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ICS

Will supersede EN 12184:1999

English version

## Electrically powered wheelchairs, scooters and their chargers - Requirements and test methods

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## Contents

Page

Foreword.....	4
Introduction .....	5
<b>Electrically powered wheelchairs, scooters and their chargers — Requirements and test methods .....</b>	<b>6</b>
1 Scope .....	6
2 Normative references .....	6
3 Terms and definitions .....	8
4 Test apparatus .....	9
5 Type classes.....	11
6 General requirements.....	11
7 Design requirements .....	12
8 Performance requirements .....	22
9 Electrical requirements .....	32
10 Information supplied by the manufacturer .....	33
11 Test report .....	36
<b>Annex A (informative) Recommendations for dimensions and manoeuvring area of electrically powered wheelchairs .....</b>	<b>40</b>
A.1.1 Dimensions when ready for use.....	40
A.1.2 Push handle height.....	40
A.1.3 Ground clearance .....	40
A.2.1 Turning radius.....	41
A.2.2 Turn-around width .....	41
<b>Annex B (informative) Recommended design features.....</b>	<b>43</b>
B.2.1 Anti-tip devices .....	43
B.2.2 Component weight.....	43
B.2.3 Fittings and tools .....	43
B.2.4 Tyres .....	43
B.2.5 Means to inflate tyres .....	43
B.2.6 Surface temperature.....	44
B.2.7 Recommendations related to the user transferring into or out of the wheelchair .....	44
B.2.8 Resistance to contamination from urine incontinence .....	44
B.2.9 Indication for maximum safe slope.....	44
B.2.10 Mirrors.....	44
B.2.11 Head support.....	44
B.2.12 Activation of running brakes .....	45
B.2.13 Accidental operation of parking brakes or freewheel.....	45

<b>B.3.1</b>	<b>Mechanical damage of electronic units .....</b>	<b>45</b>
<b>B.3.2</b>	<b>Indication of electrical faults .....</b>	<b>45</b>
<b>B.3.3</b>	<b>Single fault protection.....</b>	<b>45</b>
<b>B.3.4</b>	<b>Batteries and their containers.....</b>	<b>45</b>
<b>B.3.5</b>	<b>Lighting.....</b>	<b>45</b>
<b>B.3.6</b>	<b>Control mechanism feedback .....</b>	<b>46</b>
<b>B.3.7</b>	<b>Freewheel alarm .....</b>	<b>46</b>
<b>B.3.8</b>	<b>Maximum speed.....</b>	<b>46</b>
<b>Annex C (informative)</b>	<b>Recommended seating design.....</b>	<b>47</b>
<b>Annex D (informative)</b>	<b>Manoeuvring.....</b>	<b>48</b>
<b>Annex ZA (informative)</b>	<b>Relationship between this European Standard and the Essential Requirements of Council Directive 93/42/EEC of 14 June 1993 concerning medical devices.....</b>	<b>49</b>

## **Foreword**

This document (prEN 12184:2004) has been prepared by Technical Committee CEN/TC 293 “Technical aids and systems for disabled persons”, the secretariat of which is held by SIS.

This document is currently submitted to the CEN Enquiry.

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directive 93/42/EEC of June 1993 concerning medical devices.

For relationship with EU Directive(s), see informative Annex ZA, which is an integral part of this document.

Annexes A, B, C & D are informative.

## Introduction

This is the first revision of this standard which was originally issued in 1999.

Where this standard does not apply to particular wheelchairs, contracting parties should consider if appropriate parts of this standard can be used. Manufacturers may also wish to consider if appropriate parts of this standard can be used to assess the performance of their products against the Essential Requirements of the Council Directive concerning medical devices 93/42/EEC of 14 June 1993.

This standard contains requirements for ergonomic design related to the ease of wheelchair operation. They are intended to be applicable to at least 80% of adult users and are based upon:

- the body size of users within the range 5th percentile adult female to 95th percentile adult male;
- the abilities and restrictions of a 65 year old 50th percentile female;
- the wheelchair being equipped with operating devices which are not custom-made for individual users.

# Electrically powered wheelchairs, scooters and their chargers — Requirements and test methods

## 1 Scope

This European Standard specifies requirements and test methods for electrically powered wheelchairs with a maximum speed not exceeding 15 km/h intended to carry one person which includes

- manual wheelchairs with add-on power kits used for propulsion;
- electrically powered wheelchairs;
- electrically powered scooters with three or more wheels.

It also specifies requirements and test methods for battery chargers for wheelchairs, and scooters.

This European Standard does not apply in total to:

- wheelchairs intended for special purposes, such as sports;
- custom-made wheelchairs;
- handrim activated power assisted wheelchairs;
- powered office chairs.

NOTE The requirements for manually propelled wheelchairs is specified in EN 12183:1999.

## 2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN ISO 14971:2000, *Medical devices — Application of risk management to medical devices*

EN 1021-1, *Furniture assessment of the ignitability of upholstered furniture-Ignition source: smouldering cigarette*

EN 1021-2, *Furniture assessment of the ignitability of upholstered furniture-Ignition source: match flame equivalent*

EN 12182:1999, *Technical aids for disabled persons — General requirements and test methods*

ISO 68-1:1998, *ISO general purpose screw threads — Basic profile — Part 1: Metric screw threads*

ISO 7176-1:1999, *Wheelchairs — Part 1: Determination of static stability*

ISO 7176-2:2001, *Wheelchairs — Part 2: Determination of dynamic stability of electric wheelchairs*

ISO 7176-3:2003, *Wheelchairs — Part 3: Determination of effectiveness of brakes*

ISO 7176-4:1997, *Wheelchairs — Part 4: Energy consumption of electric wheelchairs and scooters for determination of theoretical distance*

- ISO 7176-5:1986, *Wheelchairs — Part 5: Determination of overall dimensions, mass and turning space*
- ISO 7176-6:2001, *Wheelchairs — Part 6: Determination of maximum speed, acceleration and retardation of electric wheelchairs*
- ISO 7176-7:1998, *Wheelchairs — Part 7: Measurement of seating and wheel dimensions*
- ISO 7176-8:1998, *Wheelchairs — Part 8: Requirements and test methods for static, impact and fatigue strengths*
- ISO 7176-9:2001, *Wheelchairs — Part 9: Climatic test for electric wheelchairs*
- ISO 7176-10:1988, *Wheelchairs — Part 10: Determination of obstacle-climbing ability of electric wheelchairs*
- ISO 7176-11:1992, *Wheelchairs — Part 11: Test dummies*
- ISO 7176-13:1989, *Wheelchairs — Part 13: Determination of coefficient of friction of test surfaces*
- ISO 7176-14:1997, *Wheelchairs — Part 14: Power and control systems for electric wheelchairs – Requirements and test methods*
- ISO 7176-15:1996, *Wheelchairs — Part 15: Requirements for informative disclosure, documentation and labelling*
- ISO 7176-19:2001, *Wheelchairs — Part 19: Wheeled mobility devices for use in motor vehicles*
- ISO 7176-21:2003, *Wheelchairs — Part 21: Requirements and test methods for electromagnetic compatibility of electrically powered wheelchairs and motorized scooters*
- ISO 7176-22:2000, *Wheelchairs — Part 22: Set-up procedures*
- ISO DIS 7176-26:2003, *Wheelchairs — Nomenclature, terms and definitions*
- ISO 10542-1:2001, *Technical systems and aids for disabled or handicapped persons — Wheelchair tiedown and occupant restraint systems — Part 1: Requirements and test methods for all systems*
- ISO/FDIS 10542-5:2004, *Technical systems and aids for disabled or handicapped persons — Wheelchair tiedown and occupant restraint systems — Part 5: Systems for specific wheelchairs*
- IEC 60529:1989, *Degrees of protection provided by enclosures (IP code)*
- IEC 60601-1:1988, *Medical Electrical Equipment — Part 1: General requirements for safety*
- IEC 61942:2003, *Electroacoustics – Sound Calibrators*

### 3 Terms and definitions

For the purposes of this European Standard the terms and definitions given in ISO DIS 7176-26:2003 (with the exception of the definition of wheelchair which is replaced by 3.11 below), ISO 7176-14:1997, EN 12182:1999 and the following apply.

#### 3.1

##### **audible warning device**

device making a warning sound or noise

EXAMPLE horn

#### 3.2

##### **automatic brake**

means for holding a wheelchair stationary on the level or on a slope when the speed control input device is set for zero speed

#### 3.3

##### **carry-on battery charger**

off-board charger intended for transportation on a wheelchair

#### 3.4

##### **ground clearance**

height of free space below the occupied wheelchair

NOTE The ground clearance is an indication for the capability of the wheelchair to negotiate obstacles.

#### 3.5

##### **loaded wheelchair**

wheelchair loaded with a dummy as specified in 4.10 or loaded with a human test occupant

#### 3.6

##### **maximum safe slope**

maximum slope specified by the manufacturer on which the wheelchair meets all the requirements of dynamic stability, static stability, braking performance and slope climbing, traversing and descending ability

#### 3.7

##### **on-board charger**

charger that is built into the wheelchair

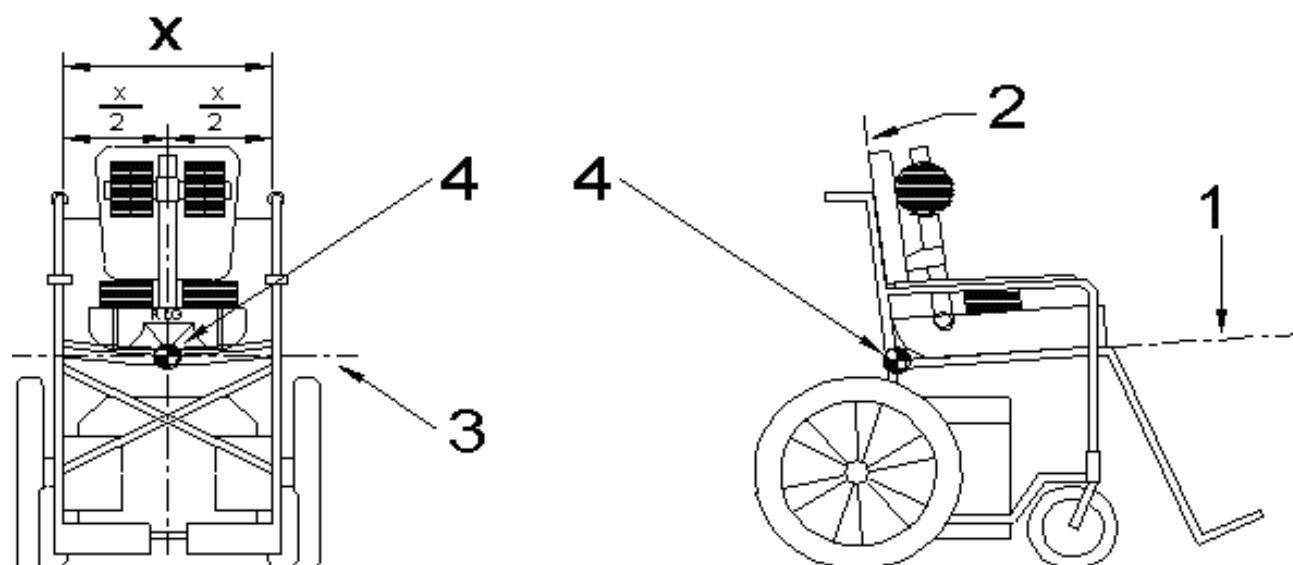
#### 3.8

##### **seat reference point**

intersection of the seat reference plane and the back support reference plane at half the width of the seat (see Figure 1)

NOTE The seat reference plane and the back support reference plane are specified in ISO 7176-7:1998.



**Key**

- 1 seat reference plane
- 2 back support reference plane
- 3 intersection line between seat reference plane and back support reference plane
- 4 seat reference point

**Figure 1 — Seat reference point****3.9****turn-around width**

minimum width in which the wheelchair can be turned through 180° by operation of its control input device and where applicable its manual steering system

**3.10****unspillable battery**

battery from which the electrolyte can not escape whatever its orientation

**3.11****wheelchair**

electrically powered wheelchair or scooter or manual wheelchair with an add-on power kit used for propulsion or a pushrim activated power assisted wheelchair covered by the scope of this standard, to which the requirements and test methods are applied

**4 Test apparatus**

**4.1 Adjustable test plane**, a flat, rigid plane with an adjustable slope, with a coefficient of friction as defined in ISO 7176-13:1989, of sufficient size to accommodate the wheelchair during the tests specified indicated in 8.4.2 and 8.4.4 and such that the whole surface lies between two imaginary parallel planes 5 mm apart per 1000 mm of extension in any direction and 25 mm apart per 6000 mm of extension in any direction.

**4.2 Flat, horizontal test plane** with a coefficient of friction as defined in ISO 7176-13:1989, of sufficient size to accommodate the wheelchair under test, and such that the whole surface lies between two imaginary horizontal planes 5 mm apart per 1000 mm of extension in any direction and 25 mm apart per 6000 mm of extension in any direction.

**4.3 Means to apply a force** of between 25 N and 200 N with an accuracy of  $\pm 2\%$ .

**4.4 Means to measure force** with an accuracy of  $\pm 2$  N in increments of 1 N in the range of 0 N to 200 N.

**4.5 Means to measure sound pressure level** to an accuracy of  $\pm 3$  dB(A).

**4.6 Means to measure speed** between 0 km/h and 20 km/h to an accuracy of  $\pm 5\%$ .

**4.7 Means to measure distance** to an accuracy of  $\pm 2\%$ .

**4.8 Supplementary weights** to add to a human test driver to achieve the maximum user mass as specified by the manufacturer and to achieve a similar mass distribution to the dummy to be used as specified in 4.10.

**4.9 Test block**, capable of supporting the loaded wheelchair under each of its wheels, with length and width  $200 \text{ mm} \pm 10 \text{ mm}$ , thickness given in Table 1 'ground unevenness' and corner radii greater than 2,0 mm. For the two large surfaces, the parallelism shall be less than 1,0 mm, the flatness less than 1,0 mm and the coefficient of friction shall be as specified in ISO 7176-13:1989.

**4.10 Test dummy** as specified in ISO 7176-11:1992 of mass equal to the maximum occupant mass specified by the manufacturer up to 100 kg.

If there is no dummy of equal mass use the dummy of the next greater size.

If the maximum occupant mass specified by the manufacturer is greater than 100 kg use an augmentation to the 100 kg test dummy from ISO 7176-11: 1992 as specified below.

where  $M$  is the total mass of the required dummy

**4.10.1** The theoretical head and upper torso mass does not increase from the 100 kg dummy.

Mass of head = 7.9 kg

Mass of upper torso = 21.6 kg

**4.10.2** The theoretical lower torso mass is obtained from the following:

Lower torso mass =  $0.83M - 51.8$  kg

**4.10.3** The additional lower torso mass is obtained from the following:

Lower torso mass =  $0.83M - 83$  kg

**4.10.4** The Y axis for the centre of mass for the torso mass is obtained from the following:

Y axis measured from the base of the seat of the dummy =  $\frac{22.1M + 823}{M - 26.9}$  (cm)

Y axis measured from the pivot point of the dummy =  $\frac{22.1M + 823}{M - 26.9} - 4.8$  (cm)

**4.10.5** The Y axis of the centre of mass (com) of the additional torso mass is obtained from the following:

$$\frac{\left[61 + \frac{5}{6}(M - 100)\right] \times 28.8 - (61 \times 29.8)}{\frac{5}{6}(M - 100)}$$
 (cm)

**4.10.6** The X axis centre for the centre of mass for the additional torso mass measured from the front face of the 100kg torso is obtained from the following:

$$\text{X axis from front face of 100kg dummy} = \frac{0,14M^2 - 6,8M - 731,4}{\frac{5}{6}(M - 100)} - 25,1 \text{ (cm)}$$

**4.10.7** The additional mass of the upper legs is obtained from the following:

$$\text{Upper legs additional mass} = 0,17M - 17 \text{ kg}$$

**4.10.8** The additional mass for the upper leg is evenly distributed so as not to change the centre of mass for this segment.

**4.10.9** The mass of the lower legs/feet does not increase from the 100 kg dummy.

**4.11 Test track** marked on a hard, non-porous surface horizontal test plane in a room with an ambient noise level not exceeding 45 dB(A) and of sufficient length for the wheelchair to attain its maximum speed, maintain its maximum speed and decelerate within the measuring distance specified in Figure 6.

**4.12 Means to measure sound pressure** calibrated in accordance with the manufacturer's instructions, using an acoustic calibrator class 1 as described in IEC 61942:2003, Electroacoustics – Sound Calibrators, Third Edition, 2003-01.

## 5 Type classes

Wheelchairs shall be classified in one or more of the following three classes, dependent upon their intended use.

- **Class A** - compact, manoeuvrable wheelchairs not necessarily capable of negotiating outdoor obstacles
- **Class B** - wheelchairs sufficiently compact and manoeuvrable for some indoor environments and capable of negotiating some outdoor obstacles
- **Class C** - wheelchairs, usually large in size, not necessarily intended for indoor use but capable of travelling over longer distances and negotiating outdoor obstacles

NOTE Scooters are included within the classes above.

## 6 General requirements

The wheelchair shall conform to the requirements as specified in EN 12182:1999 for the following:

- intended performance and technical documentation;
- aids that can be dismantled;
- single use fasteners;
- biocompatibility and toxicity;
- contaminants and residues;

## prEN 12184:2004 (E)

- infection and microbiological contamination;
- overflow, spillage, leakage and ingress of liquids;
- safety of moving parts;
- prevention of traps for parts of human body;
- folding and adjusting mechanisms;
- surfaces, corners and edges;
- risk analysis.

NOTE The risk analysis requirement in EN 12182:1999 refers to EN 1441:1997 which will be withdrawn and superseded by EN ISO 14971 at the latest by March 2004.

## 7 Design requirements

Unless otherwise specified in this clause, the wheelchair shall be prepared as specified in ISO 7176-22:2000 for each test.

### 7.1 Foot supports and leg supports

#### 7.1.1 Requirements for foot supports and leg supports

**7.1.1.1** The wheelchair shall be capable of being fitted with a means of positioning the user's feet at the required height, and preventing the user's feet from sliding backwards.

**7.1.1.2** Foot supports and leg supports that can be adjusted or moved from one position to another shall have provision to be fixed securely in any operating position.

**7.1.1.3** Foot supports and leg supports that can be adjusted in increments shall have increment adjustments not exceeding 25 mm.

**7.1.1.4** When tested as specified in 7.1.2 wheelchairs fitted with a separate foot support for each foot shall:

a) have a gap between the foot supports that does not exceed

- 35 mm if intended for adults;
- 25 mm if intended for children;

or

b) be fitted with a means to prevent the occupant's feet from sliding into the gap between the foot supports.

#### 7.1.2 Test method for foot supports

a) Simultaneously apply a force  $f + 5 \text{ N} - 0 \text{ N}$  to the centroid of each foot support normal to the plane of the unloaded foot support. In cases where the foot support has no identifiable plane, apply the force within  $5^\circ$  of vertical. The force  $f$  is calculated from the following expression:

$$f = 1.25 \times M$$

where

$f$  is the force in newtons applied to each foot support

$M$  is the maximum user mass in kilograms specified by the manufacturer

b) Measure the shortest distance between the foot supports.

## 7.2 Requirement for pneumatic tyres

If the wheelchair is fitted with pneumatic tyres, they shall have the same type of valve connection on all tyres.

The tyres or the rims shall have the recommended pressure range shown.

## 7.3 Requirement for fitting an anterior pelvic support

The wheelchair shall have provision for an anterior pelvic support to be fitted.

## 7.4 Requirement for static loading

When the maximum occupant mass specified by the manufacturer does not exceed 100 kg, arm supports and back supports shall conform to the static loading requirements of ISO 7176-8:1998 in all intended incremental operating positions with the exception of the upward force on a push handle which shall be 880 N. For continuously variable operating positions test at the most upright position, the mid-point adjusted (or nearest) position and the least upright position.

NOTE The upward force is a correction of the value for upward force on push handles stated in Table 8 of ISO 7176-8:1998.

For occupant mass higher than 100 kg specified by the manufacturer the appropriate dummy as specified in 4.10 and the forces shown in Table 3 replace the forces specified in ISO 7176-8:1998.

## 7.5 Requirement for wheelchairs for use as seats in motor vehicles

**7.5.1** If the manufacturer specifies that the intended use of the wheelchair includes use by an adult as a seat in a motor vehicle, the wheelchair shall conform to the performance requirements of ISO 7176-19:2001.

**7.5.2** If the manufacturer specifies that the intended use of the wheelchair includes use as a seat in a motor vehicle by a child of mass greater than 22 kg, the wheelchair shall conform to the performance requirements of ISO 7176-19:2001 with the exception of the horizontal excursion limits and the selection of the ATD. The horizontal excursion limits specified in Table 1 of ISO/FDIS 10542-5:2004 and the ATD selection specified in Table A.1 of ISO/FDIS 10542-5:2004 shall apply.

## 7.6 Requirements for braking systems and freewheel devices

### 7.6.1 Braking systems

#### 7.6.1.1 Requirements

The wheelchair shall be fitted with a braking system that shall:

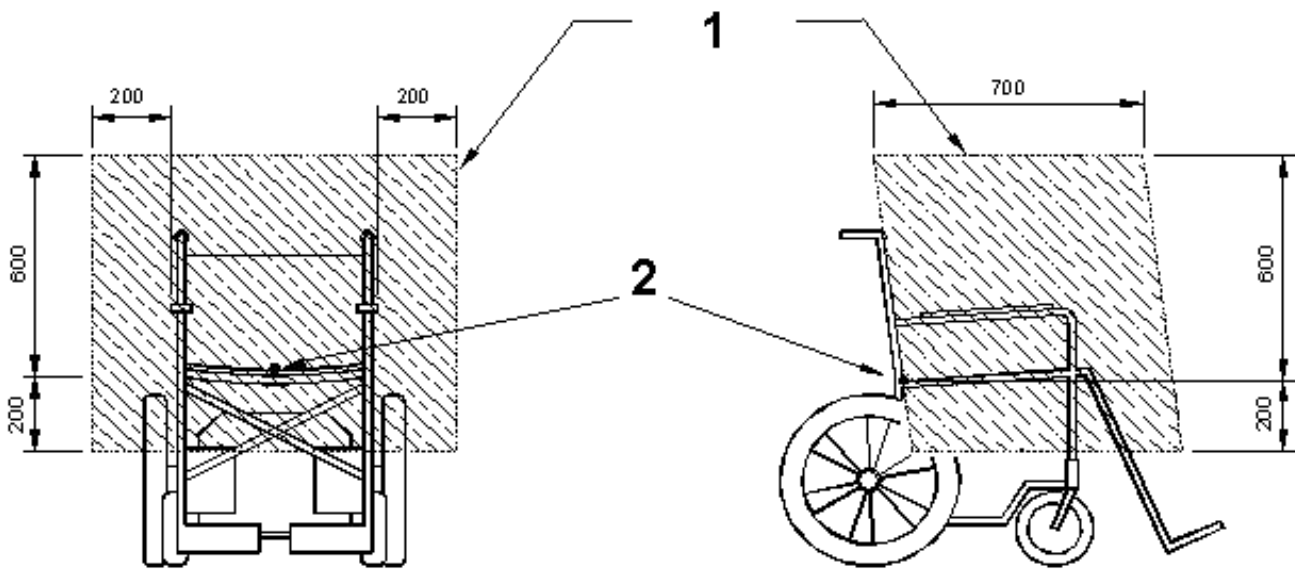
- be accessible and operable by the occupant and the attendant;
- be within the reach specified in Figure 2, if it is intended to be operated by the occupant;
- have operating forces for engaging and disengaging as stated in Table 1;

- include a running brake, which operates independently of tyre wear and inflation pressure and when tested according to 8.2.3 does not exceed the maximum stopping distance specified in Table 2. (e.g. manual brake control or control input device);
- include an automatic brake, which operates independently of tyre wear and inflation pressure and is operated by releasing the input control device to achieve a zero speed command (e.g. spring loaded disc brake);
- include a parking brake which operates independently of tyre wear and inflation pressure (e.g. drum brake in wheels, spring loaded disc) that:
  - 1) shall be operable when there is no power from the battery supplying the drive system;
  - 2) shall be operable when the motor drive system is in freewheel mode;
  - 3) shall meet the parking brake effectiveness requirement in Table 1 as a minimum when tested according to 8.2.2;

NOTE Braking functions may be combined in one device (e.g. the spring loaded disc brake could combine automatic brake and parking brake).

- 4) shall have provision for adjustment and/or replacement as specified by the manufacturer, if the parking brake is subject to wear;
- 5) shall not have parts that protrude above the level of the unoccupied seat when the brake is engaged, if the wheelchair is fitted with arm supports that can be moved or removed to enable transfer when tested according to 7.6.1.2.

all dimensions are in mm



- Key
- 1 space of occupant reach
  - 2 seat reference point

Figure 2 - Occupant reach

### 7.6.1.2 Test for protrusion of parts of the parking brake

To test for protrusion of parts of the parking brake above the level of the unoccupied seat perform the following.

- a) Engage the parking brake.
- b) Move or remove the arm support to enable transfer.
- c) Check whether any part of the parking brake is above seat height. Any protrusion fails this requirement.

### 7.6.2 Freewheel devices

The wheelchair shall be fitted with a freewheel device that shall:

- a) be accessible and operable by the occupant and the attendant;
- b) be within the reach specified in Figure 2, if it is intended to be operated by the occupant;
- c) have operating forces for engaging and disengaging as stated in Table 1;
- d) be operable without detaching any parts;
- e) not depend on the battery power supplying the motor drive system;

NOTE A battery independent from the motor drive battery may be used to supply energy to enable freewheel mode.

- f) have two defined positions including clear indication of freewheel mode and drive mode;

NOTE An audible alarm activated continually when the freewheel device is in operation and deactivated when the drive and braking systems are fully operational would assist the occupant and/or attendant.

- g) be protected from unintended operation;
- h) prevent use of the wheelchair's drive system.

NOTE This requirement overrides 7.2 of ISO7176-14:1997 concerning requirements for non-powered mobility.

## 7.7 Requirement for component weight

If the wheelchair is intended to be dismantled for carrying, any component that has a mass greater than 10 kg shall be provided with suitable handling devices (e.g. handles) or the manufacturer shall provide information indicating the points where it can be lifted and describe how it should be handled during lifting, assembling and carrying to reduce risks to the person or persons lifting the equipment.

## 7.8 Requirements for battery enclosures and containers

### 7.8.1 Requirements

- a) Batteries that are used for wheelchair propulsion shall be accessible without the use of tools for inspection and service specified by the wheelchair manufacturer.
- b) Battery enclosures shall be ventilated at the side facing near the highest point by an opening or openings which have a total area not less than 100 mm<sup>2</sup>.

NOTE The openings are intended to permit escape of gases.

## **prEN 12184:2004 (E)**

- c) Batteries shall be protected in such a way that the battery cannot be accessible from above by fluids.
- d) Battery containers shall be used where spillable batteries are fitted to the wheelchair.
- e) Batteries shall have protection to stop any objects contacting the terminals and connections between cells and/or batteries and causing a short circuit.
- f) Battery containers shall be resistant to corrosion caused by battery gases and acid.
- g) Battery containers intended for use with batteries that contain freely moving liquid electrolytes shall not leak or spill when tested according to 7.8.2.

### **7.8.2 Test**

To test for leakage and spillage from battery containers perform the following.

- a) Place the battery or batteries in the container.
- b) Fill the container with water to a depth of half of the total battery height  $\pm$  3 mm.
- c) Tilt the container through  $20^\circ \pm 3^\circ$  from the horizontal in all directions.
- d) Examine the container for visible evidence of leakage or spillage.

## **7.9 Audible warning device**

### **7.9.1 Requirements**

- a) The wheelchair shall be equipped with a user-operable audible warning device.
- b) The sound of the warning device shall be a single continuous tone between 500 Hz and 3 kHz.
- c) The minimum sound pressure level of an audible warning device at  $1,0 \text{ m} \pm 0,05 \text{ m}$  shall be:
  - 65 dB(A) for Class A and B wheelchairs and
  - 75 dB(A) for Class C wheelchairs.

### **7.9.2 Test**

- a) Position the wheelchair on the test track specified in 4.11.
- b) Position the sound pressure level measurement device at a height of  $1 \text{ m} \pm 0,05 \text{ m}$  at one of the positions specified in Figure 7.
- c) Operate the horn. Measure and record the sound pressure level.
- d) Repeat the test for each of the remaining positions specified in Figure 7.
- e) If any of the recorded values are below the minimum requirement of 7.9.1 c), the wheelchair fails this test.



## 7.10 Requirements for ease of operation by occupant or attendant

### 7.10.1 Parts intended to be operated by the occupant and/or attendant

Wheelchairs shall be designed to facilitate ease of operation by the occupant and/or attendant as specified in the manufacturer's instructions.

Examples include:

- a) operation of adjustable seating;
- b) use of detachable components; including removable arm supports, leg supports etc., to facilitate safe transfers into and out of the wheelchair;
- c) use of folding mechanisms; including folding frames etc., to facilitate storage and transportation of unoccupied wheelchairs;
- d) carrying out maintenance; including use of tools etc.;
- e) use of manual steering controls;
- f) use of braking systems and freewheel devices;
- g) use of attendant controls;
- h) use of control input devices.

### 7.10.2 Controls operated when seated

Controls intended to be operated by the occupant while seated shall be within the occupant reach as shown in Figure 2. The following controls, if fitted, are included:

- on/off switch or key;
- speed regulator;
- speed pre-setting;
- running brake;
- parking brake;
- audible warning device;
- direction indicator;
- direction switch;
- control input device;
- manual steering system;
- lighting;
- seating adjustments;

- detachable components, including removable arm supports, leg supports etc., to facilitate safe transfers into and out of the wheelchair;
- steering controls;
- braking systems and freewheel devices;
- control input device.

### **7.10.3 Operating force Requirement**

All controls shall have an operating force as follows:

- for operation by a single finger, the force shall not be greater than 5 N;
- for operation by one hand, the force shall not be greater than 13,5 N;
- for turning knobs operated by one hand:
  - the numerical value of the torque, expressed in Nm, for knobs greater than or equal to 25 mm in diameter shall not be greater than 0,05 times the numerical value of the diameter of the knob, expressed in mm, where the force is transmitted by friction;
  - the numerical value of the torque, expressed in Nm, for knobs less than 25 mm diameter shall not be greater than 0,025 times the numerical value of the diameter of knob, expressed in mm, for knobs with finger grips;
- for combined hand and arm operation, the force shall not be greater than 60 N;
- for foot operation in the pulling direction, the force shall not be greater than 60 N;
- for foot operation in the pushing direction, the force shall not be greater than 100 N.

NOTE This information is included in Table 1.

#### **7.10.3.1 Test**

- a) Position a means to apply the force as appropriate.
  - 1) Where the operation is performed by pushing or pulling, position the means to apply the force parallel to the direction of operation and in the middle of the knob or button.
  - 2) In case of a lever, at a distance of 15 mm from the end of the operating lever.
  - 3) For a turning knob use a torque meter with a suitable means (e.g. an adapter) to position the torque meter concentrically on the knob.
- b) Gradually increase the force to the maximum operating force.
- c) Measure and record the maximum operating force.
- d) Perform b) to c) three times in total.
- e) Calculate and record the arithmetic mean of the three recorded measurements.

## 7.10.4 Additional requirements concerning ease of operation

### 7.10.4.1 Seating adjustments for tilt and recline systems

#### 7.10.4.1.1 Requirement

**7.10.4.1.1.1** If the manufacturer specifies that the seating can be adjusted by an attendant and the occupant while the occupant is seated:

- uncontrolled movement of the seating shall not exceed  $\pm 5$  mm;
- the attendant and/or the occupant shall not have to lift the combined weight of the occupant and the seating.

**7.10.4.1.1.2** Controls for seating adjustments intended to be operated by the occupant shall be accessible to the occupant from all seating positions.

#### 7.10.4.1.2 Test

- a) Place the test dummy specified in 4.10 in the wheelchair. Adjust the seating as specified in the manufacturer's instructions.
- b) Record whether the wheelchair meets the requirements.

### 7.10.4.2 Brake levers

#### 7.10.4.2.1 Requirement

Where brake levers are fitted they shall:

- be accessible and operable by the occupant and attendant;
- be within the reach specified in Figure 2, if they are intended to be operated by the occupant;
- have operating forces for engaging and disengaging as stated in Table 1.

#### 7.10.4.2.2 Test

- a) Apply brakes as specified in the manufacturer's instructions for the occupant.
- b) Apply brakes as specified in the manufacturer's instructions for the attendant.
- c) Record whether the brake levers meet the requirements.

### 7.10.4.3 Foot supports, leg supports or arm supports

#### 7.10.4.3.1 Requirement

Any swing-away, movable or removable foot support, leg support or arm support fitted on the wheelchair shall be:

- easy to reach according to the limits in Figure 2;
- operable without the use of tools by the occupant and attendant.

**7.10.4.3.2 Test**

- a) Swing away, move or remove foot supports, leg supports and arm supports as specified in the manufacturer's instructions.
- b) Record whether the foot supports, leg supports and arm supports meet the requirement.

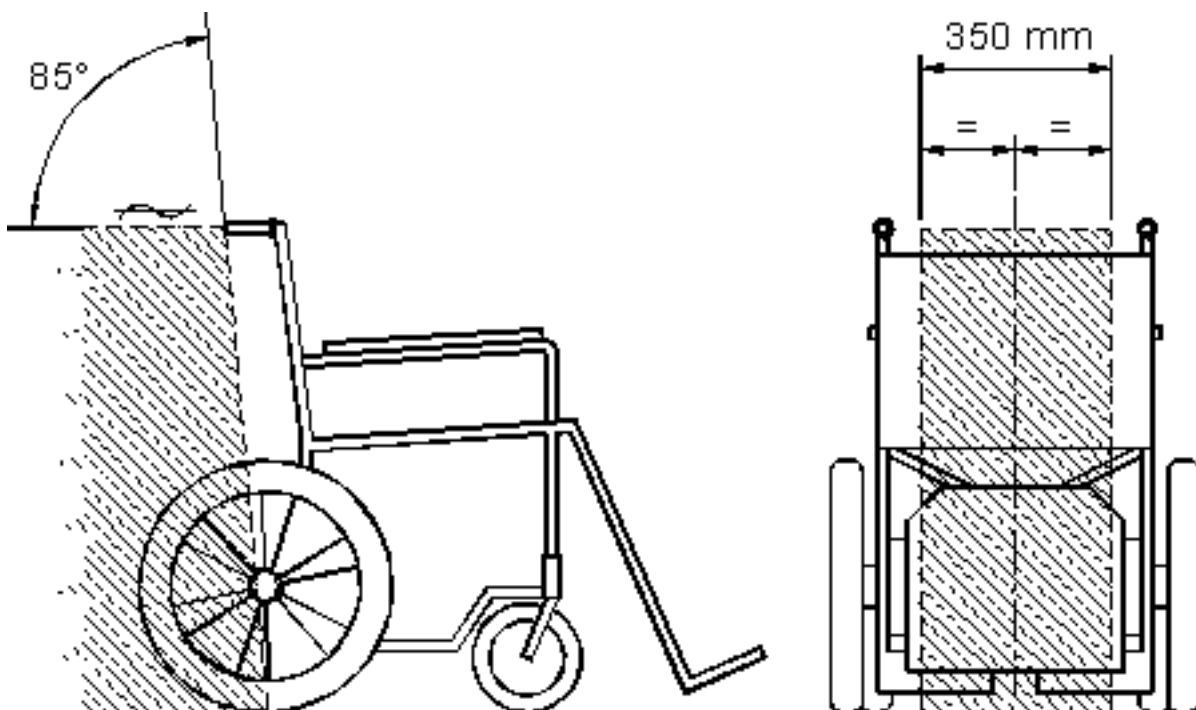
**7.10.4.4 Attendant control unit**

**7.10.4.4.1 Requirements**

**7.10.4.4.1.1** The attendant's control unit shall be positioned behind the wheelchair's back support, between 900 mm and 1200 mm from the floor to the centre of the operating means for the control input device (e.g. joystick knob).

**7.10.4.4.1.2** When push handles are fitted, no part of the wheelchair shall lie within a space to the rear of the wheelchair bounded by the following:

- a plane at 85° to the horizontal, that touches the rearmost points of the push handles as shown in Figure 3;
- two planes not less than 350 mm apart equidistant from a vertical plane parallel to the forward direction of travel that bisects the wheelchair;
- horizontal test plane.



**Figure 3 - Wheelchair construction and movement of attendant**

**7.10.4.4.1.3** If the wheelchair is fitted with steering and/or manoeuvring handgrips for attendant use, the handgrips shall be at least 75 mm in length and between 20 mm and 50 mm in diameter.

**7.10.4.4.1.4** If manoeuvring handgrips are fitted with controls that are intended to be used by being gripped by one hand, the hand grip width needed to grip them shall be no greater than 90 mm (see Figure 4).

**7.10.4.4.1.5** The wheelchair shall be fitted with a means to support the attendant's hand or hands used to operate the control input device while the wheelchair is being driven.

#### **7.10.4.4.2 Test**

- a) Place the wheelchair on the horizontal test plane.
- b) Note the position of the attendant's control input device and measure the height of its operating means above the test plane.
- c) Project the planes specified in 7.10.4.4.1 and determine whether any part of the wheelchair lies within the enclosed space.
- d) Measure the dimensions of the steering and/or manoeuvring handgrips.
- e) Where applicable, measure the grip width of the controls fitted to the manoeuvring handgrips that are intended to be used by being gripped by one hand.
- f) Inspect the wheelchair for means to support the attendant's hand or hands used to operate the control input device while the wheelchair is being driven.
- g) Record whether the wheelchair meets the requirements.

#### **7.10.4.5 Charging connector**

##### **7.10.4.5.1 Requirement**

The charging connector shall be accessible and operable by the occupant and attendant within the area specified in Figure 2 when operated as specified in the manufacturer's instructions.

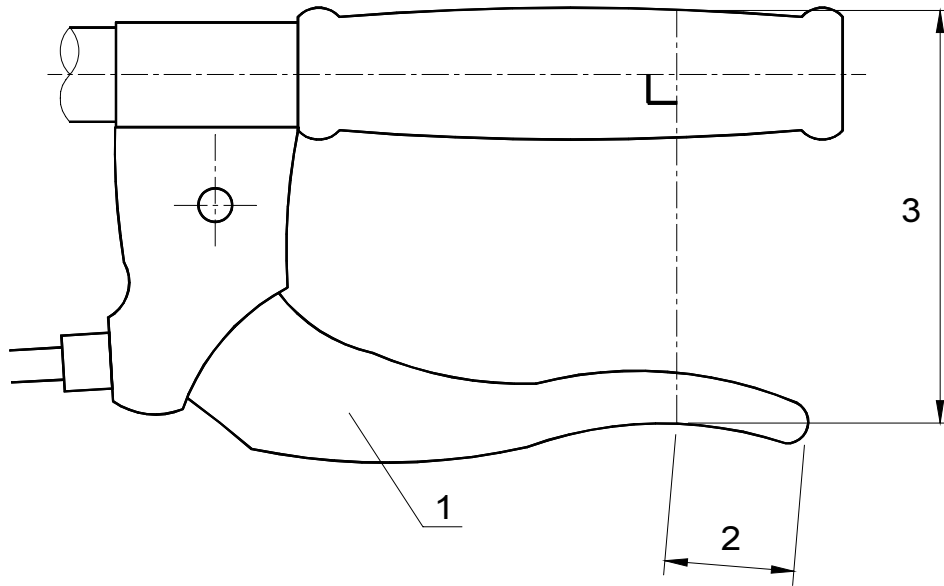
NOTE The shape and position of the charging connector are important factors contributing to the ease of operation.

##### **7.10.4.5.2 Test**

- a) Connect the charging connector to recharge the battery as specified in the manufacturer's instructions.
- b) Record whether the charging connector meets the requirement.

#### **7.10.4.6 Brake lever**

If one or more brake levers are fitted to a wheelchair in the form used on bicycles and mopeds, the hand-grip width of such brake levers, measured 15 mm from the end of the brake lever, shall not be greater than 90 mm before a force is applied. See Figure 4.



- Key**
- 1 lever gripped by the whole hand
  - 2 15 mm
  - 3 hand grip width

**Figure 4 — Grip distance**

## 8 Performance requirements

Unless otherwise specified in this clause, the wheelchair shall be prepared as specified in ISO 7176-22:2000 for each test.

### 8.1 Static, impact and fatigue strength

Wheelchairs with a maximum occupant mass of 100 kg shall conform to the requirements of ISO 7176-8:1998, with the exception that wheelchairs of type class A are not required to be tested as specified in 10.5 (drop test) of ISO 7176-8:1998.

Wheelchairs with an occupant mass greater than 100 kg shall be tested using a dummy as specified in 4.10. When tested the wheelchair shall conform to the requirements of ISO 7176-8:1998 with the exception of the static loads which shall conform to the requirements in 7.4 of this standard.

### 8.2 Parking brake performance and strength

#### 8.2.1 Requirements for parking brakes

##### 8.2.1.1 Requirements for operation forces of manually operated parking brakes

**8.2.1.1.1** The parking brakes operated either by hand or foot, shall meet the requirements for brake lever operating forces of Table 1 when tested in accordance to 8.2.2.1, 8.2.2.2, 8.2.2.3 and 8.2.2.4.

**8.2.1.1.2** The wheelchair shall not slide nor shall its wheels rotate when tested as specified in ISO 7176-3:2003 on the maximum safe slope established by Table 1 or on the maximum safe slope specified by the manufacturer if greater, with the loaded wheelchair facing

- a) up the slope;
- b) down the slope.

### **8.2.1.2 Requirements for fatigue strength of manually operated parking brakes**

The brake mechanism shall not have moved from the pre-set positions, no component or assembly of parts shall exhibit deformation, free play or loss of adjustment that adversely affects the function of the wheelchair when:

- the wheelchair has been tested as specified in ISO 7176-8:1998; and
- the parking brake has been operated for 60 000 cycles as specified in 8.2.2.3.

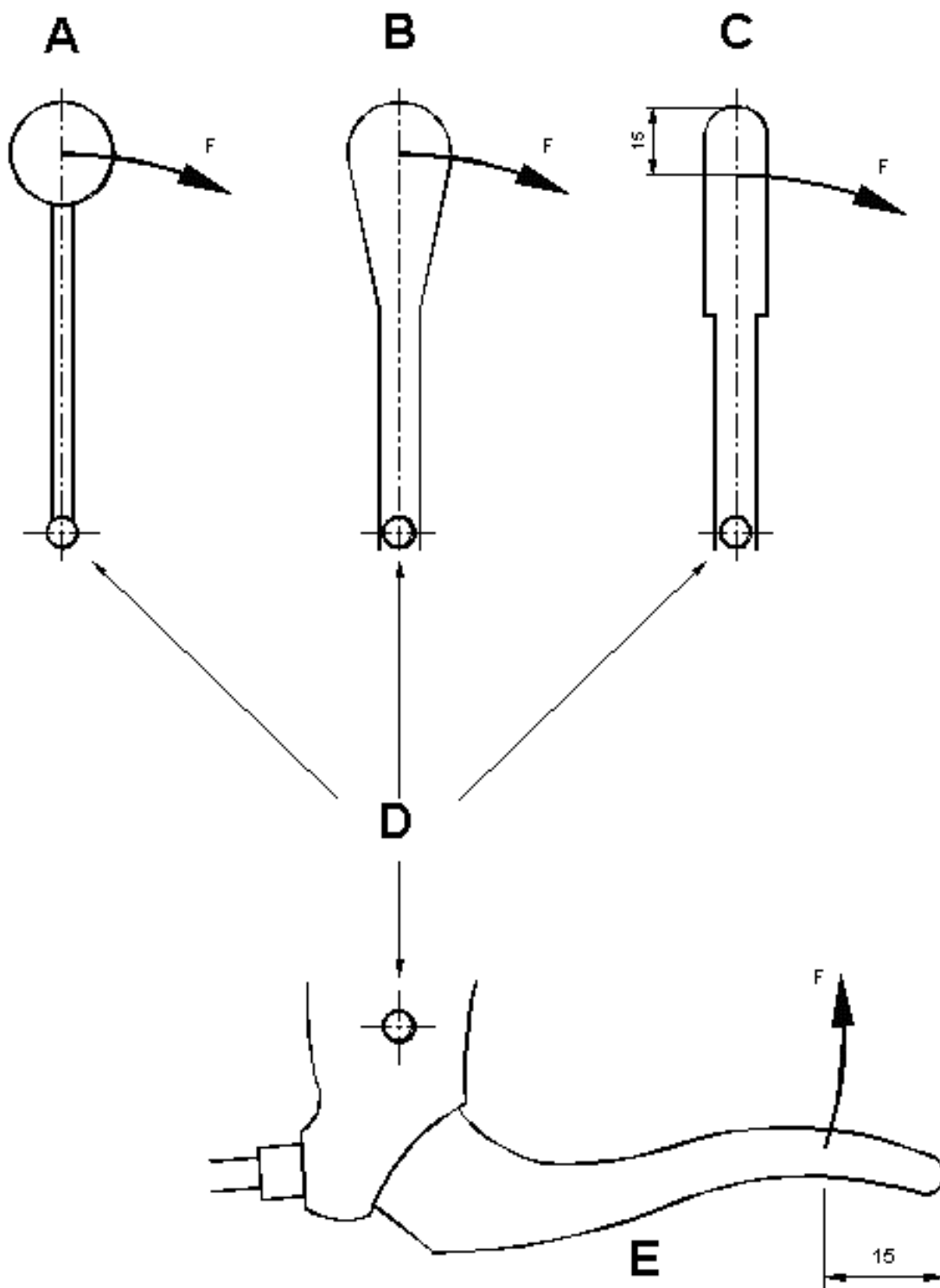
## **8.2.2 Test methods for parking brakes**

### **8.2.2.1 Test method for determination of effectiveness of parking brakes**

- a) Adjust the brakes as specified by the manufacturer.
- b) Measure the force required to operate the brake as set out in 8.2.2.2.
- c) Test the wheelchair facing up the slope as specified in ISO 7176-3:2003 on a test slope inclined to the horizontal at the value stated in accordance with the values in Table 1 or at the maximum slope specified by the manufacturer if greater.
- d) Repeat a) to c) facing downhill.
- e) Determine if the parking brakes hold the loaded wheelchair stationary on the slope.

### **8.2.2.2 Test method for determination of brake lever operating forces**

- a) Adjust the brakes as specified by the manufacturer.
- b) Select the part of the lever through which the force is to be applied as shown in Figure 5.
  - 1) If the lever is fitted with a generally spherical knob, apply the force through the centre of the knob.
  - 2) If the lever is tapered, apply the force through the point where the largest cross section intersects the centre line of the lever.
  - 3) If the lever is parallel or any shape other than those above, apply the force through a point on the centre line of the lever 15 mm below the top.
  - 4) If the form of the lever is such that the lever is gripped by the whole hand apply the force through the centre line of the lever 15 mm from the end.
  - 5) If the brake is operated by pushing or pulling a bar or pad, apply the force to the centroid of the bar or pad.



- Key**
- A lever with spherical knob
  - B tapered lever
  - C parallel lever
  - D fulcrum
  - E lever gripped by the whole hand

Figure 5 – Part of lever through which force is applied



- c) Apply the brakes and measure the force with the device as specified in 4.4 aligned in the direction of travel of the point of application of the force in order to measure the maximum force required.
- d) Release the brakes.
- e) Perform c) and d) three times in total and record the measurements.
- f) Calculate and record the arithmetic mean value of the forces measured.
- g) State whether or not the requirements for operating forces as stated in Table 1 have been met.

#### **8.2.2.3 Test method for manually operated parking brake fatigue strength**

- a) Adjust the parking brakes in accordance with the manufacturer's instructions without exceeding the operating force requirement stated in Table 1.
- b) Carry out the test with the parking brake mounted on the wheelchair. The wheelchair shall be fully equipped and if fitted with pneumatic tyres they shall be inflated to the maximum pressure specified by the manufacturer.
- c) Move the lever of the brake smoothly from non-braking position to braking position for 60 000 cycles at a frequency of not more than 0,5 Hz. If fitted with two identical brakes (left and right) only one of the brakes shall be tested.

#### **8.2.2.4 Test method for the determination of effectiveness of brakes after fatigue strength testing**

- a) Adjust the parking brakes in accordance with the manufacturer's instructions without exceeding the operating force requirement stated in Table 1.
- b) Repeat the test specified in 8.2.2.1.

#### **8.2.3 Test Method for the determination of the effectiveness of running brakes.**

Perform the tests for normal, reverse command and emergency operation as specified in clauses 7.3, 7.4 and 7.5 of ISO 7176-3:2003 using a dummy or human tester as specified in clause 4.10 of this standard. The wheelchair fails the requirement if the maximum stopping distance specified in Table 2 are exceeded.

### **8.3 Control input devices**

#### **8.3.1 Requirement for fatigue strength of joystick and lever operated control input devices**

The performance of the control input devices shall not be affected when tested as specified in 8.3.2.

#### **8.3.2 Test method for fatigue strength of joystick and lever operated control input devices**

- a) Perform the functional check specified in ISO 7176-9:2001 to verify if the control input device operates the wheelchair as specified by the manufacturer.
- b) Determine the magnitude of the joystick or lever operated control input device operating force (**F**) and its point of application as specified in Clause 10 of ISO 7176-14:1997.
- c) Measure the distance (**d**) moved by the point of application of force (**F**).
- d) If the distance (**d**) moved by the point of application of the force is greater than 5 mm, follow the procedure given below in 1), otherwise follow the procedure given below in 2).

- 1) Move the control input device from its neutral position through a displacement (x) and back to its neutral position.

NOTE 1 This action is one cycle.

Where:

$$0,90 d < x < 0,99 d$$

Ensure that no load is applied to the control input device at the extremes of travel.

NOTE 2 An eccentric driving motor, lifting magnet or similar device may be used to move the control input device.

- 2) Apply a force parallel to the forward direction of travel  $\pm 5^\circ$ , normal to the centre line of the control input device, gradually increasing the force from 0 to F,  $\pm 5\%$ , and then gradually reduce the force to 0.

NOTE 3 This action is one cycle.

NOTE 4 An eccentric motor and a spring or a similar arrangement may be used to provide the force.

- e) Repeat the operation for 1,5 million cycles,  $\pm 1\%$ , at a frequency between 1 Hz and 2 Hz.
- f) Perform the functional check specified in ISO 7176-9:2001 to verify if the control input device operates the wheelchair as specified by the manufacturer.

## **8.4 Performance of driving characteristics**

### **8.4.1 General requirements**

The wheelchair shall meet the driving performance requirements specified in Table 1 and Table 2 for the type class (see Clause 5).

### **8.4.2 Ability to climb maximum safe slope**

#### **8.4.2.1 Requirements for ability to climb maximum safe slope**

The wheelchair shall be capable of climbing at a minimum speed of 2 km/h

— the appropriate maximum safe slope specified in Table 1;

or

— the maximum safe slope specified by the manufacturer, whichever is greater.

The wheelchair passes the test specified in 8.4.2.2 if it achieves or exceeds a speed of 2 km/h after travelling 5 m up the specified maximum safe slope without any visible lifting of any uphill wheel(s).

#### **8.4.2.2 Test method for ability to climb maximum safe slope**

- a) Select a test dummy as specified in 4.10 equal to the maximum occupant mass specified by the manufacturer.

— If there is no dummy of equal mass use dummy of the next size greater.

or

- If human driver is used, make provision for a wheelchair driver of the same mass  $\pm 1$  kg as the dummy specified above. Supplementary weights as specified in 4.8 may be used.
- b) Adjust the gradient of the adjustable test plane as specified in 4.1 to the appropriate slope specified in Table 1 or the maximum safe slope specified by the manufacturer whichever is the greater.
- c) Starting on the adjustable test plane drive the loaded wheelchair up the adjustable test plane using the maximum speed command.
- d) Measure and record the speed of the wheelchair to an accuracy of  $\pm 10\%$  at the point it has travelled 5 m  $\pm 10$  cm up the slope.

### 8.4.3 Ground unevenness

#### 8.4.3.1 Principle

A wheelchair shall be able to drive on uneven terrain without stopping even if one wheel is at a higher level than the others.

#### 8.4.3.2 Requirement

The wheelchair shall be capable of driving when any of the wheels of the wheelchair is raised to a height as specified in Table 1 for ground unevenness.

#### 8.4.3.3 Test

- a) Place the wheelchair on the horizontal test plane.
- b) Place the test block as defined in 4.9 under one wheel, such that one of its largest faces is flat on the test plane with the centre of the block beneath the point of contact with the wheel.
- c) Attempt to drive the wheelchair slowly off the test block.
- d) Repeat for the remaining wheels, one at a time.

### 8.4.4 Maximum downhill speed

#### 8.4.4.1 Requirement

The wheelchair shall not exceed 125 % of its maximum speed on the horizontal, when driving down a gradient equivalent to its maximum safe slope.

#### 8.4.4.2 Test

- a) Drive the wheelchair at maximum speed down a gradient equivalent to its maximum safe slope and measure the speed with a device as specified in 4.6.
- b) Record the measured speed and record whether the wheelchair meets the requirement.

## **8.4.5 Dynamic stability**

### **8.4.5.1 Requirement**

The wheelchair shall

- a) meet or exceed the minimum requirements for dynamic stability as specified in Table 1 for the type class of wheelchair;
- b) not have any visible lifting of any uphill wheel(s) or tip beyond the balance point when the test plane is inclined at the maximum safe slope as specified by the manufacturer.

### **8.4.5.2 Test**

**8.4.5.2.1** Test the wheelchair to the clauses of ISO 7176-2:2001 listed below to determine the dynamic stability of the wheelchair on the test plane inclined at the angle to the horizontal stated in Table 1 for the type class of the wheelchair.

- 8.1 Preparation;
- 8.2 Starting forwards uphill;
- 8.3 Stopping forwards uphill;
- 9.1 Preparation;
- 9.2 Stopping forwards downhill;
- 9.3 Stopping backwards downhill;
- 10.1 Preparation;
- 10.2 Turning on a slope

**8.4.5.2.2** If the maximum safe slope as specified by the manufacturer is greater than the values in Table 1 repeat 8.4.5.2.1 with the test plane set at the maximum safe slope as specified by the manufacturer.

## **8.4.6 Obstacle climbing**

### **8.4.6.1 Requirement**

The wheelchair shall be capable of climbing and descending obstacles of the height specified in Table 1 for the type class of the wheelchair.

### **8.4.6.2 Test**

Climb and descend the obstacle of the height specified in Table 1 for the class of the wheelchair using the method specified by the manufacturer to climb kerbs, steps or obstacles.

- If the manufacturer does not specify a direction, test in both the forward and backward directions.
- If the manufacturer does not specify a method, test as specified in ISO 7176-10:1988.

In all tests, the run-up distance shall not be greater than 500 mm, measured horizontally between the step and the leading edge of the nearest wheel at the height of the obstacle.

NOTE The run up distance is less than that specified in ISO 7176-10:1988.

## 8.4.7 Static Stability

### 8.4.7.1 Requirement

The wheelchair shall meet or exceed the minimum requirements for static stability as specified in Table 1 for the type class.

### 8.4.7.2 Test

Test the wheelchair as specified in ISO 7176-1:1999 using a dummy equal to the maximum user mass as specified by the manufacturer to determine if the static stability meets or exceeds the angles in Table 1 for the type class.

## 8.5 Surface temperature

Surfaces which can come into direct contact with the occupant's skin and/or attendant's skin during normal use and are within the envelope illustrated in Figure 2 shall not exceed 41°C as specified in EN 12182:1999.

## 8.6 Noise

### 8.6.1 Requirements

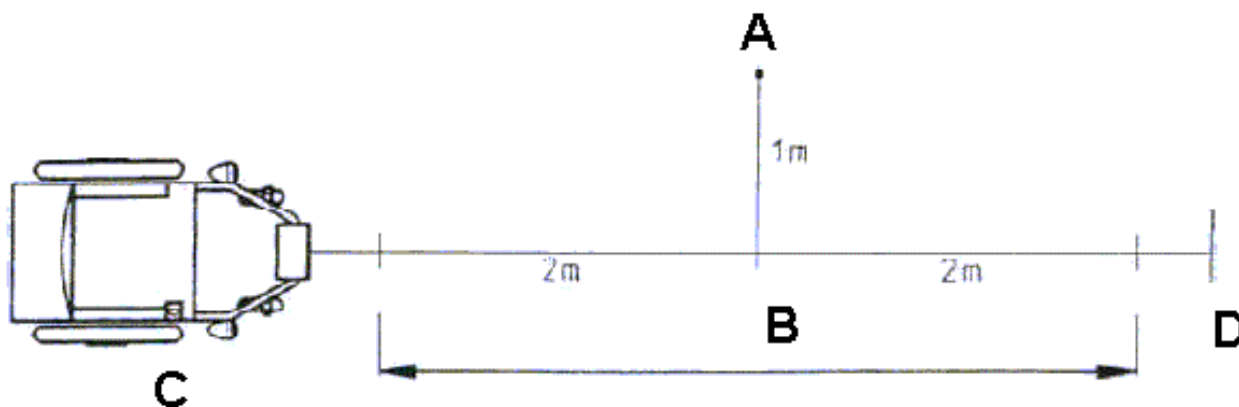
When the wheelchair is tested as specified 8.6.2.1 and the ancillary equipment, with the exception of the audible warning device, is tested as specified in 8.6.2.2, the sound pressure level shall not exceed

- 65 dB(A) for wheelchairs in type class A, and B;
- 75 dB(A) for wheelchairs in type class C.

### 8.6.2 Tests

#### 8.6.2.1 Wheelchair

- a) Position the sound pressure level measurement device, specified in 4.5, 1 m  $\pm$  0,05 m above the test track specified in 4.11 and 1 m  $\pm$  0,1 m from the centre line of the test track as illustrated in Figure 6.
- b) Drive the wheelchair at its maximum speed as measured by the method specified in ISO 7176-6:2001 along the centre line of the test track. The wheelchair shall attain maximum speed before it reaches the measuring distance shown in Figure 6 and maintain its maximum speed within it.
- c) Measure and record the quasi-peak sound pressure level to an accuracy of  $\pm$  3 dB(A), using frequency weighting (A), time weighting (F)AST, in the "max. hold" mode. At the beginning and at the end of each series of measurements the sound pressure level meter shall be calibrated in accordance with the spl meter manufacturer's instructions, using an acoustic calibrator class 1 as described in IEC 61942:2003, Electroacoustics – Sound Calibrators, Third Edition, 2003-01.
- d) Repeat the test with the wheelchair travelling in the opposite direction.
- e) Perform b) to d) twice .
- f) Calculate the arithmetic mean value of the four recorded values. If this value exceeds the appropriate requirement of 8.6.1, the wheelchair fails this test.



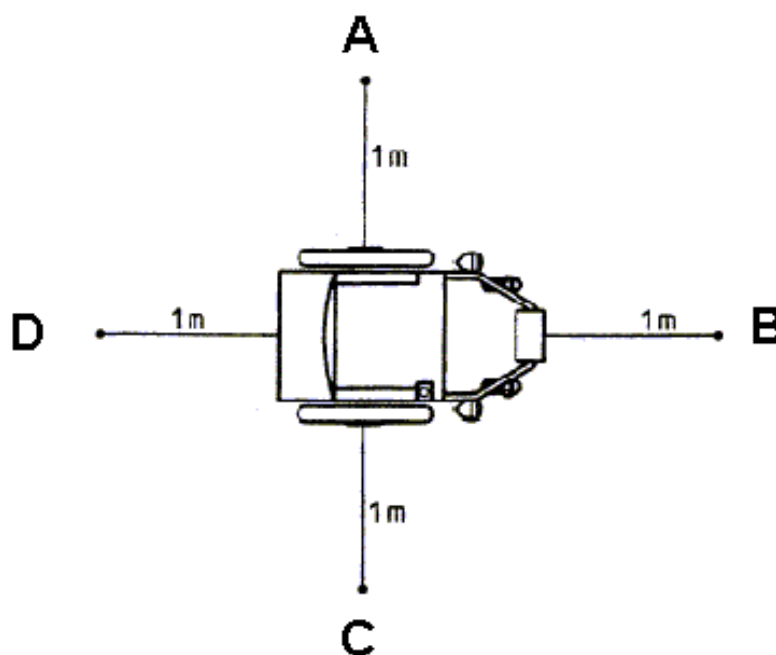
**Key**

- A measuring device
- B measuring distance
- C start
- D stop

**Figure 6 — Wheelchair drive test**

**8.6.2.2 Ancillary equipment**

- a) Position the wheelchair on the test track specified in 4.11.
- b) Position the sound pressure level measurement device at the height of  $1\text{ m} \pm 0,05\text{ m}$  at one of the positions specified in Figure 7.
- c) Operate an electrical seat, back support or leg support mechanism throughout its range of operation. Measure and record the sound pressure level.
- d) Repeat the test for each of the remaining positions specified in Figure 7.

**Key**

- A measuring point 2
- B measuring device at point 1
- C measuring point 4
- D measuring point 3

**Figure 7 — Ancillary equipment test**

- e) Perform b) to d) for each of the remaining electrical seat, back support and leg support mechanisms.
- f) If any of the recorded values exceeds the appropriate requirement of 8.6.1, the wheelchair fails this test.

The wheelchair shall conform to the requirements of ISO 7176-9:2001.

NOTE See Annex D for information concerning resistance to corrosion.

**8.7 Resistance to ignition****8.7.1 Upholstered composite parts**

For upholstered parts which are composites of cover and filling, with or without a support base or interliner, the complete composite shall be tested by the methods detailed in EN 1021-1 and EN 1021-2. Progressive smouldering ignition and flaming ignition as defined in these European standards shall not occur.

**8.7.2 Foam materials**

For foam materials which form all or part of a seat, back support, positioning support, arm support or leg support which consist of foam material with or without an integral skin the material of each part shall be tested

by the methods detailed in EN 1021-1 and EN 1021-2. Progressive smouldering ignition and flaming ignition as defined in these European standards shall not occur.

### **8.7.3 Other parts**

For single membrane seats and back supports, posture belts and harnesses, foot supports and footboards the material of each item shall be tested by the methods detailed in EN 1021-1 and EN 1021-2. Progressive smouldering ignition and flaming ignition as defined in these European standards shall not occur.

## **9 Electrical requirements**

### **9.1 General requirements**

**9.1.1** The wheelchair shall conform to the requirements of ISO 7176-14:1997 and ISO 7176-21:2003.

**9.1.2** In addition, wheelchairs that include battery chargers that

— cannot be removed without the use of tools

and/or

— are permanently connected to the wheelchair battery

shall conform to the relevant electrical requirements of IEC 60601-1:1988.

### **9.2 Requirement for controller on/off switch**

**9.2.1** Provision shall be made for the occupant and/or attendant to switch the wheelchair on and off when seated in the wheelchair (see 7.10.2).

**9.2.2** If the wheelchair is switched off while driving, it shall come to a controlled stop within the maximum stopping distance specified in Table 2.

### **9.3 Requirement for power indicator**

The wheelchair shall be fitted with a device to indicate to the occupant and/or attendant that power is switched on. The colour of this indication shall conform to IEC60601-1:1988.

### **9.4 Requirements for circuit protection**

**9.4.1** Circuits connected to batteries on the wheelchair shall be protected against excessive current.

NOTE Fuses, automatic and manually re-settable circuit breakers are examples of means of protection.

**9.4.2** The driving, braking and steering functions shall not be affected by the operation of the means of protection of any other circuit.

**9.4.3** Lights, direction indicators and hazard warning flashers functions shall not be affected by the operation of the means of protection of any other circuit.

### **9.5 Requirements for connections to batteries**

Connections between batteries that are connected in series shall not be used to supply power.

EXAMPLE Power drawn from the link between two batteries connected in series.



## 9.6 Requirements for battery chargers

Battery chargers for wheelchairs shall conform to the requirements of Clause 9 of ISO 7176-14:1997, together with the following provisions.

- a) Battery chargers shall indicate when charging is in progress and when charging is complete.
- b) Battery chargers shall have the capability of charging batteries discharged to 70% of their nominal voltage.
- c) The average trickle charging current shall not exceed  $I_{\max}$  when calculated from the following expression:

$$I_{\max} = C / 100$$

where:

$I_{\max}$  is the maximum trickle charging current in A

C is the capacity of the batteries in Ah

100 is time in hours

- d) Battery chargers shall operate without the need for intervention or supervision apart from connecting and turning on at the start of charging and turning off and disconnecting at the end of charging.
- e) Carry-on and on-board battery chargers shall meet the environmental protection requirements of IPX4 when tested in accordance with IEC 60529: 1989 and meet the Class II Test Voltage requirements of IEC 335 concluding the test.

## 9.7 Charge level indicator

The wheelchair shall be equipped with an indicator showing the capacity remaining in the battery.

## 10 Information supplied by the manufacturer

### 10.1 General

**10.1.1** Each wheelchair shall be provided with documentation and labelling that conform to the requirements in EN 12182:1999 and ISO 7176-15:1996.

**10.1.2** In addition the manufacturer shall provide the documentation in three separate sections. These are pre-sale, user and servicing/repair information as specified in 10.2, 10.3, 10.4. These may be provided as separate printed documents or in other forms of media to meet the needs of individual users or their attendants.

### 10.2 Pre-sale information

In addition to the requirements of 10.1, pre-sale information shall include the following:

- a) the wheelchair type class: A, B or C;
- b) description of the intended user of the wheelchair (functionality, mass, demands in relation to visual ability and cognisance as a minimum);
- c) the overall dimensions (width, length and height) and weight when folded or dismantled and when operational;

- d) the turn-around width;
- e) the maximum safe slope;
- f) the maximum obstacle climbing ability;
- g) instruction on transport of the wheelchair when not occupied (e.g. in a car or plane);
- h) if the manufacturer specified that the wheelchair is intended for use as a seat in a motor vehicle, the method of attaching wheelchair tiedown and occupant restraints and recommendations about suitable tiedown and restraint systems;
- i) if a programmable controller is fitted, information on method of programming, who should carry out the programming and the effect it can have on driving performance;
- j) if and how the wheelchair can be folded or dismantled to assist in storage or transport;
- k) if the wheelchair has any removable parts; the weight of the heaviest part;
- l) if the removal of parts will have adverse effects or beneficial effects on the wheelchair;
- m) standard options that are available for the wheelchair;
- n) type of tyres that can be used on the wheelchair;
- o) user control adjustments;
- p) name and address of the manufacturer in sufficient detail to enable contact to be established;
- q) maximum height of kerb which the wheelchair can descend;
- r) description of the intended use and the intended environment;
- s) expected maximum distance that the wheelchair would travel under its own power with the maximum user mass on board on the level as tested in accordance with ISO 7176-4:1997 with the addition of a note explaining that the distance will be reduced if the wheelchair is used frequently on slopes or to climb kerbs etc.;

NOTE This additional requirement may be reduced to some degree if an accurate charge level indicator is fitted.

- t) maximum speed;
- u) maximum range.

### **10.3 User information**

Copies of user information should be available from the manufacturer for the first user and any subsequent user of the wheelchair during the manufacturer's intended lifetime of the wheelchair. User information shall contain all pre-sale information and the following:

- a) any adjustment or settings required before the wheelchair can be used;
- b) service interval required and information on who is competent to carry out the service;
- c) instructions for battery maintenance;
- d) unique identification number of the wheelchair;

- e) information on the location of the unique identification number;
- f) instructions on operation of all controls, including brakes;
- g) instructions for operating the battery charger, including warnings regarding any potential safety hazards (e.g. a possibility of gas accumulating in the charging area);
- h) description of the intended use and intended environment;
- i) instructions on dismantling and re-assembly of the wheelchair or any removable parts;
- j) mass of parts of the wheelchair that are expected to be handled during dismantling, reassembly, or carrying;
- k) positions of points where the component parts can be gripped for safe moving and handling and/or a method for handling during dismantling, assembly or carrying;
- l) the wheelchair manufacturer's recommended tyre pressure;
- m) instructions for dealing with tyre punctures, where pneumatic tyres are fitted;
- n) instructions on care and cleaning;
- o) warning that surface temperatures may be increased by the effects of direct sunlight;
- p) warning that the wheelchair itself can disturb the performance of electromagnetic fields (e.g. alarm systems of shops, automatic doors etc.);
- q) warning that the driving performance of the wheelchair can be influenced by electromagnetic fields (e.g. those emitted by portable telephones, electricity generators or high power sources);
- r) warning if driving characteristics can be adjusted outside the limits specified in Table 1 and Table 2;
- s) warning for trapping hazards (e.g. pinch points);
- t) information on how to obtain the user information in a format appropriate for use by visually impaired people;
- u) the level of resistance to ignition of materials and assemblies;
- v) maximum height of kerb which the wheelchair can descend;
- w) the battery type and nominal voltage;
- x) recommendation for the recycling of used batteries and parts of the wheelchair;
- y) instruction on how to engage and disengage the drive system;
- z) where applicable, information on any adjustments that can be made and who is competent to carry out these adjustments;
- aa) expected maximum distance that the wheelchair would travel under its own power with the maximum user mass on board on the level as tested in accordance with 7176-4:1997.

NOTE 1 This distance will be reduced if the wheelchair is used frequently on slopes or to climb kerbs etc (this requirement may be reduced to some degree if an appropriate accurate charge level indicator could be stipulated in 8.9.)

## **10.4 Service information**

The service information shall contain all the pre-sale, user information and instructions necessary for the maintenance, adjustment and repair of the wheelchair and for the replacement of parts.

## **10.5 Labelling**

In addition to the requirements of 10.1, the manufacturer shall apply permanent labelling for the following:

- a) devices for disengagement of the drive system, showing engaged and disengaged positions, including a warning that the drive system should be re-engaged before an occupant is left unattended or operates the wheelchair;
- b) for off-board battery chargers that are not built in, information and connection details specified in Clause 9 of ISO 7176-14:1997 on the front of the battery charger;
- c) for wheelchairs where the intended use includes use as a seat in a motor vehicle the position of attachment points for wheelchair tie-down and occupant restraint systems (WTORS).

## **11 Test report**

The test report shall contain the following information:

- a) a unique report number;
- b) the name and address of the testing institution;
- c) the date of issue of the test report;
- d) a reference to this standard;
- e) the name and address of the manufacturer of the wheelchair;
- f) a description of the sample including the manufacturer's or vendor's trade mark, model or type, and serial number;
- g) the source of the sample;
- h) details of the set-up of the wheelchair as specified in ISO 7176-22:2000, including details of how it is equipped and adjustments;
- i) the size of the dummy used or, if a person is used, the mass of the driver and weights;
- j) where the controller is programmable, the settings used while testing;
- k) a photograph of the sample equipped as during the test;
- l) the results of the tests;
- m) a statement whether or not the tested sample met the applicable requirements of this standard.

**Table 1 — Requirements and test methods for driving characteristics of type classes**

Driving characteristics	Test method	Requirement		
		Class A	Class B	Class C
Maximum safe slope	8.4.2.2	minimum 3°	minimum 6°	minimum 10°
Dynamic stability - starting forwards uphill* - stopping forwards uphill* - stopping forwards downhill* - stopping backwards downhill* - turning on a slope. * Limiting stability is any visible lifting of any uphill wheels.	8.4.5	3° minimum slope 3° minimum slope 3° minimum slope 3° minimum slope No tipping beyond balance point shall occur	6° minimum slope 6° minimum slope 6° minimum slope 6° minimum slope No tipping beyond balance point shall occur	10° minimum slope 10° minimum slope 10° minimum slope 10° minimum slope No tipping beyond balance point shall occur
Static stability - all directions	8.4.7	6° minimum slope or the maximum safe slope claimed by the manufacturer if greater	9° minimum slope or the maximum safe slope claimed by the manufacturer if greater	15° minimum slope or the maximum safe slope claimed by the manufacturer if greater
Maximum operating forces Brake levers Freewheel lever and controls - single finger operation (N) - one hand operation (N) - combined hand and arm operation (N) - foot operation, pushing direction (N) - foot operation, pulling operation (N)	7.10.3 7.10.4.2.2 7.6.2	5 13.5 60 100 60	5 13.5 60 100 60	5 13.5 60 100 60
Parking brake effectiveness	8.2.2.1	6° or the maximum safe slope claimed by the manufacturer if greater	9° or the maximum safe slope claimed by the manufacturer if greater	15° or the maximum safe slope claimed by the manufacturer if greater
Maximum Speed - forwards horizontal (km/h) - reverse horizontal (km/h)	8.4.8	15 70% of maximum forward speed of the wheelchair or 5 km/h whichever is lower	15 70% of maximum forward speed of the wheelchair or 5 km/h whichever is lower	15 70% of maximum forward speed of the wheelchair or 5 km/h whichever is lower
Obstacle climbing and descending ability - minimum obstacle height (mm)	8.4.6	15	50	100
Minimum range (km)	8.4.9	15	25	35
Ground unevenness (mm)	8.4.3	10	30	50

**Table 2 — Requirements and test methods for driving characteristics of all type classes**

Driving Characteristics and requirements		Test method
Maximum value of deceleration Peak lasting more than 0,03 s = 4 m/ s <sup>2</sup>		8.4.8
Maximum stopping distance		8.2.3
Speed	Distance	
4,0	0,6	
5,0	0,8	
6,0	1,0	
7,0	1,2	
8,0	1,5	
9,0	1,8	
10,0	2,1	
11,0	2,5	
12,0	2,9	
13,0	3,4	
14,0	3,9	
15,0	4,5	

Table 3 — Forces for static loading with occupant mass greater than 100 kg

Test method		Equation	Dummy mass	
			125 kg	150 kg
Arm support downward		$F = \frac{M_d \times g \times S}{2 \times \cos 15^\circ}$	952 N use 950 N	1142 N use 1140 N
Foot support downward		$F = M_d \times g$	1226 N use 1230 N	1471 N use 1470 N
Tipping lever downward		$F = \frac{20}{15} (M_d + M_w) g$	13,08x(M <sub>d</sub> +M <sub>w</sub> ) use 13x(M <sub>d</sub> +M <sub>w</sub> ) with a limit of 1250 N	
			Example (M <sub>w</sub> =100 kg): 1250 N	Example (M <sub>w</sub> =100 kg): 1250 N
Handgrip pull off		Limited by max force of one hand	750 N	
Arm support upward		$F = \frac{S(M_d + M_w)g}{3 \times \cos 10^\circ}$	4,98x(M <sub>d</sub> +M <sub>w</sub> ) use 5x(M <sub>d</sub> +M <sub>w</sub> )	
			Example (M <sub>w</sub> =100 kg): 1125 N	Example (M <sub>w</sub> =100 kg): 1250 N
Foot support upward Two single foot supports		$F = \frac{S(M_d + M_w)g}{4}$	3,68x(M <sub>d</sub> +M <sub>w</sub> ) use 3,7x(M <sub>d</sub> +M <sub>w</sub> )	
			Example (M <sub>w</sub> =100 kg): 833 N	Example (M <sub>w</sub> =100 kg): 925 N
	Foot support upward	$F = \frac{S(M_d + M_w)g}{2}$	7,36x(M <sub>d</sub> +M <sub>w</sub> ) use 7,4x(M <sub>d</sub> +M <sub>w</sub> ) with a limit of 1250 N	
	One-piece foot support		Example (M <sub>w</sub> =100 kg): 1250 N	Example (M <sub>w</sub> =100 kg): 1250 N
Push handle upward Two single handles		$F = \frac{S(M_d + M_w)g}{3}$	4,9x(M <sub>d</sub> +M <sub>w</sub> ) use 5x(M <sub>d</sub> +M <sub>w</sub> ) with a limit of 1250 N	
			Example (M <sub>w</sub> =100 kg): 1125 N	Example (M <sub>w</sub> =100 kg): 1250 N
	Push handle upward	$F = \frac{2 \times S(M_d + M_w)g}{3}$	9,8x(M <sub>d</sub> +M <sub>w</sub> ) use 10x(M <sub>d</sub> +M <sub>w</sub> ) with a limit of 2500 N	
	One cross bar handle		Example (M <sub>w</sub> =100 kg): 2250 N	Example (M <sub>w</sub> =100 kg): 2500 N

## **Annex A** (informative)

### **Recommendations for dimensions and manoeuvring area of electrically powered wheelchairs**

#### **A.1 Specific dimensions**

##### **A.1.1 Dimensions when ready for use**

See Table A.1.

##### **A.1.2 Push handle height**

Push handle height, if fitted, should be between 900 mm and 1200 mm.

##### **A.1.3 Ground clearance**

###### **A.1.3.1 Recommendation**

The ground clearance, as measured by the test specified in A.1.3.2, should not be less than the value specified in Table A.1. This recommendation is not applicable to wheelchairs designed for special purposes that are incompatible with the recommendation, e.g. stand-up wheelchairs and wheelchairs with a seat that lowers to ground level.

###### **A.1.3.2 Test**

- a) Position the loaded wheelchair on the test plane.
- b) Identify the lowest point of the wheelchair that is not a wheel, as shown in Figure A.1.
- c) Determine the distance between the test plane and the lowest point of the wheelchair.
- d) Measure and record the ground clearance to an accuracy of  $\pm 1$  mm.



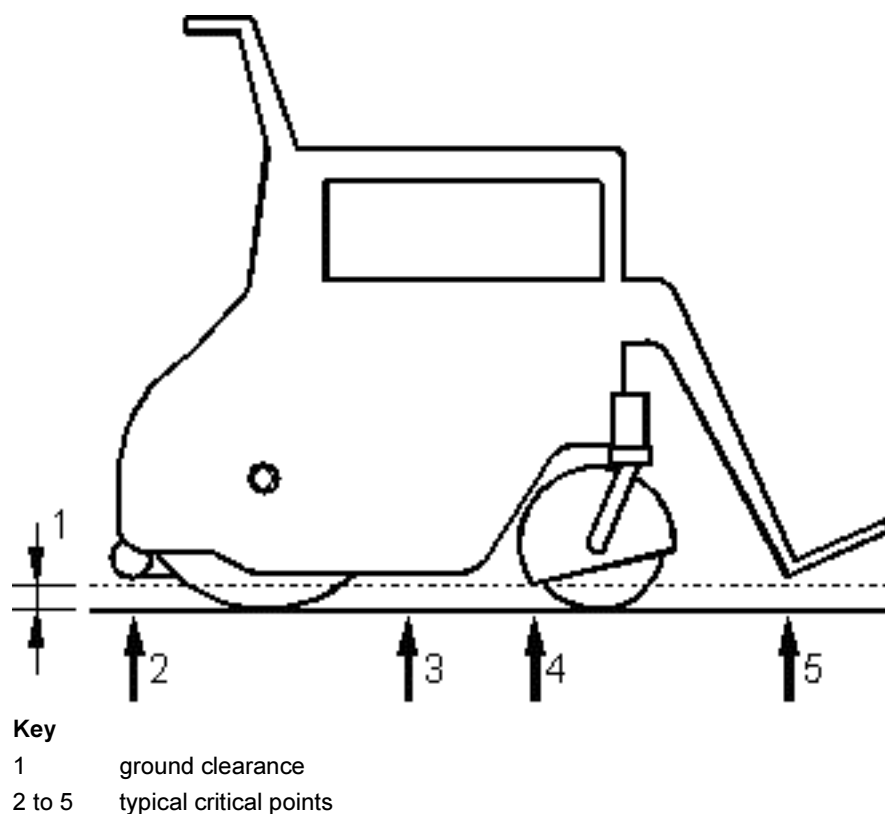


Figure A.1 - Ground clearance (example)

## A.2 Manoeuvring area

### A.2.1 Turning radius

The turning radius, as measured by the test specified in ISO 7176-5:1986 should not be greater than the value specified in Table A.1 for the type class.

### A.2.2 Turn-around width

The turn-around width, as measured by the test specified in ISO 7176-5:1986 should not be greater than the value specified in Table A.1 for the type class.

## A.3 Speed settings

The pre-set value of the maximum speed should be limited to a maximum of 15 km/h.

If a maximum speed regulator is present, the highest values capable of being set by the user should not exceed 15 km/h.

It should not be possible to change other settings of the wheelchair without the aid of a tool, key entry combination or similar means of restricting access. If the means of restricting access is other than a tool, it should not consist of operations that are performed in normal use of the wheelchair.

**Table A.1 — Dimensions and manoeuvring area of electrically powered wheelchairs in mm**

<b>Dimensions</b>	<b>Class A</b>	<b>Class B</b>	<b>Class C</b>
Total length	1200	1400	no recommendation
Total width	700	700	800
Turning radius	1000	1400	no recommendation
Turn-around width	1300	1800	no recommendation
Ground clearance (*)	30	60	80

## **Annex B** (informative)

### **Recommended design features**

#### **B.1 Introduction**

Since wheelchairs serve many different users who have many different requirements and demands, it is not possible to make the recommendations contained in this annex mandatory for every wheelchair. Manufacturers should follow the recommendations as far as possible and applicable, depending on the intended use of the wheelchair.

#### **B.2 General recommendations**

##### **B.2.1 Anti-tip devices**

If fitted with anti-tip devices, these should not move from their pre-set positions when preventing a loaded wheelchair from tipping.

Anti-tip devices should be positioned so they will not exceed the total length of the wheelchair and they should not interfere with mounting or dismounting kerbs when in non-working position.

Anti-tip devices should be labelled with a warning that the occupant should be informed when an anti-tip device is fitted or removed.

##### **B.2.2 Component weight**

If any parts can be removed from the wheelchair, or if the wheelchair can be dismantled, the maximum mass of any component should not exceed 10 kg.

##### **B.2.3 Fittings and tools**

All screws, fasteners and similar fittings should be of metric size as specified in ISO 68-1:1998. A minimum of tools should be required for their operation and maintenance.

##### **B.2.4 Tyres**

The wheelchairs should be fitted with tyres that do not mark indoor floors.

##### **B.2.5 Means to inflate tyres**

An appropriate means to inflate the tyres should be supplied with the wheelchair if it is fitted with pneumatic tyres.

### **B.2.6 Surface temperature**

The thermal properties of materials that come into direct contact with the user, e.g. control units or upholstered parts, should be considered when selecting these materials to avoid excessive surface temperatures when exposed to external sources of heat (e.g. sunlight).

### **B.2.7 Recommendations related to the user transferring into or out of the wheelchair**

When the manufacturer specifies that a sideways transfer can be made, leg supports should be removable and mountings should not protrude more than 50 mm in front of the seat and/or protrude more than 20 mm above the unoccupied seat when the leg supports are removed.

When the manufacturer specifies that the occupant can make a sideways step to a standing position in front of the wheelchair, leg supports should be removable.

When leg supports are not removable, foot supports should be movable or removable so that the occupant has room to raise from a seated position in the wheelchair to a standing position. The underside of a movable foot support should not present any sharp edges or protrusions that may contact an occupant's lower legs or feet when the foot supports are raised.

### **B.2.8 Resistance to contamination from urine incontinence**

Contamination resistance and methods for cleaning and decontamination should be considered when selecting materials that can come in contact with urine (e.g. upholstered parts) in order to avoid the occurrence of unhygienic conditions and odours.

### **B.2.9 Indication for maximum safe slope**

The wheelchair should have the provision for including a device which indicates or provides an alarm to the user when 80% of the maximum safe slope is reached.

This indicator should operate when facing up a slope, down a slope and also across a slope.

### **B.2.10 Mirrors**

The wheelchair should have the capability of mounting a rear view mirror or mirrors when required by the occupant.

NOTE This is essential where the occupant cannot rotate their upper body or neck to see behind them when seated in the wheelchair.

### **B.2.11 Head support**

If the use of the wheelchair requires the seat or the back support to be reclined to an angle of more than 25° to the vertical, the wheelchair should have a head support or provision to attach a head support.

The manufacturer of a wheelchair that has such provision should have available as an option a head support as specified hereafter.

The "head support height above seat" dimension (see ISO 7176-7:1998, dimension 10) should be capable of covering the area from 680 mm to 844 mm in order to be appropriate for the body size of various users.

If a wheelchair is available with a head support and the seat or the back support can be reclined to an angle of more than 25° to the vertical, the user manual should contain a statement to the effect that: "When reclining the back support, the head support shall be used".

### **B.2.12 Activation of running brakes**

Running brakes of wheelchairs should be designed such that they are easily activated by the occupant (e.g. by releasing the speed control device).

### **B.2.13 Accidental operation of parking brakes or freewheel**

Parking brake and freewheel operation systems should be designed so that they are guarded against accidental contact causing either the parking brake to release or the freewheel mode to be engaged.

EXAMPLE the use of two separate mechanical actions or electrical interlocks to operate or release

## **B.3 Performance characteristics**

### **B.3.1 Mechanical damage of electronic units**

Electronic units should be protected from mechanical damage.

### **B.3.2 Indication of electrical faults**

The wheelchair should be equipped with an indicator showing electrical fault(s).

### **B.3.3 Single fault protection**

The wheelchair should not move after a single fault has occurred in the drive circuit and the control device set for zero speed.

### **B.3.4 Batteries and their containers**

Batteries and battery containers should be resistant to mechanical damage (e.g. cracking).

Batteries should be removable from wheelchairs with powered seat lifts, with the seat at any position of its travel.

Batteries used for driving the wheelchair should be of the traction or semi-traction type.

Batteries for wheelchairs which may be used indoors (type classes A and B) should be unspillable.

NOTE Unspillable batteries may be more acceptable in aircrafts and road vehicles than batteries containing free liquid electrolytes.

### **B.3.5 Lighting**

The wheelchair may be subject to national requirements for lights and reflectors.

If there are no national requirements, the manufacturer should make an effort to conform with EEC automotive Directives of the European Union (76/756/EEC, 97/28/EEC).

### **B.3.6 Control mechanism feedback**

The occupant and/or attendant should receive feedback from a function's control mechanisms (i.e. light or noise, etc.) to verify that the function is actually operating.

### **B.3.7 Freewheel alarm**

When the freewheel device is operated a continuous audible warning should be omitted until the freewheel device is deactivated and the drive and braking system is fully operational (EN 475:1995 Medical devices. Electrically-generated alarm signals).

### **B.3.8 Maximum speed**

Operation of functions which may adversely affect the stability and safety of a wheelchair (e.g. elevating seats, leg supports and reclining back supports) should automatically reduce the maximum speed of the wheelchair.

## Annex C (informative)

### Recommended seating design

The following recommendations apply.

- a) Care should be taken to minimise the likelihood of seating producing pressure sores.
- b) Foot support height adjustments should allow small changes to suit an individual user and allow a good pressure distribution under the user's upper leg.
- c) The seat angle, measured as specified in ISO 7176-7:1998, should be between + 4° and + 14°.
- d) The angle between the back support plane and the seat plane should be between 90° and 100° when not adjustable. If the angle is adjustable, the range of adjustability should be at least 15°.
- e) Combined seats and back support units which can be pivoted (i.e. tilt-in-space) should have a range of at least 20° of adjustment and be capable of operation by the user or attendant with the user seated in the wheelchair.

NOTE The user and attendant will require mechanical advantage within the operating system so that he or she does not have to lift the full weight of the user whilst adjusting the tilt.

- f) Seat depth for wheelchairs intended for adults should be between 305 mm and 565 mm, when measured as specified in ISO 7176-7:1998.
- g) Effective seat-width for wheelchairs intended for adults should be between 320 mm and 610 mm, when measured as specified in ISO 7176-7:1998.
- h) Seat height should be between 370 mm and 580 mm, when measured as specified in ISO 7176-7:1998, with 30 mm of free space between the bottom of the foot support(s) and the floor for wheelchairs for indoor use or for wheelchairs with a tilt-in-space system and with 70 mm of free space between the bottom of the foot support(s) and the floor for wheelchairs for outdoor use.
- i) Arm support height for wheelchairs intended for adults should be between 155 mm and 325 mm, when measured as specified in ISO 7176-7:1998.
- j) Back support height for wheelchairs intended for adults should be between 300 mm and 740 mm, when measured as specified in ISO 7176-7:1998.

NOTE Back support height of 740 mm is for specific wheelchair types such as geriatric and comfort chairs. With this height the back support can support the head of the occupant.

## **Annex D** **(informative)**

### **Manoeuvring**

#### **D.1 Manoeuvring test for loaded wheelchairs in free wheel mode**

**D.1.1** The manoeuvrability of loaded wheelchairs when in freewheel mode is determined in two ways:

- by determining the force required to turn the wheelchair through the mid-point of its turning radius (rotation of the castor wheels in another direction of travel);
- by determining the force required to change the direction of travel of the wheelchair from a stationary position (likewise rotation of the castor wheels in another direction of travel).

**D.1.2** The force on pushing handles necessary for turning in a turning radius should not be greater than 125 N. The force on pushing handles necessary for turning direction should not be greater than 150 N.

#### **D.2 Manoeuvring test for pushrim activated power assisted wheelchairs**

**D.2.1** The manoeuvrability for a pushrim activated power assisted wheelchair when in freewheel mode is determined in two ways:

- by determining the force required to turn the wheelchair through the mid-point of its turning radius (rotation of the castor wheels in another direction of travel);
- by determining the force required to change the direction of travel of the wheelchair from a stationary position (likewise rotation of the castor wheels in another direction of travel).

**D.2.2** The force on hand rims necessary for turning in a turning radius should not be greater than 75 N. The force on hand rims necessary for turning direction should not be greater than 75 N.



## Annex ZA (informative)

### Relationship between this European Standard and the Essential Requirements of Council Directive 93/42/EEC of 14 June 1993 concerning medical devices

This European Standard has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association to provide a means of conforming to Essential Requirements of the New Approach Directive 93/42/EEC of 14 June 1993 concerning medical devices.

Once this standard is cited in the Official Journal of the European Communities under that Directive and has been implemented as a national standard in at least one Member State, compliance with the clauses of this standard given in table ZA confers, within the limits of the scope of this standard, a presumption of conformity with the corresponding Essential Requirements of that Directive and associated EFTA regulations.

**Table ZA: Correspondence between this European Standard and EU Directives**

Clauses/subclauses of this European Standard	Corresponding Directive 93/42/EEC Annex 1 Essentials Requirements	Comments
Partial conformity within all clauses	1	Each device needs to be considered against its intended user and its intended usage.  BS EN 14971 Risk Management is generally valid.  EN 12182:1999 is a general reference document.  The ISO 7176 series is used as basic reference in particular concerning test methods. However some results are comparative and require further interpretation to show how specific risks have been reduced or removed.  Annexes B-D give guidance concerning other aspects of design, performance etc.
Partial conformity clauses 6 & 10	2	EN ISO 14971 Risk Management is generally valid.  The minimum requirements for information, labelling, warnings etc are in clause 10.
Partial conformity clauses 6, 7, 8 & 9	3	Each device needs to be considered against its intended user and its intended use. EN ISO 14971 Risk Management is generally valid.
Partial conformity clauses 7, 8 & 9	4	The test methods are based on stresses which can occur during the lifetime of the device under conditions of use. Test results may require further interpretation to fully cover intended user and intended usage.
Partial conformity clauses 6, 7, 8, 9 & 10	5	Packaging and storage included in section 10.
Partial conformity clauses 6 & 10	6	BS EN 14971 Risk Management is generally valid.
Partial conformity clauses 6 & 8.7	7.1	Toxicity and biocompatibility:  Reference to EN 12182:1999  Flammability:

Partial conformity clauses 6 & 10	7.2	Contaminants and residues: Reference to EN 12182:1999 Storage referred to in information to be supplied by manufacturers
Not covered	7.3	Manufacturers should be aware that in some circumstances their products may be exposed to unusual risks and provide appropriate advice, information etc. Examples: Body fluids, outdoor environment etc
Not covered	7.4	Not generally a wheelchair requirement
Partial conformity clauses 6 & 7.8	7.5	Overflow, spillage, leakage, ingress of liquids: Reference to EN 12182:1999 Leakage from battery containers
Partial conformity clauses 6 & 9	7.6	Overflow, spillage, leakage, ingress of liquids: Reference to EN 12182:1999 Electrical enclosures
Partial conformity clause 6	8.1	Biocompatibility, toxicity, contaminants, residues, infection: Reference to EN 12182:1999
Not covered	8.2	Not normally applicable unless leather is used as a seating cover or posture belt.
Not covered	8.3, 8.4, 8.5, 8.6, 8.7	Not normally applicable
Partial conformity clauses 7, 9 & 10	9.1	Manufacturers should consider that in some circumstances their products may be used in combination with other equipment and provide appropriate advice, information etc. Example: occupied in vehicles, battery chargers, environmental controls, communication aids, supportive seating.
Partial conformity clauses 6, 7, 8, & 9 & Annex A, B, C, D	9.2	Dimension/ergonomics: EN 12182:1999 gives additional guidance Guidance on dimensions, ergonomics etc Electrical safety, EMC, mobile telephones Requirements not covered are: Volume/pressure ratio Ageing of material Accuracy of measuring and control mechanisms The other aspects of MDD Annex 1, 9.2 are not normally applicable.
Partial conformity clause 9	9.3	Charging of batteries, batteries and circuit protection
Partial conformity clause 9	10	Charge level indicator
Not covered	11	Not generally applicable
Partially conformity clause 9	12.1	Power and control systems
Partial conformity clause 9	12.2	Power indicator and charge level indicator
Not covered	12.3 & 12.4	Not normally applicable

Partial conformity clause 9	12.5	Reference to ISO 7176-21:2003
Partial conformity clause 9	12.6	Off board and on board battery chargers
Partial conformity clause 6, 7 & 8	12.7.1	Moving parts, traps, adjusting mechanisms, surfaces, corners, edges: Reference to EN 12182:1999 and ISO 7176-14:1997 (pinch points) Foot supports, leg supports, static and dynamic stability Further guidance is given in Annexes B-D
Partial conformity clause 6	12.7.2	Vibration is not covered. EN 12182:1999 gives some guidance
8.6	12.7.3	Noise
7 & 9	12.7.4	Electrical connectors and terminals for batteries and charger Gas, hydraulic and pneumatic connectors and terminals, normally not applicable
8.5	12.7.5	Surface temperature, including reference to EN 12182:1999
Not covered	12.8.1	Not generally a wheelchair requirement
9	12.8.2	Power indicator
9 & 10	12.9	Specification of controls etc
10	13	Information supplied by the manufacturer
Not covered	14	Not normally a wheelchair requirement

**WARNING** — Other requirements and other EU Directives may be applicable to the product(s) falling within the scope of this standard.