INTERNATIONAL STANDARD

ISO 7176-7

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Wheelchairs —

Part 7:
Measurement of seating and wheel dimensions

Fauteuils roulants —

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

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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*.

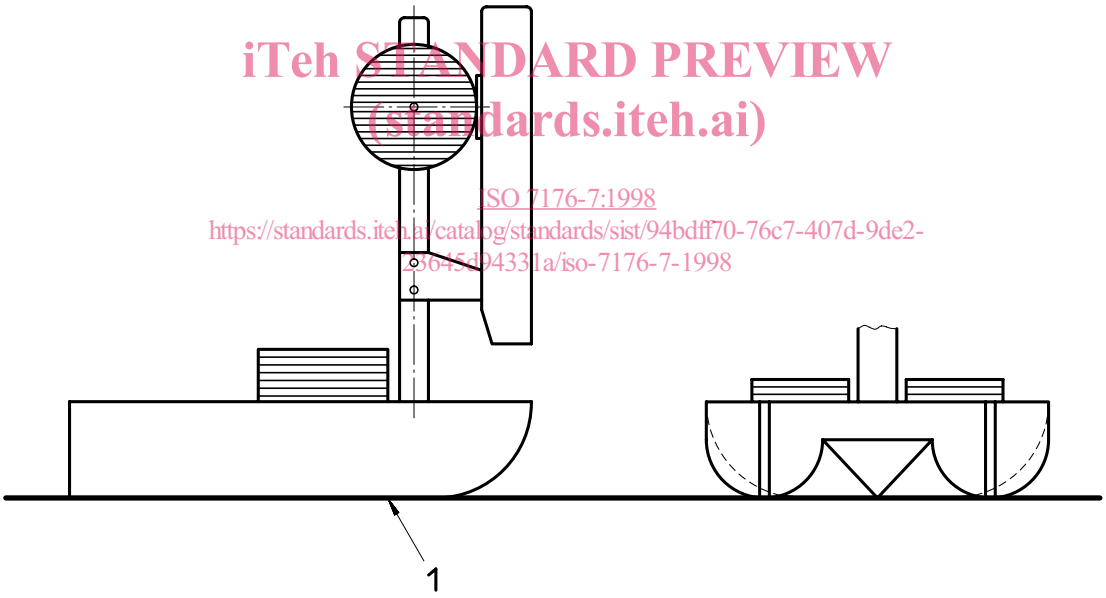
ISO 9999:1992, *Technical aids for disabled persons — Classification*.

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

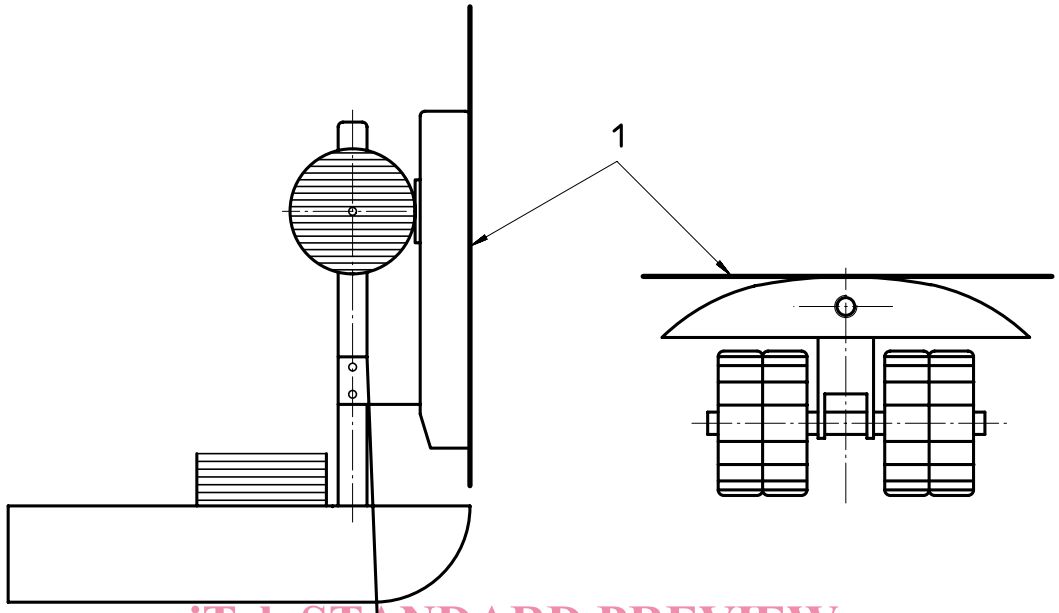


Key

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

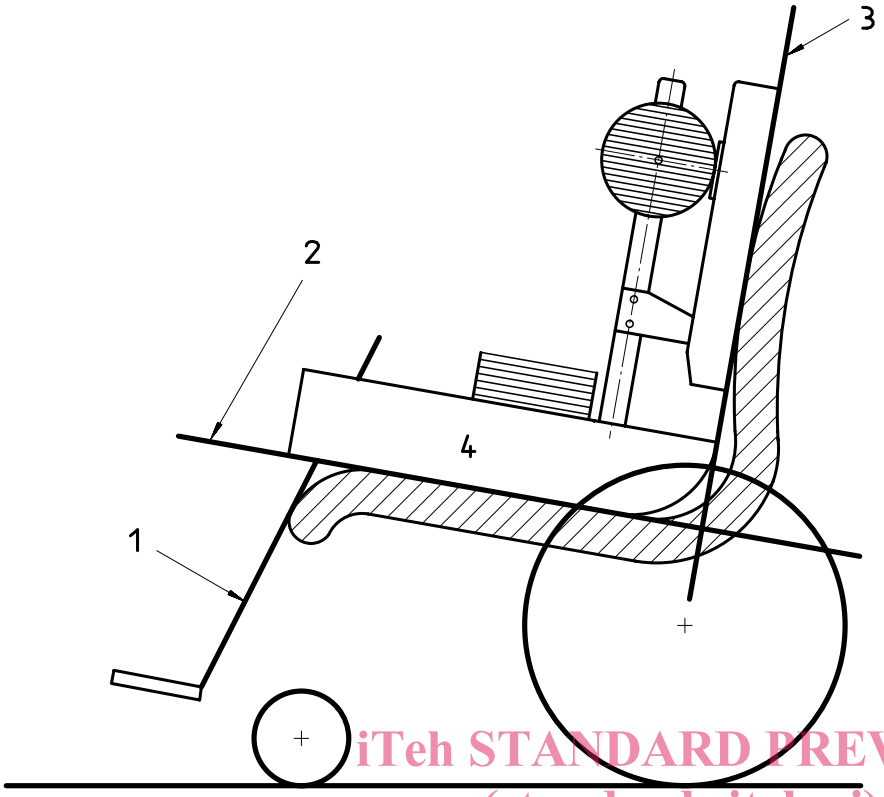
1 Backrest reference plane

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)]

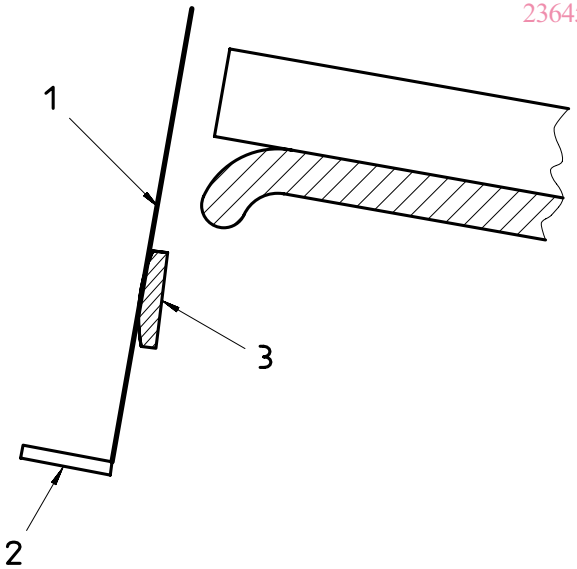
NOTE Figure 4 shows the tangent point of the leg reference plane (point X) with different types of foot support.



Key

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

a) Leg reference plane with forward seat projection



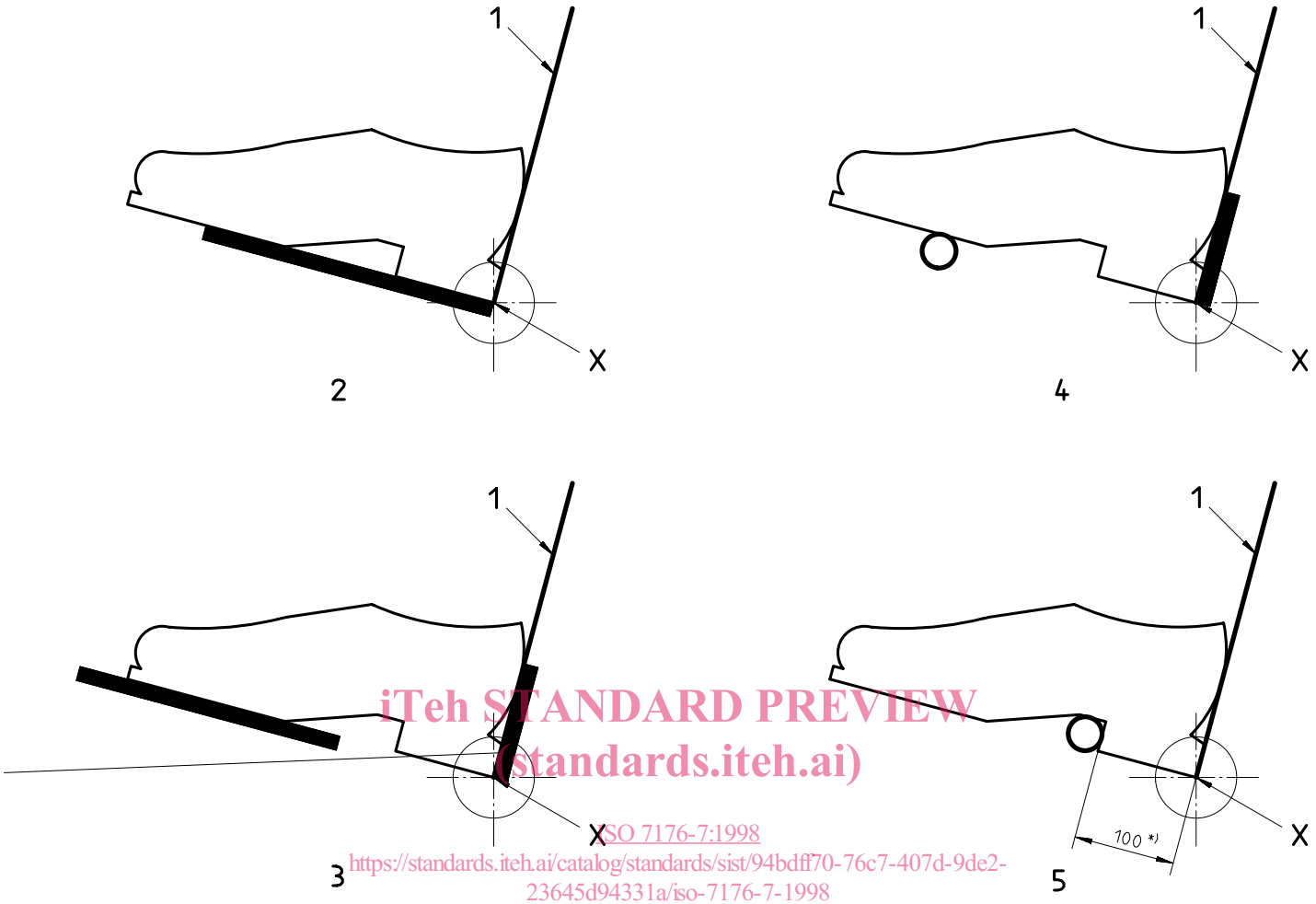
Key

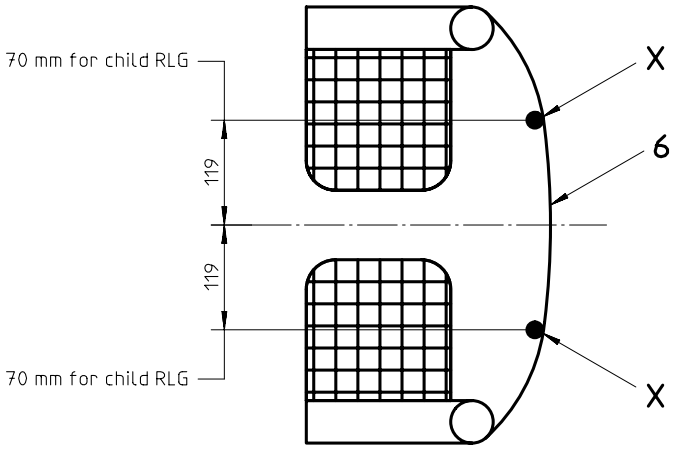
1 Leg reference plane
2 Footrest
3 Calf support

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 ± 0,2°.

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 simular 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 $^{0°}_{-1°}$ 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 mid-position ± 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° ± 2° 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° ± 2° 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 ± 1° 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° ± 1° 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

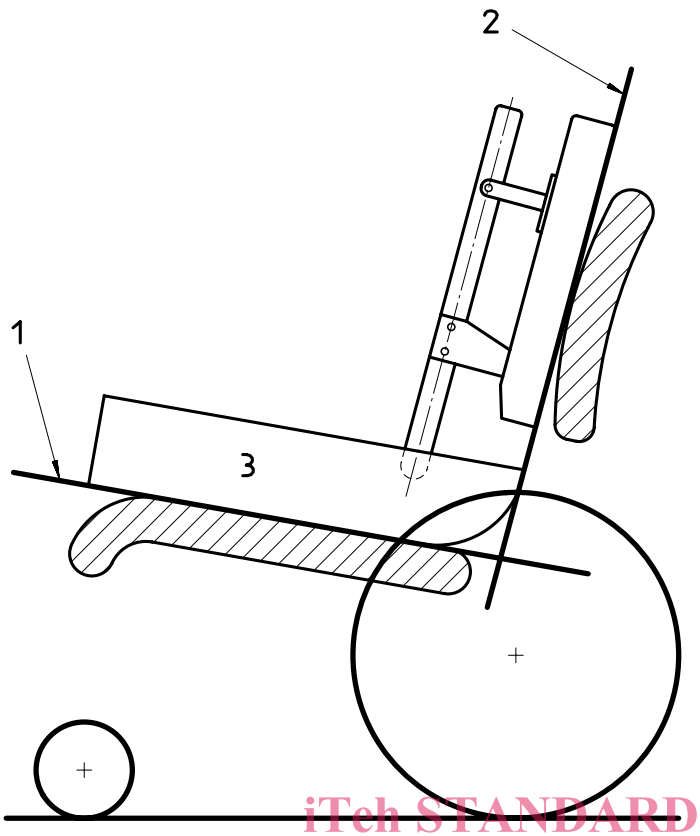
NOTE Individuals unfamiliar with this technique are recommended to practise the loading procedure a few times and record seat plane angle and backrest angle (see 7.3, dimensions 1 and 6) to establish a consistency within ± 2°.

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)].

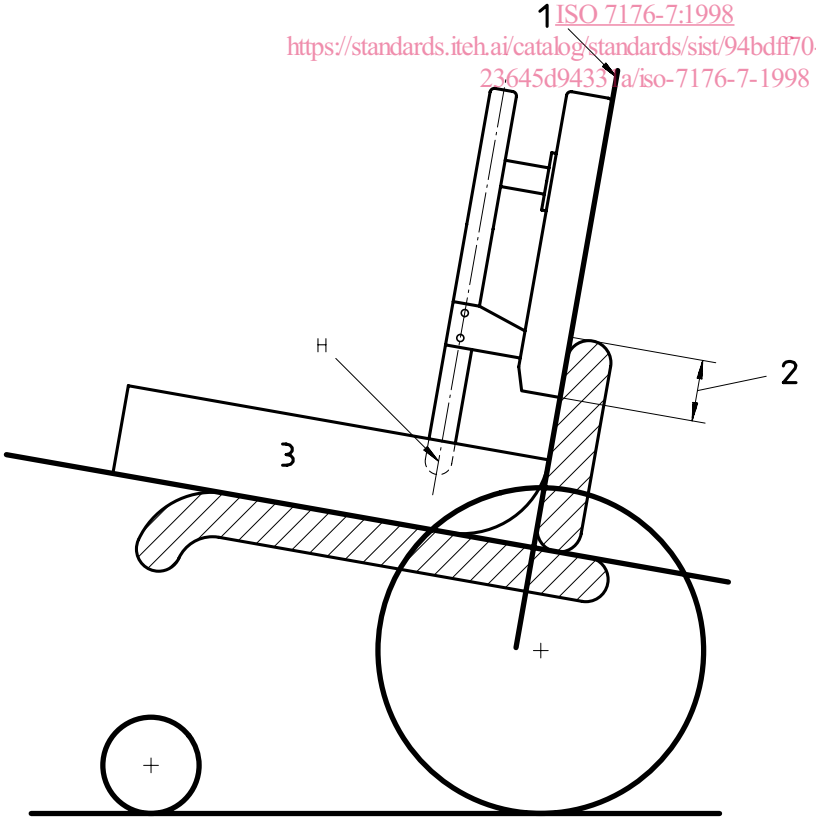
b) For wheelchairs with backrests which do not extend 150 mm above the bottom of the adult RLG back unit or 90 mm above the bottom of the child RLG back unit [figure 5 b)], fix the pivot point H with the back unit (backrest reference plane) at 90° ± 1° to the horizontal [figure 5 c)]. Record this in 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