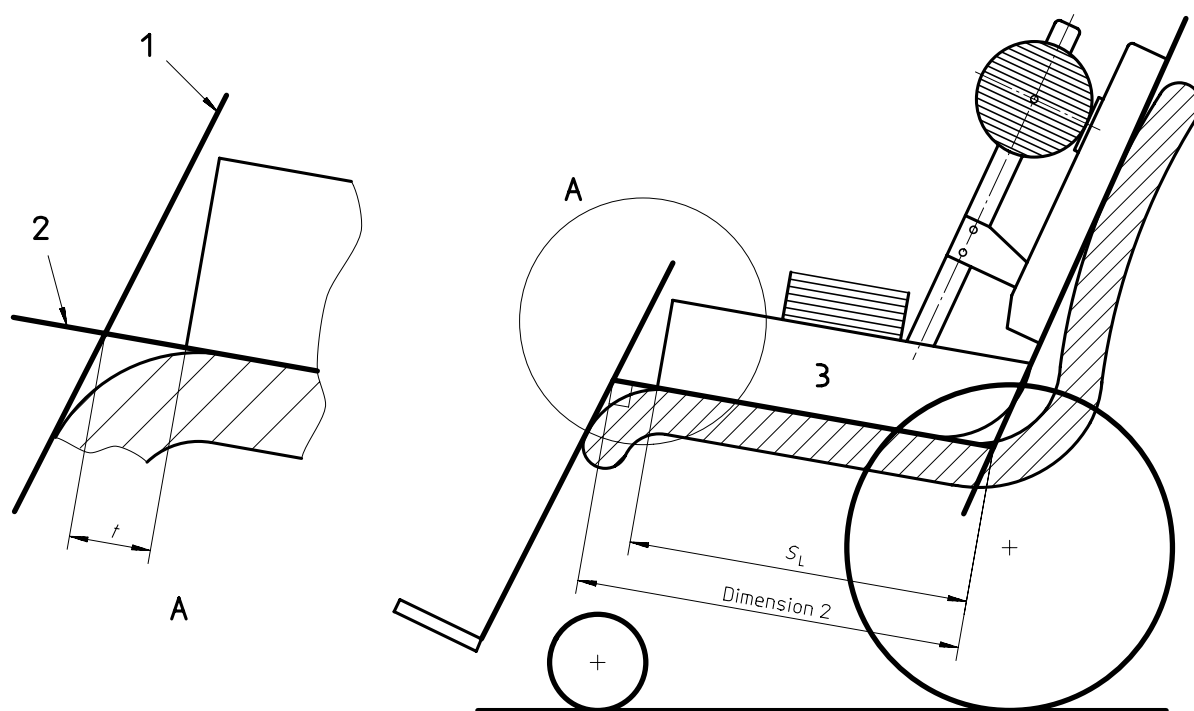
The distance from the intersection of the leg reference plane (see 3.4) and the seat reference plane (see 3.2) to the intersection of the backrest reference plane (see 3.3) and the seat reference plane [figure 11 a)].

For seats with adjustable seat depth, measure the maximum and minimum depths and the number of increments, if not continuously adjustable.

If dimension 2 is longer than the seat RLG unit, it can be determined from $S_L + t$ [figure 11 b)], where S_L is derived in 7.3, note 2.



a) Effective seat depth



Key

- 1 Leg reference plane
- 2 Seat reference plane
- 3 RLG

b) Determining effective seat depth for seat deeper than RLG seat unit

Figure 11 — Seat depth

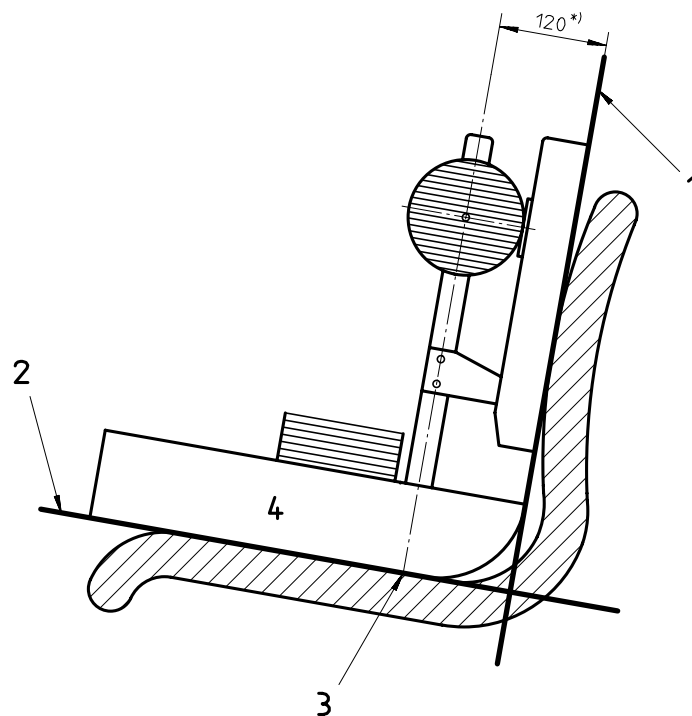
7.3.4 Dimension 3: Seat width

Width of loaded seat support surface at a distance 120 mm (72 mm when using child RLG) forward from the intersection of the backrest reference plane and the seat reference plane [figure 12 a)], measured along the seat reference plane between A-A as shown in figure 12 b).

Measurement for "bucket" type seats less than 50 mm deep is made at a different location than for "bucket" type seats greater than 50 mm deep [see figure 12 b)].

For seats with adjustable seat width, measure the maximum and minimum widths and the number of increments, if it is not continuously adjustable.

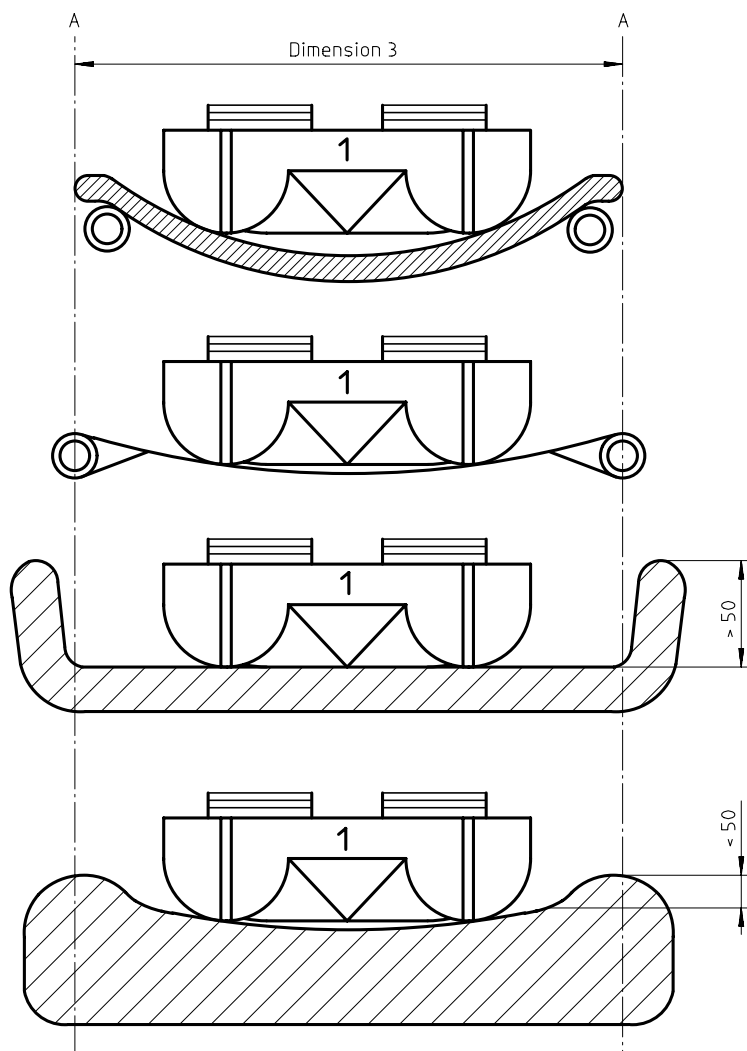
Dimensions in millimetres



Key

- 1 Backrest reference plane
- 2 Seat reference plane
- 3 Location A of the measurement
- 4 RLG
- *) (72 mm for child RLG)

a) Location A of seat width measurement



Key

1 RLG

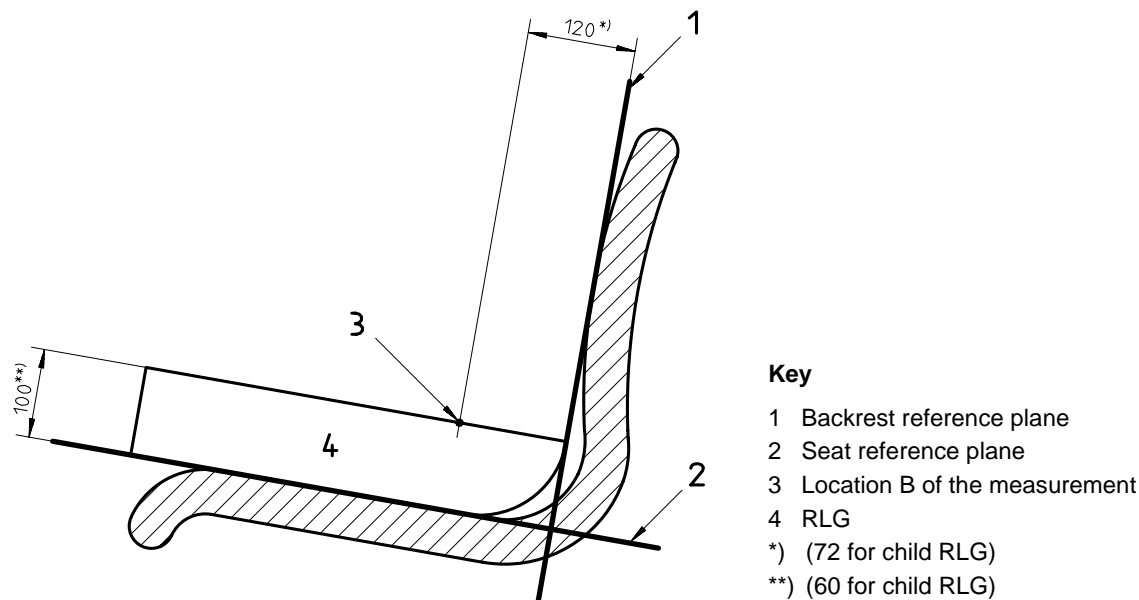
b) Seat width for different type seats

Figure 12 — Seat width

7.3.5 Dimension 4: Effective seat width

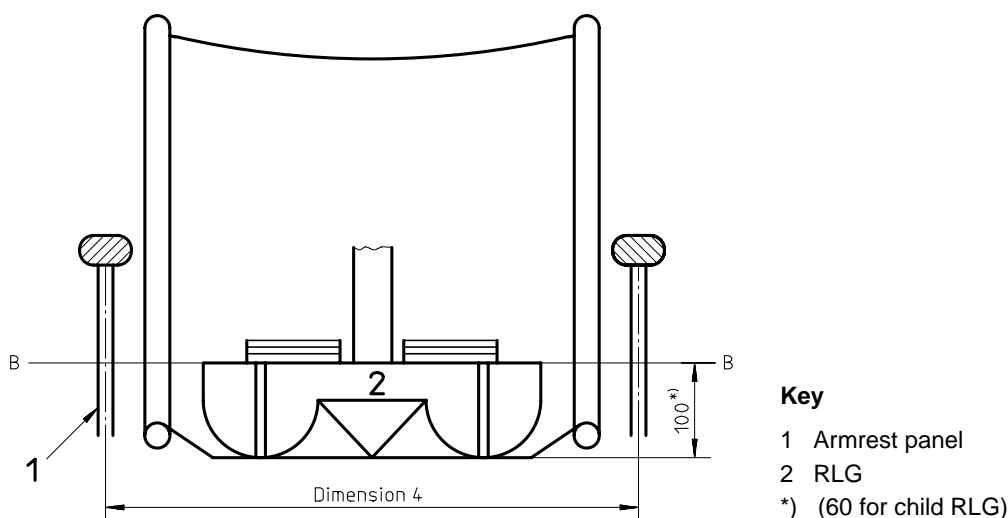
Maximum width within the wheelchair's seat structure at a height 100 mm (60 mm when using child RLG) above and parallel to the seat reference plane and 120 mm (72 mm when using child RLG) forwards from the backrest reference plane at location B [see figure 13 a)]. This width is normally limited by armrest panels [figure 13 b)] or may be limited by high-sided seats [figure 13 c)]. It does not apply if seat or armrest structure does not limit this dimension, for example if there are no armrest panels. For seats with adjustable effective seat width, measure the maximum and minimum widths and the number of increments, if it is not continuously adjustable.

Dimensions in millimetres



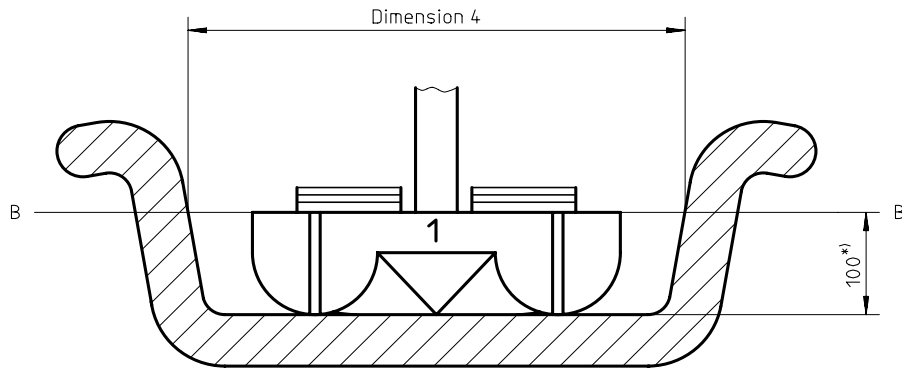
a) Location B of effective seat width measurement

Dimensions in millimetres



b) Effective seat width for wheelchair with armrest panels

Dimensions in millimetres



Key

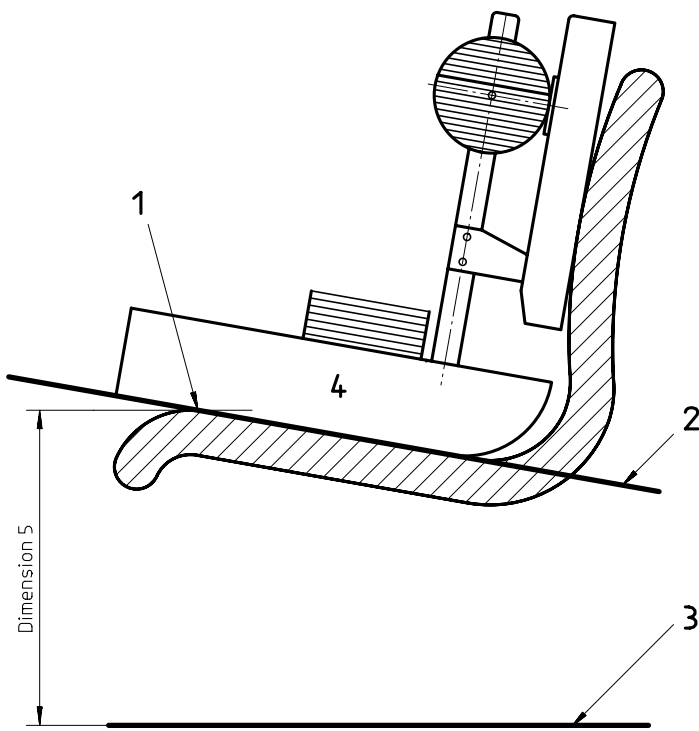
- 1 RLG
- *) (60 for child RLG)

c) Effective seat width for wheelchair with high-sided seat

Figure 13 — Effective seat width

7.3.6 Dimension 5: Seat surface height at front edge

Vertical distance from the floor to the most forward point of the seat [see figure 14 a)] 115 mm (69 mm for child RLG) from the midline of the seat [see figure 14 b)], where the seat first contacts the seat reference plane [location C in figure 14 a) and b)]. For seats with adjustable height, measure the maximum and minimum heights and the number of increments, if it is not continuously adjustable.

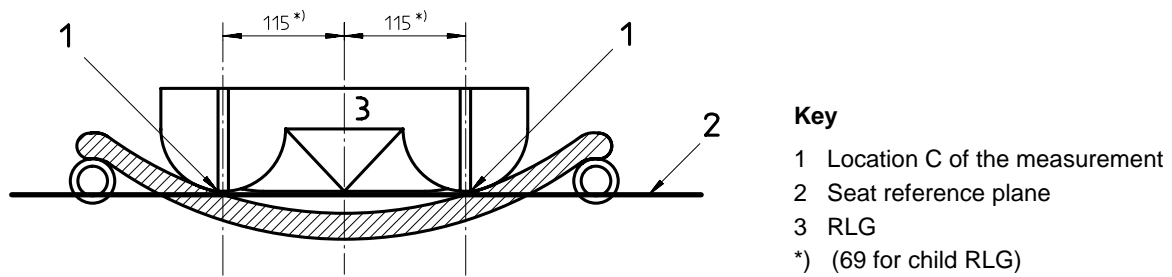


Key

- 1 Location C of the measurement
- 2 Seat reference plane
- 3 Test plane
- 4 RLG

a) Location 1 of seat surface height at front edge

Dimensions in millimetres



b) Seat surface height at front edge

Figure 14 — Seat surface height

7.3.7 Dimension 6: Backrest angle

Angle between the vertical and the backrest reference plane. The angle shown in figure 15 is positive. This measurement does not apply to wheelchairs with low backs or seat gaps as defined in 7.2 b) and c). In such cases record 'low back' or 'seat gap' as appropriate. For seats with adjustable backs, measure the maximum and minimum angle dimensions and the number of increments if it is not continuously adjustable.

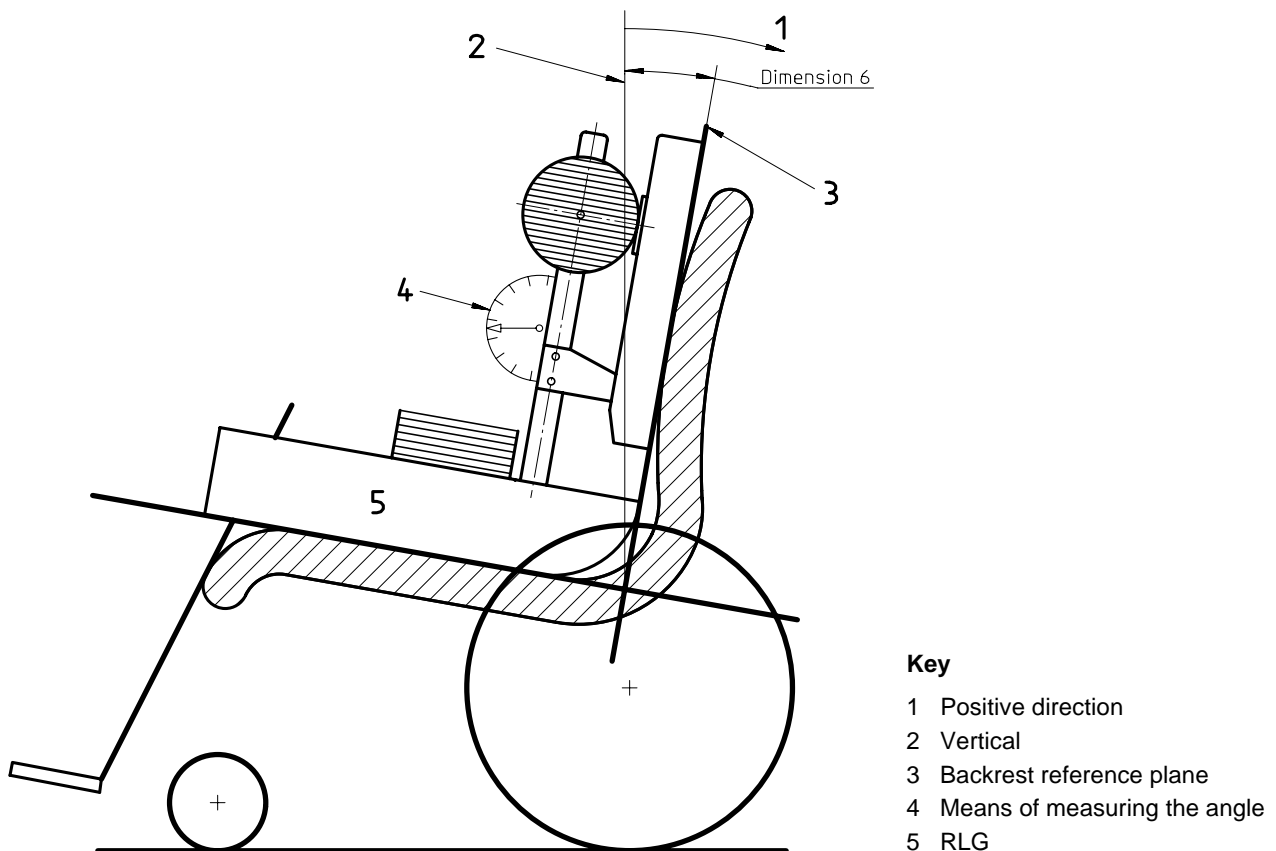


Figure 15 — Backrest angle

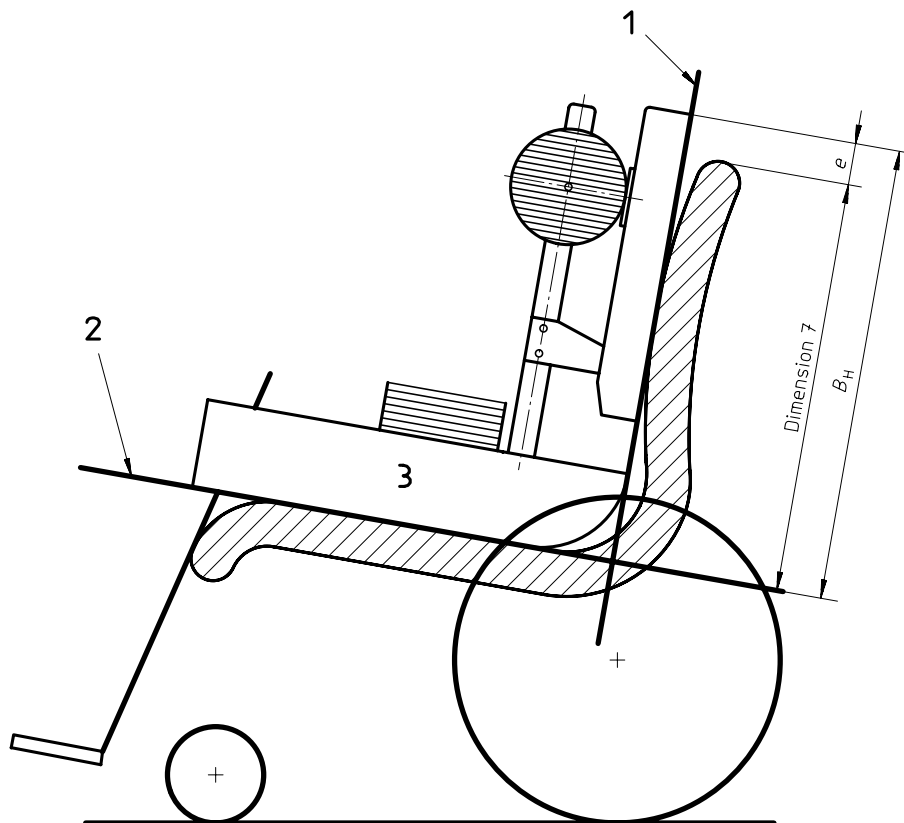
7.3.8 Dimension 7: Backrest height

NOTE This measurement does not apply to backrests with integral headrests.

Distance from the seat reference plane to the centre of the top of the backrest measured parallel to the backrest reference plane as shown in figure 16. A removable headrest should not be included in this dimension.

This dimension can be determined by measuring e as shown in figure 16 and adding or subtracting from B_H (B_H derived as described in 7.3.1 note 2).

For seats with adjustable backrest height, measure the maximum and minimum heights and the number of increments, if it is not continuously adjustable.



Key

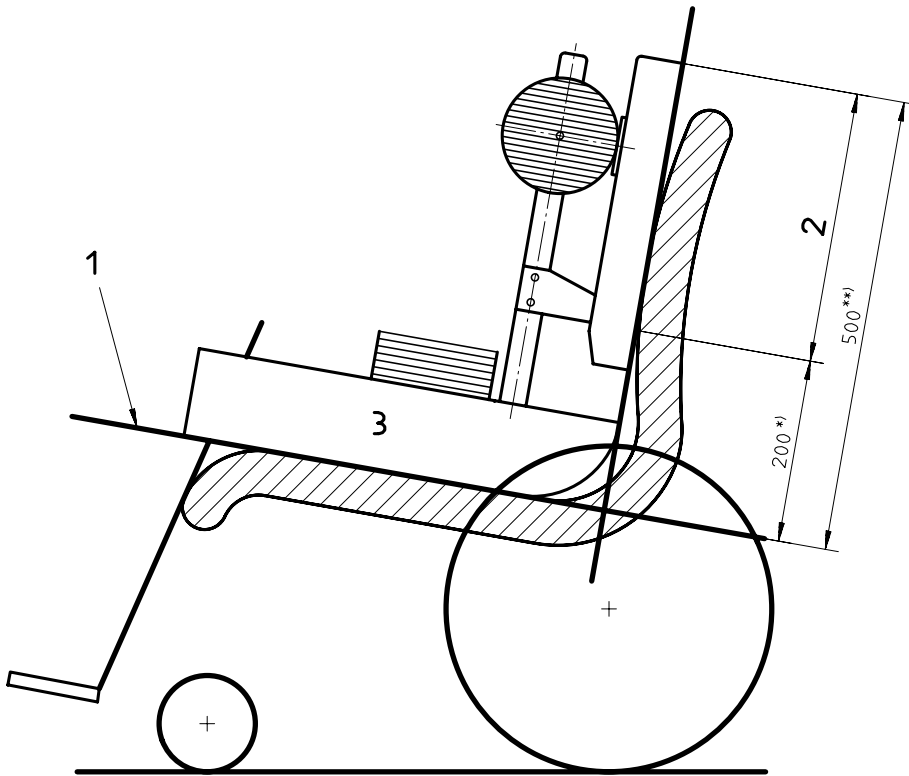
- 1 Backrest reference plane
- 2 Seat reference plane
- 3 RLG

Figure 16 — Backrest height

7.3.9 Dimension 8: Backrest width

The width [D-D in figure 17 b) and c)] of the loaded backrest support at its widest point between 200 mm and 500 mm (120 mm and 300 mm for child RLG) above the seat reference plane [see figure 17 a), b) and c)]. For seats with adjustable backrest width, measure the maximum and minimum widths and the number of increments, if it is not continuously adjustable.

Dimensions in millimetres

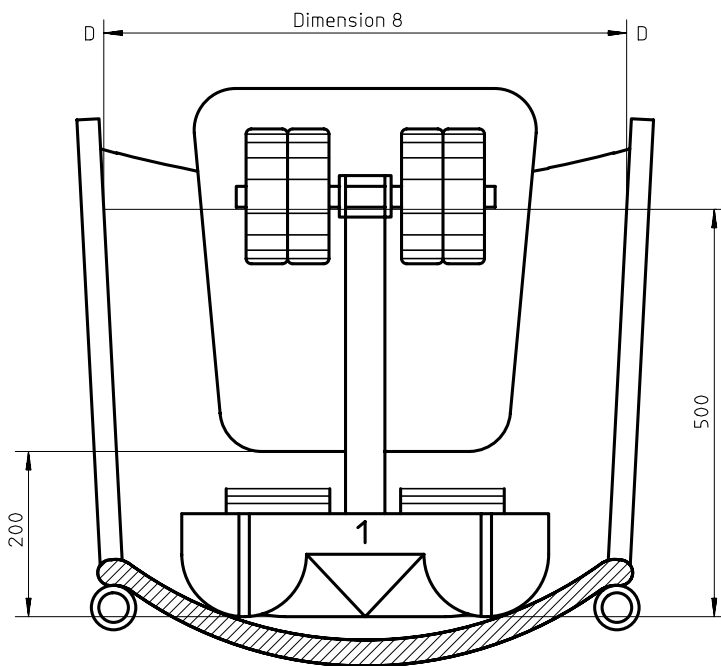


Key

- 1 Seat reference plane
- 2 Region where maximum width to be measured
- 3 RLG
- *) (120 for child RLG)
- ***) (300 for child RLG)

a) Location of backrest width measurement

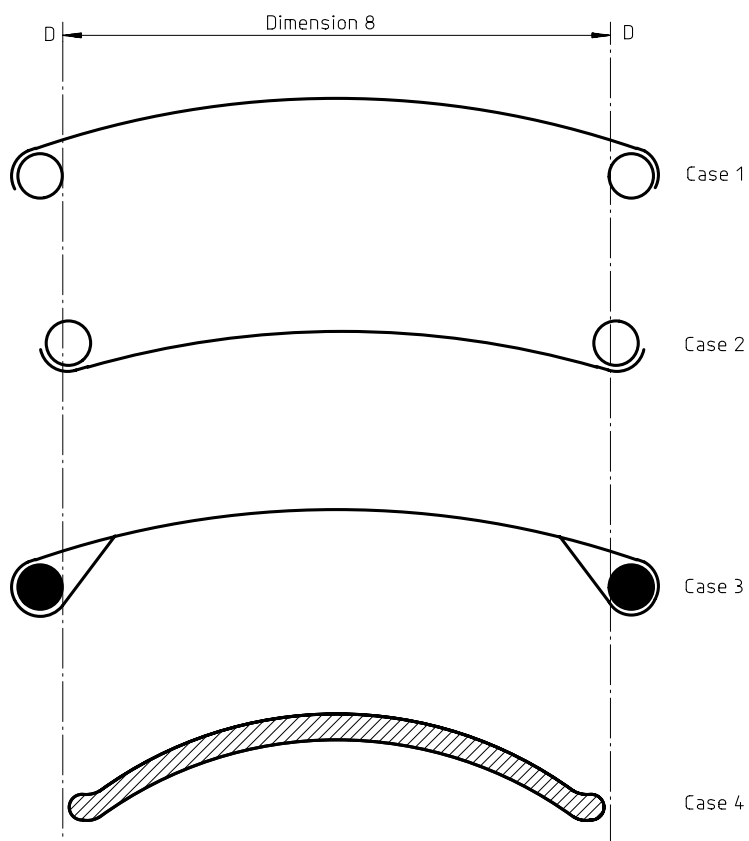
Dimensions in millimetres



Key

- 1 RLG

b) Backrest width — Front view

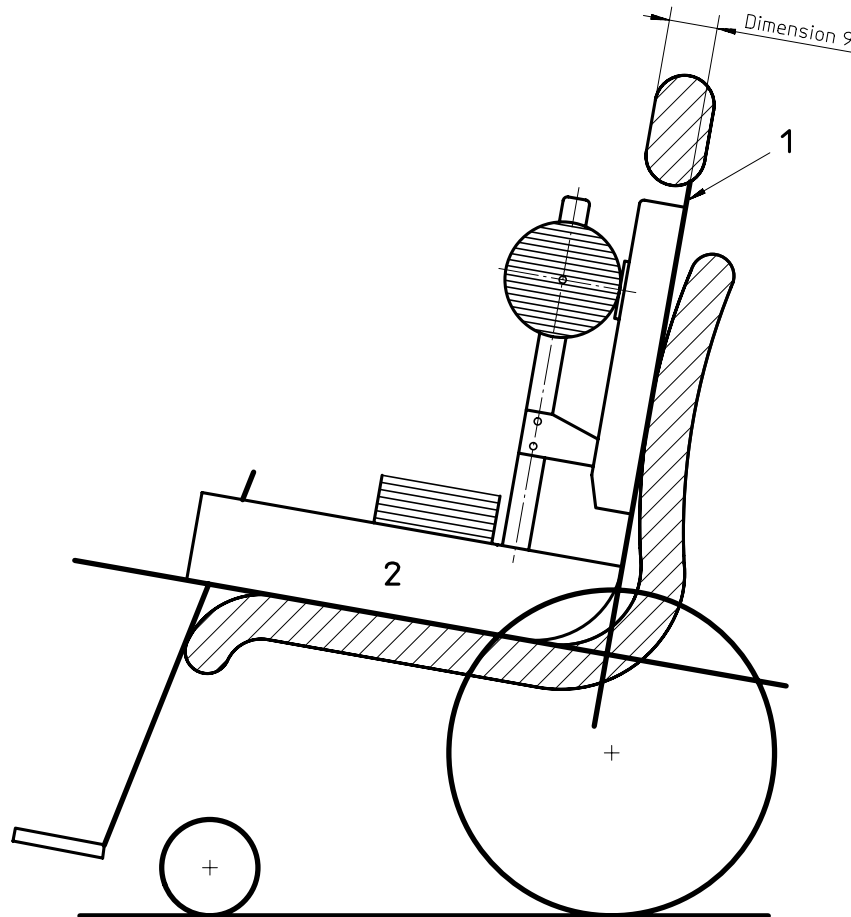


c) View of backrest width from the top

Figure 17 — Backrest width

7.3.10 Dimension 9: Headrest in front of backrest

The distance from the most forward point of the vertical midline of the headrest support surface to the backrest reference plane (3.3), measured perpendicular to that plane. The dimension shown in figure 18 is positive. For seats with adjustable headrests, measure the maximum and minimum values and the number of increments, if it is not continuously adjustable.



Key

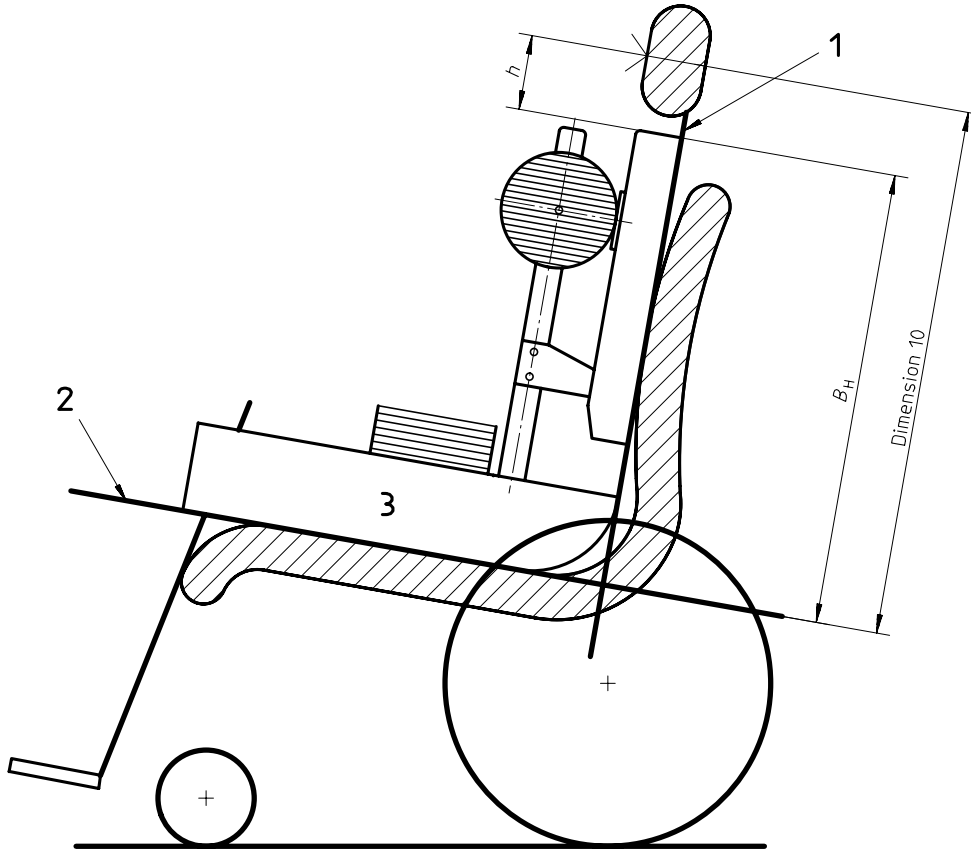
- 1 Backrest reference plane
- 2 RLG

Figure 18 — Headrest in front of backrest

7.3.11 Dimension 10: Headrest height above seat

The height of the most forward point of the vertical midline of the headrest support surface above the loaded seat reference plane, measured parallel to the backrest reference plane (see figure 19). For seats with adjustable headrests, measure the maximum and minimum heights and the number of increments, if it is not continuously adjustable.

This dimension can be determined by measuring h as shown in figure 19 and adding or subtracting from B_H (B_H derived as described in 7.3.1 note 2).



Key

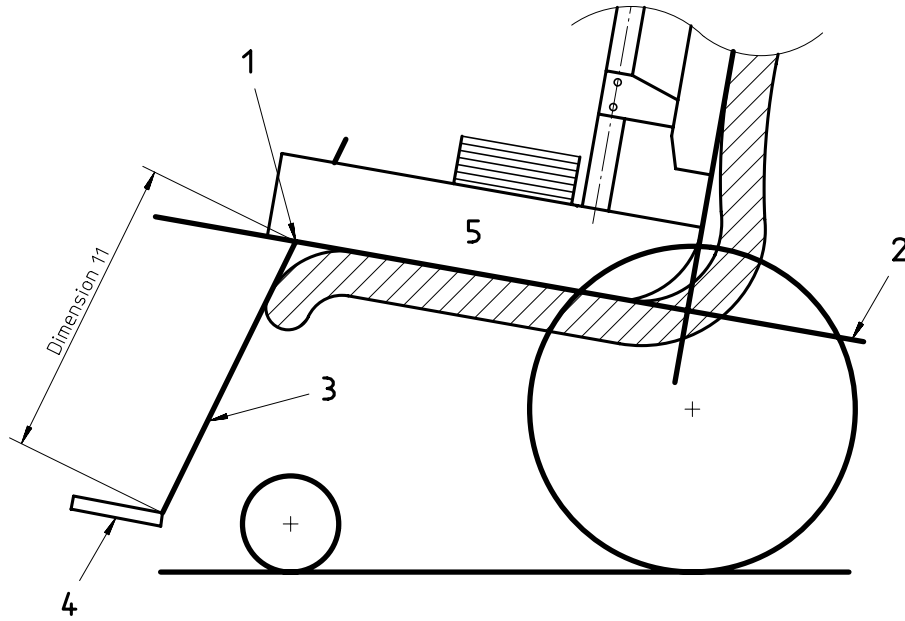
- 1 Backrest reference plane
- 2 Seat reference plane
- 3 RLG

Figure 19 — Headrest height above seat

7.3.12 Dimension 11: Footrest to seat

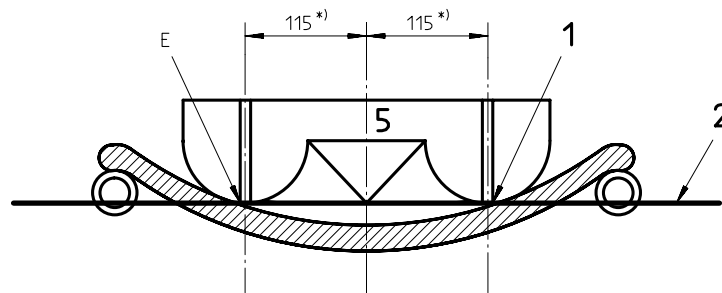
Distance from the seat reference plane [point E in figure 20 a), b) and c)] to the rear support point of the foot support 115 mm (69 mm for child RLG) from the midline of the seat, measured in the leg reference plane. This corresponds to the slots in the seat unit.

For seats with adjustable footrests, measure the maximum and minimum values and the number of increments, if it is not continuously adjustable.

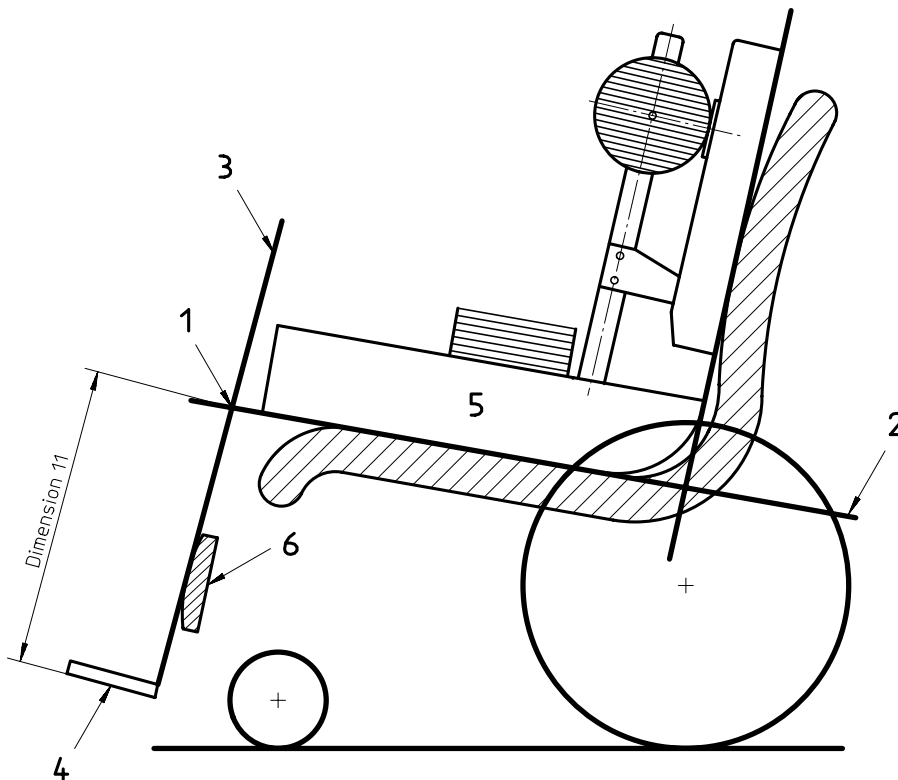


a) Footrest-to-seat measurement

Dimensions in millimetres



b) Lateral location of footrest-to-seat measurement



Key

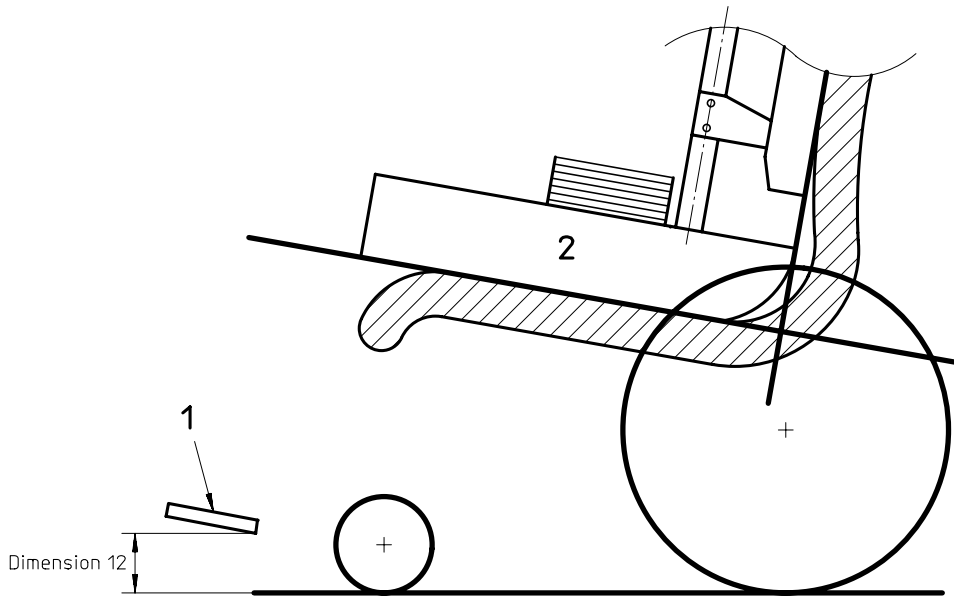
- 1 Location E of measurement
- 2 Seat reference plane
- 3 Leg reference plane
- 4 Footrest
- 5 RLG
- 6 Calf support
- *) 69 for child RLG

c) Footrest to seat for wheelchairs with forward-projecting calf support

Figure 20 — Footrest to seat

7.3.13 Dimension 12: Footrest clearance

For wheelchairs with non-adjustable footrests, measure the vertical distance from the floor to the lowest point underneath the footrest/foot support, as shown in figure 21.



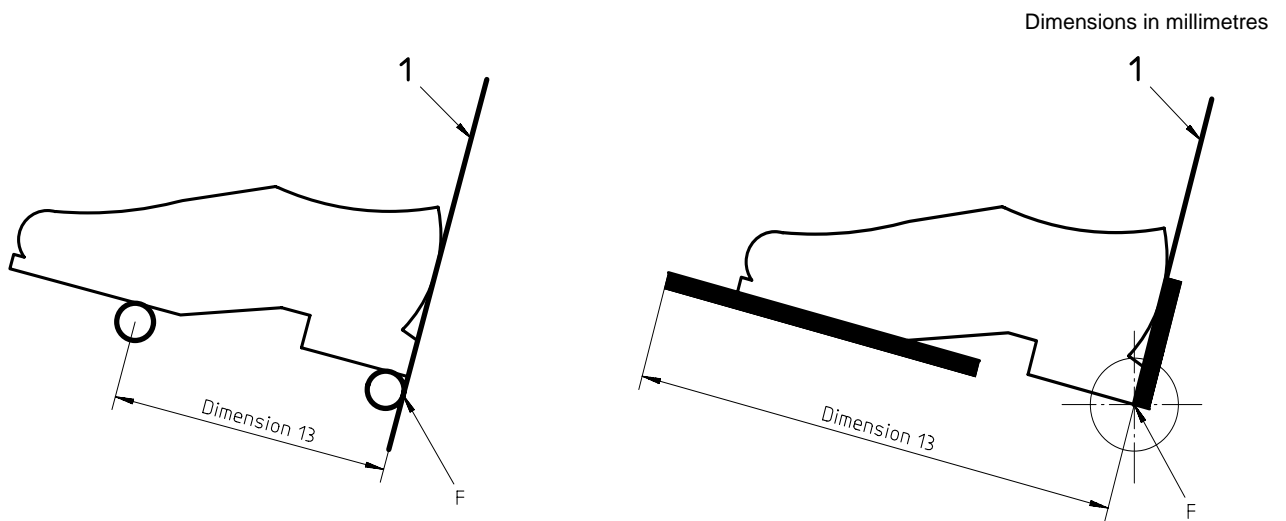
Key

- 1 Footrest
- 2 RLG

Figure 21 — Footrest clearance

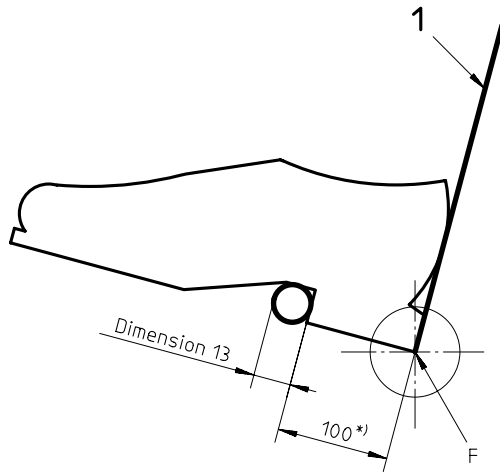
7.3.14 Dimension 13: Footrest length

The distance from the most forward point on the front edge of the footrest to the leg reference plane (point F) as shown in figure 22 a) to f). For footrests with support surfaces consisting of a single tube and no heel loop, measure the outside diameter of the tube. For wheelchairs with adjustable footrest length, measure the maximum and minimum lengths and the number of increments, if it is not continuously adjustable.

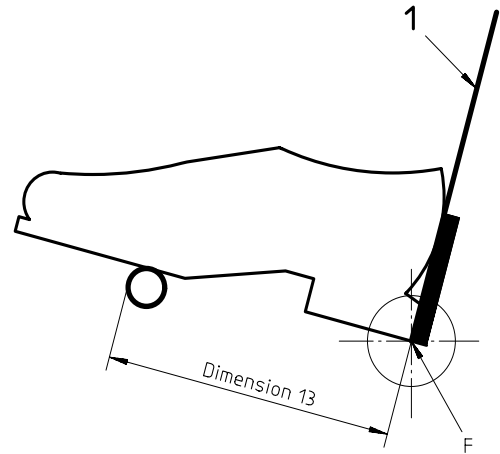


a) Footrest length for double tubular footrest

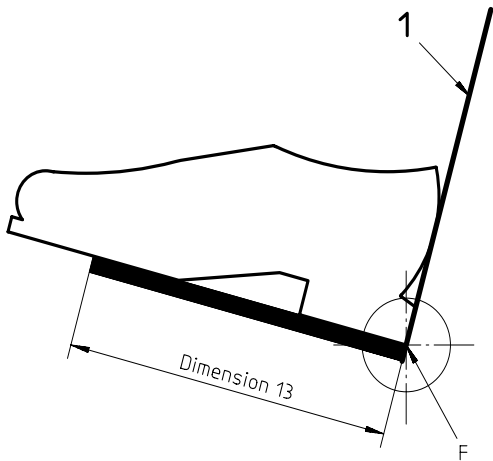
b) Footrest length for foot support with heel loop



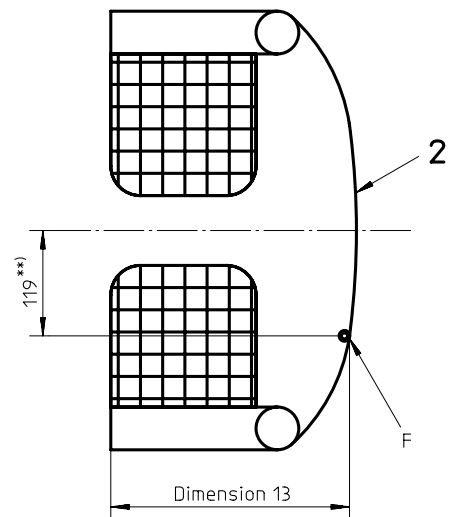
c) Footrest length for tubular foot support without heel loop



d) Footrest length for tubular foot support with heel loop



e) Footrest length for standard foot support



f) Lateral location of footrest length measurement for footrest with single heel loop

Key

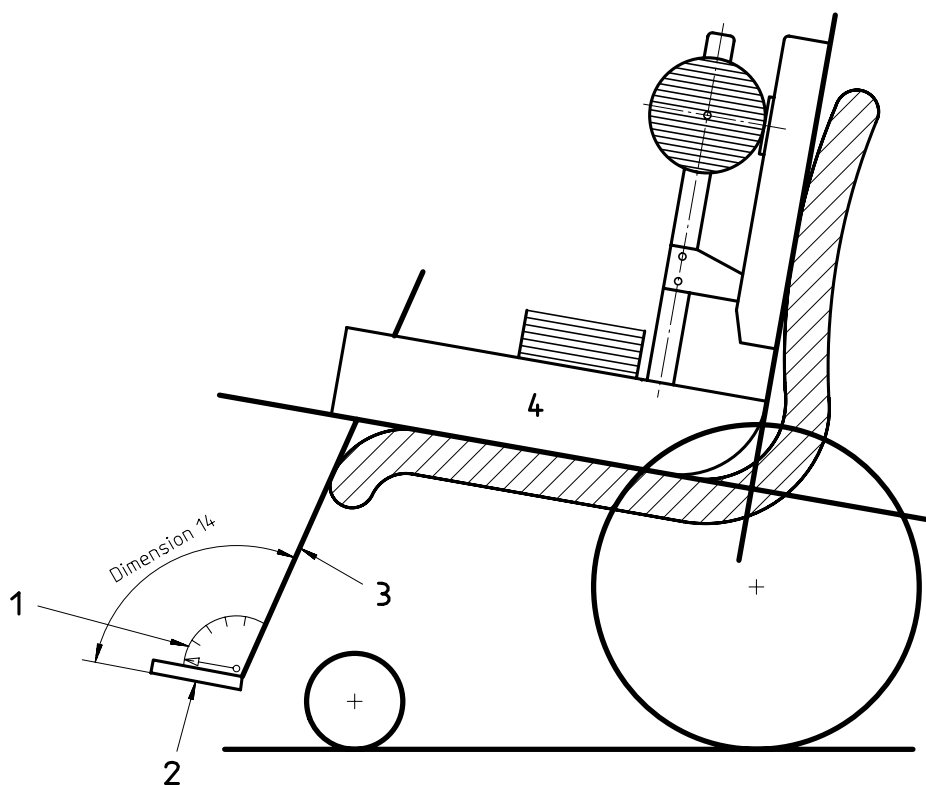
- 1 Leg reference plane
- 2 Heel loop
- F Location of the measurement
- *) (60 for child RLG)
- **) (70 for child RLG)

Figure 22 — Footrest length

7.3.15 Dimension 14: Footrest-to-leg angle

NOTE This measurement does not apply to footrests with support surfaces consisting of a single tube.

The angle between the footrest and the leg reference plane (3.4), as shown in figure 23. For wheelchairs with adjustable footrest-to-leg angles, measure the maximum and minimum angles and the number of increments, if it is not continuously adjustable.



Key

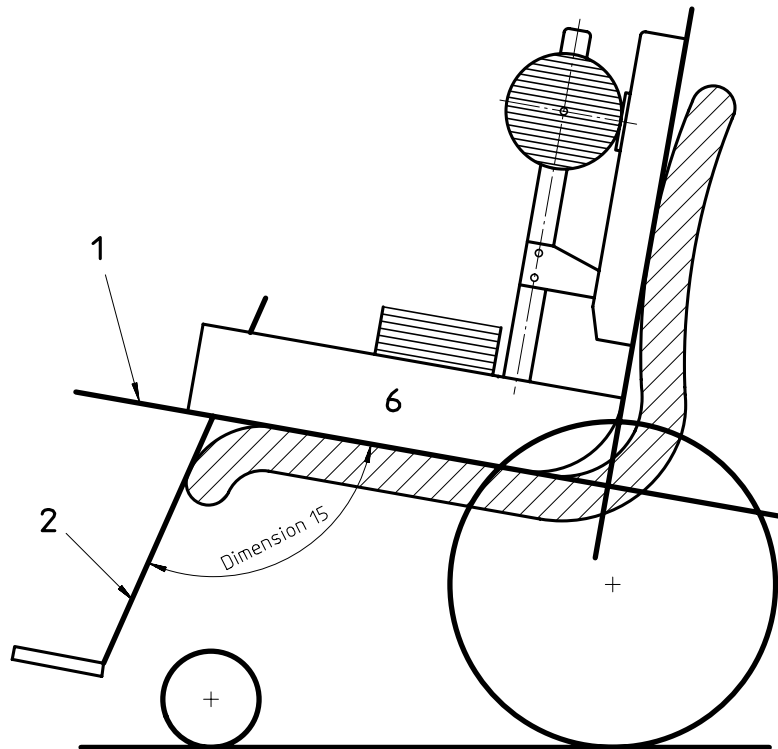
- 1 Means of measuring the angle
- 2 Footrest
- 3 Leg reference plane
- 4 RLG

Figure 23 — Footrest-to-leg angle

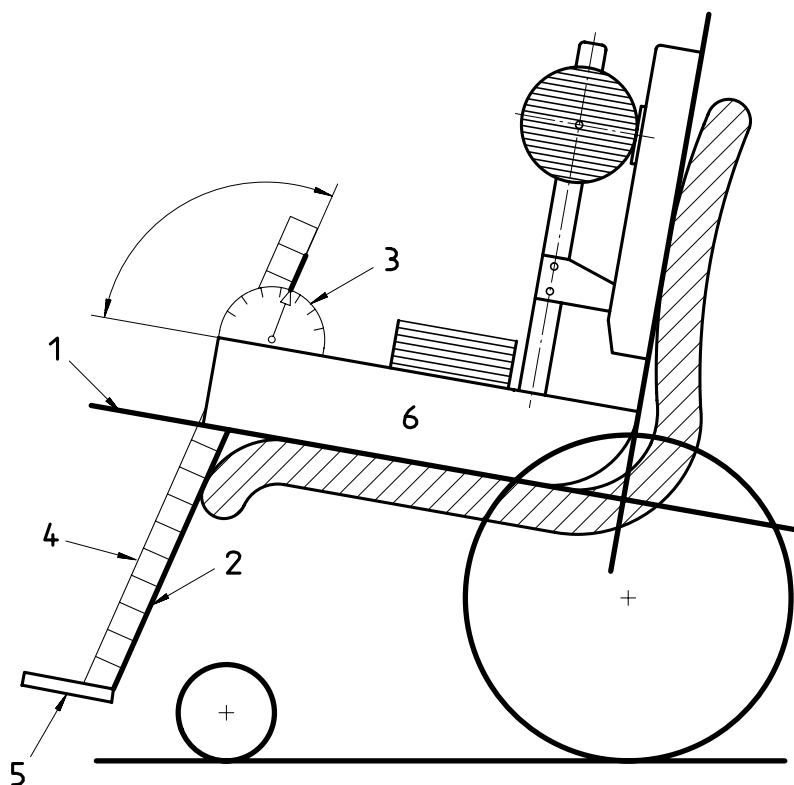
7.3.16 Dimension 15: Leg-to-seat-surface angle

The angle between the seat reference plane (3.2) and the leg reference plane, as shown in figure 24 a). For seats with adjustable leg-to-seat-surface angles, measure the maximum and minimum angles and the number of increments, if it is not continuously adjustable.

Dimension 15 can be determined by measuring the congruent angle, as shown in figure 24 b).



a) Leg-to-seat-surface angle



Key

- 1 Seat reference plane
- 2 Leg reference plane
- 3 Means of measuring the angle
- 4 Bar, e.g. steel
- 5 Footrest
- 6 RLG

b) Measuring leg-to-seat-surface angle

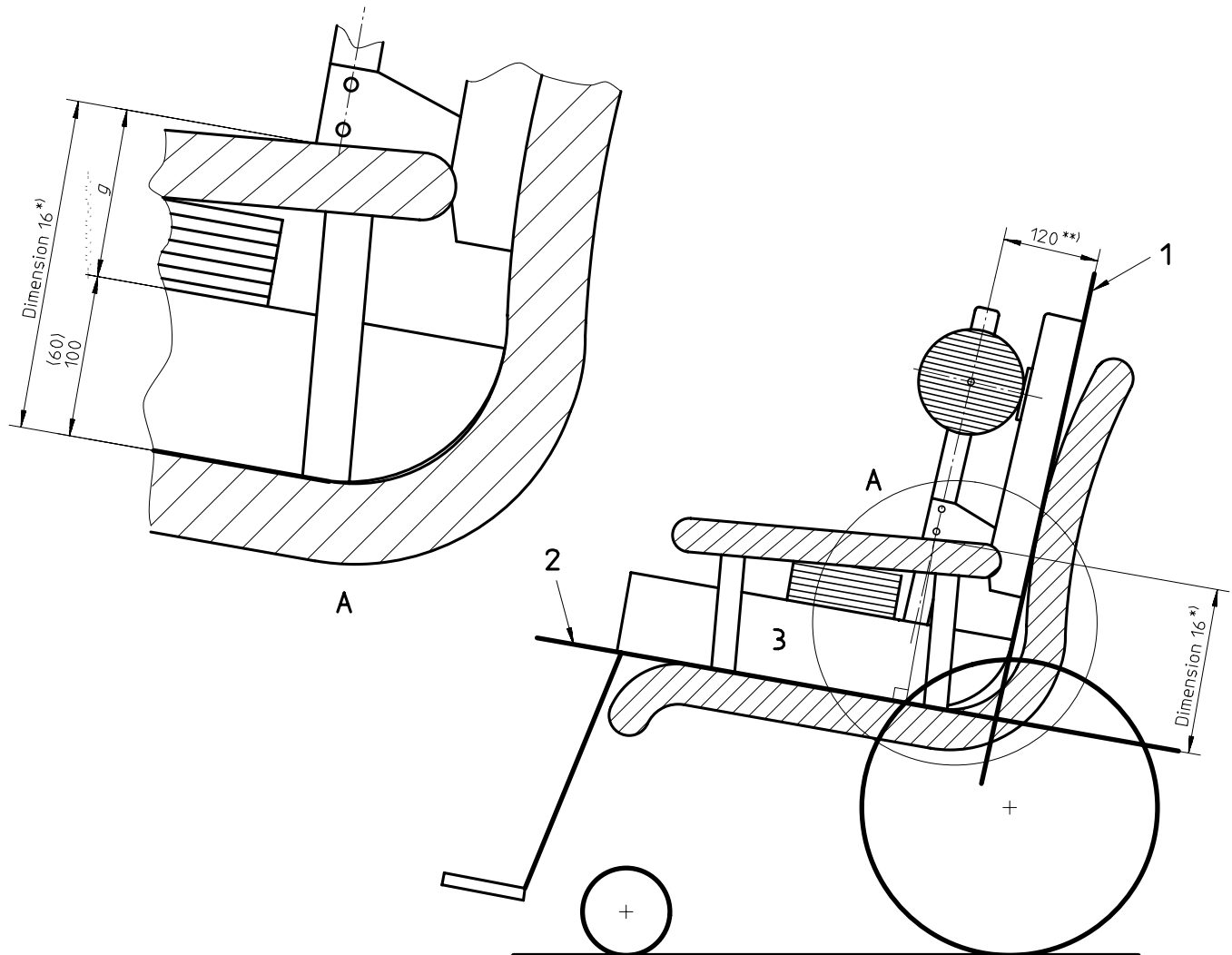
Figure 24 — Leg-to-seat-surface angle

7.3.17 Dimension 16: Armrest height

The distance from the seat reference plane to the top of the armrest, perpendicular to the seat reference plane and at a distance 120 mm forward (72 mm for child RLG) from the backrest reference plane (see figure 25). For seats with adjustable armrest height, measure the maximum and minimum heights and the number of increments, if it is not continuously adjustable.

This dimension can be determined by measuring g as shown in figure 25 and adding 100 mm (60 mm for child RLG) obtained as in 7.3.1 note 2.

Dimensions in millimetres



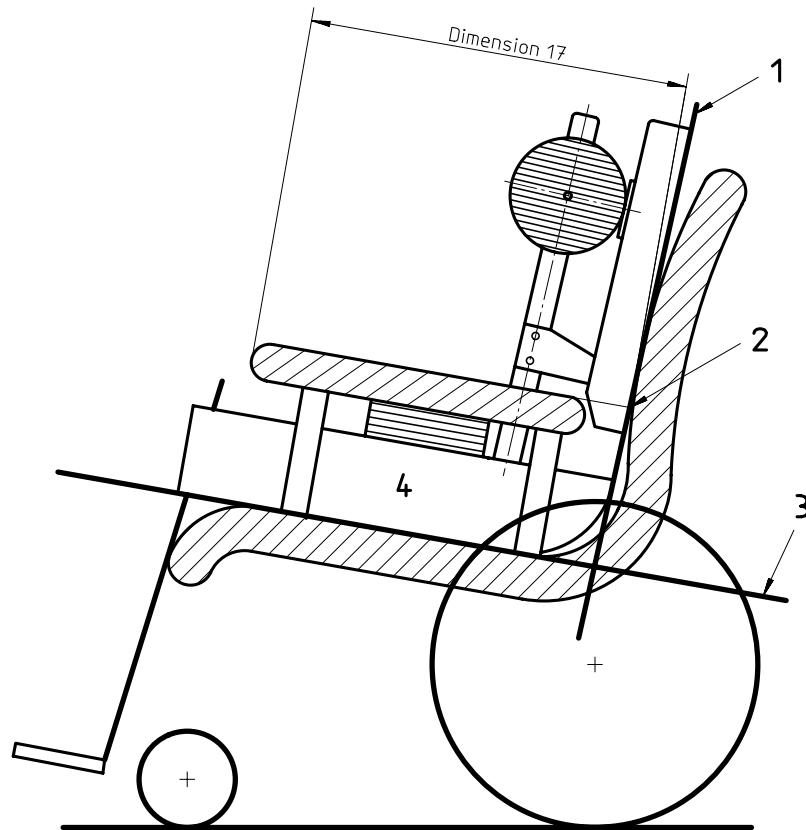
Key

- 1 Backrest reference plane
- 2 Seat reference plane
- 3 RLG
- *) Armrest height = $g + 100$
Armrest height = $g + 60$ (for child RLG)
- ***) (72 for child RLG)

Figure 25 — Armrest height

7.3.18 Dimension 17: Front-of-armrest to backrest

The distance from the front of the arm support surface to its intersection with backrest reference plane (point G in figure 26) parallel to the seat reference plane. This applies only if a surface for supporting the arm is present. For seats with adjustable armrests, measure the maximum and minimum values and the number of increments, if it is not continuously adjustable.



Key

- 1 Backrest reference plane
- 2 Location G of the measurement
- 3 Seat reference plane
- 4 RLG

Figure 26 — Front-of-armrest to backrest

7.3.19 Dimension 18: Armrest length

NOTE This dimension applies only if armrest support surface is present.

The length of the arm-support surface, as shown in figure 27. For seats with adjustable armrests, measure the maximum and minimum lengths and the number of increments, if it is not continuously adjustable.

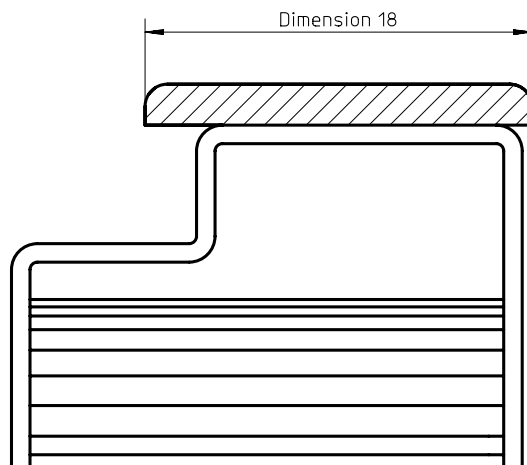


Figure 27 — Armrest length

7.3.20 Dimension 19: Armrest width

NOTE This dimension applies only if armrest support surface is present.

The maximum width of the surface that supports the arm, as shown in figure 28.

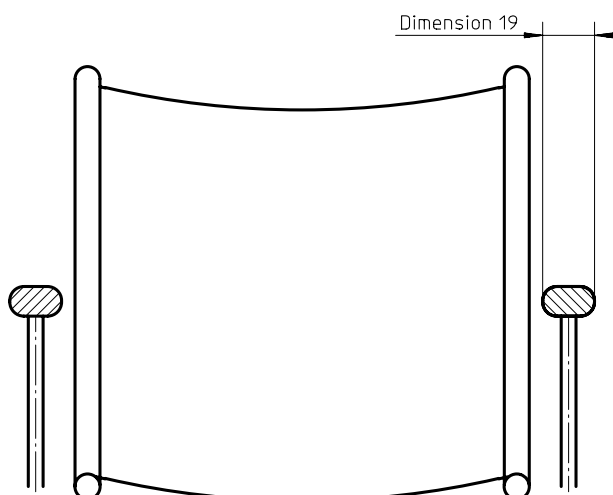
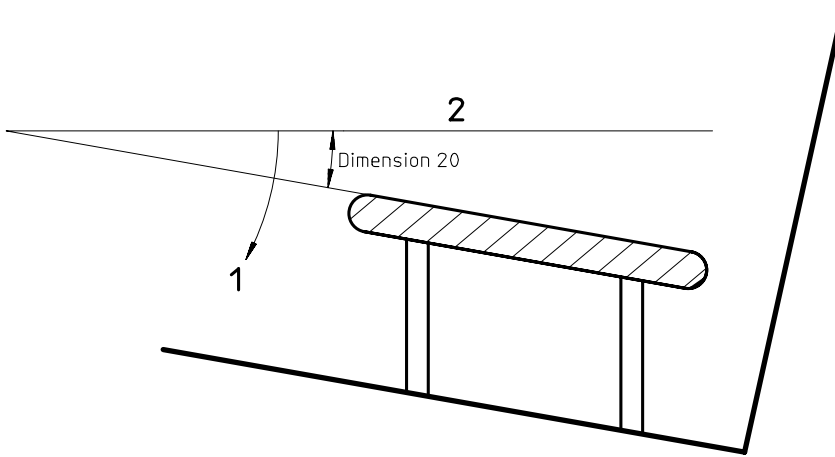


Figure 28 — Armrest width

7.3.21 Dimension 20: Armrest angle

NOTE This dimension applies only if armrest support surface is present.

The angle of the arm-support surface with respect to the horizontal. The angle shown in figure 29 is positive. For seats with adjustable armrest, measure the maximum and minimum angles and the number of increments, if it is not continuously adjustable.



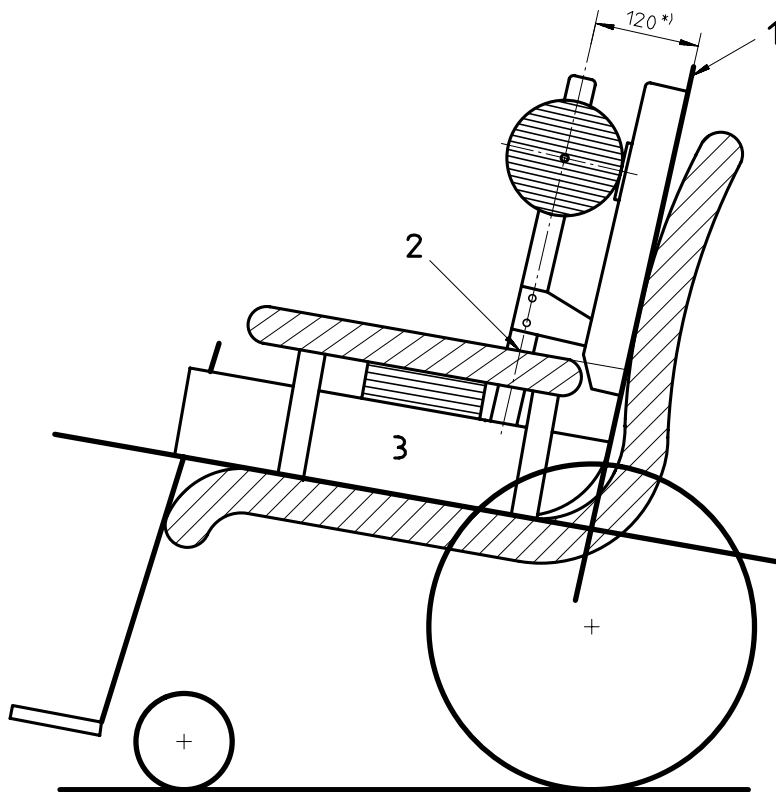
Key
 1 Positive direction
 2 Horizontal

Figure 29 — Armrest angle

7.3.22 Dimension 21: Distance between armrests

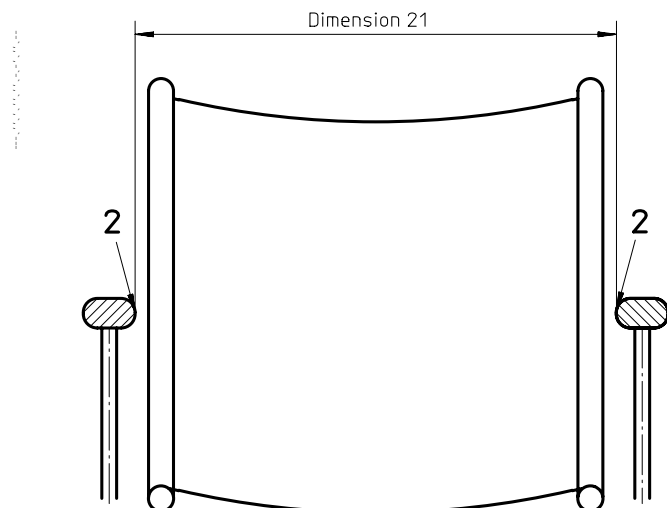
Maximum distance between the innermost part [point H in figure 30 a) and b)] of the armrests at a distance 120 mm (72 mm for child RLG) forward of the backrest reference plane as shown in figure 30 a) and b). For seats with adjustable armrests, measure the maximum and minimum values and the number of increments, if it is not continuously adjustable.

Dimensions in millimetres



Key
 1 Backrest reference plane
 2 Location H of the measurement
 3 RLG
 *) (72 for child RLG)

a) Location of measurement of distance between armrests



Key

2 Location H of the measurement

b) Measurement of distance between armrests

Figure 30 — Distance between armrests

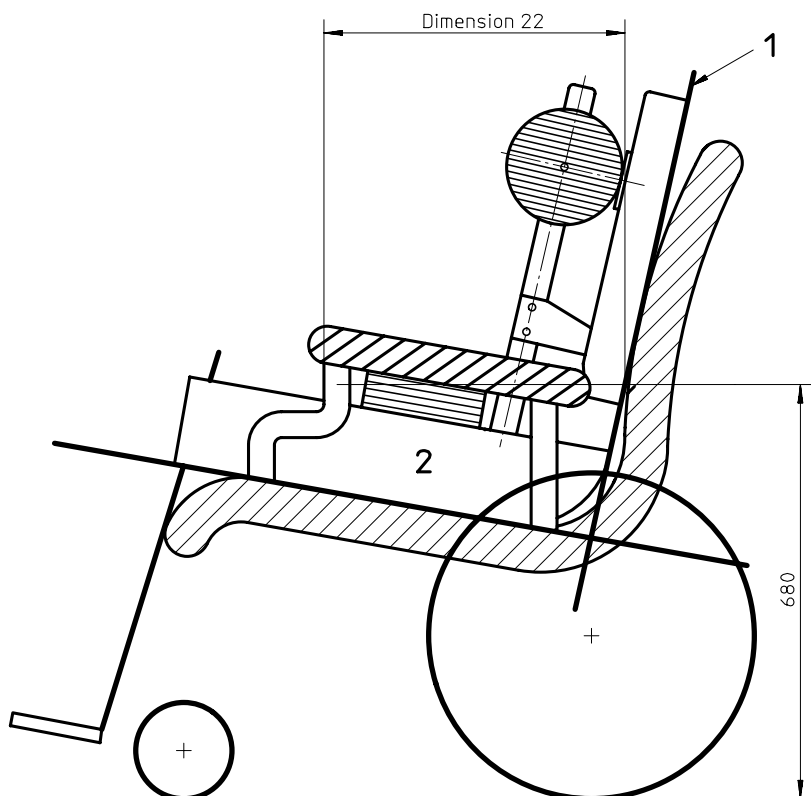
7.3.23 Dimension 22: Front location of armrest structure

The distance between the backrest reference plane and the most forward part of the armrest assembly, measured in a plane 680 mm above and parallel to the ground, as shown in figure 31.

NOTE Table height is usually approximately 680 mm above the ground. This measurement determines whether a part or all of the wheelchair/armrest structure will pass under a table.

For seats with adjustable armrests, measure the maximum and minimum values and the number of increments, if it is not continuously adjustable.

Dimensions in millimetres



Key

1 Backrest reference plane

2 RLG

Figure 31 — Front location of armrest structure

7.3.24 Dimension 23: Handrim diameter

Outside diameter of the handrim (see figure 32).

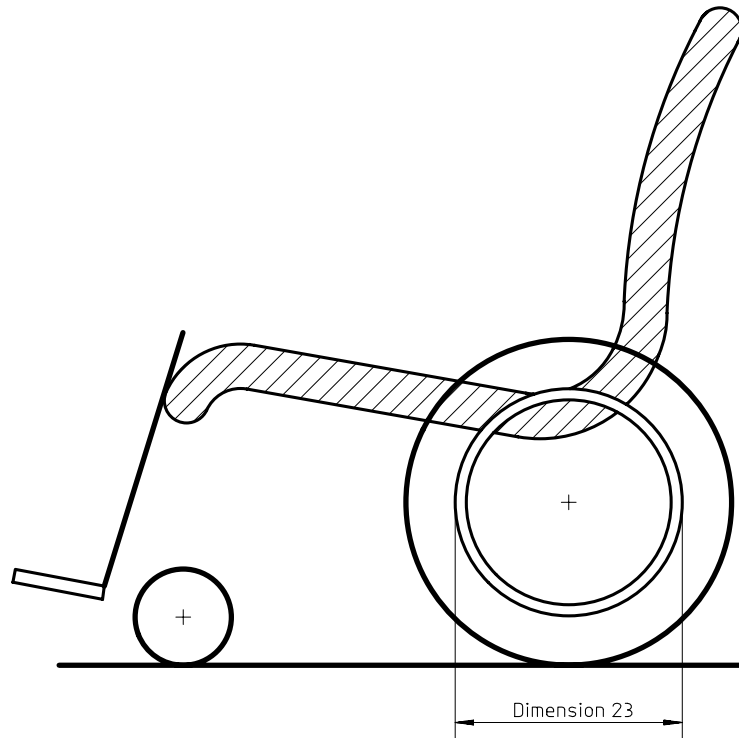


Figure 32 — Handrim diameter

7.3.25 Dimension 24: Propelling wheel diameter

Outside diameter of the tyre of the propelling wheel (see figure 33).

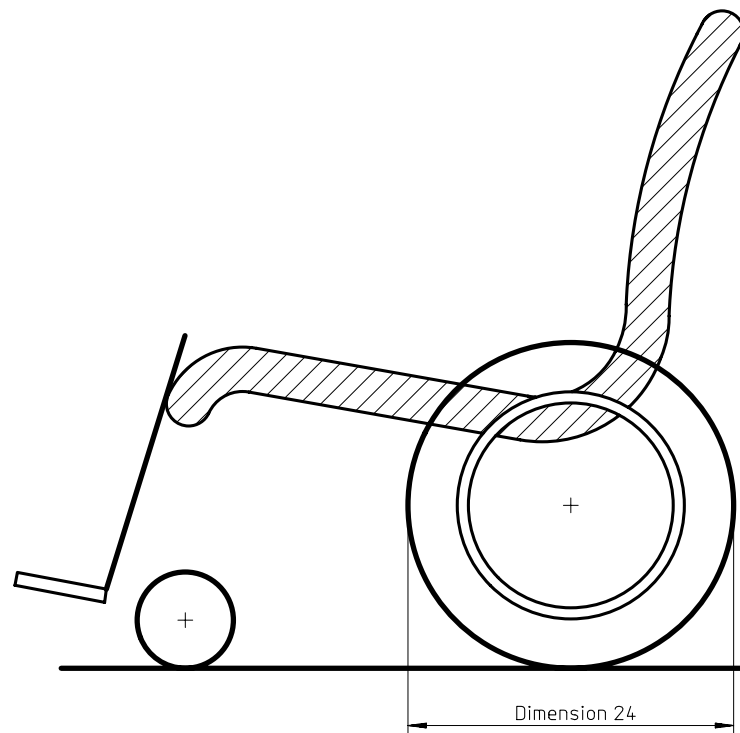


Figure 33 — Propelling wheel diameter

7.3.26 Dimension 25: Horizontal displacement of wheel axle

The horizontal distance of the wheel axle from the intersection of the loaded seat and backrest reference planes. The dimension shown in figure 34 a) is positive. For wheelchairs with adjustable wheel positions, measure the maximum and minimum values and the number of increments, if it is not continuously adjustable.

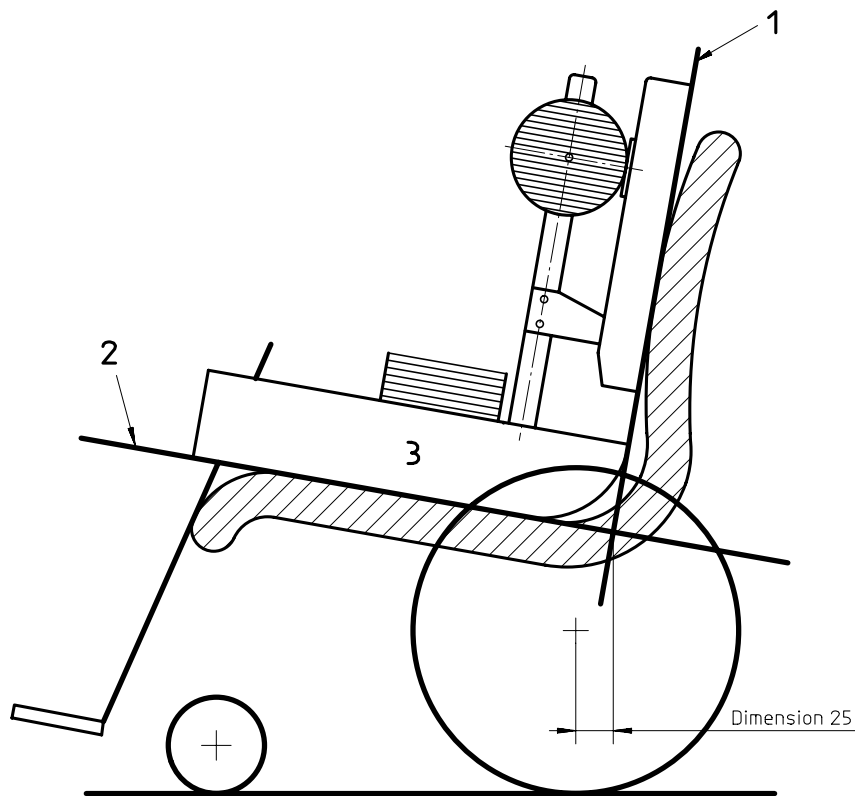
This dimension can be determined by measuring the horizontal distance M from the readily accessible front edge of the RLG base to the centre of the axle, as shown in figure 34 b). The horizontal displacement of wheel axle x can then be obtained from the following:

- For seat plane angle θ between 0° and 5° (see dimension 1, S_L obtained from 7.3.1, note 2)

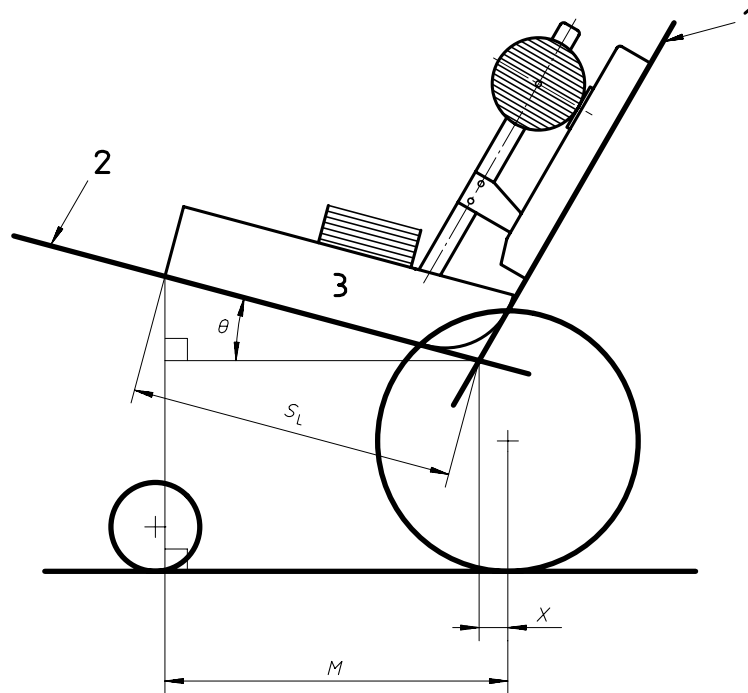
$$x = M - S_L$$

- For seat plane angle θ greater than 5° (see dimension 1)

$$x = M - S_L \cos \theta$$



a) Horizontal displacement of wheel axle

**Key**

- 1 Backrest reference plane
- 2 Seat reference plane
- 3 RLG

b) Determination of x**Figure 34 — Horizontal displacement of wheel axle****7.3.27 Dimension 26: Vertical displacement of wheel axle**

The distance between the wheel axle and the line of intersection of the loaded seat and backrest reference planes measured vertically. The dimension shown in figure 35 a) is positive. For wheelchairs with adjustable wheel positions, measure the maximum and minimum values and the number of increments, if it is not continuously adjustable.

The vertical displacement of the wheel axle, y , can be determined by measuring the vertical distance H from the readily accessible front edge of the RLG base [see figure 35 b)] to the centre of the axle as shown. The vertical displacement of wheel axle y , can be obtained from the following equation.

$$y = H - R - S_L \sin \theta$$

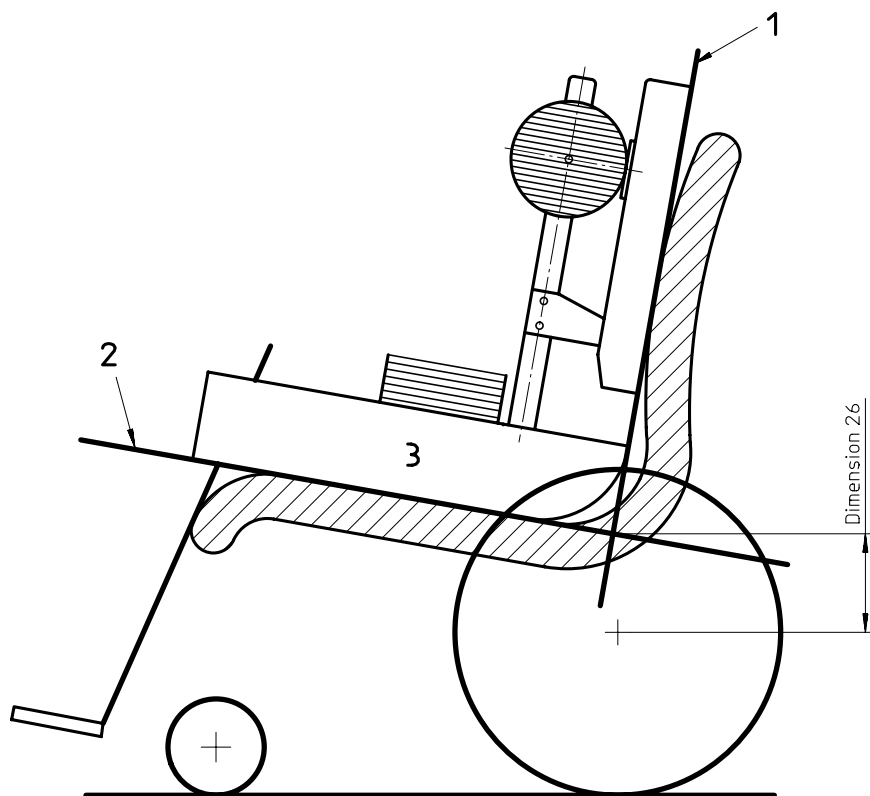
where

H is the height of front edge of RLG;

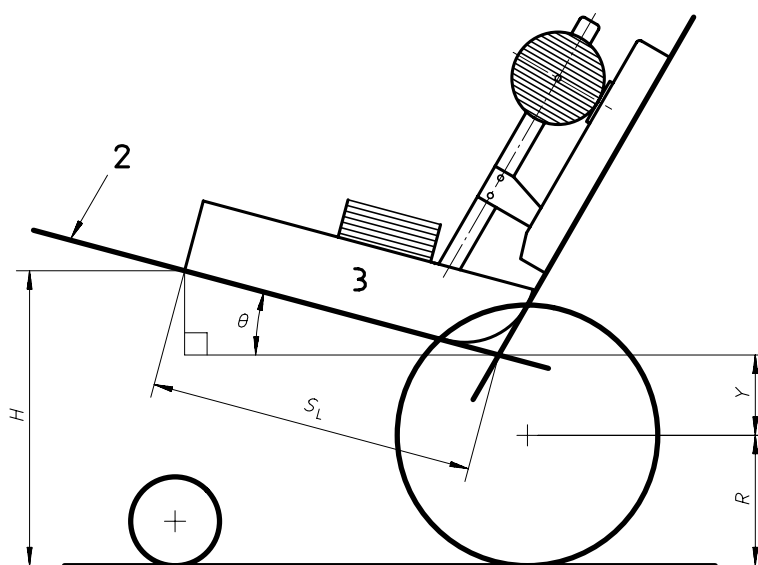
R is the radius of the rear wheels;

S_L is as derived in 7.3.1, note 2;

θ is dimension 1, seat plane angle.



a) Vertical displacement of wheel axle



Key

- 1 Backrest reference plane
- 2 Seat reference plane
- 3 RLG

b) Measurement of vertical displacement of wheel axle

Figure 35 — Vertical displacement of wheel axle

7.3.28 Dimension 27: Castor wheel diameter

Outside diameter of castor wheel tyre.

8 Measurement records and disclosure

8.1 Test report

The test report shall include at least the following information.

- a) The name and address of the organization which carried out the measurements;
- b) the name and address of the manufacturer of the wheelchair;
- c) the wheelchair type and any serial and batch number;
- d) a description of how the wheelchair was equipped;
- e) the RLG size used for the measurements;
- f) if the RLG pivot is fixed as described in 7.2 b) and c), the angle of the RLG back unit relative to the horizontal;
- g) date of measurement;
- h) the dimensions measured as specified in 7.3.

NOTE Annex B provides a recommended data form to report this information.

8.2 Disclosure of information for wheelchair prescribers and users

Manufacturers shall disclose in their specification sheets, in the manner and sequence specified in ISO 7176-15, the measurements indicated in table 1 and in the format specified in table 1.

Table 1 — Requirements for disclosure of measurements

Measurement	Dimension No.	Fixed or minimum value	Maximum value, if relevant
Seat plane angle	(1)°°
Effective seat depth	(2)	..... mm	..... mm
Effective seat width	(4)	..... mm	..... mm
Seat surface height at front edge	(5)	..... mm	..... mm
Backrest angle	(6)°°
Backrest height	(7)	..... mm	..... mm
Footrest-to-seat distance	(11)	..... mm	..... mm
Leg-to-seat-surface angle	(15)°°
Armrest-to-seat distance	(16)	..... mm	..... mm
Front armrest-to-backrest distance	(17)	..... mm	..... mm
Handrim diameter	(23)	..... mm	..... mm
Horizontal location of axle	(25)	..... mm	..... mm

Annex A (normative)

Reference loader gauges

A.1 General

Reference loader gauges (RLG) are designed to simulate the mass distribution of the human body. They consist of a seat unit upon which pivots a back unit, each with a specified mass distribution. There are two sizes of RLG, corresponding to adult and child body sizes.

A.2 Construction

The main components of an RLG can be fabricated from any material (wood or plastic shell, for example), provided the shape and mass distribution specified below is obtained. Unless otherwise indicated, tolerances for all linear dimensions shall be ± 5 mm and all edges shall be rounded with a radius of approximately 5 mm.

A.3 Adult RLG

A.3.1 Adult seat unit

The seat unit is specified in figure A.1. The mass of the adult seat unit shall not exceed 10 kg excluding supplementary weights.

Mark point X at the front of the seat unit (location of application of positioning force F_s)

A.3.2 Adult back unit

The back unit consists of an upright member, pivoted at H, and a back panel as shown in figure A.2 with provision to lock the pivot throughout its range. The mass of the adult back unit shall not exceed 6 kg excluding supplementary weights.

A.3.3 Location of centre of gravity of adult RLG

Provide the adult RLG with supplementary weights to give a total seat unit mass of $24 \text{ kg} \pm 0,2 \text{ kg}$ and a total back unit mass of $27 \text{ kg} \pm 0,2 \text{ kg}$. Supplementary weights shall be distributed in such a manner that the centre of gravity of the fully assembled loader gauge is located as shown in figure A.3.

NOTE For the purposes of this annex, seat unit and back unit are set mutually perpendicular.

Provide means to secure the weights in position to prevent their movement during the measuring process and to remove them afterwards.

A.4 Child RLG

The child RLG has dimensions of the adult version scaled by a factor of 0,6. In addition, the seat unit is extended forward to facilitate the measuring process.

A.4.1 Child seat unit

The seat unit is specified in figure A.4. The mass of the child seat unit shall not exceed 2,2 kg, excluding supplementary weights.

Mark point X as in A.3.1 above.

A.4.2 Child back unit

The back unit consists of an upright member, pivoted at H, and a back panel as shown in figure A.5 with provision to lock the pivot throughout its range. The mass of the child back unit shall not exceed 1,7 kg, excluding supplementary weights.

A.4.3 Location of centre of gravity of child RLG

Provide the child RLG with supplementary weights to give a total seat unit mass of $5,2 \pm 0,2$ kg and a total back unit mass of $5,8 \pm 0,2$ kg.

Supplementary weights are to be distributed in such a manner that the centre of gravity of the fully assembled loader gauge is located as shown in figure A.6.

NOTE For the purposes of this annex, seat unit and back unit are set mutually perpendicular.

Provide means to secure the weights in position to prevent their movement during the measuring process and to remove them afterwards.

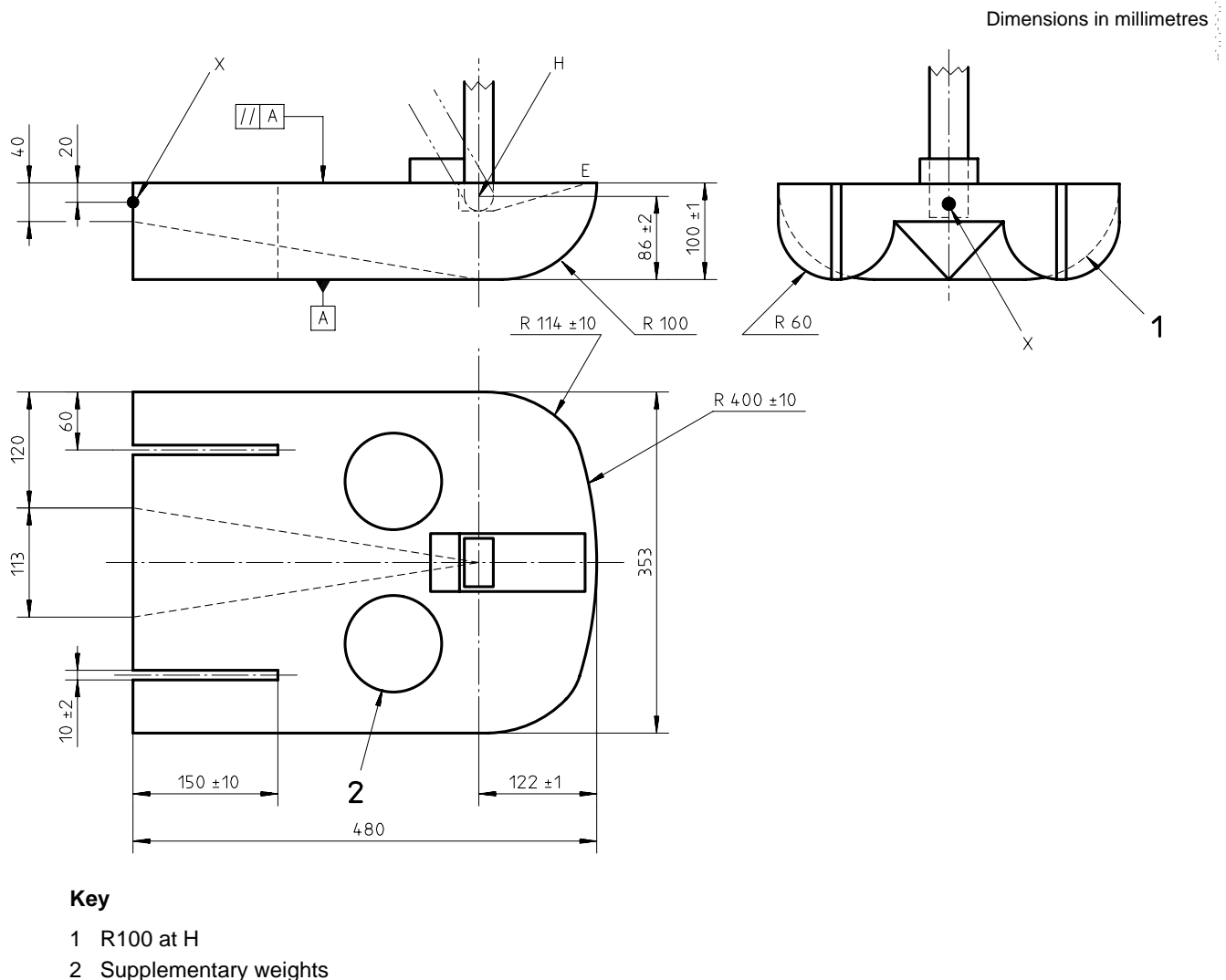


Figure A.1 — Adult RLG seat unit

Dimensions in millimetres

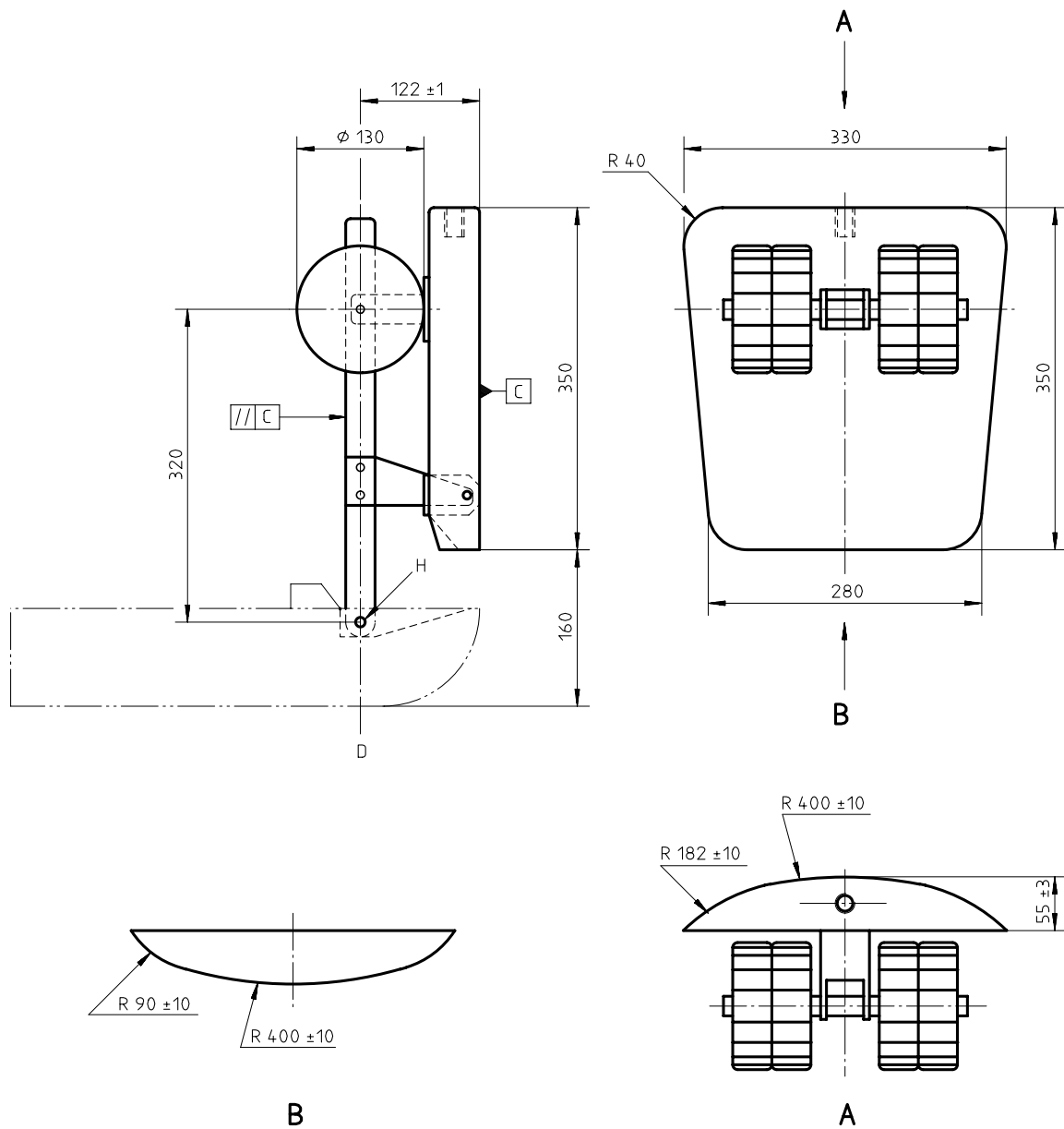
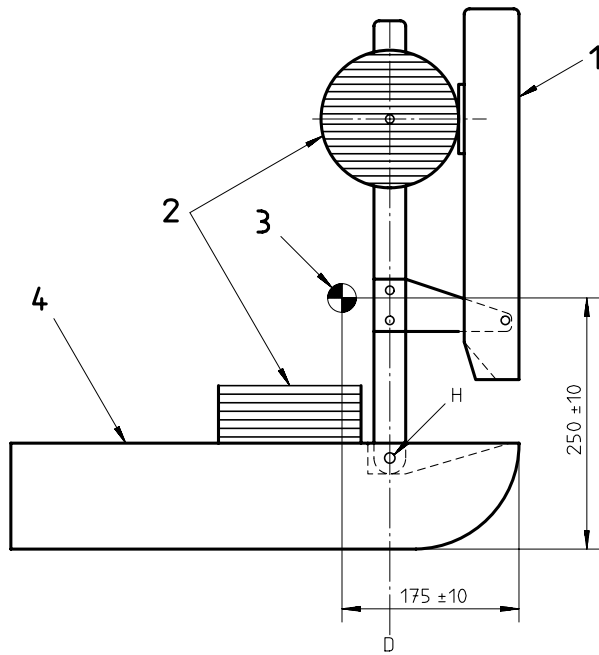


Figure A.2 — Adult RLG back unit

Dimensions in millimetres

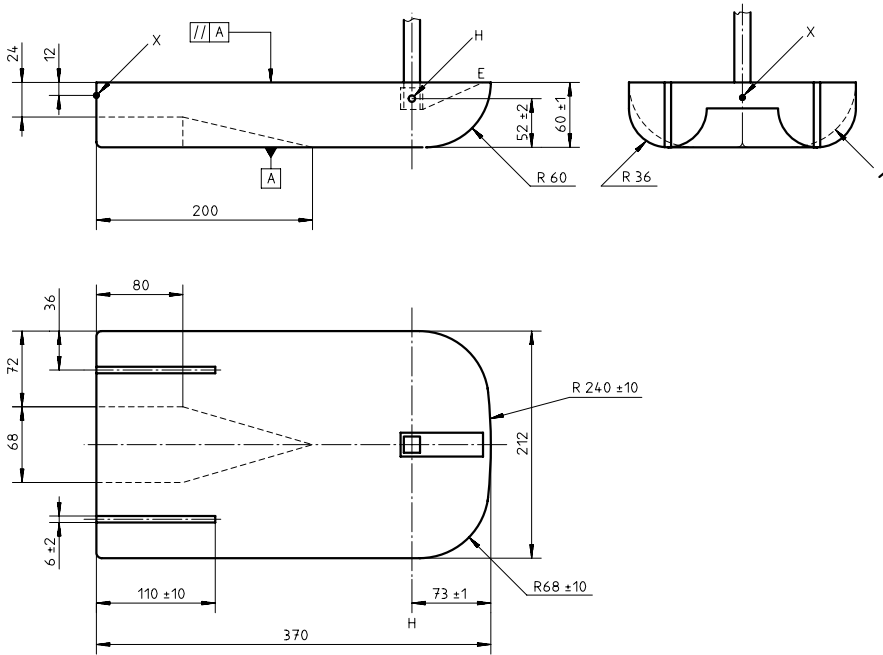


Key

- 1 Back unit
- 2 Supplementary weights
- 3 Centre of gravity
- 4 Seat unit

Figure A.3 — Adult RLG — Location of centre of gravity

Dimensions in millimetres



Key

- 1 R60 at H

Figure A.4 — Child RLG seat unit

Dimensions in millimetres

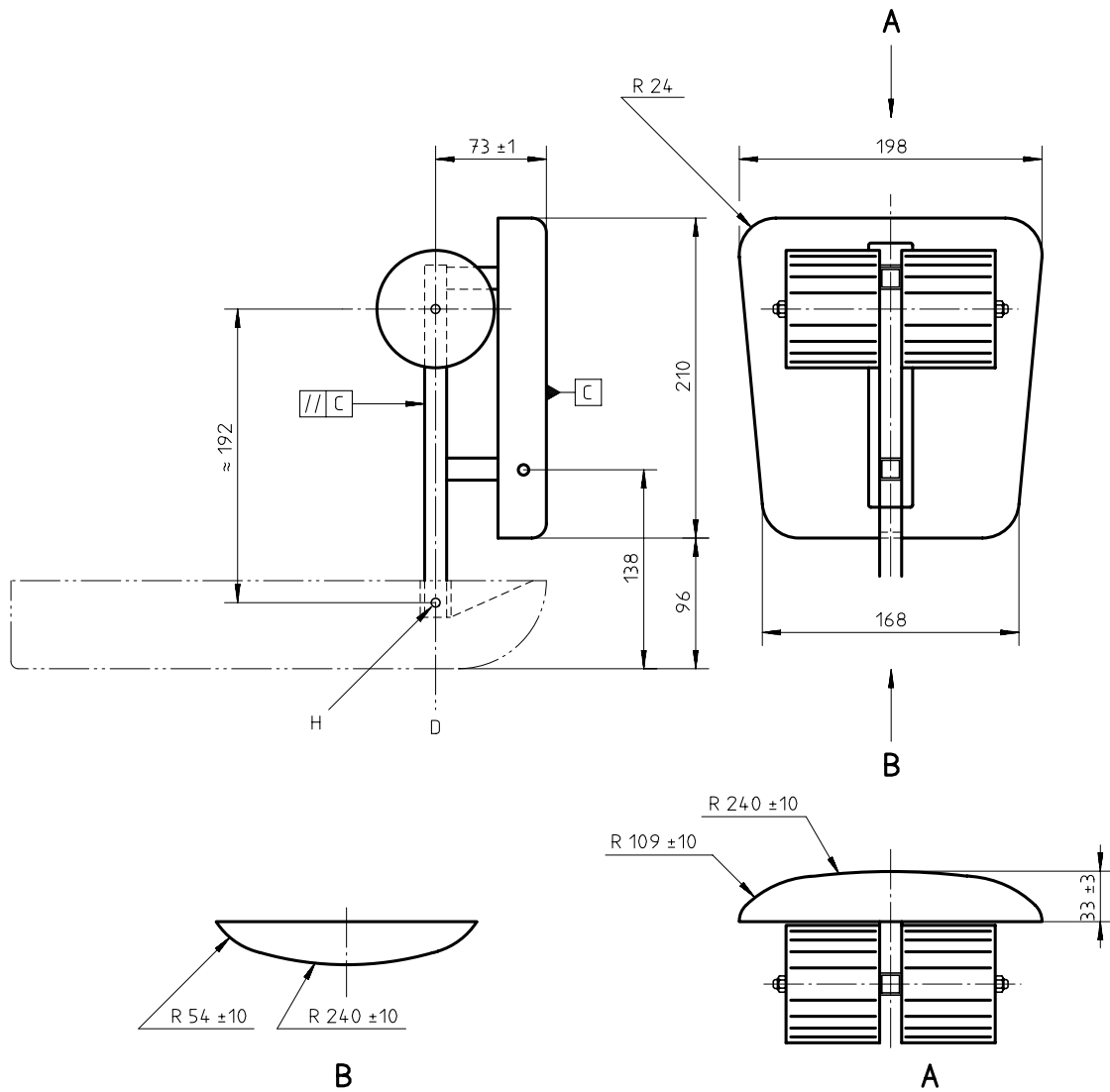
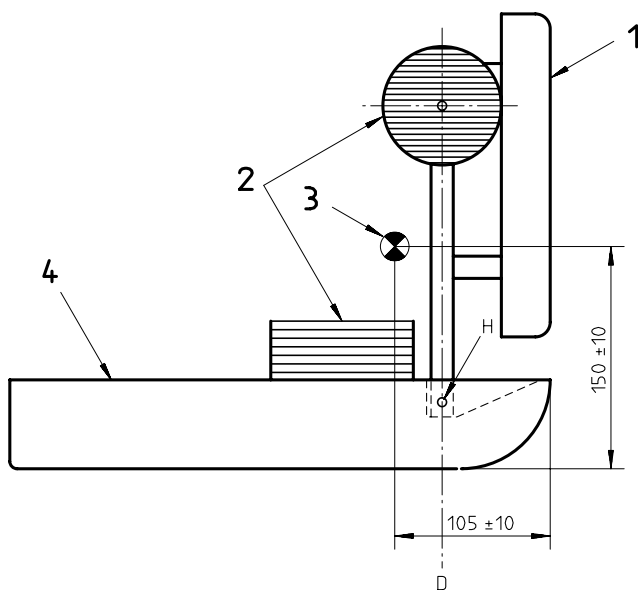


Figure A.5 — Child back unit

Dimensions in millimetres



Key

- 1 Back unit
- 2 Supplementary weights
- 3 Centre of gravity
- 4 Seat unit

Figure A.6 — Child RLG — Location of centre of gravity

Annex B (informative)

Data forms

The measurement data forms should include the following information (see 8.1) in the order given:

- a) the name and address of the organization which carried out the measurements;
- b) the name and address of the manufacturer of the wheelchair;
- c) the wheelchair type and any serial and batch number;
- d) a description of how the wheelchair was equipped;
- e) the RLG size used for the measurements;
- f) if the RLG pivot is fixed as described in 7.2 b) and c), the angle of the RLG back unit relative to the horizontal;
- g) date of measuring;
- h) the dimensions measured as specified in 7.3 and presented in the following format:

Dimension	Fixed or minimum value	Maximum value if relevant	Number of increments
1	Seat plane angle °	
2	Effective seat depth	..... mm	
3	Seat width	..... mm	
4	Effective seat width	..... mm	
5	Seat surface height at front edge	..... mm	
6	Backrest angle °	
7	Backrest height	..... mm	
8	Backrest width	..... mm	
9	Headrest in front of backrest	..... mm	
10	Headrest height above seat	..... mm	
11	Footrest to seat	..... mm	
12	Footrest clearance	..... mm	
13	Footrest length	..... mm	
14	Footrest-to-leg angle °	
15	Leg-to-seat-surface angle °	
16	Armrest height	..... mm	
17	Front-of-armrest to backrest	..... mm	
18	Armrest length	..... mm	
19	Armrest width	..... mm	
20	Armrest angle °	
21	Distance between armrests	..... mm	
22	Front location of armrest structure	..... mm	
23	Handrim diameter	..... mm	
24	Propelling wheel diameter	..... mm	
25	Horizontal displacement of wheel axle	..... mm	
26	Vertical displacement of wheel axle	..... mm	
27	Castor wheel diameter	..... mm	

ICS 11.180

Descriptors: disabled persons aids, wheel chairs, vehicle wheels, seats, determination, dimensions, dimensional measurements.

Price based on 47 pages
